THERAPEUSIS OF INTERNAL DISEASES

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EDITED BY

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DISEASES OF THE CIRCULATION EXCEPT PERICARDITIS

CHARLES SPENCER WILLIAMSON

THERAPEUSIS OF INTERNAL DISEASES

VOLUME III

I. DISEASES OF THE DIGESTIVE SYSTEM

CHAPTER I

DISEASES OF THE MOUTH

LOUIS STARR

The non-surgical diseases of the oral cavity are much more frequently encountered in children than in adults, but it is important at all ages, and in systemic as well as in suspected local morbid conditions, to make a careful examination of the mouth. With the patient's face in a good light, and with the aid of a clean spoon-handle, or, better, one of the inexpensive tongue depressors of clean wood (used only once and destroyed), to separate the lips and hold down the tongue, inspection and palpation readily reveal the condition of the lips, gums, teeth, tongue, floor of the mouth, salivary glands, and general mucous membrane. The perfection of the sense of taste is easily determined, and examination of the saliva as to consistency, quantity, odor, reaction, and chemical composition is simple. Finally, a bacteriological study is essential when there is a suspicion of gonorrhea, diphtheria, tuberculosis, or other specific disease.

Normally the mouth contains many bacteria, the majority of which are harmless, though there are some that possess pathogenic powers, which they exert in the mouth or elsewhere, under suitable conditions. These bacteria mainly enter from without in the inspired air and in food and drink, but they may find their way into the oral cavity from within, when organs directly or indirectly communicating with the mouth are involved in infectious processes. For instance, in pulmonary phthisis tubercle bacilli may, by expectoration, be deposited in the mouth, and

it has been demonstrated that bacteria circulating in the blood current can be eliminated with the saliva through the salivary glands. The number of pathogenic and non-pathogenic bacteria present depends directly upon the attention given to the cleanliness of the mouth.

The hygiene of the mouth varies in detail with the age of the individual. In the newly-born and before the eruption of the teeth the natural secretions are sufficient to keep the cavity clean; consequently frequent washing is not only unnecessary, but is harmful. Once daily only, in the morning after the bath, the infant's mouth should be cleaned with a piece of absorbent cotton moistened with boric acid solution (saturated solution), and wrapped around an ordinary applicator. The attendant's hand must be thoroughly clean, no force should be employed, and especially must no hard pressure be made on the roof of the mouth, lest the delicate mucous membrane be wounded, with resulting ulceration and an opened way for the entrance of bacteria, which may even cause general sepsis. It is equally important, in breast-fed infants, that the nurse's nipple be carefully cleaned with boric acid solution before each nursing, and with the artificially-fed the feeding bottles must be kept absolutely clean, and the rubber tips must be sterilized by boiling for ten minutes once daily, and washed carefully in hot water after each feeding; in the interval the tips are best kept in a clean, covered glass jar or wrapped in a piece of absorbent gauze. When the teeth appear they, of course, must be kept clean; this is accomplished by gentle washing, morning and evening, with boric acid solution on a pledget of absorbent cotton; and, when a number have been cut, by the use of a very soft tooth-brush carrying the same solution or some bland chalk powder. In older children and adults the care of the teeth and mouth becomes still more important to the health of the buccal mucous membrane. The mouth should be cleaned on rising in the morning and before retiring at night, and after every meal. The steps of this process are; first to remove lodged food particles from between the teeth with waxed dental thread; next wash the mouth and throat with normal saline solution; then scrub the teeth, front and back, above and below, with a firm but not too hard tooth-brush carrying some bland powder or dental soap, and finally repeat the washing with salt solution.

The diseases of the mouth may be subdivided into four classes: first, the affections of the lips; second, those involving the layers and glands of the mucous membranes lining the oral cavity and covering the tongue, and grouped for convenience under the heading Stomatitis; third, lesions of the tongue itself; and, fourth, the disorders of certain subsidiary organs, namely, the salivary glands and the ducts.

Prefatory to the detailed discussion of these groups, a brief consideration should be given to oral sepsis, halitosis, and certain disturbances of sensation in the tongue.

Septic Infection of Oral Origin.—Decaying teeth, alveolar abscesses, and some forms of stomatitis may produce disease at a distance from their seat, either through the absorption of toxins and bacteria into the blood, or by the swallowing of toxin and bacteria-laden pus. The former process may be a very probable explanation of some cases of sepsis of hidden etiology, ulcerative endocarditis, for example; while the latter is an important causal factor in the production of septic gastritis, and, according to some observers, pernicious anemia. In either case the possibility of injury is strong enough to force attention to the condition and care of the mouth, to the cleaning and filling of cavities in the teeth, to the removal of decayed stumps, and the treatment of any abscess or suppuration that may be present in the oral cavity.

Offensive Breath.—The breath of a healthy individual is odorless, except, perhaps, immediately after eating, when it may temporarily have the smell of food or drinks. A persistent odor is abnormal. Any morbid condition of the system that prevents the elimination of metamorphosed nitrogenous tissue through the mucous membrane of the intestines, or retards the passage of decomposing detritus along the bowel, will cause an offensive breath. Under this head are conditions characterized by high temperature, catarrhal inflammation of the gastrointestinal tract, chronic debilitating diseases, etc. The same result also frequently attends structural lesions of the kidneys. The reason of this is that the system, in order to get rid of accumulated waste and to maintain the balance between the constant construction and destruction of tissue, must throw off elsewhere what the intestinal glands and kidneys fail to excrete; so the lungs take on vicarious activity and the expired air becomes tainted. Purely local causes of halitosis also exist. These are decayed teeth, lack of cleanliness, and mouth breathing, caries of the nasal and maxillary bones, ulceration of the mucous membrane of the mouth, nose, larynx, trachea, and bronchial tubes, and gangrene of the cheek. Chronic poisoning by lead, arsenic, or mercury is another cause of ill-smelling breath, and a peculiar odor follows the use of phosphorus and the bromids and iodids. To speak in general terms, the breath may become sour, catarrhal, fetid, gangrenous, ammoniacal, or stercoraceous.

Treatment.—The discovery and, if possible, the removal of the causal factor are the most important steps in the management of halitosis.

Further, cleaning the mouth twice daily with boric acid solution (gr. x-℥j) or Dobell's solution diluted with an equal quantity of cold boiled water, or, in local ulceration and suppuration, with peroxid of hydrogen (1 part to 2-6 of water) and the frequent employment of ordinary antiseptic mouth washes are required.

Disturbances of Sensation.—Disturbances of sensation in the tongue may be either general or special. In the former case the general sensitiveness may be diminished or exaggerated.

(a) *Anesthesia.*—Anesthesia is occasionally due to lesion of the supe-

rior or inferior maxillary nerve, or of the cerebrum, being in the latter case associated with anesthesia of one-half of the body; but usually it is hysterical, more frequently unilateral than bilateral, and involves all forms of sensation.

(b) *Hyperesthesia (Altered Sensation).*—Pricking and tingling are attendants of the different varieties of stomatitis, though they may be hysterical, or due to central nerve lesion. Paresthesia especially may precede anesthesia and paralysis.

Disturbances of Taste.—The sense of taste may be abolished, exaggerated in acuteness, or perverted. Agusia may be general or partial, persistent or transitory. General agusia may be associated with general anesthesia in hysteria; partial may be limited to one lateral half of the tongue, or to the anterior (lesion of lingual nerve or chorda tympani) or posterior portion (lesion of glossopharyngeal nerve). When transitory it depends upon local conditions, as the dryness due to mouth breathing. Hyperagusia is an almost purely hysterical manifestation. Paragusia is met with in hysteria and insanity; in epilepsy, where it may constitute a variety of aura; in facial paralysis and chronic otorrhea, when it involves half the tongue on the affected side; in fevers, and in disorders of the stomach. It may be a prodrome of mental disease if it be noted in afebrile cases or without lesion of the peripheral nerves.

The treatment of all of these alterations of sensation must be directed solely to the removal of the disturbing cause, nothing is of avail locally.

DISEASES OF THE LIPS

In addition to alterations in the shape and size of the labia, and changes in their color and degree of moisture, all of which are symptomatic of general departures from health, there are several conditions localized in the lips that demand study.

Rhagades of the Commissures of the Lips

This condition is a non-specific ulceration limited to the vermilion border of the mucous membrane at the angles of the mouth, and occurring most frequently in young children who are the victims of unsanitary surroundings. The lesion begins as a small fissure, which, by constant licking and irritation, with superadded infection, gradually passes into an intractable ulcer. The subjects are anemic, are prone to chronic nasopharyngeal catarrh and skin eruptions, and present the general features of malnutrition or lymphatism. These ulcers are lineal, with a red or bluish soft base and elevated and sometimes indurated edges, occasionally surrounded with minute pustules. They are symmetrical, in-

volving both commissures, and are painless unless the mouth be stretched, or there be an accidental contact with some acid substance.

These rhagades are suggestive of syphilis, but in the latter infection the surface of the ulcer has a more waxy appearance, the base is indurated, and there are mucous patches on the lips and in the mouth. At times, again, the base of the fissure may be covered with a whitish, pseudomembranous deposit simulating diphtheria, and demanding a bacteriological investigation to establish the diagnosis. The disease runs a course of two or three weeks, and, when neglected, becomes chronic.

Treatment.—The treatment embraces attention to the general health by the betterment of unhygienic conditions, good food and tonics, and, locally, the application of a 10 per cent. solution of nitrate of silver once a day, and the use of an ointment of the yellow oxid of mercury (gr. j-3j) several times daily. [The application of the mitigated nitrate of silver by melting it on a silver probe is also very valuable, especially in older children.—Editor.]

Herpes of the Lips

This form of herpes simplex, commonly known as "fever blisters" or "cold sores," occurs very frequently, especially in childhood, and is an acute inflammatory disease characterized by the eruption, on the skin or red border of the lips, of one or more groups of vesicles seated upon hyperemic bases. The vesicles are pin-head or somewhat larger in size, isolated or assembled closely together, or even confluent. They appear abruptly, but usually with precedent sensation of burning or tingling in the affected locality. Their contents, at first clear, become, in a day or two, milky or even purulent, and later dry up into light brown crusts, which show no loss of substance when detached. The whole process occupies from 5 to 10 days. At times the contents of the vesicles are reabsorbed before the formation of crusts—aborted cases; at others, the act of opening and shutting the mouth, or picking with the fingers, a tendency difficult to control in children, causes fissuring, and the constant irritation of the food and saliva keeps the parts macerated and sore for a long period. Herpes labialis often accompanies acute catarrhal and febrile affections, inflammatory diseases of the lungs, notably croupous pneumonia, and malaria, but the old idea of its carrying prognostic significance must be abandoned; it is also a frequent attendant of digestive disorders.

A microbic origin has not been demonstrated, and it is probable that the condition is neurotic, possibly depending upon reflex irritation of the adjacent sympathetic ganglia.

Treatment.—Herpes symptomatic of general febrile states requires no different constitutional treatment than that directed to the exciting cause. In recurrent cases the general health of the patient must be built

up, special care being directed to the digestive tract and to possible malarial influence. [In a long experience I have found recurrent cases due to intestinal intoxication. As a rule, this is the ordinary form of autointoxication which is accompanied by the ordinary symptoms on the part of the whole gastrointestinal tract, and of the various eliminative organs and tissues. Rarely is the disease due to intoxication with one kind of food.—Editor.] In the latter, and in all cases where the causal indication is obscure, a continued course of Fowler's solution in small doses is most efficient.

When the vesicles first appear the application, four or five times daily, of spirits of camphor, cologne water, or an aqueous solution of sulphate of zinc (gr. i-v to ℥j) may abort the outbreak. Painting with tincture of benzoin is also useful, particularly when there is a tendency to fissuring at the angle of the mouth; in this case, the mouth being slowly opened as widely as possible, the benzoin is painted on several times and allowed to dry before the lips are closed, the process being repeated three times daily. In the drying stage an ointment of aristol (gr. iiss) to vaselin (℥i), applied every four hours, will hasten the separation of the crusts.

Inflammation of the Labial Glands

(*Baelz's Disease*)

This is a chronic affection of the mucous glands of the lips, beginning as an indolent enlargement, slowly passing into ulceration, and unassociated with involvement of the neighboring lymphatic glands, or general symptoms. The lesion is probably due to a special infection, non-syphilitic, although, in appearance, it is suggestive of labial chancre. It is usually attended by catarrhal stomatitis. The most efficient treatment is the daily application of diluted tincture of iodin and the frequent use of a bland mouth wash.

STOMATITIS

Stomatitis Catarrhalis

Acute stomatitis consists of a simple hyperemia of the mucous membrane of the mouth, with its attendant heat, redness, swelling, and altered secretions, the saliva being increased in quantity, more viscid, and laden with an augmented number of the ordinary mouth bacteria. The hyperemia may be limited, or it may extend over the entire surface of the mucosa; when it is more intense in grade, the mucous glands of the lips and cheeks become enlarged and prominent, and occasionally small herpetic patches appear.

While not confined to any special age, the affection occurs most commonly during infancy, as at this time of life several of the causal factors are apt to be simultaneously operative.

The disease may be primary or secondary. The causes of the first form are the ingestion of food or drink which is acid or irritating, too hot or too cold; decaying teeth; want of cleanliness, or too persistent cleaning; difficult sucking; the use of "pacifiers"; mouth breathing, and the continued use of certain drugs—mercury, iodin, antimony, and arsenic. The secondary form occurs in gastric and intestinal disorders, and during the course of acute febrile diseases, notably scarlatina, measles, typhoid fever, and variola; in the latter conditions being due partly to the original infective cause, and partly to lack of care and consequent decomposition of food in the mouth.

The local symptoms of the disorder embrace the ordinary features of hyperemia together with a moderate degree of pain, which is markedly increased by the act of nursing or mastication. Generally there may be restlessness, irritability, slight fever, constipation, and anorexia, due chiefly to local tenderness. In secondary stomatitis the general symptoms depend upon and vary with the originating disease. The local symptoms are the same, with the addition of certain special features, as Koplik's spots and maculation of the soft palate in measles, and punctation of the pillars of the fauces in scarlet fever. [Indeed, all the enanthemata. —Editor.] The course of the disease is usually acute, rarely lasting longer than a week.

Treatment.—After effecting the removal of the exciting cause, if this be possible, the diet should receive attention. To sucklings the breast or a carefully modified milk mixture alone should be allowed, and, for older children, milk guarded with lime water, broths, bread and milk, or other soft foods, as rice and milk, junket, and simple puddings, are sufficient, and will be readily taken, since they require no mastication.

The mouth should be thoroughly but very gently washed at intervals of an hour or two, when the patient is awake, with a mild antiseptic solution of boric acid (2-3 per cent.) or sodium borate (2 per cent.).

After every feeding, particularly, the mouth should be washed with cold, boiled water and the lotion applied on a pledget of cotton, twisted around the end of an applicator, not wrapped about the nurse's index finger. If the gums be spongy they may be touched twice a day with glycerin of tannin (1-10), and in obstinate cases a weak solution of silver nitrate (gr. j-℥j) should be applied to the general mucosa once daily.

Regular evacuation of the bowels must be secured by saline laxatives if required. If the skin be hot and dry, liquor potassii citratis, in doses of a fluid drachm every two or three hours, for a child of one year, is indicated. When the tongue is heavily coated and the stomach disordered, recovery may be much hastened by gr. ½ of calomel given in broken

doses with sodium bicarbonate, and followed by a digestant tonic of pepsin and nux vomica.

As a prophylactic measure in measles, scarlatina, and other febrile affections, careful cleansing of the mouth two or three times each day with one of the simple antiseptic lotions is of great utility.

Stomatitis Herpetica

This affection presents itself primarily as small, yellowish-white isolated spots on the mucous membrane of the mouth, which rapidly pass into superficial ulcers. These ulcers, or aphthæ, vary in number from one to twenty or more, and in size from a pin-point to a split-pea; they are oval, round, or, more rarely, linear in shape, and when they coalesce have an angular outline. While not absolutely determined, it is probable that these ulcers are the remains of vesicles which have ruptured, exposing a necrotic base, since in herpes of the tonsils, a closely allied condition, the natural transition from the vesicular to the ulcerative stage is frequently open to observation.

The disease is of much more common occurrence than uncomplicated catarrhal stomatitis, and is chiefly encountered in children, especially between the ages of six months and the third year, but it may occur in adults, frequent subjects being women at the menstrual period, after parturition, and during lactation.

The etiology is undetermined, but it is probable that the disease is due to an acute infection from the intestines, through some toxin generated in contaminated milk or other food, and acting on the nerves of the mouth in such a way as to produce an herpetic eruption. The bacteriology has not been fully investigated. Observers have found streptococci, staphylococci, and the pneumobacillus of Friedländer, but, as these bacteria are present in the normal oral secretions, they are probably not pathogenetic.

Exciting agents are want of proper attention to cleanliness, dirty tips and nursing bottles, the administration of unsound milk mixtures, or an excess of farinaceous food. In older subjects an indulgence in pastry or candy is often followed by an attack, and certain children always suffer after eating some particular article of food, as honey, walnuts, or salted fish. All these causes are active in the production of disordered digestion, a common precedent and accompanying condition. Children suffering from malaria, pneumonia, and the exanthemata, or from chronic diseases, especially of the gastrointestinal tract, are likely subjects; a greater predisposition also exists in those broken down systematically by unsanitary surroundings, and insufficient food and clothing.

Aphthous ulceration is usually attended by catarrhal stomatitis. The ulcers are extremely sensitive, and thus mechanically interfere with

sucking, chewing, and other movements of the mouth. The lips are swollen, very red, and held apart, and saliva drools away, excoriating the skin of the lower lip and chin, and there are often moderate enlargement and tenderness of the submaxillary lymph glands.

Together with the local symptoms, and those belonging to any associated condition, there are restlessness, moderate febrile reaction, thirst, anorexia, nausea with frequent eructations of acid liquid, occasional vomiting, and either constipation or diarrhea.

When all the ulcers appear simultaneously, the disease runs its course in from four to seven days. If, on the contrary, the aphthæ develop in successive crops, the duration may be prolonged for a fortnight or more, and some cases show a marked tendency to recurrence.

A *confluent form* of aphthæ, which probably differs essentially in etiology from the ordinary variety, is sometimes observed in children. It usually occurs secondarily to grave constitutional diseases, namely, measles, variola, scarlatina, diphtheria, typhoid fever, pneumonia, and whooping-cough. The ulcers, apparently benign at first, prove resistant to treatment; there are fever and rapid emaciation; at times the appearance of an infectious erythema of grave import, and, after lasting two or three weeks, the condition may pass into bronchopneumonia or meningitis. There is also a *fulminant variety,* terminating in death in twenty-four to forty-eight hours after the development of the ulcers, an autopsy revealing fatty degeneration of the liver. In these forms a bacteriological examination shows various round and rod-shaped organisms and Vincent's spirilla, but both are proper subjects for fuller investigation.

Treatment.—As some disturbance of digestion is commonly associated with the local lesions, attention to the diet is of importance. In artificially fed infants absolute cleanliness of bottles and tips must be insisted upon, and the food must be a sound milk mixture, properly modified to meet the demands of the individual case. Children of two years of age and over should be placed on a simple diet: a breakfast, luncheon, and supper of stale bread and milk guarded with lime water (one part to three), and a midday dinner of mutton or chicken broth with well-boiled rice.

The ulcers usually make their appearance too long after any causative error of diet to be stayed by the administration of an emetic. If, however, an overloaded stomach be indicated by fever, restlessness, and epigastric pain and distention, a dose of wine or syrup of ipecacuanha should be given. When the bowels are constipated, a mild laxative is required. The best under the circumstances is calomel; for a child from six to twelve months old a powder of half a grain of the mercurial and five grains of sugar may be placed dry upon the tongue in the evening, to be followed next morning by a small teaspoonful of magnesia in milk or lemonade. If, on the contrary, there be diarrhea, the bowels should be cleared of irritating materials by a teaspoonful of castor oil with

fifteen drops of brandy, and then subcarbonate of bismuth given in five-grain doses every two to four hours.

The fever when moderate requires only a plentiful supply of cool water to drink; if more severe, with a hot, dry skin, some saline diaphoretic is indicated, as liquor potassii citratis, either alone or with half-drop doses of tincture of aconite.

Finally, both tonics and digestants are often indicated during convalescence.

Locally the object is to relieve pain and to prevent infection, and the best results are obtained by touching each ulcer with trichloracetic acid. In this procedure just enough distilled water is added to the acid crystals to insure deliquescence, and a minute quantity of this liquid is gently but thoroughly applied to the floor of each ulcer by means of a smoothly pointed wooden applicator. The contact whitens the floor of the ulcer, and produces a marked burning sensation, which quickly subsides, and is followed by relief of pain and by rapid healing. More than one application is rarely required. Other less efficient means to the same end are touching with a point of lunar caustic, with solution of permanganate of potassium (1 to 150), with tincture of iodin, or a 10 per cent. solution of chromic acid.

The frequent use of an antiseptic mouth wash, such as boric acid or sodium borate (gr. x to ℥j), is advisable, if the patient be old enough to voluntarily wash the mouth by the aid of the cheeks and tongue. In infants, on the other hand, the mouth is better let alone, unless it be certain that the cleansing will be done with sufficient care and gentleness to avoid traumatism of the mucous membrane.

While the saliva is flowing freely the skin of the under lip and chin should be protected by the free application of vaselin or oxid of zinc ointment.

Bednar's Aphthæ

This lesion consists of an ulceration of the soft palate, or of the mucous membrane of the oral roof. The aphthæ are shallow and covered by a gray or yellowish coating, and present several varieties, the most characteristic being two symmetrical ulcers, rounded in outline and situated over the hamular processes of the palate bones; again, they may be Y-shaped, being then linear and seated over the palatin suture and the line of juncture of the hard and soft palates.

They occur only in the newly born, appearing from the second day up to the sixth week, and are almost uniformly due to traumatism. In cleaning the mouth the nurse's finger is apt to infringe upon the processes of the palate bones, wounding the epithelium, and thus allowing the entrance of bacteria with consequent ulceration and sometimes general

sepsis. Less frequently the friction of an overlong or badly shaped feeding bottle tip may develop an ulcer far forward on the hard palate.

The ulcers are sufficiently painful to interfere with sucking, and they may be attended by enteric disturbance, shown by greenish stools, and due to infection from swallowed bacteria.

Treatment.—Any intestinal infection must be overcome by evacuant doses of castor oil followed by subcarbonate of bismuth, and the general nutrition must be conserved.

The ulcers must not be washed or traumatized, and, as a rule, they readily heal after discontinuing rough manipulation or substituting well-shaped for clumsy bottle tips. The rest of the mouth and tongue should be very gently washed twice daily with a saturated aqueous solution of boric acid.

Should the plan of non-interference fail and the ulcers remain in an indolent condition, they should be carefully touched, once or twice daily, with a 10 per cent. solution of silver nitrate, on a small piece of absorbent cotton carried by an applicator.

Stomatitis Hyphomycetica

Thrush, as this affection is commonly called, is distinguished by the appearance of numerous rapidly growing, white, curd-like flakes upon the mucous membrane of the mouth, the latter being in a more or less catarrhal condition—injected, swollen, hot, and tender to the touch. It generally occurs in early infancy, during the first two or three months, but may be encountered at any period of childhood, and even in adult life. The flakes are due to the development of a fungus, which enters the mouth from without, and which is still considered by some observers to be the Oïdium albicans, though it is now generally classed as the Saccharomyces albicans. Under the microscope the growth appears as fine threads made up of many shorter rods, the mycelium, and small oval bodies, the spores; the mycelium is produced from the spores; these are of common occurrence in the atmosphere, but they must be deposited upon favorable soil to produce the disease. Consequently, it is rarely seen in perfectly healthy, properly cared for infants, while it is frequent in the ill-nourished and weak, and in these a simple cold or slight intestinal disorder opens the way. In older children and adults—usually the aged—it attends such severe affections as pneumonia, typhoid fever, the exanthemata, spinal caries, and tuberculosis.

The favoring oral condition is catarrhal stomatitis, a lesion which almost invariably precedes or accompanies the onset of thrush. This, through its attendant hyperemia, probably mechanically displaces the epithelial cells, preventing perfect protection of the mucous membrane and allowing the spores of the fungus to find a lodgment and place for

development. Injury of the mucosa by too forcible cleaning of the mouth, or by the friction of badly shaped bottle-tips, acts in the same way. The younger, or more feeble, or more disease-reduced the infant, and the more imperfect the motion of the tongue and jaw, the more readily will the fungi be implanted; so, too, in older patients the predisposition becomes most marked when vitality is greatly reduced by long-continued fevers and wasting diseases, and in those attended by impaired mobility. Further, if the care of the mouth be neglected, the retained secretions and food undergo acid fermentation, a result favorable to the development of the fungus.

The parasite grows most freely upon, but is not confined to, squamous epithelium, since it appears in many surfaces covered with cylindrical cells, as in the nose, in cases of cleft palate, the pharynx, esophagus, and sometimes in the stomach, intestines, and lower respiratory tract; it has also been found in the parenchyma of organs, as the liver and lungs, and in the blood vessels.

Given the predisposing conditions, thrush originates by contact with other cases, through the medium of bottle-tips, spoons, or tumblers used in common, or it may arise without traceable contagion from carelessly kept and foul feeding utensils.

The essential symptoms of the disease are the appearance, on the inside of the cheeks and tongue, of small whitish flakes which resemble adhering fragments of curdled milk, but differ in the fact that they cannot be wiped away. There may be only a few scattered patches, or the deposit may cover the mouth, the pharynx, and tonsils, and extend into the esophagus, and may change in color from white to yellow or brown. If forcibly removed they usually leave a number of bleeding points, and, when they drop off in the natural course of the disease—from six to twelve days after onset—they expose superficial abrasions which may become the foci of infection for any other morbific agent; sometimes, when confluent, large masses drop off, leaving intractable ulcers. The mouth is usually dry, the tongue coated, food is refused on account of pain, and there may be difficulty in swallowing. The general features depend upon the associated systemic condition.

Unless neglected, thrush in the well-to-do class of patients is, as a rule, little more than a local affection, readily yielding to treatment; but in the ill-nourished and feeble, whether from disease or bad hygiene, it is a serious complication, as it usually develops in the course of some grave gastrointestinal disturbance, and, by interfering with sucking and swallowing, deprives the infant of the food supply necessary for recovery. The mere presence, then, of thrush patches is not to be regarded with so much anxiety as the condition accompanying their formation.

Treatment.—In the way of prophylaxis, which is of great importance, proper hygiene of the mouth is essential. With infants, the usual sub-

jects of the disease, the mouth should not be washed after every feeding, but be very gently cleaned once daily only, with a piece of absorbent cotton moistened with saturated solution of boric acid. Care must be taken not to wound the mucous membrane, and unclean fingers must never be introduced into the mouth. If fed at the breast, the nipples must be thoroughly washed with boric acid solution before and after each nursing, and, if artificially fed, the bottle-tips must be sterilized by boiling once daily, and the bottles must be kept absolutely clean. The same care should be taken with spoons and other feeding utensils, and feeding bottles must never be passed from child to child. Further, any abrasion of the mucosa should receive prompt attention. Equally urgent precautions are properly regulated diet, either maternal or artificial, and attention to general hygiene, that the infant may not pass into the condition of malnutrition so favorable to the development of the local disease.

The same measures, together with an endeavor to meet whatever systemic disturbance may be associated, constitute an essential part of the curative measures after the appearance of the fungus flakes. Locally, the objects of treatment are to hasten the removal of the patches without causing bleeding and without injuring the mucous membrane; to prevent their reformation, and to relieve the attending catarrhal stomatitis.

With the first indication I have had good results from smearing the patches with a thin coating of cosmolin, applied once or twice daily, with a swab of cotton The other ends are accomplished by very carefully cleaning the mouth three times daily, with absorbent cotton moistened with a saturated solution of boric acid, or an aqueous solution of sodium bicarbonate (gr. x-℥j); one pledget of cotton should be used for the roof of the mouth, another for the tongue, and separate ones for the inside of either cheek. For the same purpose potassium permanganate (1-150) has been recommended, also corrosive sublimate (1-2,000), but these are less satisfactory than the boric acid solution. Applications to be especially avoided are those carried in honey or syrup.

General treatment of a tonic and supporting nature will be required in the ill-nourished or feeble; gastrointestinal complications must be met, and so, too, the indications presented by whatever disease may coexist.

Stomatitis Ulcerosa

Ulcerative stomatitis is a peculiar molecular or cellular necrosis beginning in the free margin of the gum and gradually involving the deeper tissues, even to the periosteum and jaw bone, at the same time infecting the parts which lie in apposition to those previously affected, thus spreading, but never extending beyond the cavity of the mouth. The disease never occurs when there are no teeth. It is most frequent in children between the ages of three and eight years, though it is met with in adults.

The onset is favored by any condition that tends to the reduction of constitutional vigor, as life in damp, dirty, ill-ventilated houses, or an insufficient food supply; it also follows certain debilitating diseases, especially measles, scarlatina, whooping-cough, and infantile scurvy, less frequently typhoid fever or pneumonia, and may be produced by the internal administration of mercury, copper, or iodin. Under proper conditions it seems to be contagious, endemics occurring in crowded hospital wards or dwellings, and among soldiers in barracks. In the latter a scorbutic influence is a probable factor in the predisposition. Lack of care of the mouth, and decayed or overcrowded teeth, are also active exciting causes.

Bacteriologically, in addition to the common pyogenic germs, the fusiform bacillus of Vincent is very constantly present. This organism is probably a potent agent in the production of the disease, and has led to its being miscalled Vincent's angina.

An attack begins with severe pain and heat in the mouth, and offensive breath. Next, the external gingival border about the lower incisor teeth becomes intensely injected and rapidly swells, the interdental points of the gum standing out like flasks and bleeding upon the lightest touch. Soon the margin of the gum changes from a livid red to a yellow-gray color and softens into ulcers, which are depressed, have a ragged, dirty gray or brownish floor, and very red swollen edges. Later the ulcers may appear on the outside surface of the upper gum, the interior aspect of both lower and upper gums, on the edges of the tongue, and on the inside of the cheeks; in this position the loss of substance corresponds with one or both gingival borders, forming a single or double strip running parallel with the jaw. In severe and protracted cases the ulcers increase in breadth and depth, the teeth become loose, and there may be destruction of the periosteum and necrosis of the maxillary bone. While these changes are taking place the mouth is the seat of burning and pain and is very tender, the breath has a characteristic fetid odor, streams of yellow, sometimes bloody, ill-smelling saliva drip away, excoriating the skin over which it flows; there is often edema of the face, limited or general, according to the extent of ulceration, and the submaxillary glands and the lymph glands of the neck are moderately enlarged, but rarely suppurate.

There are loss of appetite, due chiefly to the pain caused by chewing, restlessness, and, with little alteration in the temperature range, a weak pulse, and other evidences of general debility.

The symptoms ordinarily reach their height in from two to five days, and when properly treated disappear in as many more, the ulcers healing without cicatrization. Severe or badly managed cases rarely recover under three or four weeks, and may sometimes pass into noma, with its attendant grave consequences.

Treatment.—The main prophylactic measures are to prevent the transmission of the disease by isolating affected patients, and to reduce the susceptibility of those predisposed, from bad hygiene or debilitating diseases, by bettering their surroundings and by insisting upon proper cleanliness of the mouth and attention to decaying or overcrowded teeth.

When the disease is existent, the first step is to improve the sanitary surroundings of the subject, or, if this be impossible, to remove him to healthful quarters. The importance of cleanliness, fresh air, and sunlight is not to be lightly estimated.

The diet should be liquid, but nutritious. Apart from the fact that solid food will be refused on account of the pain caused by mastication, milk, junket, custards, and animal broths are better suited to the somewhat enfeebled digestive powers; water must be given as freely as thirst demands, and, if there be any tendency to scurvy, fresh fruit and green vegetables should form an essential part of the dietary.

Of drugs, potassium chlorate is the most efficient, ranking almost as a specific, and, in my experience, can be used without danger if given in small doses and with due and constant regard to its poisonous properties. One grain, every two hours, is the proper, and, also, an efficient, dose for a child of three years; it may be administered alone, simply dissolved in water, or combined with some bitter tonic, as elixir of calisaya.

Locally, cleanliness is of great importance. The ulcers should be cleaned once or twice each day with peroxid of hydrogen, diluted with from two to ten parts of water, and in the interval washed every three hours with a potassium chlorate solution, made by adding one fluid-drachm of a saturated solution to six fluid ounces of water, or with an 0.5 per cent. solution of formalin. The lotion may be applied on a bit of absorbent cotton, or the child may take a quantity into the mouth, move the cheeks and tongue in such a way as to bring it in contact with the whole mucous surface, and then expel it. After the ulcers have healed the specific treatment should be discontinued, and the patient placed upon a full diet with a tonic, such as ferrated elixir of cinchona or tincture of nux vomica with elixir of calisaya.

The potassium chlorate treatment should be effective in the course of a week; if otherwise, careful search must be made for and attention given to any local cause. It is unwise to disturb sound teeth if loosened, since, if allowed to remain in position, they usually become firm again after recovery; on the other hand, carious teeth must either be filled or treated with antiseptics, and dead bone must always be removed. If these procedures be unsuccessful, the ulcers, after being cleaned with peroxid of hydrogen, should be lightly cauterized with the solid stick of silver nitrate. Sometimes no progress can be made until the teeth about which the ulceration is most marked are removed, and after extraction

the resultant cavity must be carefully and frequently cleaned. When the local factor of continued ulceration cannot be discovered, frequent applications of potassium permanganate are most useful.

Stomatitis Ulcerosa Chronica.—This form of the disease presents the same oral symptoms, though of a much milder grade, and runs a protracted course without involving the deeper tissues. It is characterized by its resistance to the usual methods of treatment, and by a marked tendency to relapse. Potassium chlorate, while less effective in these chronic cases, should still be used in combination with tincture of the chlorid of iron, gr. j of the former with ♏ ii of the latter, every two hours at the age of three years, and a plentiful supply of good food and proper sanitation are essential.

Locally, peroxid of hydrogen should be employed once daily; the ulcers cleaned every fourth hour with boric acid solution, and lightly cauterized with silver nitrate at intervals of three or four days.

Mercurial Stomatitis.—Mercurial stomatitis (salivation), in our day an uncommon subvariety of the ulcerative, is never met with in infants before the eruption of the teeth, or in the odentate, and rarely during childhood. While its mode of origin is not fully established, it is probable that the mercury by its reducing action injures the tissues and so prepares the way for pathogenic bacteria. Certain preëxisting diseases, as chronic nephritis and cirrhosis of the liver, predispose to salivation, and some individuals seem to have an idiosyncrasy to mercury, several small doses or even a single small dose being sufficient in them to affect the gums. In some grave cases death may result from extreme ulceration or from gangrene and septic infection.

Treatment consists in stopping the administration of the mercury, the employment of peroxid of hydrogen (2 to 3 per cent.) or other antiseptic lotions, and the internal use of potassium chlorate in doses of gr. ii to iii every second hour in the adult.

Stomatitis Gangrenosa

This is a specific bacterial affection resulting in rapidly extending gangrenous destruction of the cheek and adjacent soft and hard tissues. It begins in the mucous membrane, occasionally of the lip, but usually near one corner of the mouth, and is generally asymmetrical, though sometimes both cheeks are involved.

Noma, on account of its high mortality—75 to 80 per cent.—is fortunately an uncommon disease. Sucklings seem to be exempt, and it is very rare in adults, most of the cases occurring between the ages of ten and twelve years. It is always of secondary origin, following severe maladies, such as the acute exanthemata, especially measles, whooping-cough, syphilis, scorbutus, chronic intestinal catarrh, protracted malaria,

and not infrequently stomatitis ulcerosa. These, then, may be regarded as predisposing causes, but, despite the preëxistence of any one of them, noma only develops in those children who have been previously weak, ill-housed, and ill nourished.

From the fact that several cases may be encountered in the same family, or a number in one ward of a hospital, there is little doubt that the disease may become infective; on the other hand, many cases are observed in which the isolation is so complete that there can be no question of contagion.

The bacteriology is still undetermined. Babés and Zambolovici have isolated a very minute bacillus, and by inoculation in animals have produced typical noma. Accompanying this organism are a large number of streptococci, spirochetes, and other bacilli that play an active secondary rôle in the production of the gangrene, which is due to an overwhelming bacterial invasion of the tissues, the resulting toxins causing destruction of cell life and necrosis in mass. In another group of cases Walsh found the Klebs-Loeffler bacillus (Koplik).

The first symptoms to arrest attention are a characteristic gangrenous odor of the patient's breath, and the appearance of a small, indurated, very sensitive nodule involving the tissues of the cheek, and situated near the corner of the mouth. Very early in the course the mucous membrane over this nodule is raised into a flat bulla; usually, however, the membrane is found hanging in ragged shreds from a black, gangrenous base. The skin over the induration is pale, tense, and shiny, as if oiled.

The gangrene extends rapidly in superficial area and depth, and as it approaches the exterior the superimposed skin becomes discolored, then red, blue, purplish, and black. Soon the cheek is perforated, and a dirty, stinking saliva, carrying fragments of broken-down tissue, flows out freely on the cheek. The lips, chin, and surrounding portions of the cheek become edematous, and the adjacent cervical glands enlarged. The odor from the patient is overpowering and widely diffused.

At the onset there are few special constitutional symptoms. The child has little or no pain, persists in his amusements, has a good appetite, an almost normal temperature, and a pulse but little altered in quality; but, as the gangrene extends, marked features of constitutional depression set in.

Perforation of the cheek takes place after a period varying from twenty-four hours to three or four days, and many patients die at this time. Others linger until the end of the first or second week. Under these conditions the tissue destruction invades the face generally, on the originally affected side, very infrequently becoming bilateral. Extending inward, the gums and the periosteum of the jaw bones are destroyed; the bone becomes necrotic, and the teeth so loose that they can be readily pushed out by the finger, together with pieces of the alveoli. The tongue,

the hard and soft palate, and the tonsils may be involved and converted into a fetid, softened, blackish mass. Finally, the cheek is cast off in large, black sloughs, leaving huge openings with black, ragged, and indurated edges, through which the discolored and necrosed bones and loosened teeth can be seen. Simultaneously the symptoms of systemic depression are greatly intensified; there are subnormal temperature, or high pyrexia of the hectic type, delirium, and profuse septic diarrhea, and death follows from bronchopneumonia or exhaustion. Severe hemorrhage almost never occurs, as the blood vessels are early sealed by thrombi.

Exceptional cases recover. In these a line of demarcation forms around the gangrenous area, the clean edges become covered with healthy granulations, and after months cicatrization takes place, with great disfigurement.

Treatment.—Something can be done in the way of prophylaxis by careful attention to every case of stomatitis, especially the ulcerative form; by frequent and thorough cleansing of the mouth in all acute infectious diseases, and by the proper management of the known predisposing affections. Secure sound hygiene in the sick room, give good and sufficient nourishment, and avoid the abuse of mercurials and debilitating treatment generally. As contagion seems possible, every case should be isolated.

If, notwithstanding these precautions, noma develops, it is of the first consequence to maintain the patient's strength by the use of concentrated liquid food, strychnia, and quinin, and alcoholic stimulants. Sometimes, on account of the difficulty of swallowing after perforation of the cheek, rectal alimentation suggests itself and should be resorted to, though offering little prospect of success in children.

The room in which the treatment is conducted should be large and sunny, with windows constantly open, and must be kept as pure as possible by the aid of disinfectants. For this purpose cloths saturated with a solution of chlorinated soda or other deodorizer may be hung about the bed.

The local treatment must be very prompt and radical. Excision and cauterization under anesthesia are the most promising procedures. In excising, the surgeon should cut some distance into apparently healthy tissue, and the edge of the wound should then be boldly cauterized with the thermocautery of Paquelin. After the operation a solution of boric acid, thymol, or potassium permanganate should be used to wash the parts, or pieces of lint saturated with one of these solutions may be kept in constant contact, if the child will tolerate a fixed dressing. At the same time the mouth must be kept as clean as possible by repeated syringings with the same antiseptic lotions.

Those cases in which the Klebs-Loeffler bacillus is present demand

and are aided by injections of antitoxic diphtheria serum in full and, if necessary, repeated doses.

It must be remembered, however, that, despite all measures of treatment, there is but little hope of a favorable outcome, because the gangrenous process only develops in children who are very much reduced systematically and in whom the slightest complication is apt to prove fatal.

When recovery takes place and is fully established, loss of tissue and the deformities resulting from cicatricial contraction may be, to some extent, remedied by plastic surgery. Early operations are never advisable, on account of their tendency to reëstablish the disease.

Stomatitis Crouposa

A croupous membrane—that is, one in which the Klebs-Loeffler bacillus is absent—may be encountered in the mouth. It can be produced by a variety of chemical and bacterial agents, and as a primary affection is very rare. Secondary croupous stomatitis develops simultaneously with the same deposit on the tonsils, and, in severe cases, the membrane forms on the cheek, the tongue, and the lips.

A special form, pseudodiphtheritic stomatitis, described by Epstein and Koplik, is seen in the newly born. The subjects are always feeble from neglect and bad sanitation, and have sustained a traumatism of the mucous membrane of the mouth, through which a streptococcic infection occurs with the formation of a membrane closely resembling that of true diphtheria. This pseudomembrane is greenish-yellow in color, extends over the hard and soft palate, the tongue, the pharynx, and may secondarily involve the epiglottis, the entrance of the larynx, and the esophagus. There is little tendency to enlargement of the cervical lymph glands; the temperature, as in other instances of sepsis, may be normal or subnormal, and, as the disease progresses, gastrointestinal symptoms appear and septic pneumonia is developed. A microscopic examination is often necessary to differentiate this condition from thrush and diphtheria.

Treatment.—The treatment includes the ordinary measures for oral cleanliness, and the limitation of the extension of the patches by applications of a 10 per cent. solution of silver nitrate. The membrane should never be forcibly peeled off.

Stomatitis Diphtheritica

Diphtheria of the mouth may arise as a primary disease, though it is usually secondary, the membrane extending from the tonsils to the soft palate, tongue, gums, cheeks, and lips. When primary, the deposit appears first upon the lips, and thence may spread to any portion of the mucous membrane of the mouth; it often runs a most insidious course.

The symptoms are salivation, fetor of the breath, enlargement and tenderness of the submaxillary lymphatic glands, the ordinary constitutional features of the infection, and the presence of the characteristic patches of false membrane upon the mucous surface. The membrane remains from three to six or more days, and then exfoliates or ulcerates away, leaving a denuded base. Hemorrhage takes place frequently; when due to mechanical irritation, it is of little moment, but, occurring spontaneously, it is an evidence of grave cachexia even when trifling in amount, and when profuse may be the direct cause of a fatal termination.

The diagnosis of the primary form can only be positively established by culture and the discovery of the Klebs-Loeffler bacillus; the secondary can readily be distinguished as an extension of tonsillar diphtheria.

Treatment.—The treatment consists of the early and free injection of antitoxin; the removal of the false membrane, if this can be accomplished without traumatism; the continuous employment of antiseptic mouth washes, and the internal administration of bichlorid of mercury to counteract the toxalbumins produced by the diphtheria bacillus. Great care must be taken to maintain the patient's strength by strychnia, alcoholic stimulants, and nutritious, easily digested food.

Gonorrheal Stomatitis

An infection of the mucous membrane of the mouth by the gonococcus of Neisser—an unusual condition in adults—is seen most frequently in infants, developing from two to twelve days after birth. A previous injury of the oral mucosa is a favoring factor, and the germ may be introduced by the finger of the mother or nurse, or, if the mother be suffering from gonorrhea, the inoculation may take place during parturition.

The lesions, which are due to infiltration of the superficial epithelial layer of the mucous membrane with inflammatory products, appear as yellowish-white patches on the anterior two-thirds of the tongue, the anterior half arches, the posterior border of the alveolar process of the upper jaw, the free edge of the gum anteriorly, and sometimes on the frenum of the tongue and lips. There is a pultaceous thickening, but no true pseudomembranous formation, the symmetrical plaques show little tendency to spread, there is no general inflammation, nor sufficient discharge to alter the character of the saliva, though a microscopic examination of the secretion from the patches shows multitudes of gonococci both on the surface and in the cement substance between the epithelial cells. Constitutional reaction is almost nil, and there is no pain, nor difficulty in sucking.

In adults, on the contrary, marked systemic disturbance and inflammation of the whole mucous surface of the mouth are associated with pain and a profuse ichorous discharge.

Treatment.—Absolute cleanliness must be observed by the attendants. Rapid relief follows the local use of silver nitrate, 1 to 2 per cent., mercuric chlorid 1 to 7,000, or a solution of protargol. These applications should be made once or twice daily, and with a swab of absorbent cotton on an applicator, never with the finger.

Stomatitis Syphilitica

Syphilis may indirectly produce stomatitis, first by causing certain specific lesions, which give rise to disease of the mucous membrane generally, and, secondly, by inducing a greater susceptibility to the ordinary causes of oral disorders.

The primary sore is found in the adult mouth in the majority of cases of extragenital syphilis; in infants and children this seat, as well as any primary infection, is much less common, though it may occur from contact with a syphilitic nipple. The sore is usually situated on the lip, tongue, hard and soft palate, or the tonsil, and has either an identical appearance to the ordinary initial lesion on the genitalia, or may be simply a fissure, or a superficial erosion covered by a pseudomembrane.

The secondary, and in children the inherited, lesions are fissures chiefly at the corners of the mouth, and mucous patches, which may appear on any part of the mucous surface, but most frequently on the lips, the palatine arches, and the tonsils. The tertiary lesions belong to the gummata, and are usually observed on the hard and soft palate, where in breaking down they lead to perforation. The tongue may be affected by sclerosing or gummatous glossitis, the latter having a tendency to ulcerate, especially when so situated as to be irritated by sharp or decaying teeth.

Treatment.—Syphilis of the mouth yields readily to constitutional measures, but local prophylaxis and treatment are very essential. Thorough cleanliness is necessary to avoid salivation as well as to insure local recovery; the teeth must be kept in good condition, and all sources of irritation must be removed.

Antiseptic mouth washes must be used frequently, and with due care as to traumatism, and, with the assistance of wooden tongue depressors and applicators, to be burned after use, direct applications must be made from two to four times daily to the lesions. The best solutions for this purpose are mercuric chlorid, 1 per cent.; silver nitrate, 10 per cent. to 20 per cent., and chromic acid, 5 per cent. to 10 per cent. With the fissures at the angles of the lips, very good results can be obtained by the constant application of emplastrum hydrargyri, 2 parts, to lanolin, 1 part, placed upon a bit of chamois leather.

Pyorrhea Alveolaris

Riggs' disease is a common affection of obscure origin, usually developing after the age of thirty years, and involving the loss of teeth. It may be local or systemic. The first form is due to the deposit of tartar upon the crown surface of the teeth in the neighborhood of the gum and pericemental membrane; the second, to vascular disturbance in this membrane resulting from some constitutional disease, especially gout; also from rheumatism, syphilis, tuberculosis, and Bright's disease; heredity, too, seems to play some part in its production. Both forms are characterized by a gradual destruction of the pericemental membrane and an inflammation of the gums about the affected teeth, the latter depending mainly upon the influence of pneumococci.

In the local variety the deposits form upon the crowns of the teeth, usually the inner surface of the lower incisors and the outer aspect of the first and second molars, and consist of a precipitate from the saliva. In systemic pyorrhea no deposit takes place on the exposed dental surface, but is found high up on the roots of the teeth, and is composed of calcium salts derived directly from the blood, or, in gouty cases, of a nidus of sodium and calcium urate enveloped by a layer of calcium phosphate.

The gums are deep red or purple in color, and, becoming detached from the teeth, pockets are formed from which pressure forces a semi-purulent fluid. The affected teeth, which are usually free from decay, are tender to the touch, gradually become loose, and are finally exfoliated. In addition there is general catarrhal stomatitis, with a characteristic offensive breath. During the always protracted course of the disease the constant swallowing of the purulent matter may ultimately lead to disordered gastric digestion, the general features of pneumococcic infection, and possibly pernicious anemia.

Treatment.—The treatment of local pyorrhea is purely mechanical, consisting of the removal of the salivary deposit and polishing the surface of the teeth. After this is done the gums should be touched with tincture of iodin or with tannic acid and glycerin, gr. x to ℥j.

In the systemic form removal, so far as possible, of the causal condition must be accomplished, and the dentist must care for the teeth. Here also the application of tincture of iodin to the gums and the use of stimulating and antiseptic mouth washes are indicated—for example, a combination of hydronaphthol, gr. x, alcohol and water, each ℥j, and of this thirty drops in a tumblerful of warm water, used as a mouth wash two or three times daily.

DISEASES OF THE TONGUE

Acute Glossitis

Acute inflammation of the tongue may be superficial or parenchymatous. It is of rather infrequent occurrence, but is more commonly encountered in adults than in children.

Superficial glossitis may attend diseases of the mouth, pharynx, tonsils, and stomach, or it may accompany various febrile affections, or result from traumatism. When the inflammation is confined to the superficies, the epithelium increases in thickness, and either hardens into a crust or exfoliates, leaving a bright red surface, with unusually prominent papillæ. This condition is unattended by constitutional symptoms, there being merely local pain on moving the tongue in swallowing and talking, and heat and dryness of the organ.

The acute parenchymatous form may be due to such injuries as biting the tongue in a fall or an epileptic seizure, the sting of some insect, a burn, the action of corrosive substances, or the irritation of decayed teeth. It may also occur in the course of variola, erysipelas, scarlatina, or typhoid fever, or in scurvy, gout, syphilis, tuberculosis, and poisoning by mercury. In this form there is rapid congestion of the whole substance of the tongue, followed by exudation, the process usually ending in resolution, but sometimes proceeding to suppuration. Enormous and painful swelling of the tongue takes place within a few hours, the organ is hard, immovable, and very painful, and fills the oral cavity, or even protrudes beyond the lips and depresses the jaw. Speaking becomes impossible, swallowing difficult, and respiration may be dangerously impeded by pressure upon the soft palate and epiglottis. The sublingual glands are enlarged, the breath has a fetid odor, the saliva is increased, and there are restlessness and decided fever. Resolution generally begins in a few days and is quickly completed, though some superficial ulceration may be left. When the inflammation advances to the formation of an abscess the symptoms become intensified, and a soft circumscribed swelling appears in some portion of the tongue. Rarely extensive gangrene results.

The outlook for both forms of acute glossitis, even in the event of suppuration, is favorable. Death may, however, occur in forty-eight hours, and the development of gangrene adds greatly to the gravity of the prognosis.

Treatment.—In acute superficial glossitis the first step is to attend to the removal, so far as possible, of any favoring cause. Locally the sucking of small pieces of ice will give comfort, but, on account of its tendency to increase the dryness or "burn" of the mucous membrane, must not be steadily continued.

Better results are obtained by frequent spraying of the surface with some mild antiseptic lotion, as boric acid, 3 to 5 per cent., or sodium borate, 5 per cent. In cases that can be traced to the over-use of mercury, the employment of potassium chlorate internally, and locally in the form of a wash—gr. x to ℥j—is the most efficient therapeutic measure.

In the beginning of parenchymatous glossitis the patient should be put to bed and given a saline purge. Antiseptic washes or sprays should be used freely and frequently to keep the tongue moist and remove inspissated secretions. So soon as swelling becomes marked free leeching under the jaw should be resorted to, and, if this be not quickly successful in reducing the size of the organ, or if breathing be difficult, one or two long, deep incisions must be made into the substance of the tongue, in the dorsum and along the side of the raphé. If it be impossible to get food into the mouth, nourishment may be given through a nasal tube or by enema. An abscess must be freely opened when discovered. Too great obstruction of respiration demands tracheotomy.

Chronic Glossitis

Like the acute form, chronic inflammation may affect either the surface or the substance of the tongue.

Chronic superficial glossitis is caused by persistent gastrointestinal disturbance, chronic alcoholism, and sometimes directly follows the acute type of the disease; again, long-continued local irritation may produce a circumscribed inflammation. The lesion consists of a cellular infiltration of the mucous membrane, filling up and obstructing the spaces between the papillæ, and forming moderately deep fissures extending through the mucosa and dividing the surface of the organ into irregular areas.

In other instances patches denuded of epithelium and smooth and shining are scattered over the dorsum of the tongue; these patches, oval, round, or irregular in shape, are surrounded by slightly raised narrow white or yellowish borders, and are subject to rapid appearance and disappearance and change in outline. This condition is common in both children and adults, and is known as "ringworm of the tongue" or "geographical tongue." In still other cases there is desquamation of the epithelium, usually near the edges of the tongue, leaving red shiny areas, with irregular but unbanded borders.

As a rule, protracted superficial inflammation gives rise to no symptoms, though occasionally there are local pain and a sense of burning.

Chronic parenchymatous glossitis is infrequently seen, but it may occur from the same causes and as a sequel of acute inflammation of the substance of the tongue, the process undergoing incomplete resolution and terminating in overgrowth of the connective tissue, with subsequent atrophy of the muscle fibers. It may be general or local. This form

is unattended by constitutional disturbance. At first the tongue may be somewhat enlarged, generally or locally; later there are a reduction in size and slight pain and difficulty in articulation and deglutition.

The course of both chronic forms is very prolonged, and the prospect of relief depends entirely upon the possibility of removing the predisposing factor.

Treatment.—The treatment of chronic superficial glossitis consists primarily in efforts to overcome the cause. In addition the tongue must be kept very clean by frequent spraying with boric acid solution, so that remnants of food may not remain in the fissures or about the edges of eroded patches and produce irritation. Stimulating applications of tincture of myrrh or tincture of iodin are useful. In lingua geographica good results have been obtained by the employment of a combination of sodium hyposulphate and glycerin, each 1 part, to 18 parts of water.

In chronic parenchymatous glossitis the same attention to the causal factors is indicated. The localized form should be treated by removing the irritant—a sharp, carious tooth, for instance—by painting the part with tincture of iodin once daily, and the internal administration of potassium iodid, with or without alterative doses of mercury.

Leukoplakia

This disease, also called psoriasis linguæ, keratosis buccalis, etc., is a chronic affection of the tongue, and is marked by the appearance on the mucous membrane of raised, hard, whitish patches, having a fissured or smooth surface. It is of rather infrequent occurrence, and is encountered usually in male adults, though it has been observed in women and, still more rarely, during late childhood.

The habit of tobacco smoking is a prominent factor in the etiology, also the overuse of spices, condiments, and alcohol, and the irritation of decaying teeth or badly fitting dental plates; in a word, any frequently repeated and long-continued irritation of the mucosa. The cases often present a past history of syphilitic infection, but the lesion is not, strictly speaking, syphilitic, and may be associated with certain diseases of the skin, characterized by scaling and keratosis, especially psoriasis.

Pathologically the condition is one of hyperkeratosis of the mucous membrane. "Under the microscope the epithelium, especially the corneous layer, is greatly thickened. The subcorneous stratum contains many cells filled with eleidin droplets and granules. Mitotic figures are abundant in the deeper layers of the rete mucosum; while the elongated papillary processes are extensively infiltrated with leukocytes" (Riesman). The transformation of leukoplakia into carcinoma, by a purely evolutionary process, takes place in about 20 per cent. of the cases.

Early in the course of the disease deep red erythematous patches ap-

pear upon the surface of the tongue, gradually become white in color, and, increasing in thickness and size, may cover the whole dorsum of the organ and completely conceal the papillæ. The patches may extend to the lips, cheeks, gums, and palate, but are seldom found in the pharynx or on the base of the tongue behind the circumvallate papillæ.

The subjective symptoms are inconspicuous, unless the plaques be deeply fissured and irritated, when there is pain on chewing. In nervous patients the fear of cancer, or of recurrent syphilis, may cause profound mental depression.

Treatment.—Absolute abandonment of the smoking habit is essential to the cure of leukoplakia, and the removal or smoothing of sharp-edged teeth and cleanliness of the mouth are important adjuvants.

Of local applications, diluted tincture of iodin, 10 per cent., and salicylic acid solution, 1 to 100, have been recommended; also balsam of Peru rubbed into the indurations once daily, with the use of salt solution, ½ per cent. to 3 per cent., as a wash every two hours or oftener.

Antisyphilitic treatment and the employment of strong caustics or astringents are harmful, and it is questionable whether any therapeutic measure is of value in preventing the development of cancer.

DISEASES OF THE SALIVARY GLANDS

Parotitis

Inflammation of the parotid gland exhibits two forms, namely: specific parotitis or mumps, which is considered elsewhere, and symptomatic or secondary parotitis.

Symptomatic Parotitis

Secondary inflammation of the parotid gland occurs most frequently in diseases having their lesions seated below the diaphragm, as typhoid fever, dysentery, pyelitis, and perinephritic abscess, and sometimes follows operations upon the abdominal organs, especially excision of the ovaries. It may, however, result from any septic fever, from pneumonia, variola, measles, or scarlet fever, and has been noted after the prolonged administration of potassium iodid, and in lead poisoning. The method of production seems to be either an infection through the blood, or an ascent through the duct of Steno of toxic substances or bacteria, resulting from decomposition of the secretions, or neglect of the cleanliness of the mouth.

The general anatomical changes in the gland are those due to inflammatory, serous, and cellular infiltration of the interalveolar fibrous tissue,

resulting in resolution, fibroid induration, suppuration, or gangrene. When the inflammation tends to suppuration—the most common outcome is secondary parotitis—the lobules of the gland soften and break down, and are converted into numerous small cavities filled with pus. If the suppuration still extends the interstitial tissue is destroyed and a large abscess forms.

Occasionally there are extensive destruction and gangrene of the gland tissue and interstitial substance, and the inflammation may spread in various directions and cause dangerous results. It usually involves the neighboring connective tissue and muscles, the periosteum of the maxillary, temporal, and sphenoid bones, and even the bones themselves, and may pass from them to the middle and internal ear, the meninges, or the brain itself. Finally the inflammation may produce phlebitis and thrombus of adjacent veins—posterior facial and external jugular—and these thrombi by disintegrating may lead to embolism and septicemia.

Bacteriologically the condition must be classed with the mixed infections, since its occurrence as a complication of so many diverse diseases is a strong argument against the existence of a specific microbe, and in all of these sepsis, and hence infection, are possibilities. Many of the associated diseases are certainly due to a special germ, but, whether the complicating parotitis depends upon the irritating presence of these germs within the gland, or to streptococci or staphylococci which cause marked inflammation wherever localized, is as yet undetermined.

When symptomatic parotitis arises during the course of typhoid fever or other of the diseases mentioned, the apathetic patient makes no complaint of pain or discomfort. A slight chill or an exacerbation of fever may precede the formation of the tumor, which develops gradually or rapidly, feels hard to the touch, and is usually unilateral. If it appear during convalescence, the swelling is accompanied by a sense of tension in the part, the movements of the head are impeded, the mouth can only be partially opened, and chewing and swallowing are difficult. The tumor, when moderate in size, little indurated, and slow in development, may disappear gradually or rapidly by resolution. When suppuration takes place it becomes uneven, nodulated, and red, fluctuates on palpation at several points, and, when opened, spontaneously or by incision, discharges pus. Spontaneous rupture may take place on the surface of the cheek or into the external auditory meatus, or simultaneously in both positions, or, much more rarely, into the mouth or pharynx. Again, the pus may burrow along the sternocleidomastoid muscle, or the esophagus and trachea, and form abscesses in the lower part of the neck, or even enter the thoracic cavity.

The old idea that symptomatic parotitis is a critical indication and exerts a favorable influence on the course of the original disease is utterly

unreasonable; on the contrary, it is always an undesirable, and often a prolonged and grave, complication.

Treatment.—Something can be done in the way of prevention by due attention to the care of the mouth in those diseases in which the parotid inflammation is apt to arise as a complication. In any severe febrile attack, particularly typhoid fever, the mouth should be carefully washed three times a day with boric acid solution, or some other antiseptic lotion, to remove altered secretions and decomposing detritus of food.

When the gland begins to swell, treatment must be directed to the encouragement of resolution. The best measure for this purpose is the constant application of cold by means of an ice-bag. Tincture of iodin and mercurial ointment are also employed, but are nearly so effective as an ointment of ichthyol (gr. xx) with lanolin (℥j). Before this is applied, the skin covering the tumor is washed with warm water and carefully dried, the ointment is then gently rubbed in, some being left on the surface, and covered with cotton-wool, or flannel and gutta-percha tissue; this dressing should be freshly made each morning and evening.

When it is evident that suppuration must take place, hot fomentations will relieve discomfort and hasten pus formation; and an early incision, even though it must be a deep one, is urgently demanded. The incision should be made with careful antisepsis, so directed as to avoid the larger blood-vessels, the facial nerve, and the duct of Steno, and should be drained, packed with iodoform gauze, and covered by an antiseptic dressing. The wound should be dressed daily, sterilized with hydrogen dioxid, and allowed to granulate. This procedure secures thorough evacuation, with the least ultimate disfigurement.

When the inflammation is followed by induration, potassium iodid must be administered internally and a compressive bandage used locally. In these cases the inunction of iodin petrogen or of an ointment of calomel and vaselin, gr. x to ℥j, are often very useful.

Chronic Parotitis

Chronic inflammation, while generally confined to the parotid, may involve any of the salivary glands. It is attributable to an infection spreading from the mouth, and usually depends upon retention of salivary secretion due to obstruction of the gland ducts by calculi; it may, again, follow an attack of secondary parotitis, the inflammation undergoing incomplete resolution and terminating in induration. The gland assumes somewhat the appearance of malignant disease, being hardened and enlarged, the increase in size varying with the degree of obstruction and retention.

Treatment.—The treatment embraces removal of the obstructing cause, if possible; the internal administration of potassium iodid, and the local use of alteratives and absorbents, such as iodin petrogen or mercurial ointment.

Salivary Deposits

A laminated deposit, so-called tartar, often forms on the teeth, and leads to chronic gingivitis and absorption of the alveola. The internal surface of the lower incisors and canines, and the external surface of the upper molars, being closest to the orifices of the ducts of Wharton and Steno, are usually most markedly involved.

Two forms of tartar are described, the *serumal* and the *salivary*. The first is derived from the blood, is deposited under the gum, around the roots of the teeth, contains uric acid and urea, and has a close association with gout.

The salivary form is more slowly deposited, harder and darker in color, adheres firmly to the tooth surface, and is composed of the precipitated inorganic constituents of the saliva—calcium carbonate and phosphate forming the bulk of the mass. This deposition is due to the too rapid escape of carbonic acid, which holds the salts of the saliva in solution.

Treatment.—Prevention is difficult, especially in the serumal variety, though something can be expected from attention to the patient's general health, regulation of the diet, exercise, the employment of the measures ordinarily directed to the removal of a gouty tendency, and by careful brushing of the teeth and general cleanliness of the mouth.

When tartar has formed, its removal must be left to the dentist. Subsequently the gums should be treated with tincture of iodin, the teeth and mouth kept as clean as possible, and liquid magnesia used as a wash twice daily.

Salivary Calculi

Concretions, composed mainly of calcium carbonate and phosphate, may form within the salivary glands, or, much more commonly, in the excreting ducts; the most frequent situation being the duct of Wharton, at a point a short distance behind the oral orifice. These calculi vary in size, but are not often larger than a pea, and differ in shape; those found in the duct being cylindrical and smooth, those in the gland round or irregular.

The concretion may form around some foreign body that has found its way into the duct from the mouth, as a seed or fragment of food or tartar, but bacterial infection may play the same part here as in the production of gallstones.

Calculi seated in the gland usually gives rise to no symptoms, though the organ sometimes becomes enlarged, hard, and tender. With the duct stones there is pain—"salivary colic"—which is generally felt along the floor of the mouth, and comes on during eating and continues for several hours. At the same time the corresponding gland becomes swollen, the

proximal end of the duct distended, and there is no flow of saliva. The stone can be detected by sounding the duct, by digital examination, and by the X-ray.

Treatment.—The treatment is purely mechanical, the removal of calculi being left to the surgeon.

Angina Ludovici

Ludwig's angina is a cellulitis of the tissue of the floor of the mouth, probably, in most cases, starting as an inflammation of the submaxillary gland, and due to bacterial infection, extending from the mouth through the lymphatic vessels. The focus of infection is usually some slight lesion, such as a carious tooth, or an ulceration of the oral mucous membrane, or of the tonsil.

The condition occurs more commonly in the male sex, and the onset is acute with moderate fever and some difficulty in swallowing. Soon an indurated swelling appears in the region of the submaxillary gland, on one or both sides, and rapidly extends forward toward the chin, backward toward the angle of the jaw, and downward to the sternum. The sublingual tissue grows congested, tense, and swollen, and forces the tongue upward, or, when the inflammation is unilateral, upward and toward the unaffected side. The skin covering the tumor, at first movable, becomes after several days red, edematous, and adherent. Next, an opening forms in the floor of the mouth, through which a thin ichorous fluid is discharged. There are increased pyrexia, restlessness, sweating, dyspnea, delirium, and the patient becomes septic and passes into the typhoid state.

Death often results from extension to the larynx or lungs, or from widespread gangrenous destruction of the involved tissues.

Treatment.—At the beginning of the disease effort should be directed to securing resolution by the application of leeches or by ice bags, but so soon as suppuration begins prompt and thorough surgical measures alone offer any prospect of relief.

[I have found the colloidal silver preparations, especially collargol, very valuable for the prevention, as well as for the treatment, of this disease. The collargol ointment, unguentum Credé, should be rubbed into the skin covering the swollen glands twice or three times daily as early as possible. If, notwithstanding this, the connective tissue surrounding the swollen glands is invaded, it should be incised with a fine pointed bistoury, and either collargol ointment or collargol applied, so that they enter the incisions, thus penetrating into the infected tissue. The ointment should be applied freely as well as the collargol; the latter is prescribed as a one per cent. aqueous solution, and employed as a wash or injected into the incisions.—Editor.]

CHAPTER II

DISEASES OF THE PHARYNX

B. R. Shurly

ACUTE NASOPHARYNGITIS AND PHARYNGITIS OR FAUCITIS

Acute nasopharyngitis and pharyngitis or faucitis occur usually with involvement of the nasal passages, tonsils, uvula, or larynx. These acute inflammations are familiarly known as "colds." They may develop as independent affections, or it may be necessary to treat an attending digestive disorder as well, or the acute process may be recognized as really an exacerbation of a chronic inflammation. The treatment by a mild calomel purge, followed by a saline laxative, may be entirely efficacious. If abnormal temperature or dysphagia be prominent symptoms then salol with acid acetyl salicylate, five-grain doses each, will give prompt relief. Tincture of aconite or phenacetin may well be chosen instead.

In cases with considerable edema of the mucous membrane and glandular involvement an irrigation or douche, by means of a fountain syringe, with a solution containing a teaspoonful of pulv. antiseptic comp. to a quart of very hot water is a valuable remedy. The nozzle of the syringe or douche should be placed well back in the throat and the solution allowed to bathe the inflamed area before flowing out of the mouth cavity into a receptacle. An astringent and antiseptic gargle consisting of carbolic acid, ten minims, with pulverized alum, one-quarter of a teaspoonful, in a glass of water gives great relief. The use of orthoform, or mentholated lozenges, often affords great comfort. Pellets of cracked ice allowed to dissolve in the mouth lessen congestion. An ice collar is both grateful and useful if the glandular swelling produces pain, although hot applications may prove more soothing in some cases. If the patient is under observation early in the attack an application of argentum nitrate (gr. xx-℥i) to the pharynx and ten grains to the ounce to the nasopharynx will have prompt astringent and analgesic effects upon the congested area. When these acute conditions are attended by uvulitis the powerful astringents, such as tannic acid, ferri-alum, or iron persulphate, may be applied. If these measures fail the sides of the uvula may be incised. Adrenalin

chlorid (1-1,000), or cocain and antipyrin (of each 2½ per cent.), will afford temporary relief. The diet should be liquid or simple and non-irritating. Ice cream is acceptable.

It is well to bear in mind that these acute inflammatory conditions are frequently nothing more than an initial demonstration of some constitutional infection or dyscrasia such as measles, scarlet fever, varioloid, pertussis, diabetes mellitus, diphtheria, tonsillitis, gout, acute articular rheumatism, typhoid fever, erysipelas, pernicious anemia, or the onset of tuberculosis. Therefore constitutional treatment must be administered accordingly.

CHRONIC NASOPHARYNGITIS AND PHARYNGITIS

The local inflammation of the pharyngeal mucosa is frequently a reflection of some important constitutional dyscrasia, such as rheumatism, gout, syphilis, tuberculosis, the anemias, renal and cardiac lesions, digestive disorders, and intoxications, or the excessive use of alcohol and tobacco. All of these, especially the latter habits, must receive prompt and appropriate attention and treatment. The use of the voice must be investigated and regulated. Questions regarding clothing, exercise, occupation, and bathing must receive attention and proper advice. High blood pressure, if present, should be modified by giving epsom salts before breakfast, or other appropriate laxatives. Chronic nasopharyngitis is frequently the result of neglected adenoids. If remnants of this enlarged or altered tissue be present they should be destroyed or, better, removed. The prevention of acute rhinitis should be urged, and radical treatment adopted at the onset of each attack. Internally the administration of the syrup of the iodid of iron or hydriodic acid may prove of value. The tonic alterative effect of "Llewellyn's solution of the compound wine of iodin"—which contains phosphorus, grain 1-100; bromin, gr. ⅛, and iodin, gr. ⅛—if given after each meal is especially efficacious. Locally—sprays and gargles afford comfort and relief to the patient. Where painful deglutition exists a hot throat douche, or a nasal douche of a solution of pulv. antiseptic Co. (℥i to the quart of very hot water), may be applied. It is grateful and cleansing. When the mucus is particularly tenacious a strong saline solution or equal parts of soda biborate and boric acid (a teaspoonful to a glass of hot water) is a readily prepared and useful solution. In addition, the posterior, pharyngeal, and nasopharyngeal wall should be painted daily with a pigment compound of iodin, grs. x; potassium iodid, grs. xx; and glycerin, ℥i; also a solution of silver nitrate, grs. x—℥i—should be applied once or twice a week. When a granular pharyngitis or chronic folliculitis exists these should be treated by touching the top of each hypertrophic zone with a galvanocautery tip at white heat, or with fused nitrate of silver. When the blood vessels leading to the follicles are large

and tortuous they should be cut off by touching them lightly with the galvanocautery electrode at a point in the middle of their course.

Among the astringents of value may be mentioned the sulphocarbolate of zinc, grains x to ʒi; alumnol, grs. ten to twenty; or a 20 per cent. solution of argyrol. The severe types of chronic pharyngitis will not respond to remedial measures until complete surgical methods are adopted, as necessity requires. It is also true that surgical procedure is frequently chosen too hastily, and may thus be harmful. The tonsils may be completely enucleated in some cases, after which a modified method of treatment to the pharynx may prove sufficient. Anterior or posterior hypertrophies or any marked pathologic condition should always be removed. A deflected septum when actually obstructive should be resected, and spurs, ridges, or excrescences should be removed surgically if necessary. Adenoid vegetations are especially a source of recurrent infection, in which event adenectomy only will afford relief in such cases.

CHRONIC PHARYNGITIS

This disease in its various pathologic conditions demands a careful investigation of the nose, nasopharynx, and accessory side cavities to determine and relieve the etiologic factors contributing to the chronic pathologic changes.

Operative procedure should be instituted to correct nasal obstruction and restore good drainage. The use of alcohol and tobacco should be prohibited or greatly curtailed. Spirituous liquors particularly are irritating and develop chronic hypertrophy.

The nose may be washed with one of the agreeable and efficient alkaline solutions. A small rubber syringe or glass douche may be recommended for the purpose with careful instructions to tip the head to the opposite side when each nasal passage is slowly irrigated. The Eustachian tubes are not in danger when proper position and muscular control are attained.

Hypertrophied follicles should be obliterated by a galvanocautery tip at cherry red heat. Five or six follicles may be cauterized at a sitting by gently sinking a fine pointed electrode into the center of each follicle. Four per cent. cocain will suffice to produce good local anesthesia. Hypertrophy of the lateral walls may be promptly reduced by the same process. A suitable electrode may be chosen for this application. Nitrate of silver (xx—xxx grains to the ounce), or argyrol, 20 per cent., should be applied at intervals of four days to relieve mild forms of chronic pharyngitis. A gargle of alum, grs. v; potassium chlorate, grs. xv to the ounce of water, or a solution of alum, grs. viii, ac. carbolic, mii, glycerin and water to

an ounce will add greatly to the comfort of the patient. Menthol or red gum lozenges are used with advantage.

Gouty and rheumatic subjects, and all cases of pharyngitis secondary to systemic disease should receive a carefully prepared diet, a morning saline such as soda phosphate, and appropriate systemic treatment.

ATROPHIC NASOPHARYNGITIS

In atrophic nasopharyngitis the crusts are often removed with the greatest difficulty. Hydrogen peroxid will prove valuable in cleansing a space that resists the application of a postnasal douche. The methods of treatment used in the nasal passages are equally efficacious for the nasopharynx. A change of climate is often of advantage. Some cases do well in a moist, warm climate. The accessory sinuses should be carefully investigated, and drained when necessary. (See Atrophic Rhinitis.)

ACUTE RETROPHARYNGEAL ABSCESS

This disease generally affects infants and children. It is frequently mistaken for spasmodic croup in cases attended by edema of the larynx. Adults are occasionally affected. Digital examination of the oropharynx and laryngopharynx will reveal the developmental stage and location of the abscess. The chief aim is to evacuate the abscess as soon as possible. Pointing is usually present when the diagnosis is made. Medicinal methods of treatment are of little value except during convalescence. The internal method of incision should be chosen unless a communicating cervical abscess is found or the condition is probably tuberculous.

The following is the method of incising internally: The patient is prepared according to the method of intubation. A sheet is firmly pinned around the body of the infant, in this manner holding the arms firmly at the sides. An assistant seated in a straight back chair firmly holds the body and legs of the child, while a second assistant holds the head and mouth gag in position. The operator, standing in front of the patient, depresses the tongue firmly with a tongue depressor until the abscess is exposed. A bistoury, with the blade covered by adhesive plaster, so as to leave only half an inch of the point exposed, is inserted into the abscess. The incision is made longitudinally from above downward, inclining toward the median line. The assistant is instructed to quickly turn the infant forward face down as soon as the incision is made, so that pus may run from the mouth. When the abscess is pointing below the line of vision it may be successfully evacuated by the finger nail of the index finger. The

writer has opened many cases of retropharyngeal abscess by this method that went on to speedy recovery.

The use of chloroform or ether should be avoided if possible. In cases that require the external operation general anesthesia may be adopted without hesitation.

ACUTE UVULITIS

Inflammatory processes that involve the uvula are usually attended by similar pathology of the surrounding tissue. A troublesome edema is frequently associated with peritonsillar abscess. This condition is relieved by scarification or multiple puncture with a sharp pointed scissors. Hot astringent gargles, preferably alum (¼ teaspoonful to a glass of hot water), are valuable. Hot irrigation with alkaline solutions from a fountain syringe promotes a reduction of edema. Ballinger recommends a five hundred candle power leukodescent lamp to the neck at the angle of the lower jaw passed back and forth for fifteen to thirty minutes, and held at a distance of eighteen inches. Lozenges of krameria or red gum, an ice collar, and chipped ice served at intervals add to the comfort of the patient.

When the congestion continues or ulceration develops an application of silver nitrate, sixty grains to the ounce, hastens recovery. General as well as local treatment is required. Temporary relief may be obtained by the application of 1-1,000 adrenalin solution. When these measures fail the tip of the uvula may be excised and the exudate allowed to drain out.

HYPERTROPHY OF THE PHARYNGEAL TONSIL OR ADENOID VEGETATIONS

The development of adenoid vegetations in early infancy and childhood demands prompt attention by the family physician. A pathologic condition of the nasopharyngeal space is responsible for more complications in the infectious diseases of children than any other anatomic region. The nasopharyngeal catarrhs of adult life are largely the result of neglected adenoids and acute infections attending this condition during the developmental period.

The treatment of adenoid vegetations may be both local and general. The indication for local treatment is the relief of nasal obstruction. This should be accomplished by surgical measures at the earliest possible moment. This is one of the most successful operations in the field of rhinology or laryngology, and should be performed with great thoroughness.

Adenoids is extremely common in children from two to eight years of age, and may persist into and through adult life. The old idea of letting the patient outgrow this condition, which is still accepted by some practitioners, should be most severely condemned.

The nasopharyngeal space may be low and broad, high or narrow, or greatly deformed by bony projections, especially in the median line of the roof, or in the region of the cervical vertebræ. Patients with severely crowded teeth and high arched palate should receive continuous and painstaking care by the orthodontist. The jaw may be spread and the crowded teeth gradually forced into proper alignment. This procedure may so affect the floor of the nose that additional air capacity may be obtained.

Innumerable remedies in the form of sprays, applications, and internal medication have been advocated for the relief of adenoids. Fowler's solution, the syrup of the iodid of iron, cod liver oil, and potassium iodid have been lauded in the various text-books. Iodin in formulæ of various kinds has been highly recommended. The fact has been demonstrated, however, that these remedies are practically worthless, and valuable time may be lost unless proper surgical methods are instituted for the complete removal of the hypertrophied lymphoid tissue.

Until operation can be performed palliative measures may be adopted. Adrenalin ointment or solution, 1-10,000, followed by a warm saline irrigation with an eye dropper or syringe, will afford great relief to infants especially. This may be followed by a spray of menthol, gr. v to the ounce of liquid petroleum.

Within the realm of laryngology it would be difficult to mention an operation followed by the satisfactory results that come from adenectomy. The relief of symptoms and probability of recurrence are generally in a direct ratio to the thoroughness with which this operation is performed.

It is important to examine carefully each patient and determine all causes of nasal obstruction. The promise of complete and speedy relief by operative procedure cannot be offered when deflected septa, high-arch palate, hypertrophied turbinates, polypi, enlarged tonsils, and congenital malformation exist. Open mouth breathing may continue after operation and require a special apparatus for holding the lower jaw in place until a habit of normal nasal respiration can be acquired.

The technique of adenectomy is comparatively simple, yet considerable dexterity is required to perform a complete operation. The beginner meets with many puzzling questions he must settle. Many hundred varieties of instruments are on the market that are recommended for the operation. The majority of them are worthless to the beginner. Certain principles may be outlined in establishing a satisfactory method of procedure.

The American practitioner stands preëminently for the comfort and welfare of the patient. He administers ether on account of its safety. Selected cases may require a departure from this rule, and the anesthetic chosen may be nitrous oxid. Chloroform is unquestionably dangerous, as

statistics have shown. The writer has discarded it entirely, although many operations have been performed without a fatality.

The anatomy of the nasopharyngeal space should be constantly borne in mind. A digital exploration will determine any peculiarity in the location of the hypertrophy. The mouth should be held open with a reliable mouth gag and the tongue held with a suitable depressor. A Gottstein curette should be passed in the median line behind the uvula and soft palate to the most anterior portion of the roof of the nasopharynx. It is important that the cutting edge should engage the hypertrophy at its upper anterior border. A sweep of the very sharp blade across the roof and down the posterior wall in the median line will remove the central mass of tissue. Care must be taken not to wound the tissue at the Eustachian eminences when succeeding lateral sweeps are made. All growths in the fossæ of Rosenmüller should be removed with a suitable curette or the aseptic finger nail. Hypertrophy along the posterior wall may be removed with a right angled curette. The space should be examined digitally and any remaining tissue removed. A piece of gauze wrapped about the index finger will bring away retained shreds. A sea sponge of ice water is held at the root of the nose to control hemorrhage.

The patient is put to bed and turned on the side to allow the blood and secretion to drain out. Unless signs of sepsis develop no irrigation of the nose is required. A spray of adrenalin (1-10,000) or albolene may be used occasionally for the comfort of the patient. Excessive hemorrhage is exceedingly rare. It may be controlled by packing the nasopharynx with adrenalin and alum soaked gauze or prepared bismuth gauze.

The question of the regrowth of adenoids deserves attention. Many instances where a return of the original symptoms of hypertrophy have taken place, the operation was not thoroughly done. Care should be taken to remove all adenoid growth in the interior and upper angle of the vault of the pharynx. Many instruments are so imperfectly constructed that the sweep of the curette does not include this offending tissue. It is true, however, that in older children (over three years) a small percentage of cases will show recurrence of adenoid growth.

As has been suggested, where congenital narrowing of the bony nasal passages is present, and in cases of deflected septa, anterior and posterior hypertrophy of the turbinated bodies, guarded opinions should be rendered to the patient in reference to complete relief and restoration of normal breathing, after this operation is performed.

MEMBRANOUS PHARYNGITIS

The treatment of pseudomembranous inflammation of the pharyngeal mucous membrane requires for its scientific basis a thorough bac-

teriologic study of the infecting microorganisms. The management of the disease of the Klebs-Loeffler variety is described in detail under the classification of diphtheria. This disease is simulated clinically by pseudomembranous formations that are attended by the presence of numerous streptococci, staphylococci, pneumococci, the fusiform bacillus, and the spirillum of Vincent. A vaccine may be prepared from a culture taken, or a stock preparation may be used in these cases with advantage, in addition to the local and constitutional treatment given. Antidiphtheritic serum in full dosage (5,000 units) should be given promptly if a question of doubt exists as to the possibility of diphtheria. These cases are contagious, especially among children, and the prophylaxis of a rigid quarantine with proper disinfection is worth the effort.

For destroying pseudomembrane Loeffler's solution, which consists of toluol, 36 parts; absolute alcohol, 60 parts, and liquor ferri sesquichlorid, 4 parts, is most efficient. It should be applied in small quantity to the false membrane for about ten seconds. It is well to dry the area before the application, in order to avoid the danger of the solution flowing on to the healthy mucosa. The procedure is often attended by sharp pain for a while—extending to the ears.

Peroxid of hydrogen ranks second in efficiency. In children it may be used diluted with equal parts of lime water in the form of a throat douche, or irrigation. The large soft rubber bulb syringe is a most useful instrument for the purpose. The process should be repeated hourly through the day. The interval may be lengthened at night to afford time for sleep. When marked toxemia exists with exhaustion in this case, as well as in all diphtheritic cases, the irrigation must be performed with the least amount of exhaustion to the patient. It is better to accomplish this task with the head in the lateral position—the body remaining prostrate. Much harm may be done by disturbing the patient with nourishment, medication, and throat treatment at irregular intervals. An effort should be made (when the case is not too serious) to arrange a plan that will include every attention after a three-hour interval. The heart should be examined frequently for indications of circulatory distress. A specimen of urine should be examined every second day in order to detect early nephritis, which may also furnish much information of therapeutic value. An ice collar will minimize lymphatic absorption and add to the comfort and welfare of the patient.

Inasmuch as many pseudomembranous conditions are contagious—especially among children—a strict isolation and quarantine should be enforced. A room with good sunlight and more than two thousand cubic feet of air per person should be selected. All unnecessary furniture should be removed and such articles chosen for use in the sick room as may be readily disinfected. A moist alkaline atmosphere may be obtained by the boiling of a soda bicarbonate solution—a dram to the pint of water.

Where it is impossible to use an electric heater, a tea kettle on a gas stove will answer the purpose. A piece of garden hose may be attached to the spout of the kettle, and steam sent in any direction. Croup kettles of several patterns may be obtained in the market, but they are undesirable and increase the labors of the nurse, besides the danger of fire imminent with an alcohol lamp. In the houses of the very poor the crude method of placing a very hot flat iron or very hot bricks in a pail containing a small quantity of alkaline water will serve the purpose very well in cases of involvement of the larynx. The ingenuity of the physician may be required in the management of the diet. Milk, eggs, and beef broth will furnish the basis of many palatable preparations. Ice cream and fruit juices are grateful.

Constitutional treatment in the form of the tincture of the chlorid of iron, one part; and glycerin, four parts; thirty drops t. i. d. will prove of service. Full doses of whiskey may be indicated at the onset of symptoms of exhaustion.

VINCENT'S ANGINA

The differential diagnosis of this infection from follicular tonsillitis and diphtheria may be promptly determined by the microscopic examination of a specimen taken directly with the swab. Klebs-Loeffler bacilli may also be found by this method and many hours of early treatment gained in this way. The fusiform bacillus and the spirillum of Vincent succumb usually to the application of peroxid of hydrogen, strong nitrate of silver solution, trichloracetic acid, 50 per cent., Lugol's solution, 10 per cent. chromic acid or methylene blue. The latter preparation should be rubbed well into the affected area, which is usually the tonsils.

Some epidemics show considerable mortality. An autogenous vaccine may prove beneficial, although these microorganisms are cultivated with difficulty.

PHLEGMONOUS PHARYNGITIS

This infective process is marked by superficial ulceration of the pharyngeal mucous membrane and is usually of streptococcic origin. Treatment is started with a free calomel and soda purge, followed by salines. Ice-bags to the neck and hot alkaline irrigation hourly are indicated. The ulcerated areas should be painted with nitrate of silver or argyrol, 20 per cent. Membranous formation may require light applications of Loeffler's solution or peroxid of hydrogen irrigation and antiseptic gargles. Orthoform insufflation may be used to relieve pain. In later stages with cellulitis of the neck, heat and free incision of suppurative areas may be necessary. General septic infection should be combated with antistreptococcus

serum or streptococcus vaccine. Large doses of quinin are administered with advantage.

The subcutaneous injection of 200 to 500 grams of normal saline solution is an excellent supporting measure. The administration of strychnin and alcohol may be necessary.

When the acute symptoms subside reconstructive tonics should be prescribed.

CHAPTER III

DISEASES OF THE TONSILS

B. R. Shurly

ACUTE TONSILLITIS

Acute tonsillitis which affects the superficial tissues, the crypts, or the parenchyma is usually of bacterial origin. A culture should be taken at the first examination and the therapeutic indications promptly fulfilled by the use of the proper stock or autogenous vaccine, or antitoxin. Treatment should be initiated with a brisk calomel purge followed by a suitable saline. Abortive treatment may be attempted by the application of strong silver nitrate, 40 to 60 grains to the ounce, or tincture of guaiac in milk, three times during the first day. The pyrexia may be reduced by tinct. of aconite in drop doses at one or two hour intervals. Myalgia and pyrexia will be mitigated by the use of aspirin in doses of five grains until three or four capsules are administered, and continued at three-hour intervals during the attack. Sodium salicylate in ten-grain doses every two hours is indicated in cases of rheumatic origin. When salicylates are ordered great care should be exercised to guard the gastrointestinal tract from excessive irritation. Tinct. of the chlorid of iron with glycerin may be applied locally, and given internally with advantage. The method that affords greatest relief locally is the tonsil douche or irrigation. This is prepared in a two to four-quart fountain syringe by adding a teaspoonful of compound antiseptic powder U. S. P. to the quart of very hot water. The nozzle of the syringe is placed well into the mouth cavity and the stream of water allowed to irrigate the offending tonsil. The overflow passes into a suitable basin selected for the purpose. This procedure may be repeated every hour. The ice-bag, the leiter coil, or cold compresses externally relieve the lymphatic swelling. Sprays or applications of menthol (grs. five to twenty to the ounce of albolene) are soothing to the inflamed tonsil. When gargles are used it is essential to instruct the patient in the proper method of use: A small quantity of fluid only is necessary, then the head should be thrown well back, the mouth opened, and the nose held firmly with the thumb and forefinger while gargling.

Equal parts of hot milk and water, to which fifteen or twenty drops of tinc. opium are added, may prove soothing and agreeable for a gargle. Ten drops of acid carbolic and a tablespoonful of compound antiseptic solution to a glass of water will also give temporary relief when used as a gargle. Dry sodium bicarbonate may be applied to the part with a spatula or the finger of the patient. A half teaspoonful of alum to a glass of water affords a ready and satisfactory astringent gargle. Much comfort may be derived from the use of lozenges of menthol, orthoform, or chlorate of potash, held in the mouth. The crypts may be cleansed with a cotton applicator saturated with hydrogen peroxid, during office treatment, and sprays of Dobell's solution or permanganate of potash may be used for temporary relief. An efficient and old-time prescription for a gargle is:

℞

Potass. chlor., ½ dram.
Tinc. ferri chlor., ½ oz.
Glycerin, 3 drams.
Aquæ dist. p. s. ad ℥iii.
S. Gargle every hour.

MYCOSIS OF THE TONSILS AND FAUCES

This persistent invasion of the crypts and glandular tissue of the tonsils, fauces, and frequently the base of the tongue demands energetic and continuous treatment until the fungus growth has been completely obliterated. The benign nature and slow progress of this affection may give no discomfort to the patient, while others are made especially unhappy by its presence. Any gastrointestinal disturbance should receive appropriate treatment. The toilet of the teeth and mouth cavity should receive proper attention. While spontaneous cure may occur, it is not a self-limited disease.

The treatment required is chiefly a topical one. Antiseptic sprays and astringents are useless. The fungus with its mycelia must be destroyed. A small sharp curette is the most efficient instrument for clearing the follicles and crypts. After the application of cocain, 4-10 per cent., a small region of invasion should be selected for curettage and the application of the galvanocautery point. This method should be followed persistently each week until satisfactory results are obtained. During the interval hydrogen peroxid, nitrate of silver, or tincture of iodin may be applied. Mercuric chlorid or formalin is recommended when other methods fail. It sometimes requires many weeks of treatment to obliterate the growth.

The disease is more frequent in females and rarely observed in smokers.

ACUTE PERITONSILLITIS OR QUINSY

While medical art offers no preëminently successful remedy for this condition much can be done to alleviate the suffering of the patient, hasten his recovery, and prevent a recurrence. In cases that apparently develop as a manifestation of acute rheumatism the salicylates and alkalies should be pushed to full dosage. The initial symptoms call for calomel or blue mass to be followed by one half ounce (16.0) of magnesium sulphate. Aspirin (grains five) (0.3) with sodium bicarbonate (grains ten) (0.6), every two hours, should be given during the first day, after which the interval may be changed to four hours. Bicarbonate of soda may be applied hourly to the offending tonsil, in the form of a saturated solution. Tinct. guaiac ammoniat., in gruel or milk every four hours, is highly recommended by many text-books; but in my practice it has been of little service. In cases with pyrexia tinc. of aconite in drop doses, hourly, until the physiological effect is noted, has many staunch supporters. The pain may become so acute that morphin or codein hypodermically may be required. A culture should be taken because the abscess is frequently due to infections of the staphylococcus, streptococcus, or pneumococcus. An appropriate autogenous or stock vaccine may be of value in the treatment. Locally an hourly irrigation with alkaline solutions from a fountain syringe affords great comfort and relief. These may consist of comp. antiseptic powder or bicarbonate of soda, or equal parts of borax and boric acid in the proportion of a teaspoonful (4 c. c.) to a quart (1,000 c. c.) of very hot water, for an efficient irrigation. An ice bag or collar to the neck often gives additional comfort. Numerous remedies have been thought especially efficacious, among which may be mentioned iodin, carbolic acid, peroxid of hydrogen, nitrate of silver, guaiacum, tinct. of chlorid of iron, iodoform, and formaldehyd. When suppuration seems inevitable it is a better plan to favor it by hot irrigation, hot fomentation, and steam from a nebulizer or croup kettle, containing an alkaline solution. When an abscess is formed it should be opened, and when localized much valuable information of the condition may be obtained by a digital exploration of the tonsil and peritonsillar tissue. Contrary to the usual sensation of fluctuation, as in soft tissues covered by epidermis, the muscles in the region of the tonsil assume a condition of tension and rigidity, and the point of selection for incision will be found to be the most tense or hardest area along the velar lobe or anterior pillar of the fauces.

A half-inch incision should be made over the selected spot (which has been previously cocainized) with a sharp-pointed curved bistoury partly covered with absorbent cotton or adhesive plaster so as to limit the cutting edge to one half inch. A blunt probe of good size should be passed through the open wound and any communicating pockets of pus carefully

broken down, so as to insure thorough and continuous drainage. A general anesthetic is dangerous in these cases and should be avoided when possible. Pressure on the part, then gargling, and irrigation should be continued to favor drainage.

Complete radical tonsillectomy should be recommended and performed at the earliest opportunity afterward, and great care should be taken to completely enucleate the velar or upper hidden lobe of the tonsil during the operation. This method of procedure is almost universally curative. Dr. Leland, of Boston, recommends incising the tonsil with his right-angled knife, then inserting the index finger and gouging out a thorough drainage canal. The danger of heroic and traumatic methods lies in the favoring of metastasis—especially the induction of infection of the joints or endocardium.

CHRONIC TONSILLITIS

The treatment of the various forms of pathologic tonsils should be selected after a careful investigation into the actual amount and variety of disease manifested by the given tonsil. It is important to decide by personal observation and a careful history the objective and subjective symptoms produced.

The one popular method of procedure established and practiced by the leading laryngologists of the present time in this country is the revival of the ancient method of Celsus, viz.: the complete enucleation of the tonsil. The furore that has swept over the new world that demands tonsillectomy while a remnant of tonsil tissue remains has reached its zenith and methods of compromise will resume a place of recognition at least.

Complete enucleation is demanded in tonsillar tuberculosis, in tonsillar rheumatism, in cervical adenitis of definite tonsillar origin, and after suppurative tonsillitis or quinsy. It is a well recognized fact that scarlet fever, influenza, quinsy, and tonsillitis are often direct etiologic factors in the development of the various types of Graves' disease. This interrelation of the physiology of the tonsil and ductless glands is well known but not scientifically elaborated. It is true that the complete removal of the tonsils is often attended by a subsequent diminution in hypertrophy of the thyroid gland.

Cases of chronic inflammation occurring in adults without much enlargement and possessing a few pathologic crypts can often be successfully relieved by simple methods. The offending crypt should be enlarged with a suitable tonsil knife and curetted. It may be washed with peroxid of hydrogen or 1-3,000 mercuric chlorid solution by means of a small curve-pointed syringe. Fused nitrate of silver on a small probe may be passed into the crypt once or twice a week.

In the fibrous variety local applications prove of little service. In some

cases the galvanocautery will be useful when the tonsil is boggy and hyperemic with several pathologic crypts containing foul secretion or food particles. In these cases a fine-pointed electrode passed at a red heat into the offending crypts will relieve the cough or other annoying symptoms by means of the resulting irritation by burning rather than a complete destruction of the tissue.

The selection of treatment is a matter for careful deliberation. All slightly hypertrophied or pathologic tonsils do not necessarily require tonsillectomy as advocated by some of our radical surgeons. It is possible and probable that the tonsil manufactures an internal secretion of some value in early infancy at least.

The older methods, however, for reduction of enlarged tonsils, such as ignipuncture, electrolysis, the galvanocautery knife, and the applications of escharotics such as chromic acid, trichloracetic acid, London or Vienna paste, have gone into just retirement. When operation is indicated and impossible on account of great danger from hemorrhage or anesthetic or systemic disease these methods may be considered.

A large number of astringents and solutions containing iodin have been recommended from time to time as efficient in the reduction of enlarged tonsils. The use of these medicaments has proven so unsatisfactory that valuable time should not be wasted in affording surgical relief to the surgical tonsil. Tonsillotomy or tonsillectomy must be performed. The former should be the method of choice when tonsils are simply hypertrophied and not otherwise diseased and when the services of a competent laryngologist cannot be obtained. The complete enucleation of the tonsil is not an operation to be undertaken without deliberation. It involves the most important questions of anesthesia, hemorrhage, and technique. It is best performed in a hospital. Adults who are not nervous and excitable may be operated upon with local anesthetics—menthol, cocain, and ac. carbolic equal parts may be applied, and urea and quinin hydrochlorate, 1 per cent., injected in drops along the anterior and posterior pillars, or cocain, 1 per cent., with adrenalin chlorid, 1-10,000, may be chosen. Children and nervous women are more successfully operated under a general anesthetic as a rule. Ether is recognized as chief of the list of anesthetics chosen for this operation. Chloroform is contraindicated.

Hemorrhage at the time of operation should be controlled by artery forceps and ligature. Post operative bleeding may require the application of adrenalin, alum, the hemostat, or a general anesthetic and ligature.

In the last decade our literature has been flooded with articles upon the subject of tonsils. Instruments have been showered upon the market, until the progressive laryngologist has found his office filled with useless instruments. The question of technique must be settled by each individual operator for himself. The choice of anesthetic has been so thoroughly determined by custom and safety that the surgeon is not willing to depart

from the administration of ether. The choice of a position is determined by training. In the New England States the sitting posture with the head erect is selected. Under the teaching of Todd, in Minnesota, the head is allowed to drop well back while the patient lies on the table. In the middle west we prefer the reversed Sims position with the head on the side and inclined downward to allow the secretions to drain from the side of the mouth. In this position the lower tonsil is removed and a clear field remains for the enucleation of the upper tonsil. Some operators prefer to turn the patient to the opposite side for the removal of the second tonsil. The operation is facilitated by the use of a conducting tube apparatus, such as the Fillebrown, leading the vapor to the side of the mouth during etherization.

Four methods of technique are popular in this country. The finger enucleation. Sharp dissection with knives or scissors. Blunt dissection with spuds, elevators and the snare. The Sluder tonsillotome with or without the snare attachment. Personally I feel that none of these methods as classified apply to the average laryngologist as suitable for all cases. Speed, dexterity, and diminished hemorrhage will result from a proper choice of instruments for the proper case.

The surgical tonsil may be defined as one which is so thoroughly diseased that surgery alone can remedy the condition. This question must be determined upon the basis of pathology and the amount of trouble arising therefrom. Tonsils not in this class should be allowed to remain unless we wish to bring this operation into disrepute.

The general practitioner with surgical inclination who enjoys this field of endeavor may readily master the difficulties of tonsillectomy. If the indications for a complete and thorough operation are present none other should be attempted. The peculiarities of the patient and the personal equation of the surgeon necessitate a wide difference in the choice of method.

CHAPTER IV

DISEASES OF THE ESOPHAGUS

BERTRAM W. SIPPY

The esophagus begins at a point behind the lower border of the cricoid cartilage on a level with the 6th cervical vertebra, and joins the stomach about three-quarters of an inch after passing through the diaphragm. The lower end of the esophagus is on a level with the spine of the 12th dorsal vertebra. In a normal adult the upper end of the esophagus is about 6 inches from the incisor teeth. Measuring from the incisor teeth it is about 10 inches to the bifurcation of the trachea, 11 inches to the point where the left bronchus crosses in front of the esophagus, and 16 inches to the lower end of the esophagus. The esophagus serves the purpose of conveying food and drink from the pharynx to the stomach. Corresponding to its simple function its anatomical structure is simple, and disorders of the esophagus other than those associated with conditions causing esophageal obstructions are relatively rare.

ESOPHAGEAL STENOSIS

Stenosis is by far the most important disorder of the esophagus. The treatment of esophageal obstruction is governed by the cause, location, and degree of stenosis. In all cases early diagnosis is of great importance. Although in a given case there should be no difficulty in determining that stenosis of the esophagus is present, experience shows that the condition is frequently overlooked or mistaken for a gastric or some other disorder. The symptoms vary with the cause and location of the stenosis. As a rule, the patient first notices that deglutition is uncomfortable. A choking sensation or a sense of fullness behind the sternum is experienced. He is compelled to eat slowly, and, as the obstruction increases, regurgitation of food is likely to occur either during the meal or shortly afterward. Nausea is usually absent. Pain may be a prominent feature or may be entirely absent.

Direct observation of the patient during the act of swallowing is of great value in diagnosis. Many serious mistakes would be avoided by

carefully observing the patient eat and drink when difficulty or pain in swallowing or when vomiting at meal time is a feature in the symptomatology. Suspecting that stenosis is present, thoracic aneurysm should be excluded, and then, if no other contraindication exists, an attempt should be made to pass a soft rubber stomach tube. If successful the degree of stenosis is slight, and, if any exists, it may be accurately located by means of an ordinary esophageal bougie armed with graduated olive bulbs. A medium-sized bulb should be used first. If this meets with obstruction the smallest-sized bulb may be used next. Great caution should be exercised regarding the use of force.

To determine the nature of esophageal obstruction is often difficult. Carcinoma is by far the most common cause in adults. In order to avoid serious error, however, in every case of esophageal stenosis all other causes should be carefully excluded before it is assumed that carcinoma is present.

The following conditions may cause esophageal stenosis: anatomical disease either of the esophagus or adjacent structures, spasmodic contraction of its muscular fibers, and the impaction of foreign bodies.

Extraesophageal disease causing stenosis is relatively rare, but compression from aneurysm, mediastinal growths, extraesophageal cicatrix, a distended diverticulum of the esophagus, pericardial exudate, and disease of the vertebræ must always be considered as possible causes of esophageal compression, resulting in obstruction. Thyroid and thymus tumors, enlarged cervical glands, and retropharyngeal growths may also produce stenosis.

Intraesophageal conditions causing stenosis may be from cicatricial narrowing, tumor, chiefly cancer, spasmodic contraction of the esophageal muscle, chiefly cardiospasm, diverticula, and the impaction of foreign bodies.

Cicatricial Stenosis of the Esophagus

Next in frequency to carcinoma, cicatricial contraction is the most common cause of esophageal stenosis. From a therapeutic standpoint it takes first rank, because the treatment of cicatricial stenosis should be reasonably satisfactory in all cases. The most frequent cause of cicatricial stenosis of the esophagus is the swallowing of caustic acids, alkalies, and other corrosive substances. More rarely cicatricial stenosis results from the healing of ulcers due to the impaction of foreign bodies, the peptic action of the gastric juice, and ulceration of the esophagus that occurs during the course of typhoid fever.

Treatment.—During the first week or ten days subsequent to severe corrosion of the esophagus, as from caustic acids or alkalies, no attempt should be made to pass dilating bougies. After the intensity of the in-

flammation has subsided bougies should be passed at least once or twice each week until the maximum-sized lumen is obtained. The passage of the bougie is facilitated by directing the patient to drink half an ounce of olive oil just preceding its use. The maximum dilatation should be maintained by using the bougie every few weeks, perhaps for years, as experience with the individual case may require. Usually patients with cicatricial narrowing of the esophagus do not apply for treatment until the scar tissue is old and firm. In many cases real obstruction does not occur until years after the injury to the esophagus. If the stricture is not long and tortuous, ordinary olive-tipped esophageal bougies may be passed, beginning with a small-sized bulb that may go through the stricture without the use of dangerous force. The opening should be cautiously enlarged by using bulbs of gradually increasing size. The rapidity with which dilatation should be accomplished is influenced by the resulting inflammatory reaction, fever, pain, hemorrhage, and the length and firmness of the cicatricial narrowing.

It is impossible to successfully dilate a long, narrow, and tortuous stricture with an ordinary esophageal bougie of the whalebone or steel rod type. The whalebone or steel rod is too inflexible to follow the tortuosity of the canal. In such cases the conical-tipped flexible linen bougie with a gradually increasing diameter is used; but great caution must be exercised, otherwise a false passage may be made. The small conical tip of the flexible bougie is trusted to enter the opening or channel leading into the stricture, and in many cases to follow the windings of a tortuous and, at times, a sloughing canal, and thus guide the thicker dilating portion of the instrument safely through the stricture. It is truly remarkable how many times such bougies may be used without serious accident. Experience has abundantly demonstrated, however, that the point does not always follow the canal. Many deaths have resulted from perforation of the esophageal wall by the use of such bougies.

It is obvious that there must be great danger in forcing any form of unguided bougie through a strictured area of the esophagus. To obviate the danger the writer has devised an esophageal dilator that at present would seem to embody the maximum efficiency and the minimum danger. The method of application is extremely easy.

Because of the very greatly increased safety and efficiency of this method of dilating esophageal strictures, the writer urges the use of this or some similar method in all cases of organic stricture of the esophagus that admit of the use of any dilating instrument. The advantages are particularly striking when dealing with tight and tortuous strictures, whether due to cicatricial contraction or carcinoma. The principle of using the silk thread as a guide is utilized in the following manner:

A foot or more of a spool of ordinary silk twist, such as Belden or Corticelli, size D, is placed in a small capsule or wadded up in a piece

of chocolate candy and swallowed. After about an hour the spool is slowly unwound, so that three or four yards is swallowed during the first twenty-four hours. Subsequently from 1 to 3 yards may be swallowed each day. The taking of food and water facilitates the passage of the thread into the stomach. If the stricture is extremely tight only a small amount of water should be swallowed at one time. If the esophagus is overfilled, its contents, including the thread, are likely to be regurgitated. A small twisted silk thread will eventually go through any stricture that will permit the passage of even a small quantity of water. After the silk reaches the stomach, the normal peristalsis carries it onward. Usually at the end of twenty-four hours the thread that was first swallowed becomes deeply anchored in the intestine. It later passes out through the rectum. The thread is ready for use as soon as it is determined that it is securely anchored by pulling back on the end attached to the spool. The dilator (Fig. 1) consists of a series of graduated

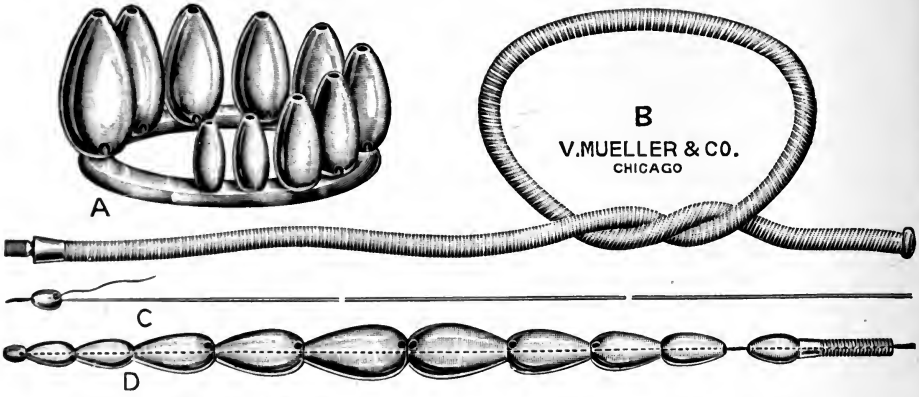

FIG. 1.—FLEXIBLE ESOPHAGEAL DILATOR AND PIANO-WIRE GUIDE. (Sippy)

conical metal bulbs (A) that may be screwed on to a very flexible spiral introducer (B) 20 inches long, made of piano wire, size No. 8. Each conical bulb is provided with a central canal that is continuous with the lumen of the spiral introducer when the bulb is adjusted. This canal is large enough to glide readily over the piano wire guide (C). The guide is four feet long and made of piano wire, size No. 20. A small perforated metal bulb, size No. 10, French scale, is firmly secured to one end of the wire by screw and solder. For a distance of 8 inches adjacent to the bulb the wire is reduced in size to increase its flexibility.

The silk thread protruding from the mouth is first drawn back from the esophagus until it is moderately taut. The thread is then passed through the perforated bulb on the end of the piano wire guide. Holding the silk thread taut with the hand, the wire guide is introduced into the esophagus. The bulb follows the course of the thread and carries the

wire safely through the stricture into the stomach. The lower end of the wire should be passed at least 4 or 5 inches beyond the lower end of the esophagus. If the thread is held firmly no harm can result even if the wire enters the pylorus. The wire is easily held in position and serves as a firm guide for the conical bulbs used in dilating the stricture.

The diameter of the stricture is next determined by attaching conical bulbs to the spiral introducer, and passing the bulb and introducer over the wire and through the stricture. Beginning with small-sized bulbs, larger ones are substituted until one is found that passes through the strictured area snugly, but without the use of force. A bulb slightly larger in diameter is selected with which to accomplish the first dilatation. The following procedure is advised:

A bulb several sizes smaller than the diameter of the stricture is first threaded point downward over the wire guide. From one to three bulbs, each slightly larger than the one preceding, are then threaded, to be followed by the dilating bulb. A similar cone of two or three bulbs is next threaded with points directed upward. The spiral introducer with a small-sized bulb attached is next threaded on the wire. The operator then holds the end of the wire guide firmly in one hand. The detached bulbs sliding on the wire are then pushed down through the stricture by the spiral introducer. The first bulb being several sizes smaller than the diameter of the stricture enters without friction, opening the way for the slightly larger bulb immediately behind it. The next bulb, being still larger, prepares the way for the dilating bulb, which enters the stricture in such a way as to exert an almost purely lateral or dilating pressure. All the bulbs are pushed through the stricture and into the stomach. The bulbs are drawn back through the stricture by means of the wire guide. As the guide is withdrawn the tiny bulbous point securely fastened at the lower end comes in contact with the lowest conical bulb, which forces all the other bulbs backward through the stricture. The small bulb at the end of the introducer opens the way for the conical bulbs threaded with points upward. The stricture is thus gradually opened from below, so that the dilating bulb enters the stricture both from above and below with the least possible traumatism to its walls. The pressure exerted in forcing the bougie is applied in such a way as to act almost entirely as a dilating force. The operator is enabled to judge with a great degree of accuracy the readiness with which the tissue of the stricture yields. Thus friability of tissue with perhaps increased dangers, or firm connective tissue requiring more force, may be suggested. If thought best, one or more larger sized dilating bulbs may be used in the same manner at each treatment. The rapidity with which a stricture may be safely dilated is influenced by the character of the stricture, its length, the dilatibility and friability of its tissue, and such factors as pain, hemorrhage, inflammatory reaction, and other conditions peculiar to the individual case.

After years of experience in esophageal work the writer has perfected and adopted this method of dilating organic esophageal strictures. When pressure is required one knows that the point of the dilator is directly in the channel of the stricture and that it cannot go astray. The sense of security experienced in applying the method is exceedingly gratifying. The danger of making a false passage by forcing an unguided bougie down the throat of a confiding patient is practically eliminated. The most tortuous stricture may be dilated with the minimum degree of traumatism. Carcinomatous strictures are thus treated with greatly increased safety.

In selected cases, particularly if one has had considerable experience in esophageal work, a piano wire guide may be introduced without the aid of the silk thread. It is always much safer, however, to use the thread as a guide. A baby 18 months old, with an exceedingly tight stricture extending the entire length of the esophagus, caused by swallowing lye, was able to swallow the thread. In some instances, however, the patient comes under observation at a time when the stricture is so tight and starvation so far advanced that even the delay of a few days may be dangerous. An expert may then be able to safely pass fine filiform bougies or hair-like wires armed with minute bulbs and accomplish dilatation over these guides, and thus spare the patient the inconvenience and danger of a gastrostomy. In managing cicatricial stenosis of the esophagus it should rarely be necessary to perform gastrostomy for the purpose of feeding the patient, provided the stricture permits the passage of even a small quantity of water.

After the stricture has been dilated to the maximum size desired, it is necessary to pass bulbs every few weeks or months, or as often as experience with the individual case demands. Otherwise the tendency is for the connective tissue to contract and narrow the opening.

It would seem that one would seldom be justified in using an esophagotome, or such instruments as the Abbé string saw. The old method of retrograde dilatation of the stricture through an opening in the stomach should be relegated to the rarest necessity.

CARCINOMA OF THE ESOPHAGUS

Carcinoma is the most common serious disease of the esophagus. Compared with carcinoma of other organs, the esophagus stands fifth in frequency. The disease occurs chiefly between the ages 40 and 60, and more frequently in men than in women. About 50 per cent. are located at the lower end of the esophagus; 40 per cent. at or near the bifurcation of the trachea, and 10 per cent. in the cervical portion of the esophagus.

The growth usually surrounds the esophagus and may extend along the course of the tube from 1 to 5 inches. Its tendency is to produce stenosis and break down in ulceration. Gangrenous sloughing of the exposed

surface of the tumor is common. Metastatic growths develop in the bronchial glands, liver, cervical glands, pleura, lung, and other organs. The pericardium and thoracic blood vessels may be invaded.

Extensive metastases are relatively late and are frequently not demonstrable during life. There is little tendency to the development of dilatation of the esophagus above the seat of a carcinomatous stricture. The course of the disease is progressive. The duration varies with the tendency to early obstruction and such accidents as perforation. The early stages may be slow in development. After the first symptoms of difficulty in swallowing become manifest, the average duration of life is six or eight months. Death may occur within a few weeks, and is rarely delayed more than 12 to 14 months.

Treatment.—The location of the disease, the degree of stenosis, the probable duration of the disease, the general condition of the patient, must be carefully considered. These factors, combined with a knowledge of what may be accomplished by palliative treatment and by radical surgical measures, should leave no doubt as to the course to be pursued in a given case. The surgical treatment of carcinoma of the esophagus is confined to resection, esophagostomy, and gastrostomy. Only a relatively small number of growths are located in the cervical region, where they are accessible to radical operation. There is reason for hoping that within a few years operations on the thoracic portion of the esophagus may be performed with a much greater degree of safety than at present. The tissues of the thorax in the neighborhood of the esophagus seem to have little resistance to the character of infection that is likely to develop when the esophagus is opened. At present resection of the esophagus and esophagostomy are limited to very rare and selected cases.

Gastrostomy has a legitimate, although rather restricted, application in the treatment of carcinoma of the esophagus. As a rule, the operation should not be performed as long as a sufficient quantity of nourishment can be given by mouth to prevent the patient from losing in weight more rapidly than would naturally result from the destructive action of the carcinoma. With rare exceptions, the careful use of the bougie will render the operation unnecessary. Unusual pain, hemorrhage, or inflammatory reaction following the use of the bougie may justify gastrostomy. The operation is of the greatest value in those cases in which a high grade obstruction of the esophagus occurs relatively early in the course of the disease, and unusual difficulty is experienced in maintaining an adequate opening through the stricture by the careful use of bougies. If perforation into a bronchus occurs, gastrostomy may be justified. The duration of life, however, after such an accident is usually very short.

Palliative Treatment.—The great tendency of a carcinomatous growth of the esophagus is to obstruct the lumen of the tube and cause death from starvation. Since it is practically impossible to arrest or

eradicate the disease, the chief indication in treatment is to provide nourishment and add to the comfort of the patient by treating the symptoms as they arise.

A sufficient quantity of nourishment can be supplied only through the natural channel or a gastrostomy opening. Palliative treatment seeks to prevent the growth from obstructing the lumen of the tube. Inflammatory swelling and spasm are often important factors in contributing to the obstruction. Autopsies on cases in which the obstruction during life seemed almost or quite complete usually show a surprisingly large opening through the tumor mass.

If the nature of the disease is discovered before the stenosis has become pronounced, it is usually possible to prevent the lumen of the tube from becoming obstructed sufficiently to cause death from starvation. The chief aids in overcoming the obstruction are dilating bougies and appropriate diet. In selected cases drugs, irrigation of the esophagus, and the X-ray are of distinct value.

The method advised for dilating strictures due to cicatricial stenosis, already described, is largely applicable to the dilatation of carcinomatous strictures. Owing to the friability of the carcinomatous tissue and consequent danger of tearing and perforating the wall of the esophagus, the silk thread and piano wire guide are to be particularly recommended. The dilating force must be used with even greater gentleness than is employed in dilating cicatricial strictures. A sufficient number of conical bulbs of gradually increasing size should be threaded on the flexible wire guide both in front and behind the dilating bulb to insure the minimum degree of traumatism.

As a rule, the carcinomatous tissue yields readily to the dilating force. The danger from hemorrhage and reactionary inflammation is greatly reduced if one is content with a small gain each treatment. The most satisfactory results are usually obtained by dilating only once each week. By gradually enlarging the opening one may finally succeed in passing a full-sized esophageal bulb. Cases apparently on the verge of starvation may thus be enabled to take a sufficient quantity of nourishment until death occurs from causes other than starvation.

Other mechanical means have been employed to prevent the tumor mass from obstructing the lumen of the esophagus. Leyden and Renvers used graduated hard rubber cannulas. It is doubtful whether the use of such agencies is justified.

Diet.—In all cases the diet should be non-irritating and contain a sufficient quantity of nourishment. If the disease is discovered before obstruction is pronounced, a gain in weight may be accomplished by giving a quart of milk and a pint of cream each day, together with soft toast, rice, oatmeal, vegetable purées, soft eggs, and scraped beef. All coarse and irritating foods should be avoided. The diet should be as varied as

possible, as long as the lumen of the esophagus is adequate. As the obstruction increases it usually becomes necessary to confine the diet entirely to liquids. Then milk, cream, kumyss, beef tea, and raw eggs should form the basis of nourishment. The deficiency in carbohydrates may be supplied in part by adding grape sugar.

A man weighing 160 pounds will be adequately nourished if able to take each day 24 ounces of milk, 24 ounces of cream, four eggs, and three ounces of grape sugar. The eggs may be beaten up with the milk and the grape sugar dissolved in a portion or all of the mixture. The quantity of nourishment may be so divided that the same amount is given every two hours.

As the obstruction increases, regurgitation may be reduced to the minimum by administering the nourishment in tablespoonful doses repeated frequently until the full quantity, or as much as possible, has been taken. Aversion to the continued use of milk and cream diet may be greatly overcome by giving it at different temperatures and changing its flavor by adding small amounts of coffee, tea, or chocolate. A taste of the various fruit juices or a bit of cracked ice after each feeding increases the tolerance of a liquid diet.

Stagnation of food and mucus above the seat of the stricture may be accompanied by decomposition, resulting in local irritation and inflammation of the mucous membrane of the esophagus. Relief may be obtained by irrigating the esophagus with a solution of permanganate of potassium each night before retiring.

In some cases the X-ray reduces the size of the tumor mass and thus facilitates feeding. Drugs are of subordinate value. Twenty drops of a 1 to 1,000 adrenalin chlorid solution in half an ounce of water taken just before feeding may cause some shrinking of the tissue and render swallowing easier. During the course of the disease sudden narrowing of the lumen of the esophagus may arise from acute inflammatory swelling. Deglutition becomes unusually difficult and painful. The passage of a bougie causes unusual pain. Both pain and obstruction may be greatly relieved by giving the esophagus absolute rest and substituting rectal feeding for a period of two or three days. The diet should then be restricted to liquids entirely for a few days at least.

If, notwithstanding the use of dilating bougies, appropriate diet, and the other measures advised, regurgitation of food takes place to such an extent that the patient is inadequately nourished, as shown by a rapid loss in weight, great thirst, and a reduction in the daily quantity of urine to less than one pint each day, death will soon take place unless relief is afforded by gastrostomy. If gastrostomy is contraindicated, the intense thirst may be greatly relieved by the use of saline enemas.

SPASM OF THE ESOPHAGUS

Tonic or intermittent contraction of the muscular fibers of the esophagus resulting in uncomfortable deglutition may take place at any point in the esophagus. Spasm sufficient to cause obstruction, however, rarely occurs excepting at the upper and lower ends of the esophagus. The following groups of cases may be distinguished: I. Esophageal spasm occurring as a symptom in well-recognized diseases, such as tetanus, hydrophobia, hysteria, chorea, epilepsy. II. Esophageal spasm resulting reflexly from disease located in the esophagus or elsewhere in the body, such as tubercular ulcers of the larynx, disease of the stomach, peritoneum, and uterus. III. Esophageal spasm occurring without apparent cause. In such cases ill defined nervous states are likely to be present. The familiar globus hystericus is said to be due to esophageal spasm. Spasm of the esophagus rarely causes serious symptoms except when located at the pharyngeal or cardiac orifices. Spasm of the pharyngeal orifice rarely causes serious obstruction. As a rule, it may be overcome by the passage of large-sized bougies. In a case under observation recently no improvement was noted until the orifice was forcibly stretched by the rubber bag dilator described in the treatment of cardiospasm. Spasm of the esophageal muscle occurring at points between the pharyngeal and cardiac orifices seldom requires treatment. If troublesome, the systematic passage of bougies is usually followed by satisfactory results. Bromids may be given advantageously. The underlying condition should be sought, and, if possible, removed. Spasm at the cardiac orifice will be discussed under the following heading:

Idiopathic Dilatation of the Esophagus

(*Cardiospasm*)

Dilatation of the esophagus arising independently of obstruction by an anatomical narrowing of its lumen was first described by Purton in 1821. In 1874 Ziemssen and Zenker collected from the literature 17 cases. The early cases reported were discovered post mortem. Recently the disease has been recognized ante mortem and has been treated successfully. Although 20 years ago so-called idiopathic dilatation of the esophagus was looked upon as rare, chiefly of pathologic interest, and scarcely to be diagnosed ante mortem, we now know that the condition is undoubtedly not rare and is sufficiently grave to demand a more widespread knowledge of its manifestations and treatment. The writer has recognized and treated 60 cases since 1903.

Etiology.—The following factors are recognized as contributing to the development of so-called idiopathic dilatation of the esophagus:

I. Primary cardiospasm (Mikulicz and Meltzer).

II. Primary atony of the musculature of the esophagus (Rosenheim).

III. Simultaneous development of cardiospasm and paresis of the musculature of the esophagus due to anatomical or functional disease of the pneumogastric nerve (Kraus).

IV. Congenital malformations (Fleiner).

V. Primary esophagitis (Martin).

Under normal conditions the resting esophagus contains air held by a more or less firm closure of the upper and lower ends of the esophagus maintained by the circular muscle fibers at these points. The closure of the cardiac end is firm enough to support a column of water two-thirds the height of the esophagus.

The contraction of these muscles is automatically relaxed during the acts of swallowing, vomiting, and regurgitation of food from the stomach and the eructation of gas. The writer believes that simple failure of the normal automatic relaxing force that takes place during the act of swallowing may be sufficient to cause the first retention of food. The physiological results of such food retention are dilatation and hypertrophy of the wall of the esophagus. Stagnation may give rise to reflex irritation and spasmodic contraction of the circular fibers at the lower end of the esophagus. The writer also believes that angulation of the esophagus as it passes through the diaphragm contributes to the development of the dilatation and persistence of the sac.

It is very probable that the greatest number of cases develop as a result of primary spasm or heightened contraction of the circular muscles of the cardiac orifice of the esophagus. Nervous, psychic, and emotional disturbances play an important rôle in the development of the condition. Such influences as blows on the chest, the swallowing of chemical and thermal irritants, and infectious diseases, such as pneumonia, have been among the exciting causes. Anatomically two forms of idiopathic dilatation of the esophagus may be distinguished: I. Fusiform dilatation with marked hypertrophy of the muscle wall of the esophagus. II. Dilatation with slight or no hypertrophy of the esophageal muscle.

The first is the common form. The second is favored by atony of the muscle wall and a rapid accumulation of food, stretching the esophagus before muscular hypertrophy has had time to develop. The degree of dilatation varies, being greatest when the esophageal wall is atonic. The capacity of the normal esophagus is about 100 c. c. Kinnicut recently demonstrated a specimen in which the capacity of the dilated esophagus was 1,800 c. c. In the majority of cases the capacity of the dilated esophagus does not exceed five or six hundred c. c. In a fatal case observed by the writer the dilated esophagus held 500 c. c. The hypertrophied muscle was 9 mm. thick. The normal thickness of the muscle of the esophagus varies from one to two and a half mm.

The dilatation is fusiform, terminating below at a point about 3 cm. above the cardiac orifice of the stomach. The seat of the greatest dilatation is in the lower third of the esophagus. The muscular hypertrophy is practically confined to the dilated sac, little or no hypertrophy being evident at the point where the spasmodic stricture exists. The mucous membrane of the dilated esophagus may become inflamed and eroded from the stagnation of food. Ulceration may occur. This has a tendency to cause reflex spasm at the cardia and retard recovery.

Diagnostic Aids.—Nearly all of the usual signs of esophageal obstruction from organic stricture are present. The following peculiarities, however, may be observed in stenosis due to cardiospasm: 1. Great fluctuation in the course of the disease. Years may elapse before emaciation appears. 2. Difficulty in swallowing liquids may be greater and appear earlier than the difficulty in swallowing solids. 3. The degree of dilatation of the esophagus may be much greater than that which occurs from organic stricture. 4. The obstruction to the passage of liquids is more complete than that caused by organic stricture. It may be possible to aspirate from one to six hundred c. c. from the esophagus, hours after the liquid is swallowed. Except when spasm or acute inflammatory swelling complicates an organic stricture, a sufficient opening is practically always present to allow liquids to trickle through. 5. Upon passing a stomach tube or large-sized bougie it may be temporarily arrested at the cardia and then passed on into the stomach. In some cases there is no obstruction to the passage of the bougie, although food and liquids are retained in the esophagus.

The onset may be sudden or gradual. In most cases the first symptom noted is discomfort or real pain located beneath the lower part of the sternum occurring during the ingestion of food or drink. A choking sensation causes the patient to eat slowly. In mild cases there may be no other symptoms, and the condition may disappear without further development. In the more serious cases regurgitation of food and mucus takes place, and starvation is threatened. Finally, death may result if the obstruction is not relieved. The earlier the condition is recognized the more favorable the prognosis. After dilatation of the esophagus has taken place it is improbable that it ever regains its normal size. Even if the spasm is relieved, food is likely to lodge on the sides of the fusiform cavity and favor reflex spasm of the cardia and a return of the obstruction. Symptoms of the disorder have continued for twenty years. Other cases have advanced to a fatal termination in two or three years.

Treatment.—In mild cases it may be sufficient to give a soft, mushy diet combined with body and mental rest. Food should be taken slowly; chemical, mechanical, and thermal irritants should be avoided. Bromids may aid in controlling the spasm. Olive oil soothes the inflamed mucous membrane. In some cases the systematic use of the bougie is followed

by good results. If the mucous membrane is inflamed, eroded, or ulcerated, the bougie is likely to cause an increase in the spasm. Hence, if possible, the esophagoscope should be used before attempting to relieve the condition by bougies. To overstretch the muscular fibers at the seat of the spasm is the best treatment as yet devised. While large bougies give temporary relief in some cases, no actual stretching of the cardiac orifice is accomplished. Rubber bags have been introduced into the stricture and inflated with some degree of success. The principle of the urethral dilator has been utilized and long instruments constructed by which dilatation has been accomplished. Mikulicz conceived the idea of making an opening into the stomach and then forcibly stretching the cardia from below by means of an instrument acting in the manner of a uterine dilator. The success obtained by Mikulicz in the four cases thus treated by him has led others to adopt the same method. While the procedure is not particularly difficult or dangerous, it must be classed among the major operations and is no longer justified.

In 1903[1] the writer devised a rubber bag dilator, by means of which the same degree of dilatation may be obtained without subjecting the patient to the risk of a serious surgical operation. An anesthetic is not required, and the discomfort is little more than that which attends the passage of a bougie. If desired, the dilatation may be accomplished under the influence of laughing gas. The instrument consists of a thin rubber bag four inches long and one and a half inches wide when collapsed. At the upper corner of the bag a firm piece of rubber tubing about twenty inches long is attached. Another piece of tubing three inches long is secured in the center of the rubber bag. A special introducer fits into this compartment and guides the bag to the seat of the stricture. A thin, firm silk or linen sac 5 inches long and 2 to 2½ inches wide surrounds the rubber bag. When distended with air to the extreme limit a firm cylinder is produced which is about 4 inches long and 4 to 5 inches in circumference. An ordinary rubber condom protects the silk sac from becoming soiled and prevents friction when the instrument is introduced. When collapsed ready for introduction the diameter of the instrument is much less than that of an ordinary stomach tube. The bag is readily guided into the stricture, and the degree of lateral pressure exerted by the bag is accurately measured by connecting the dilator with an ordinary clinical blood pressure apparatus, or water pressure may be substituted for air pressure if desired, by connecting the rubber tubing to a fountain syringe or irrigator. The amount of pressure required to overstretch the thin muscle at the cardiac orifice is small. If using a clinical blood pressure apparatus, pressure sufficient to lift the mercury to 150 mm. is ample and should be safe if no complaint of pain is made. If water pressure is used the irrigator should not be more than 5 or 7 feet above the position of the cardiac orifice. Extreme caution must be used, as the esophagus has been ruptured by such simple acts as vomiting and the passage of the ordinary stomach tube. The larger the circumference of the dilating bag the greater the degree of the lateral pressure exerted, hence it is important that the silk bag covering which limits the extent

[1] Since that time Plummer and others have devised excellent dilating bags similar in principle.

to which the esophagus may be stretched does not exceed a circumference of 4 or 4½ inches in adults until it is demonstrated that a greater degree of dilatation is necessary or permissible.

Direct inspection of the tissue to be dilated, by means of the esophagoscope, should precede the use of even the moderate degree of forcible dilatation described. In rare cases, particularly in those in which sacculation is great, the walls relaxed and perhaps atonic, the ordinary introducer may become arrested in the bottom of the sac, and does not find its way through the cardiac orifice. To obviate this the writer has made use of the silk thread as a guide and substituted his spiral introducer, and then has had no difficulty in placing the bag accurately at any point desired. The pharynx should be cocainized to prevent the tendency to vomit while using the instrument. The procedure should not be painful. The effect of the dilatation should be tested at once after dilatation has been accomplished. The patient is able to swallow perfectly as soon as the cardiac orifice has been sufficiently stretched. As a rule, the requisite dilatation in an adult is reached by using a silk bag covering, the circumference of which is about 5 inches, the bag distended with air of 150 mm. of mercury or 7 feet of water pressure. One good stretching may suffice for years.

Of 60 cases dilated by the writer there have been only 6 recurrences requiring second dilatation. One required three separate dilatations. The procedure is almost as simple as the passage of the bougie. It is advisable to treat the mild cases also by overstretching, for the purpose of preventing dilatation and the resulting organic changes that may predispose to a return of the condition. No special after-treatment is required. A bland non-irritating diet should be recommended and nervous strain avoided.

DIVERTICULA OF THE ESOPHAGUS

An esophageal diverticulum is a pouch-shaped sacculation involving a limited portion only of the circumference of the esophagus. The condition is sharply differentiated from dilatation of the esophagus, in which the entire circumference of the tube is involved. The wall of the pouch usually consists of mucous membrane and connective tissue, the muscular coat of the esophagus having been either destroyed or pushed aside. The mucous membrane of the sac is usually only slightly altered. Deep erosion or ulceration is rare. Carcinoma may develop as a result of local irritation. According to the manner in which the pouch-like sacculation develops, three types are recognized: pressure or pulsion diverticula, traction diverticula, and traction-pressure or traction-pulsion diverticula.

Pressure diverticula, though less common than *traction diverticula,* are of much greater clinical interest. They may be located (1) in the

pharynx, (2) at the junction of the pharynx and esophagus, (3) near the bifurcation of the trachea, usually just above the left bronchus, (4) below the level of the left bronchus. These are usually deep seated, having their origin in the lower part of the esophagus, the sac usually resting upon the diaphragm.

Congenital defects may contribute to the development of a pressure diverticulum. A large bolus of food may lodge in the pharynx or esophagus and cause a slight stretching or bulging of a circumscribed area. Subsequently food may accumulate at this point, exert pressure, and finally cause the formation of a pouch. The most common and important pressure diverticula develop at the junction of the pharynx and esophagus. At this point there is a natural weakness of the muscular structure. The capacity of the pouch of a pharyngoesophageal diverticulum varies from a few cubic centimeters to two hundred and fifty and more. They usually originate in the median line posteriorly. As the pouch develops it usually pushes the esophagus aside and occupies a left lateral position.

Owing to pressure exerted by the left bronchus against the esophagus, food may lodge on the wall of the esophagus just above the bronchus and cause sacculation. Diverticula of the lower part of the esophagus usually develop from the anterior or lateral wall. Their etiology is obscure, although some are surely of the traction-pressure variety.

Traction diverticula are very common. The local bulging is nearly always due to contraction of scar tissue attached to the outer surface of the esophagus. The cicatrix usually arises from inflammation of bronchial lymph glands in the vicinity of the bifurcation of the trachea. Hence traction diverticula are frequent in tuberculous subjects. They are usually funnel-shaped and remain small if the mouth of the pouch is lower than its cavity, thus preventing the accumulation of food.

As a rule, traction diverticula produce no symptoms, except when associated with suppurative processes. Rupture may then take place into the surrounding organs, as trachea, bronchi, pleura, and blood vessels, with disastrous results.

A *traction-pressure diverticulum* may develop when the orifice and sac of a traction diverticulum favor the entrance and accumulation of food. A traction-pressure diverticulum may become large and correspondingly serious.

Course.—Symptoms of importance rarely develop before the age of fifty, except when the condition originates from a congenital stenosis of the esophagus. For years the patient may be conscious that food lodges at a certain point in the esophagus. Symptoms similar to those of a gradually increasing stenosis may subsequently appear and slowly develop until, finally, death from starvation or intercurrent disease takes place, unless the condition is relieved.

Treatment.—If the condition develops late in life, and little or no hindrance to the passage of food is present, the patient should be directed to eat slowly and avoid coarse foods. Appearing thus late in life, even though it is impossible to pass a tube into the stomach, serious symptoms may never develop. If food stagnates sufficiently to cause irritation, the pouch should be irrigated once or twice daily with permanganate solution.

If the sac does not contain lactic acid or a large number of leukocytes it will not be necessary to irrigate. If serious difficulty begins earlier in life the trouble is likely to cause death, unless more active measures are instituted.

Pharyngeal and pharyngoesophageal diverticula may be removed or otherwise relieved by surgical operation in properly selected cases.

Diverticula, having their origin below the sternum, cannot be removed. Such cases, together with those that are otherwise inoperable, may become very serious, provided the pouch is so situated that it fills with food and crowds over against the esophagus in such a way as to prevent the entrance of food into the stomach. At times the position assumed by the patient while eating and drinking influences greatly the permeability of the obstruction. Many different lateral and other positions should be faithfully tried until the one most favorable to swallowing is found. In some cases swallowing is best accomplished when the stomach is higher than the mouth, so that food and drink are forced upward entirely by peristaltic action. If starvation threatens, it may be possible to pass hollow bougies curved at the end like a Mercier catheter and feed through the bougie. By the aid of the esophagoscope it may be possible to find the opening of the esophagus distal to the pouch, and by the use of specially constructed instruments depress the partition between the pouch and the esophagus in such a way as to favor emptying of the pouch. In most cases, however, it is impossible to find the place where the pouch communicates with the esophagus by the use of the esophagoscope alone. Again, the silk thread used in the manner advised for dilating esophageal strictures becomes of inestimable value. The thread when swallowed will pass on into the stomach in a reasonable time, and serve as an accurate guide into the esophagus beyond the pouch, and may be used by an experienced operator in many ways to overcome the difficulties presented in individual cases. By using the thread as a guide the diverticulum sound of Leube becomes unnecessary. In very rare cases it may become necessary to do gastrostomy.

FOREIGN BODIES

Foreign bodies of various kinds become impacted in the esophagus, causing serious symptoms, and, unless properly managed, often death. The accident occurs most frequently in children, although adults are by

no means exempt. The natural tendency for a baby to put everything possible into its mouth is responsible for many cases. Coins, buttons, buckles, peach stones, and open safety pins are among the common objects swallowed. Adults accidentally swallow false teeth, bones, and peach stones. Rarely other foreign bodies become lodged in the esophagus.

It often happens that in swallowing a small foreign body slight traumatism of the esophagus occurs, and, although the object has passed on into the stomach, the patient declares it is lodged at the seat of the traumatism. It is important to know the shape and character of the foreign body. Unless it is perfectly obvious that the object could not become impacted it should not be assumed without proper investigation that it has

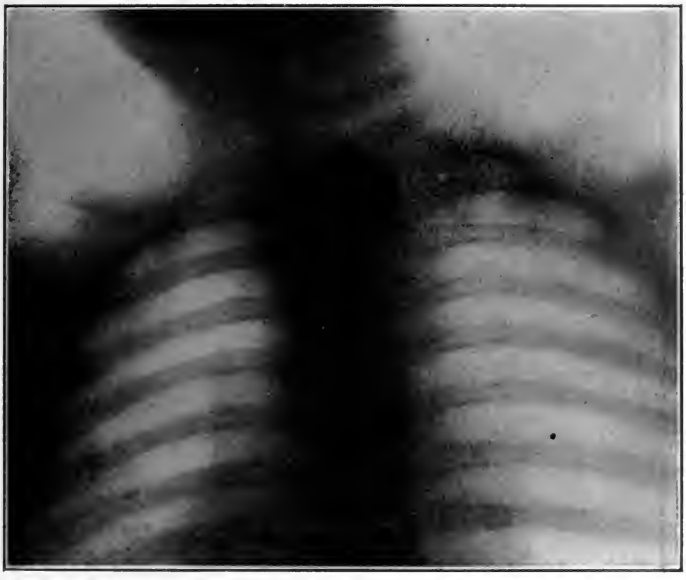

FIG. 2.—PENNY IMPACTED IN ESOPHAGUS OF CHILD 2½ YEARS OLD. USUAL POSITION. Removal after seven days. (Sippy)

not lodged somewhere in the esophagus. I wish particularly to warn against the common practice of assuring frightened mothers that pennies and similar objects will always pass without doing harm. It is true that in most cases a penny does not give rise to trouble. To my personal knowledge, however, many deaths have resulted from this cause. The penny usually lodges in the upper end of the esophagus at a point just below the cricoid cartilage. Relatively few symptoms may be present at first. For two or three days the baby may be able to swallow its liquid nourishment. Pressure necrosis is followed by inflammatory swelling and the wall of the esophagus sloughs and the penny may escape into the periesophageal tissue. Death from infection follows, unless prompt surgical

relief is instituted. At best, the mortality is high following infection through a sloughing esophagus. The earlier the attempt is made to remove the foreign body the greater the likelihood of success. Inflammatory swelling always develops sooner or later from infection due to abrasions caused by the foreign body or to pressure necrosis. The resulting edema increases the difficulty of removing the object. When there is doubt as to whether a foreign body, such as a penny, brass button, or safety pin, has passed, an X-ray plate or fluoroscopic examination should be made. If the object is located, its projecting angles should be noted. It may be possible to seize the object with specially constructed esophageal forceps and withdraw it by the aid of the fluoroscope. In other cases the esophagoscope may be passed and the foreign body grasped by long esophageal forceps working through the esophagoscope.

It often happens that, unless care is exercised, a foreign body located in the upper end of the esophagus is dislodged by the esophagoscope. In such cases evidence of pressure necrosis may show where the body was located. The whole length of the esophagus should then be explored. The dislodged foreign body is often arrested at the lower end of the esophagus. It will usually be free and easily grasped and drawn out as the esophagoscope is withdrawn.

The seriousness of delay in the removal of foreign bodies from the esophagus cannot be too strongly emphasized. Early attempt at removal by a reasonably skillful man should be successful. The longer the delay the greater the difficulties and dangers experienced.

ACUTE ESOPHAGITIS

Acute inflammation of the esophagus of such intensity as to cause symptoms is relatively rare. The most common cause is the ingestion of chemical and corrosive substances. Under ordinary conditions acute inflammation of the stomach, pharynx, larynx, or trachea is seldom transmitted to the esophagus. Acute general diseases and infections are now and then associated with a mild esophagitis. Croupous and necrotic inflammation of the esophagus is recognized as a very rare complication of typhoid fever, cholera, smallpox, measles, scarlet fever, sepsis, and uremia. In such cases there may be a direct extension of the inflammation from the pharynx or larynx. It is noteworthy that diphtheria rarely extends into the esophagus. Phlegmonous inflammation of the esophagus is extremely rare. Foreign bodies arrested in the esophagus may cause pressure necrosis and periesophageal abscess formation. Thrush may invade at the same time in the mouth and pharynx. In adults the growth of the microorganisms is seldom sufficient to cause dysphagia and is usually the mucous membrane of the esophagus. As a rule, the infection is found

associated with such processes as typhoid fever, sepsis, and advanced tuberculosis. [In marantic children I have seen the esophagus blocked by a plug consisting principally of thrush.—Editor.]

A burning sensation in the esophagus, pain upon swallowing, regurgitation of food, tenderness on pressure, are among the chief symptoms of simple esophagitis. Special etiologic factors and diseases of which esophagitis is but a complication influence the symptomatology.

Treatment.—In mild cases of acute esophagitis non-irritating foods, such as milk, cream, soft eggs, and gruels, may be taken. In more severe cases all food and drink should be withheld for a few days, the necessary fluids being supplied in the form of salt solution per rectum. After a few days milk, cream, olive oil, and other bland foods may be given. As a rule, local applications are unnecessary. If swallowing is not particularly painful, one or two ounces of a 5 per cent. suspension of bismuth in water may be advantageously administered two or three times daily. Esophagitis resulting from the swallowing of caustic chemicals may require morphin injections for the relief of pain. If it becomes necessary to give fluids by mouth before the intensity of the inflammation has subsided, some relief from pain on swallowing may be obtained by giving a teaspoonful of a 1 to 1,000 solution of adrenalin containing 1 per cent. cocain just before each feeding. The more intense the inflammation the greater the danger of subsequent cicatricial stenosis of the esophagus. Particularly in those cases in which corrosive substances have been swallowed esophageal bougies should be passed as early as a week or ten days afterward. The patient should take a few swallows of olive oil just previous to the passage of the bougie. In severe cases the narrowing may already be so great that only small-sized bougies may be used. In a few days larger sizes should be used, gradually dilating every three or four days, until the maximum sized esophageal bougie has been passed. This should be accomplished before extensive cicatricial narrowing has had time to develop. If the tissue destruction has been great it is often necessary to pass a bougie once a month for years.

ULCER OF THE ESOPHAGUS

Esophageal ulcer is not common. Among the causes may be pressure necrosis, the peptic action of the gastric juice, simple esophagitis, including the chemical action of corrosive substances, and sacculation of the esophagus with stagnation of food. Ulcer of the esophagus from tuberculosis, syphilis, and actinomycosis is extremely rare. Follicular ulceration may result from catarrhal inflammation of the mucous glands of the esophagus. This occurs chiefly in the aged. Local ulceration from the irritation of decomposing foods occurs in stricture and diverticula of the

esophagus. Decubital ulcers may develop in typhoid fever and chronic tuberculosis. A perichondritis of the cricoid cartilage is usually present. The cartilage in contact with the esophagus is often hardened by calcific deposits. This, together with prolonged pressure due to horizontal position and contributory infection, may be sufficient to give rise to local necrosis. Ulceration of the esophagus not of the decubital type also occurs during the course of typhoid fever. Thyroid tumors may press the trachea firmly against the esophagus and cause ulceration. Aneurysm may cause pressure necrosis. Foreign bodies lodged in the esophagus may cause ulceration.

Peptic Ulcer

Peptic ulcer of the esophagus is extremely rare. Less than 50 cases have been reported. A gastric ulcer may extend upward into the esophagus. The pure type of esophageal peptic ulcer, however, is confined to the mucous membrane of the esophagus and occupies without preference any part of its lower third. Normally the gastric juice is prevented from coming in contact with the esophagus by a rather firm closure of the cardia. Insufficiency of the cardia allows the gastric juice to escape upward into the esophagus and peptic ulcer may result. Benign stenosis at the pylorus from gastric ulcer with retention of secretion, inducing more or less vomiting or regurgitation of gastric contents, has been causative of esophageal ulcer. In other cases multiple ulcers of the stomach, duodenum, and esophagus have been observed, due, perhaps, to multiple hemorrhagic erosions. The disease is often latent. The chief clinical manifestations are pain, dysphagia, vomiting, regurgitation, and hemorrhage. The ulcer may be demonstrated by the esophagoscope. Healing may take place with or without stenosis.

Tuberculous Ulcer

In sharp contrast to the pharynx, larynx, large and small intestine, tuberculous ulcer is rarely found in the esophagus or stomach. Syphilitic ulcer of the esophagus is extremely rare, and only a few cases of actinomycosis of the esophagus have been reported.

Treatment

The treatment of esophageal ulcer does not differ essentially from the medical treatment of gastric ulcer. It is impracticable to apply local remedies by means of the esophagoscope. If nutrition is seriously impaired or hemorrhage alarming, gastrostomy should be performed and the patient fed through the fistula until the ulcer is healed.

CHAPTER V

DISEASES OF THE STOMACH

JACOB KAUFMANN

INTRODUCTION

Every plan of treatment must be based upon a correct diagnosis and upon a proper understanding of the nature of the disorder and of the causes which provoke it. In discussing the treatment of gastric disturbances it seems, therefore, advisable to give a short sketch of the present views on the pathology of the stomach. A few general remarks are all the more necessary as the teaching regarding diagnosis and pathology of the stomach has undergone changes several times since Kussmaul in 1867 introduced the stomach tube and used it to study gastric function and gastric disorders. This change of view has usually been due to the overestimation of new findings; and since another change of view is taking place at present it is timely to take stock and see whether the new findings are being given their proper value.

First, let me emphasize the necessity and importance of systematic and thorough examinations of stomach contents; they are essential both to gain accurate knowledge of the condition of the stomach and to assist us in directing proper treatment.

It is sometimes said that the amount of information gained by gastric analysis is small and that one is easily led to an erroneous diagnosis by overestimating its value in comparison to other findings. In this, however, there is no difference between gastric analysis and other methods of examination. With any method of examination findings are of value only when taken in connection with the history of the case and all other clinical symptoms and, furthermore, when the findings are rightly interpreted. In case certain findings lead to an erroneous diagnosis we must not deprecate the method of examination, when in reality a faulty interpretation is the trouble. There is an abundance of proof of faulty interpretation of gastric analyses; a perusal of text-books and current literature will convince any critical reader that grave errors are often committed. This fact, however, should not make us desist from examining gastric contents, for a

gastric analysis (when properly performed and interpreted) yields valuable information. Unquestionably the further development of gastric analysis will clear up features in the derangement of gastric function which at present are only poorly understood.

Progress in correct interpretation has principally been made in one direction, that is, regarding the relationship of motor and secretory disturbances, although there, too, much confusion still exists. For many years the chemistry of gastric digestion was the main object of examination, and abnormal findings were too readily attributed to derangements of the secretory function. Although the first and most important contributions to our knowledge of secretory disorders came from Kussmaul's clinic, Kussmaul (75) himself and his pupils always pointed to the greater rôle which the motor function plays in the pathology of the stomach. It was a long time, however, before most investigators could be convinced that even those conditions which appear to be entirely due to faulty secretion are to a great extent the result of motor disorders. For example, the clinical picture of continuous hypersecretion, formerly described by many as a pure secretory disturbance, is now generally considered as invariably connected with impaired motility and to a certain degree caused by the latter.

In my opinion what now-a-days is called alimentary hypersecretion is also wrongly interpreted as being mainly a derangement of secretion. Granting that there is an increased glandular activity, nevertheless, I believe that the presence of the large quantities of fluid found in such cases can only be explained by a concomitant motor disturbance (pylorospasm or more frequently gastric atony), which allows its accumulation in the stomach.

The proper understanding of some of these conditions has been greatly improved by investigations on the nature of gastric peristalsis and the activity of the pyloric part of the stomach, notably, Dr. Cannon's work, which taught us that the rhythmic movement of the pyloric antrum and with it the evacuation of the stomach are regulated by the action of hydrochloric acid.

It must be said, however, that a defect in the secretion of hydrochloric acid does not necessarily upset the mechanism at the outlet of the stomach, as is shown in case of achylia with unimpaired motility. While this and other points still have to be cleared up, I believe that prolonged and increased secretion by irritating the duodenum may cause pylorospasm and by thus interfering with the evacuation of the organ lead to the accumulation of the secretion. In this way the clinical picture known as continuous hypersecretion and gastrosuccorrhea is developed. The same picture of retention of large quantities of secretion is produced when pylorospasm is the result of some other cause than primarily increased glandular activity, for example, when it is the result of the irritating

effect of perigastritis or adhesions. It is obvious how much the proper understanding of the development of such a condition must influence our plan of treatment.

Whenever the secretory disturbance is the primary factor we should try to remedy it by eliminating its causes: faulty habits, chronic intoxications, etc. If we do not succeed, or when, from the beginning, the motor disorder is the more important part, we should attempt to break the vicious circle by improving the evacuation of the stomach. When we are unable to accomplish this by medical means we must resort to surgery.

Operative treatment, however, should never be undertaken without at the same time using every effort to reduce gastric secretion to its normal limits. We must keep in mind that the gastric function is a complex mechanism, that one of its components cannot be disturbed without soon affecting another, that a motor disorder may upset secretion and vice versa, and that both in turn may derange evacuation and absorption.

To further illustrate the great therapeutical value of reading correctly gastric analysis I mention those cases of hyperacidity in which the high degree of acidity is the result of hypermotility. The fast evacuation of the stomach brings about a high percentage of acids in the comparatively small amount of remaining contents, while the total quantity of secretion may have been small. Cohnheim (32) of Heidelberg suggested lately that in such cases the administration of hydrochloric acid proves helpful by activating the lacking pyloric movements and by thus delaying the evacuation of the stomach—apparently a paradoxical proceeding, yet well supported by physiological facts.

Aside from the correct interpretation of disorders of the gastric function we have to consider their pathological meaning. Here again we meet with repeatedly changing views.

When gastric contents were first studied the mistake was frequently made of designating as a disease every change of gastric function elucidated by these methods. Up to the present time text-books describe achylia gastrica, hyperacidity, hypersecretion, etc., as diseases per se. These and other functional disorders may be of independent character, but as a rule they are only symptoms of a pathological condition, either of the stomach proper or of some other organ, or they are manifestations of systemic derangements. It is therefore not enough to examine merely the gastric contents, for gastric analysis alone rarely permits a complete diagnosis to be made, but we must consider every other symptom and the history of the case before we can give the gastric disorder its proper place in the clinical picture. Gastric disorders are found in many different conditions, and they are provoked by numerous causes. In spite of all that is at present said to the contrary the first place should be given to those disturbances which are the result of pathological changes of the stomach proper. The stomach is constantly subjected to insults, which tend to

disease by direct harmful action upon the viscus. Faulty habits in eating, indiscriminate selection of food, abuse of alcohol, tobacco, and the like create gastritis mucosa, gastritis acida, and other organic changes, and with them all the different disorders of the gastric function.

On the other hand, we must bear in mind that the stomach more frequently perhaps than any other organ is easily upset by derangements in other parts of the body. In trying to establish a successful treatment it is therefore not sufficient to determine the condition of the stomach proper, but it is necessary to make a complete investigation of the system in order to find out whether we are dealing with a primary local disease or whether the gastric disturbances are only secondary in nature and caused by diseases in other organs. We have to consider here functional and organic derangements of the nervous system, diseases of the blood, metabolic disturbances, acute and chronic infections and intoxications, diseases of the circulatory system; diseases of the kidneys, of the liver, of the abdominal organs and of the pelvic organs, and their activity under pathological as well as under physiological conditions. We know that distinct gastric disturbances arise with menstruation, pregnancy, and the menopause.

This short summary covers a very large field and shows that the physician who undertakes to treat gastric disorders must be thoroughly familiar with medicine in all its aspects.

The occurrence of secondary gastric diseases has long been understood, as is seen in writings of older clinicians. When I first listened to lectures on gastric diseases at Kussmaul's Clinic about thirty years ago my teacher always laid great stress upon elucidating the various primary factors in cases with secondary gastric disturbances.

Of late one special group of secondary gastric disorders has aroused a great deal of attention, that is, disorders caused by chronic appendicitis, diseases of the gall bladder and the pancreas. Undoubtedly gastric disturbances are in certain cases brought on by reflex action from a diseased appendix or gall bladder, and surgical interference may prove very helpful in the treatment of such conditions. I have no intention whatsoever of disputing such occurrences. In an article published some years ago (67) I was one of the first to discuss the frequent connection of gall stones and gastric hyperacidity. But the frequency of such occurrences is greatly overrated at present and too much importance is given to this special etiologic factor at the cost of others, which are well known as the causes of gastric disorders. If we want to believe all that is claimed at present, the large majority of all gastric disturbances have to be attributed to appendicitis, gall-bladder trouble, etc.

Even gastric ulcer is not considered a primary disease of the stomach, but only secondary to chronic appendicitis and the like. Accordingly, some surgeons counsel against performing gastroenterostomy, once highly praised as the only rational treatment in gastric ulcer, and propose ap-

pendectomy or cholecystectomy as the most reliable cure of the tendency to pylorospasm, the dominating factor in many ulcer cases.

The difficulty is that, with the clinical picture clearly pointing to gastric ulcer, it is not at once evident from which other abdominal organ the reflex disturbance originates. If, for example, the diagnosis of chronic appendicitis is in such cases merely based on that most untrustworthy symptom, tenderness over McBurney's point, it often leads to the removal of an innocent organ in no way connected with the gastric symptoms. So it is also with many operations for assumed gall-bladder trouble. The frequent negative results of operations performed under such indications have brought forward the advice at the time of operation to examine all abdominal organs and correct every abnormality, lest the obvious may not be the real cause of the symptoms. This somewhat summary proceeding has certainly the advantage of sparing the patient the performance of a 2d, 3d, or 4th laparotomy, so often undertaken in the vain effort to find the real culprit. The search is made on the basis of wrong reasoning. Because in certain cases gastric disorders are provoked by appendicitis or gall-bladder troubles one is not justified in assuming that almost all gastric disturbances are due to such reflex action. While it is justly claimed that gastric analysis is of value only when properly interpreted and when taken in connection with the history and with all other clinical symptoms, we must ask the same for the valuation of anatomical findings gained at operations. The causal connection between anatomical findings and clinical manifestations must be demonstrated particularly by the further development of the case. The mere fact that at operation the appendix or other organs are found diseased does not prove that these changes are the causes of the gastric disturbances. That they are very often not the cause is amply demonstrated by the frequent failure of operative treatment to prevent the recurrence of the original gastric disturbance. Not a week passes but what I see patients who, on examination, present the scars of one, two, or more laparotomies performed for the very purpose of curing the patient of the gastric ailments for which he is still seeking relief. I am convinced that others meet with the same experience. Such patients continue to suffer for the very good reason that the operation did not remove the cause of their trouble, as was promised. This applies not only to the numerous instances where, on account of an erroneous diagnosis, the assumed anatomical changes were not present and no beneficial result could be expected; but also to those cases where anatomical alterations were actually found. In many cases of the latter group the real causes of the gastric symptoms are chronic colitis, hepatitis, cirrhosis of the liver, and other organic diseases of different abdominal organs which are not touched at all by the operation. In another group of cases organic changes of the appendix, etc., have less harmful influence upon the gastric function than have constitutional derangements, faulty habits, or some other of

the etiological factors mentioned above. These also remain unchanged by the operation. If, for example, the patient happens to be a neurotic and addicted to faulty habits he will have his gastric ailment after the operation in the same manner as he had it before.

The increasing number of unnecessary and unsuccessful operations makes me dwell upon this point, and I consider it timely to protest against a proceeding which has become quite common, that is, to take it for granted that chronic gastric disorders are almost invariably due to chronic appendicitis, gall-bladder trouble, and the like, a conception based on faulty and insufficient indications.

The presence of gastric ailments alone is not sufficient indication for operating on the appendix, the gall bladder, etc. These operations should only be performed when the indication warrants the removal of the diseased organ (appendix, etc.) for its own sake. Furthermore, when in the latter group of cases gastric symptoms form a prominent part of the clinical picture, no positive promise should be given that the operation will also cure the disorders of the stomach. It may do so, but it just as often does not. The last word about the value of surgical treatment in the cases at issue will not be spoken by the surgeon, but by the medical man who has to attend the patient after the operation. Though we grant that, in a certain group of cases, chronic appendicitis and cholecystitis are the main causes of gastric disturbances, this does not entitle us to disregard everything else which we recognize as disorders of the gastric function. We get better and more lasting results by following physiological methods, by considering all etiological factors, and by devising a treatment which deals, as far as our knowledge goes, with constitutional shortcomings, systemic diseases, chronic intoxications, or whatever etiology the individual case may present.

In basing a plan of treatment on our knowledge of etiology with the intention of removing, if possible, the causes of gastric disturbances, we must not overlook the condition of the stomach proper. This applies not only to cases where the stomach is primarily diseased, due to faulty habits, but also to secondary gastric disorders. We cannot divide the system into sections and attend only to one part if ever so important as an etiological factor. We must take a broader view and consider the individual case in all its aspects. It is poor policy, for example, to claim that a neurasthenic should have treatment only for the derangement of his nervous system without taking any notice at all of his gastric symptoms. Very often gastric disturbances form a center of irritation for the nervous system, and their elimination greatly benefits the condition of the nervous system. Again, in incipient and advanced tuberculosis, proper attention and care bestowed upon the frequently present gastric disorders will assist us in improving the nutrition of the patient, so essential in the treatment of tuberculosis. In heart cases with broken compensation the congestion of liver

and stomach often provokes severe attacks of persistent vomiting, resembling conditions usually found in gastric ulcer. When treated accordingly by exclusive rectal feeding, not only the vomiting ceases, but the diminished congestion of the upper abdomen in turn greatly facilitates and improves the heart action, as I have observed in a number of cases. So it is also with other types of secondary gastric disturbance. We must always remember that gastric disorders influence the condition of other organs and the whole system just as much as vice versa. Æsop's fable of the belly and the members still holds true. We must make full use of all information gained by gastric analysis and other means in trying to correct disturbances of the gastric function by direct physical and medical treatment and by proper dieting. Every improvement thus accomplished will in turn benefit the underlying cause which provokes the gastric disorder.

In emphasizing the necessity of direct treatment of gastric disturbances, I am fully aware of the present tendency to belittle it, particularly on the part of surgeons, who, for example, allow their patients a liberal diet shortly after operations performed for the very purpose of curing gastric ailments. This utter disregard of the grave condition of the stomach, caused by the effects of narcosis and operation, is bound to do harm even to a previously normal stomach, as is shown by the sufferers who date the beginning of their stomach trouble to the time of an operation. On the other hand, proper regard for the rôle which secondary gastric disturbances often play in the development of a vicious circle always proves a great help in the management of such cases.

The *classification of gastric diseases* is in a transitional state at present. Since we are dealing here only with the treatment of gastric diseases no choice is left but to follow the classification usually given in text-books. As a rule, text-books enumerate two groups of diseases, one group the classification of which is based on anatomical findings (gastritis, ulcer, carcinoma, syphilis, etc.), and another group which represents the different abnormalities of the gastric function (disorders of secretion, of motility, of sensibility, etc.). In most text-books the latter group is discussed under the heading of neuroses. This is erroneous, for functional disturbance is not at all identical with nervous disturbance, as is so often claimed. While, in a certain number of instances, disorders of gastric function are mainly due to a derangement of innervation, yet in the majority of cases they are connected with organic changes, and form merely symptoms of the very gastric diseases mentioned with the first group.

We shall, nevertheless, adopt the plan of giving individually the different varieties of disturbed gastric function. They merit separate discussion, because, not only in neuroses, but also in organic diseases, disorders of the gastric function are the dominant feature of the clinical picture. In both types of disease a well-arranged treatment should set out to correct the disturbance of function, which is usually the cause of subjective suffering and frequently gives rise to the development of

anatomical alterations. I favor the view of Hemmeter, who maintains that long continued hypersecretion eventually leads to secondary glandular proliferation, a condition demonstrated in such cases.

Our present methods of examination do not always permit us to draw a sharp line between functional disorders, which are provoked only by derangements of the nervous mechanism of the stomach, and those which are associated with anatomical lesions. The treatment proposed in the following chapters on functional disorders applies in the same manner to neuroses and to organic diseases.

In discussing separately individual features of disturbed gastric functions it ought to be understood that they are often met combined; for example, gastric hyperacidity with gastric atony and gastric hyperacidity with hypermotility. The treatment must be arranged accordingly. We should further always remember that in treating functional disorders we are doing only part of the work if we do not properly attend to their causes.

THE IRRITATIVE DISORDERS OF GASTRIC SECRETION

Hyperacidity and Hypersecretion

(*Acid Dyspepsia*)

For various reasons it is preferable to describe in a general way the treatment of the different forms of hyperacidity and hypersecretion. They are provoked by the same causes, the difference in the clinical picture often being due to the individual reaction of different types of patients. In many instances they appear in the same patient at different periods, the more severe disturbance of hypersecretion either gradually developing in a patient who for a long time presented the milder form of hyperacidity, or hypersecretion occurring in acute attacks in people who are habitually subject to hyperacidity. Furthermore, there is a marked difference in tolerating the various degrees of the disorder; in some patients mild hyperacidity creates such severe suffering as we observe in others only when the more advanced types of hypersecretion are present. We even find all the subjective symptoms usually ascribed to hyperacidity in cases with a moderate quantity of secretion of normal acidity. Such pain and discomfort must be attributed to hypersensibility, to lack of mucus, or to both. The indication for treatment depends very much on such factors. We cannot rely entirely on the result of laboratory findings in determining the extent and the duration of treatment, but must always take into account the degree of subjective suffering, the state of nutrition, and the condition of the nervous system.

The general ideas of treatment, however, are the same for all the vari-

eties of irritative disorders of secretion. In order to avoid unnecessary repetition they will be discussed under the heading of hyperacidity, with the understanding that they obtain in the same manner in the other forms of acid dyspepsia. As pointed out in the introduction, the different clinical pictures of irritative disorders of secretion (hyperacidity, alimentary hypersecretion, continuous hypersecretion, etc.) are the outcome of various combinations of the secretory derangement with disturbances of motility and of sensibility. We must always keep in mind that the disturbance of one function easily leads to the derangement of all the functions of the human stomach, and we shall therefore not go too far in differentiating the treatment of the various forms which are usually enumerated to-day. However, after the general discussion we shall take them up singly in order to describe whatever special treatment is indicated in a given form.

Hyperacidity

(*Superacidity; Hyperchlorhydria; Hyperchloracidity*)

Hyperacidity is the most common form of dyspepsia. If treatment is to be precise we must first clear up the cause of the disorder. In a great number of patients the derangement is due to an inborn disposition, in others it is the effect of faulty habits, of chronic intoxications, etc., and in a third group it is the result of reflex action caused by disturbances in other organs.

Disposition.—The inborn disposition, the nature of which is still unknown, is not directly amenable to treatment. Such individuals should, however, be taught to avoid certain errors in diet and life which, in them, more readily than in others, provoke the disorders of secretion. Patients of that type are usually of an excitable nature, and since hyperacidity is a disorder of an irritative character everything should be avoided which tends to increase the irritability of the system in general, and of the gastric secretory organ in particular. The necessity of avoiding stimulation of the glandular secretion obtains in the same way in the cases of the second group who, without being predisposed, suffer from hyperacidity on account of faulty habits.

Overwork.—Not a few of the latter group belong to the class of brain-workers who, due to the failure to secure reasonable recreation, either suffer constantly from acid dyspepsia or periodically have attacks after times of unusual and prolonged mental strain and worry. When such people give their systems a chance to rest and to recover they often get rid of their gastric trouble without special treatment. If, however, they continue in their bad habits and keep on hurrying at work and having unreasonable hours of labor without getting a sufficient amount of sleep, we usually see them resort to stimulating their worn out nervous systems by the use of alcohol, coffee, tobacco, etc.

Abuse of Stimulants.—As far as hyperacidity is concerned this means adding insult to injury, because all the substances named stimulate not only the whole nervous system, but also gastric secretion by increasing the irritability both of the secretory nerves and of the glandular apparatus itself. Such is the effect of coffee, of alcohol in its different forms, and I think not less pronounced of tobacco.

Hyperaciditas Nicotinica.—The abuse of tobacco may be the only cause of gastric hyperacidity. I have frequently observed that such patients continue suffering until they stop smoking. Experiments in Bickel's Institute (Skaller, 118) showed that tobacco solution hypodermically injected caused gastric hypersecretion in dogs, probably by the direct action of the nicotin on the secretory organ of the stomach. In men hyperaciditas nicotinica is one of the early symptoms of nicotin poisoning and may cause continuous complaints, or come on in paroxysmal crises, sometimes of very violent character. One of my patients who enjoyed perfect health during the rest of the year usually had each spring an attack of hyperaciditas and hypersecretio nicotinica of such a severe type that by suffering and dieting he generally lost as much as 25 lbs. in a few weeks, and several times was under the suspicion of developing a malignant growth. Nothing short of complete abstinence from tobacco relieved him.

I believe that the harmful influence of tobacco on gastric secretion is not sufficiently recognized. Lauder Brunton (25) showed that it is more pronounced when tobacco is used on an empty stomach. In cases where moderate smoking is permissible the habit should not be indulged in when the stomach is empty. Not a few of these patients, however, have to make up their minds to stop using tobacco altogether, either temporarily or permanently. Since such pronounced disturbances of gastric secretion may occur in otherwise healthy individuals, it is obvious that tobacco may do a great deal of harm in patients with an irritable system, weakened by overwork and mental strain, especially in the large group of high strung and excitable neurasthenics, who are constitutionally more susceptible to the toxic effects of tobacco.

The same consideration holds true for the deleterious effects of the other stimulants, *coffee and alcohol.* Either of the two is frequently the only cause of the gastric hyperacidity and nothing will avail but the diminution of the harmful stimulant. Not infrequently we have to forbid all these stimulants, sometimes, however, we may allow a moderate use of the one which seems least harmful. We must remember that individuals vary greatly in their toleration of the different stimulants.

Errors in Diet.—Not less important than the abuse of stimulants are errors in diet as etiological factors. Habitual overfeeding plays a great rôle in the development of hyperacidity, especially long-continued excess of protein food, not only in the form of meat, but also of bread. People who habitually take large meals, particularly of food which induces an abundant flow of gastric juice, gradually educate their stomachs to pro-

duce regularly at each meal great quantities of acid secretion. Overindulgence in rich meals leads in the same individuals often to gout or the uric acid diathesis. Here gastric hyperacidity is part of a well-defined disturbance of nutrition, and, without determining whether the gastric disorder is of independent character or only a symptom of the general metabolic derangement, it is essential that a diet should be arranged with a view to improving both conditions. Both conditions require the reduction in quantity of food, particularly of all food articles rich in protein and purin bodies. Some features, however, make it necessary to regulate the diet principally with regard to the condition of the stomach. The diet which we shall later discuss as most suited for hyperacidity will always prove beneficial in combating the metabolic disorders, not, however, vice versa, for example, acid fruits, highly recommended in the treatment of the uric acid diathesis, are often poorly tolerated by patients suffering from gastric hyperacidity and must therefore be eliminated.

Acids.—Overindulgence in acid fruits, acid drinks (lemonade, sour wines, etc.) is one of the causes of hyperacidity. Some stomachs are very sensitive to the effects of acids. They become more sensitive when the irritation causes an increased flow of juice, thereby adding the irritating effect of its own acid secretion. Here in this country indulgence in acid fruits is the more common cause. Very often we observe attacks of hyperacidity develop after fresh fruits have been in season. When eaten ripe and sweet, fruits are generally well tolerated, but most of our fruit is shipped in an unripe, acid condition. The different acids act differently, those present in strawberries, which, when unripe, greatly irritate the gastric mucosa, seem particularly harmful. But there is a wide individual variation in tolerating the different organic acids. Certain people, for example, are more susceptible to the irritating effect of the mallic and gallic acids in apples, while others have discomfort after partaking freely of grape fruit. Experiences of that kind ought to induce people to avoid whatever fruit they have found apt to provoke hyperacidity. The same advice should be given in regard to acid drinks (lemonade, sour wine, etc.) whenever they prove liable to create acid dyspepsia. I have to mention here the now fashionable soured milk and buttermilk. For many people the lactic acid of these beverages is less irritating than any other acid and may be taken with impunity for long periods. Not everybody, however, tolerates lactic acid so well. I have seen numerous patients with a tendency to hyperacidity suffer greatly after an attempt to become accustomed to the use of soured milk. The indiscriminate prescribing of soured milk as a panacea for all digestive disorders often does harm in more than one way.

Condiments and Spices.—Another common cause of hyperacidity is found in the habit of taking too many condiments and spices, common

salt as well as pepper, paprica, mustard, horseradish, sharp sauces, etc., all of which act as exciting agents of secretion.

Iced Drinks.—We should further mention here the irritating effect of ice-cold drinks of every description. Ice water acts as a stimulant to secretion, particularly highly carbonated waters, which, when taken cold, liberate great quantities of CO_2 after reaching the stomach. The stimulating effect of CO_2 makes champagne a provoker of gastric hyperacidity with many people, while others tolerate well the CO_2 in the finer form in which it emanates from champagne. As a rule, however, champagne is just as apt to cause hyperacidity as any other alcoholic drink.

Imperfect Mastication and Coarse Foods.—In many instances the development of hyperacidity can be traced to the imperfect mastication and bolting of food, especially of raw, coarse food, insufficiently cooked, hard vegetables, etc. The effect of insufficiently prepared and poorly masticated food on the stomach is different according to the tendencies in the individual case. To the stomach is given the task of dividing up the food before it is delivered to the intestine for final digestion. Thus in every instance we find it the specific function of gastric secretion to dissolve the framework, thereby effecting a chemical division of the food into its constituent elements. The comminution is effected by the chemical decomposition following the digestive action of the gastric secretion. Thus the gastric secretion in acting upon meat dissolves principally the fibrous tissue surrounding and holding together the muscle fibers and fat, which, after the solution of this fibrous tissue, fall apart. Acting upon bread the gastric secretion dissolves gluten, thus liberating the starch globules (amylorrexis—Strauss). Ad. Schmidt (115) has lately demonstrated that hydrochloric acid acting upon vegetables dissolves the binding substances (pektin, hemicellulose), which form a frame around the individual vegetable cells.

Schmidt's investigations dispose of the prevailing opinion that cellulose and like substances are digested only in the intestines by the action of bacteria. He states that hydrochloric acid in diluted solutions (as found in gastric secretion) dissolves to a certain degree the middle layers between the vegetable cells, which consist of pektin substances, hemicellulose, or young cellulose. When afterwards put in weak alkaline solutions (similar to those in the intestines) the middle layers dissolve completely. The solution does not take place with the reversed order of putting the vegetables first in an alkaline solution and then in an hydrochloric acid solution. This shows the importance of the action of gastric secretion on vegetables, which leads to their chemical division in the stomach into smaller particles and finally into single cells. The digestive effect of gastric secretion on vegetables is of the same order as on meat and on bread; in dissolving and removing the enveloping tissues the constituent

elements are freed and made accessible to the action of the different intestinal and pancreatic secretions.

We shall see later on that, when atony is associated with subacidity, coarse food failing to undergo chemical division may prove heavy ballast, which, by stagnating and fermenting, is apt to increase the motor as well as the secretory enfeeblement of the stomach. With an irritable stomach, however, the presence of coarse food invokes an abundant flow of gastric secretion to effect comminution of the food. This is as pronounced with vegetable as with animal food, and that is probably one of the reasons why so many vegetarians suffer from hyperacidity, although they abstain entirely from eating meat and other animal foods. The great quantities of vegetable food which are usually taken, particularly when ingested raw, necessitate a very copious flow of gastric secretion. Another reason is that certain foods of the vegetable kingdom contain plenty of purin bodies and extractives, which, if not removed by cooking, act as exciting agents of gastric secretion—an interesting illustration of the fallacy of strict vegetarianism, which is recommended as a panacea for all digestive derangements.

Bread.—In connection with vegetarianism, I wish to point out the great frequency of overindulgence in bread as a causative factor of hyperacidity, a point not sufficiently understood by the profession. This is not the place to consider the relationship of starch digestion and gastric secretion. It may be noted in passing, however, that among the victims of hyperacidity are many whose only error in diet is a too liberal allowance of bread, breadstuffs of some kind constituting the principal staple in their diet. Bread should not be classed entirely with the farinaceous foods, because it not only contains starch, but also a great deal of gluten, which represents the frame of the bread and is an albuminous substance. Like the fibrous tissue of meat, the gluten is dissolved by the gastric juice in order to divide up the bread. When great quantities of bread and thus of gluten are ingested they call for an increased gastric secretion in the same manner as do great quantities of meat.

That indulgence in bread proves so harmful in people with a tendency to hyperacidity finds an explanation when we consider that hyperacidity once developed greatly interferes with the digestion of starches by inhibiting too soon the action of saliva. Undigested starch is apt to stagnate in the stomach and act as a constant irritant to the gastric glands. In the most advanced forms of secretory disorder, that is, continuous hypersecretion or gastrosuccorrhea, we often find in the stagnating fluid of the fasting stomach as the only remnant of previously taken food starch globules—clear evidence that starch, although liberated into small granules, stays in the stomach when not sufficiently changed by digestion, and irritates the secretory organ. Such observations support the popular view that what is generally termed bread-dyspepsia is one of the frequent causes of an acid stomach. The same class of patients are generally fond of

desserts, rich pastries, etc. We shall have occasion to discuss how much discomfort the latter create in people with a tendency to hyperacidity.

In dealing with patients afflicted with hyperacidity it should always be our first task to clear up whatever cause is responsible for the disturbance and eliminate it if possible. As mentioned before, the inborn disposition is beyond the reach of our treatment, nor does the struggle of life permit everybody to arrange his affairs in such a way that he can avoid mental strain and worry. But it is within the control of many to abstain from the use of stimulants and from committing errors in diet. This should be particularly enforced when the disturbance comes on periodically, for example, after unusual excitement, at the time of menstruation, etc. In these cases careful dieting during such a spell will greatly alleviate or cut short the suffering. When secretory disorders are of a chronic nature most sufferers from hyperacidity are much better off if they stop altogether the use of the stimulant or the specific food which they have found to act as the exciting agent of secretion in their individual cases. Not a few are so constituted that they have to sail clear of all the stimulants and all the errors in diet which were enumerated before. If these patients wish to be free of discomfort they have to adhere permanently to a diet which others have to follow only when the suffering caused by hyperacidity becomes very annoying. For how long a period the diet should be continued in the latter cases and how strictly, has to be decided for each patient individually.

Diet.—Before describing dietetic rules for hyperacidity I wish to make a few remarks which obtain equally in disturbances of other character. In prescribing a diet the physician ought to consider the individual peculiarities of his patients, which vary greatly according to the personal equation. Especially in this country, where we meet people of different races and of various nationalities, brought up under all sorts of conditions, do different habits and modes of living account for many peculiar features of the individual in tolerating certain foods and certain ways of preparing them.

I have never found it a good plan to hand to the patient a printed diet slip which contains the names of a number of articles of food, some of which may be unknown to the patient. I prefer to give general rules in regard to dieting, arranged according to the result of the examination. Then I have the patient give me a list of the different articles of food which he is accustomed to live on and instruct him what he ought to avoid and in what way the articles permitted are best prepared. Proceeding in this way the patient may on the whole continue eating what he is accustomed to, avoiding only the harmful elements. If we have the opportunity of following up a case this method makes it a good deal easier to find out what really agrees with the patient and what disagrees with him. It takes more time and effort to prescribe a diet in this fashion, but it yields better results. Furthermore we thus avoid recommending food which very often is contrary to the habits of the patient and still more often not to his liking.

In arranging a diet and the treatment of hyperacidity in general we have to consider two indications, *first, to prevent as far as possible the excess of gastric secretion, and, secondly, to alleviate the suffering caused by the superfluous acid, whenever it appears.* Both indications are equally important and closely interrelated and we shall see that it is best always to consider them both at the same time. When we consult text-books for general diet rules in hyperacidity we are liable to find directly opposite views in regard to certain foods which are forbidden by the one and allowed by the other. One group of authors recommends a diet consisting chiefly of carbohydrates, while another advises principally food rich in albumins. That such contrary views can be held has its explanation in the fact that the respective authors adhere too strictly to one or the other of the two ideas which are generally followed in laying out a diet for hyperacidity; and, further, that in doing so a faulty interpretation is given of the effect of the two types of food on the gastric function under pathological conditions. The one idea has as its basis the indication for neutralizing the free hydrochloric acid, which is responsible for all the suffering, a task which some physicians think best fulfilled by giving meats, eggs, cheese, and similar food with a great capacity for binding acid secretion. The other idea aims at preventing hyperacidity, and to accomplish this object selects food which demands little secretion. Thus, its advocates favor a diet of carbohydrates, because the digestion of carbohydrates is known to require less gastric secretion than that of proteins. On general principles there seems to be no doubt but that the latter indication of preventing increased secretion is the more important and more rational. If we try, however, to arrange a diet accordingly we soon find out that it will not do at all to base the selection of food merely on the results of animal experimentation. While it is an experimentally well established fact that the digestion of carbohydrates calls for less gastric secretion we must remember that there is a great difference between a dog and a patient suffering from hyperacidity. Hyperacidity is a pathological condition, the irritative character of which manifests itself often in the profuse secretion which follows the ingestion of any and every kind of food. When in such cases starchy foods are taken into a stomach which already contains acid fluid or which quickly answers the ingestion with a profuse secretion the ptyalin action of the saliva is stopped very soon. The ingested starch is liable to stay in the stomach, and since it does not combine with hydrochloric acid, free hydrochloric acid appears at an early period of the digestive act. That, however, is the crucial point of the whole question, because not only does the appearance of free hydrochloric acid provoke discomfort in such cases, but eventually it also interferes with the evacuation of the stomach. Free hydrochloric acid reaching the duodenum causes closing of the pylorus until the acid is neutralized by the alkaline secretions in the duodenum. When the

stomach contents consist principally of starches and of gastric secretions this happens very soon and often, because every closing of the pylorus means a delay in the evacuation of the stomach, during which time the amount of gastric secretion is further increased. Eventually when the constant irritation of the duodenum leads to pylorospasm the stagnating acid secretion may create all the annoying symptoms which we are accustomed to connect with hypersecretion and gastrosuccorrhea. This is what we actually observe when we examine the stomach contents of patients with pronounced hyperacidity after they have taken meals consisting chiefly of starchy foods; we find a great deal of poorly digested starch and a highly acid fluid. In the well known cases of gastrosuccorrhea the stagnating acid fluid of the fasting stomach frequently contained starch globules, often as the only remnant of previously taken food. The correctness of this statement can be verified by any one who will examine such fluids microscopically. Thus we see that the kind of food which theoretically seems the most appropriate not only does not prevent increase of secretion, but actually provokes it, thereby creating all the symptoms which we set out to avoid.

Protein food, on the other hand, by binding acid secretion postpones the appearance of free hydrochloric acid. This means more than merely postponing the subjective suffering brought on by the free acid. The acid which combines with the protein effects its digestion, so far as gastric digestion is concerned, and thereby facilitates its egress from the stomach during the period preceding the appearance of free hydrochloric acid. The smaller the remaining part when free acid turns up, the shorter will be the duration of the secretory activity, which the digestion of the remaining part still requires. This shows that the selection of food which has a great capacity of binding acids may at the same time satisfy the second indication of preventing superfluous secretion. In illustrating the effect of these two types of food we again meet with the problem pointed out on several occasions, i. e., that it is faulty to consider merely one part of the gastric function. The knowledge of the action of a certain food on secretion (in animals and healthy individuals) is without value if we fail to recognize the effect it has on the evacuation of the stomach, particularly under pathological conditions. A good deal further is to be said against the tendency to restrict the diet too much to one kind of food, be it carbohydrates or protein. Aside from the experience that most patients cannot be persuaded to adhere for a long period to a one-sided diet, consideration of the state of nutrition generally forbids it. If we except special periods, during which we shall see that a greatly restricted diet is in place, we find that sufferers from hyperacidity are as a rule better off with a mixed diet, provided the constituents of the diet are properly selected and properly prepared.

In contemplating a mixed diet we have to consider more than merely

whether a certain food belongs to the carbohydrate or protein class. As a matter of fact not a few of the ordinary articles of food contain both carbohydrates and proteins as already pointed out for bread. But it is of importance to know how large is the percentage of starches in a given food, how large in a meal composed of different foods, and how large the total amount taken with all the meals of a day. Guided by the considerations given above we prefer to have a preponderance of albuminous food. Yet we shall see that a certain percentage of starches, given at the right time and in the right order, is often tolerated in hyperacidity. While it is perfectly true, on the other hand, that with an individual meal meat causes little discomfort in cases of hyperacidity, it is not advisable to keep patients on a strict meat diet. When meat forms the bulk of the meals it necessarily requires a great total amount of secretion, and when such a diet is kept up for long periods the constant taxing of the secretory organ is bound to lead to hypersecretion. Much depends, therefore, on the proper combination of different food types. For most foods much depends on the method of preparation. By certain preparations food can be changed chemically and physically to such an extent that while inducing less secretion it nevertheless exhibits an undiminished capacity for combining with acids. When meat is boiled instead of broiled it loses the extractives, which act as exciting agents for secretion, but retains the same capacity for binding gastric juice. Again, when it is given minced it taxes the activity of the stomach considerably less than when swallowed in bigger morsels, because it requires less secretion for division and, being already finely divided, it leaves the stomach quicker. In discussing the individual articles of food we shall have occasion to show that these and similar considerations are the most essential in arranging a diet list. For reasons mentioned before we shall abstain from giving complete diet lists. We prefer to discuss individually the principal articles of food, considering how much they provoke gastric secretion, how much capacity they have for binding secretion, in what way they can be prepared without destroying their acid-binding capacity so that they leave the stomach quickly. An ideal diet for hyperacidity should be composed of such food, prepared in such a way that it calls for the smallest possible amount of secretion, that at the same time it is apt to bind all the acid secreted, and that it further leaves the stomach in the shortest possible time, thereby reducing the period of secretion. Often it is a difficult task to prescribe such a diet, yet it should be the goal.

Milk.—The food which best answers these requirements is milk. The principal advantage of milk is its freedom from extractives, which accounts partly for the fact demonstrated by Pawlow (99), that of the different forms of proteid food milk induces the smallest amount of secretion, and at the same time fixes the greatest quantity of free hydrochloric acid, and when given in small or moderate quantities at a time quickly

leaves the stomach. For all these reasons milk is the most suitable food during acute attacks of the secretory disorder, especially when they are of severe character. In such cases it should constitute the staple diet and should be administered in such a form as will prove agreeable and beneficial to the patient. Patients suffering from hyperacidity often claim that they tolerate milk poorly. Not infrequently the discomfort is caused by errors in administering the milk. It is true that some patients are regularly upset by milk, no matter in what form it is given. Yet most derive the greatest comfort from a milk diet when it is given in the proper way. It is always preferable to give it by itself, without combining it with other food, particularly without bread, which is often erroneously added. When it is the only food it should be given in quantities of 6 to 8 to 10 ounces every 2 or 3 hours. We have to find out whether it is best tolerated when taken raw or boiled, as whole milk with the cream or as skimmed milk. Some patients stand it better when it is diluted with one-third to one-half vichy water, while others have to add lime water or other alkalies (sodium or magnesium preparations) to prevent its rapid coagulation in the stomach. This is particularly so when the stomach contains stagnating acid. In such cases it may be necessary to first remove the acid fluid by lavage, the drinking of alkaline waters, etc., before the milk is ingested. If plain milk disagrees peptonized or malted milk may be tried; sometimes fermented milk (koumyss, matzoon, etc.) is taken well, although these preparations are just as liable to increase the discomfort when containing much acid or much gas, both of which excite secretion. This is still more frequently so with buttermilk and soured milk on account of their pronounced acid condition, wherefore it is safer to exclude them from the diet list. Of other milk preparations we name as usually well tolerated cream, junket, pot cheese, and cream cheese if taken in moderate quantities.

I have frequently given with very good results cream diluted with a third to a half vichy water, instead of milk, when the latter caused discomfort. This is somewhat in contradiction to the usual recommendation, which lays stress on the high percentage of fat which pure cream contains.

Fat.—We may right here deal with the action of fat, which merits separate discussion. Animal and vegetable fat in the form of cream, butter, oil, and meat fats are highly recommended in hyperacidity, because animal experimentation has demonstrated that fats by reflex action from the duodenum reduce gastric secretion. As with starchy foods, however, the result of animal experimentation cannot be used without properly considering pathological conditions. When a tendency exists to delayed evacuation of the stomach, fat given in large quantities with a full meal is liable to stagnate with the rest of the food, usually collecting on the surface of the chyme. The stagnating fat eventually undergoes butyric

fermentation and the resulting fatty acids act as a very annoying irritant, causing pain and further secretion. This is particularly so with cooked fats, butter sauce, etc., which contain fatty acids before reaching the stomach. We have further to consider the regurgitation of the duodenal contents which, according to Boldireff's investigations (21), often follows the ingestion of oil and fats into the stomach. While the alkaline intestinal contents may to a certain degree neutralize the acid stomach contents the action of the pancreatic juice on the fat leads to the formation of fatty acids, which, when produced in large quantities, may give rise to severe disturbances. In not a small percentage of hyperacidity cases fat thus distinctly increases the suffering and aggravates the whole condition, which shows that the indiscriminate recommendation of large quantities of different fats for all cases of hyperacidity is unwarranted. Still, under certain conditions, fat proves very helpful. Much depends, however, on the kind of fat and on the way it is given. When given (best in the form of oil) before meals it readily spreads over the mucous membrane and by sticking to it prevents the intimate contact of the irritant acid secretion with the mucous membrane. This is particularly valuable in gastric hyperesthesia and in cases in which the lack of mucus allows a very close contact of gastric secretion and mucous membrane, a pathological condition described by the writer as amyxorrhea (or better, amyxia gastrica, 69). In these cases in which the lack of mucus often causes hyperacidity symptoms even with a normal amount of acidity, the oil furnishes an artificial covering to the mucous membrane and thereby acts beneficially. Aside from the oil given in this fashion, cream and fresh butter may be taken freely, and in cases without motor complications perhaps tend somewhat to lessen the secretion of gastric juice. One must, however, avoid giving too much fat, as large quantities of oil, butter, or cream soon become repulsive to most people. Butter and cream can easily be taken with other kinds of food. But it is always better to give butter uncooked, even when it is added to fish, vegetables, eggs, etc., instead of boiling it. Cream may also be advantageously given between meals in place of milk, either pure or mixed with vichy water. Other animal fats should be avoided, for example, fried bacon, which, especially when salty, is apt to give rise to acidity. All fried foods are prohibited It is sometimes claimed that mutton fat agrees with hyperacidity patients. This is correct for a small percentage of patients, and it should be tried carefully at first. As a rule it is better to remove the fat.

Eggs.—The fat of the egg yolk is well borne, as is the whole egg. Next to milk, eggs should form the staple element of diet and should be added after a period of straight milk dieting. The white of the egg is an albuminous substance which binds a good deal of acid without provoking much secretion. In cases of great gastric irritability egg-albumin is often retained where even milk is not tolerated. It may be given

in the form of albumin water or the white part of a boiled egg may be taken separately. Whether soft boiled or hard boiled depends on the individual tolerance. In some cases it goes best when the egg is boiled for a long period, so that it is hard enough to be ground into a fine powder. Aside from these conditions of great irritability, eggs may be taken in different forms, raw, boiled, poached, with meals and between meals. Hyperacidity patients having a mixed diet often require some food between the principal meals when annoyed at such times by the acid chyme. The acid-binding capacity of eggs makes them an appropriate food, which may be taken with or instead of milk. Eggs can further be used for preparing desserts (custards, soufflées, etc.).

Of other foods rich in protein we have to consider those of the animal and of the vegetable kingdom.

Meats.—In selecting meat, fish, poultry, preference should be given to lean kinds over the fat and oily forms. Pork, certain kinds of fowl (duck, goose, etc.), oily forms of fish (salmon, mackerel, bluefish, eel, pompano, shad, etc.), are usually classed as heavy food, because the thorough infiltration of the meat with fat prevents the access of gastric secretion, causing delay of the digestion of the meat and thereby of its egress from the stomach. The richer in fat the longer the sojourn of the food in the stomach, which prolongs the period of secretion. As belonging with the fat types, I mention beef tongue, tripe, and brains.

Of the lean ones beef is the least favorable on account of its great amount of extractives. The extractives are an excellent stimulant for gastric secretion, which is the reason that meat broth is given with advantage when gastric secretion is sluggish. In hyperacidity, however, meat broth, meat extracts, beef-tea, bouillon, etc., should be forbidden. For the same reason the coating of a roast, which is usually very rich in extractives and salts, should be avoided. On the other hand, all meat, fish, and poultry which are boiled lose their extractives while still retaining the same amount of albumen and its acid-binding capacity. We can still further reduce the amount of secretion necessary to digest a certain amount of fish or meat if, after boiling it, we have it minced and puréed so that by hastening its passage through the stomach we shorten the period of secretion. In cases where meat or fish is tried after a period of diet restricted to milk and eggs, it should at first always be given boiled, finely minced, and then rubbed through a sieve. Patients who are less restricted should always select the lean types, preferably boiled, deprived of skins and other coarse parts which require more digestive activity of the stomach than the tender meat parts.

Of lean meats I name beef (best taken in moderate quantities and not too often), lamb (young), mutton, chicken, turkey, capon (the white meat preferable to the dark meat), squab, partridge, and guinea-hen. Veal is allowed only when milk-fed and tender. In this country it is

usually too coarse and tough and is better omitted. The lean fish are: cod, halibut, haddock, striped bass, brook trout, red snapper, perch, smelt, whiting, etc. In connection with this class of food I should mention as allowed the soft part of oysters, caviar (if mild and not too salty). Lobster and crabs, although binding a great deal of acid, have too coarse a fiber and thus require too much secretion. Other forms allowed are sweetbreads and tender calf's liver. Kidneys are too hard and tough. Very recommendable is gelatin, the "albumin sparer," which, if not made too rich from added ingredients, calls for little secretion while fixing a good deal of hydrochloric acid. It can be used for making desserts, jellies, which may be flavored with some fruit juice if necessary.

Vegetables.—In selecting and preparing vegetables we are guided by the principles brought forward in discussing animal food. Vegetables which are rich in proteins have the advantage of binding a great deal of acid, prolonging thus the amylolytic period of digestion, and thereby furthering the digestion of their carbohydrate constituents. Particularly rich in proteins are the so-called legumins, peas, beans, lentils, but they must be given in the form of well-cooked purées. There are in the market fine flours made of the dried legumins (for example, Knorr's Flour), which make up fine purées, or, when somewhat more diluted with water, can be taken in the form of thick soups. In cases with pronounced irritability (as in gastrosuccorrhea, gastric ulcer, etc.), which require a prolonged period of restricted diet, I am in favor of adding to milk and eggs such purées or soups made of leguminous flours. Purée is the best form of preparation for all kinds of vegetables. It is poor advice to advocate long-continued mastication instead, because mastication reflexly provokes gastric secretion. When, however, vegetables are taken finely prepared, mashed or strained, they quickly take up a great deal of secretion and leave the stomach in short order. If necessary almost all vegetables can be puréed; spinach, green peas, carrots, lettuce, beet tops, beets, squash, lima beans, oyster plant, Jerusalem artichokes, chestnuts, etc. With a less strict diet some vegetables are much preferred when offered in natural form, but they should always be made very soft by thorough boiling; asparagus, top of cauliflower, celery, string beans, kale, French artichoke, sweet potatoes, etc. Some patients even stand well purées of turnips, parsnips, boiled Bermuda onions, etc. Coarse vegetables such as corn, cabbage, and mushrooms should be forbidden. Tomatoes are too acid. The acidity also makes most fruits harmful even when stewed. Of raw fruits sweet grapes or bananas, which are not acid, are sometimes permissible in mild cases. As a rule, however, it is better to avoid these and all other raw fruits. Salads and other raw vegetable food, celery, radishes, olives, nuts and other substances difficult of solution, all articles of food containing hard material such as seeds, etc., should be prohibited. Schmidt's (115) recent investigations have taught us that cooking dis-

solves to a certain degree the middle layers of pektin, hemicellulose, etc., which otherwise have to be dissolved by the gastric secretion. The more thoroughly cooked the vegetable, the less it taxes gastric secretion. Bickel (13) has further stated that, just as with meat, cooking deprives vegetables of extractive substances, which were shown to act as very forcible exciting agents of gastric secretion when given to animals internally or hypodermically. By being thoroughly cooked and puréed vegetables lose therefore chemically as well as mechanically a good deal of their power of exciting gastric secretion.

Starchy Vegetables and Carbohydrates.—In regard to vegetables rich in starch (potato, rice) and the so-called cereals, much depends on the state in which starch digestion is found in the individual case. The regulation of the carbohydrate intake, particularly in the form of starchy foods, is the most difficult point in hyperacidity diet. It seems to me that the difficulties are not simply to be overcome by claiming that an amylaceous diet has a curative effect, arguing that hyperacidity is rare among Eastern people who live mainly on carbohydrates, and that, as Hemmeter has shown, the acidity of the secretion in carnivora can be diminished by feeding on a carbohydrate diet for a long time. First of all, it is only in a certain percentage of cases that hyperacidity develops from long-continued overindulgence in meats. Such patients should certainly be taught to reduce the quantity of meat not only absolutely, but also relatively, and in arranging for them a mixed diet a gradually increasing amount of starchy food should be added. However, such an attempt can only be undertaken during free intervals, when the secretory disorder has abated after successful treatment. As long as hyperacidity is present, and as long as the premature rise of acidity curtails the normal period during which starch digestion can continue in the stomach, starches should be prohibited. The more pronounced the disturbance the more completely and the longer should starches be excluded. This is especially necessary in all cases with stagnation of gastric secretion. Few subjects of hypersecretion are able to take bread or other starchy foods without experiencing a considerable access of discomfort. When in such cases, after a period of milk and egg diet, the acute symptoms have subsided and the general state of nutrition makes it desirable to add some carbohydrates, we prefer, as stated above, to first allow leguminous flours. Should they prove distasteful or cause discomfort starchy foods may be carefully tried, only, however, in some special form which has been already partly digested; a gruel of oatmeal, a cereal soup, barley water, or very fine flours of cereals thoroughly gelatinized by boiling them with milk, which covers the dissolved starch and carries it along into the intestine. Even in this form they should be given only in moderate quantities, preferably in the morning and after having removed by lavage stagnating acid secretion. In not a few cases starchy foods prepared even in such careful ways are

apt to cause discomfort and then we have to restrict the diet to milk, eggs, and leguminous flours until meat and green vegetables can be taken. In such cases all other kinds of starchy food (potatoes, rice, macaroni, cereals which are not thoroughly prepared) must be avoided altogether for long periods, not less all starchy desserts and particularly bread, which, even in the form of toast and rusks, is a pronounced provoker of gastric secretion and is invariably poorly tolerated. This is especially so in the group of cases described as amylaceous dyspepsia, usually caused by overindulgence in bread and showing a great impairment of starch digestion. Such people are better off if they keep away altogether from bread and starchy foods for long periods. On the whole, in milder types of the secretory disorder when a more liberal mixed diet is in place, the allowance of starchy foods should be regulated according to the state in which starch digestion is found on examination. The degree of impairment of starch digestion varies greatly in hyperacidity cases; the less starch digestion is interfered with, the more liberal we may be with allowance of starchy foods. But even with a liberal allowance it is best given only in moderate quantities thoroughly prepared and according to the following rules. In the majority of cases it is best to give the allowance of starchy foods with the first meal in the morning, provided the fasting stomach is free from acid fluid; toast, rusk, zwieback, crackers, starch-free biscuits, a gruel of oatmeal, thoroughly boiled farina or rice. All starch should be dextrinized by dry heat or thoroughly gelatinized by moist heat. Whatever bread is allowed should be taken in the form of thin slices crisply baked in the oven, and it should always be well masticated. In this case prolonged mastication has the advantage that the starch is partly digested during the act of chewing, wherefore it is best to have the toast eaten dry, without any fluids, so that it may become thoroughly mixed with saliva.

Certain patients have the greatest annoyance from hyperacidity after breakfast, no matter what it consists of; in such cases the allowance of starchy foods should be given with the mid-day or evening meal instead; baked potato, potato purée, soft boiled rice, tapioca-pulp, etc. One kind of farinaceous food should always be sufficient with one meal, so that if potatoes are taken toast should be avoided and vice versa. The selection of the special kind of farinaceous food depends on the individual tolerance; some people have great discomfort after eating potatoes, which for others are the best tolerated of the starchy foods. The total amount of starchy foods with a single meal and with all the meals of a day should not be too great and should only form the smaller percentage of a mixed diet.

Desserts.—Great restrictions should be put on desserts. Since Strauss (123) and others found that dissolved carbohydrates (for instance, a solution of sugar) reduce gastric secretion, sweet desserts have

been recommended as a suitable food in hyperacidity. Practical experience, however, teaches us that hyperacidity patients are particularly annoyed by heartburn, flatulency, and painful sensations after partaking of sweet desserts. Even plain sugar solution readily undergoes fermentation, when motor insufficiency is combined with the secretory disorder. The advice to give therapeutically in hyperacidity a solution of dextrose or extract of malt should be followed only in selected cases without gastric atony, and then with caution. It is further often necessary to restrict the quantity of sugar used for sweetening tea, cocoa, cereals, etc. Honey is sometimes well tolerated. The combination of sugar and starchy foods seems to be especially liable to bring on fermentation, gas distention and increased secretion, and it is therefore decidedly better to eliminate entirely from the dietary of hyperacidity patients such desserts as pastries, pies, rich cakes, puddings, etc. When desserts are much desired by the patient, those prepared without starches are recommended: custards, blanc-mange, soufflés, gelatins, chocolate junket, etc. Even these are better tolerated when prepared without much sugar. Some people find a good substitute in cream cheese, best taken with a few crackers or starch-free biscuits.

Condiments and Spices.—In cooking food, vegetables as well as animal food, much seasoning should be avoided, nor should the patient himself add condiments and spices; mustard, pepper, ginger, curry, paprica, horseradish, sharp sauces, vinegar, etc., must be forbidden. As mentioned before, hyperacidity is often the result of a long-continued habit of adding great quantities of condiments, particularly table salt, to every kind of food. In France the complete withdrawal of table salt (déchlorition) is used as an effective treatment of hyperacidity, based on the results of A. Cahn's experiments (27), which showed that with a salt-free diet the secretion of gastric juice is greatly reduced. At all events excessive quantities of salt should be strictly forbidden.

Alcohol, Coffee, and Other Drinks.—As long as the disturbance is present no alcohol in any form should be taken. All alcoholic drinks are strong provokers of gastric secretion, particularly in concentrated form and when taken before meals (cocktails). With some wines it is the acid as well as the alcohol which irritates and so, when patients, after being cured of the ailment, desire again to have some wine with their meals, they should abstain from acid wines as well as from cider and similar acid fluids. Preferable are light beer or whiskey, one part diluted with 7-8 parts of water, or non-acid wines, also best well diluted with water. No alcohol of greater strength should be permitted and no alcohol of any kind apart from meals.

Patients who are not accustomed to have spirits with their meals are far better off if they take only water. Whenever the secretory disorder is combined with motor disturbances (alimentary and continuous hyper-

secretion) the allowance of all kinds of fluids taken with meals should be restricted as far as possible. With undisturbed motor activity of the stomach, however, a moderate amount of fluid taken with or at the end of a meal, may help to dilute the acid secretion. For this purpose plain water or water containing some alkali is useful, or one of the natural alkaline waters, by preference those with a small amount of CO_2, such as Vichy, Ems, Fachinger, Seltzer, Evian, Contrexéville, etc. Most people like to finish their meals with a warm drink. They can either take warm water or a weak infusion of Chinese or breakfast tea. Much in fashion again and well tolerated are aromatic teas, such as camomile or peppermint. Coffee (with and without caffein) should be strictly forbidden at all times. Tea is decidedly less irritating for gastric secretion than coffee, but only when prepared fresh and in a weak infusion. Many prefer cocoa, which, although more irritating than tea, is a good breakfast food, particularly bitter cocoa prepared partly with water and partly with milk.

Drugs.—The administration of drugs is usually described as having principally two objects, to reduce the amount of secretion and to neutralize whatever superfluous acid is present. In discussing the different remedies we shall find, exactly as we found with the different food types, that the so-called "palliative" treatment of neutralizing the obnoxious acid often answers the first "causal" indication of preventing further secretion. We shall further find a third not less important object of medication in the benefit derived from the increased secretion of mucus, which follows the use of certain remedies.

Atropin.—The remedy which is generally considered the most powerful in reducing gastric secretion is atropin, first recommended for the purpose by Riegel (107). Experimentally it was shown (v. Aldor, 132; Schiff, 113; Lientier, 85) to have an inhibitory effect on the pneumogastric nerve, the secretory nerve of the stomach. Opinions about its practical usefulness in hyperacidity are still divided. Some modern observers praise its prompt and reliable influence in most cases of secretory disorder (Tabora, 125), while others claim that they have never seen gastric secretion reduced when using atropin alone without further treatment (Elsner, 37). Fenwick (42) states that atropin does not really diminish acidity and that, on the other hand, it not infrequently induces vomiting. Personally I have found that it exerts its inhibitive influence on gastric secretion principally in those cases which present symptoms of irritation of the vagus nerve, as hypersecretio nicotinica, acute attacks of intermittent hypersecretion, and the condition lately described by Eppinger and Hess (38) as vagotony. I am not convinced, however, that its effect can be relied upon in all the different forms of irritative gastric disorder. In milder forms of hyperacidity, which usually yield to other methods of treatment, the drug is hardly recommendable on account of

the disagreeable by-effects (dryness of mouth, disturbance of vision, etc.), which rarely fail to appear when atropin is properly given in doses which guarantee its full action. On the other hand, in the severe forms of hypersecretion I have found, like Fenwick, that it sometimes increases the vomiting. I admit, however, that in the severe forms of hypersecretion the condition is usually of such character that we employ simultaneously other means to stop the secretory irritation, which makes it difficult to decide what acts beneficially and what harmfully. Still I consider it advisable to try atropin in all cases of severe type, when pains and persistent vomiting call for all available help. Aside from reducing gastric secretion atropin relieves pylorospasm, which is usually associated with severe forms of hypersecretion. Whenever feasible it is preferable to administer it hypodermically, 0.5 to 1 mg. (1-120 to 1-60 gr.) two to three times a day. In ambulatory cases it should be given internally, either in tablet form or better in solution [10 to 20 drops of a solution of atropin 0.01: 10.0 gm. (1-6 gr. to 2½ dr.) of water]. Tabora, who emphatically advocates its systematic use in all cases of pronounced hypersecretion, recommends that such doses be taken regularly for a period of two or three weeks and longer, provided the first few doses yield a favorable result. Individual intolerance will be observed immediately and should prevent the further use of the drug.

Belladonna.—Belladonna is frequently administered as a milder substitute for atropin. The extract of belladonna is the usual preparation, in doses of 0.01 to 0.02 or 0.03 gm. (1-6 to 1-3 or 1-2 gr.) three to four times a day, either in tablet form by mouth or in suppositories in somewhat larger doses. Extract of belladonna is often added to different alkaline powders. The separate administration has the advantage of allowing more exact dosage, which can easily be changed or stopped altogether, according to needs, while the alkaline powders are continued.

Eumydrin.—Another substitute for atropin is eumydrin, recommended by Haas (56) in doses of 1 to 2 or 4 mg. (1-60 to 1-30 or 1-15 gr.) three or four times a day, in solution, pills, powder, or suppositories.

Bismuth.—Next to atropin the drug most relied upon for reducing gastric secretion is bismuth. Since Fleiner (46) and later Schüle (117) described its retarding effect on gastric secretion it has been more and more extensively used for the purpose. Others (Cheinisse, 28, etc.) attribute the undoubted relief following the administration of bismuth to its stimulating action on the secretion of mucus, which could be demonstrated experimentally (Matthes, 91). In cases of amyxia, with and without hyperacidity, the effect of bismuth proves particularly beneficial in at once stimulating the secretion of mucus and retarding the glandular secretion. This justifies the extensive use of this drug in all cases of irritative secretory disorders of the stomach.

Different bismuth salts are in use: the subnitrate, the subcarbonate,

the subgallate, and the bismuth tannate, preference being given to the one or the other by different authors. I side with those who consider the subnitrate the most reliable. It yields the best results when given in doses of ½ to 1 teaspoonful on a fasting stomach and before meals. It can also be given advantageously in combination with different alkalies.

Alkalies.—Alkalies are the great standby for most sufferers from hyperacidity, which is readily understood when we consider that they usually afford immediate relief when taken at the time of discomfort and pain. In spite of the great comfort they offer to the patients many practitioners counsel against the liberal use of alkalies. They argue that by neutralizing the excess of acid the alkalies give only temporary relief, which is followed by a renewed increase of secretion, caused by the irritating effect of the resulting salts. This is said particularly of bicarbonate of soda, which with HCl forms NaCl and CO_2, both of which are stimulating agents of secretion. While thus acting symptomatically the alkalies are said to have no curative effect, which would account for the fact that so many hyperacidity patients continue using alkalies for years and come to rely upon their neutralizing action if they want to feel comfortable. Not a few of these sufferers are never without their alkaline powder, which they always carry with them. It seems to me, however, that in many of these cases the persistence of the secretory disorder is not so much due to the steady use of the alkalies as to a continuation of the original cause of the hyperacidity. One of my patients for over forty years took religiously every day about six teaspoonfuls of bicarbonate of soda, averaging between 2 and 3 pounds per month. He was a very intense worker, at the same time a very hearty eater, particularly fond of all sorts of delicacies and liquors, usually winding up the day's toil by drinking 3 to 4 quarts of beer. He maintained that the conscientious use of bicarbonate of sodium taken on a fasting stomach, after each meal, and before retiring, enabled him to work persistently without being unduly annoyed by gastric discomfort, while at the same time indulging to his heart's content in whatever he was fond of having on his table and plenty of it. And so it is with many, to whom the relief afforded by alkalies gives the pretext to perpetuate their errors in diet and life. With properly arranged diet and mode of living, however, more than a mere symptomatic effect results from the use of alkalies, and I consider it an open question whether alkalies in general (if we except bicarbonate of soda) secondarily increase gastric secretion. Experimentally it has been demonstrated (Pawlow, 99; Bickel, 9; Heinsheimer, 59) that alkalies when taken on an empty stomach reduce gastric secretion partly by direct action on the mucous membrane, partly by reflex action from the duodenum. This is the reason that some authors give for advising that alkalies be taken before meals in order to insure their full effect. We must not forget, however,

that hyperacidity is a pathological condition which often requires different action. The suffering caused by hyperacidity necessitates the administration of alkalies at the time when the discomfort becomes annoying. Even when taken at such times after meals alkalies do more than stop the pain by neutralizing the acid. In hyperacidity with a hypersensitive mucous membrane the free acid itself is a most pronounced irritant to gastric secretion, and by checking the free acid at the beginning of its appearance alkalies eliminate the irritant and act as sedatives, both by lowering the maximum of the acidity and by shortening the duration of the secretory disorder. Furthermore, in hypersecretion, particularly when pylorospasm retards the evacuation of the viscus, the spasm ceases with the neutralizing of the acid and in accomplishing a quicker egress of the stagnating contents the alkalies remove the real exciting agent of continued secretion. This shows that alkalies have not only a symptomatic, but a decided curative effect, even when given at the height of the discomfort for symptomatic purposes. For this reason I favor the liberal use of alkalies, whenever the subjective symptoms require them, at regular hours after meals, and repeated with returning discomfort, which is often necessary during the night in cases of severe character. As a rule we have to find out for each individual case the most appropriate time for the administration of the alkalies; one, two, or three hours after meals, respectively. In the cases of so-called larval hyperacidity, in which hyperchlorhydria is present during the earlier periods of digestion, the best results are obtained when alkalies are given directly after meals. When the suffering subsides alkalies may be given for curative purposes before or with meals. This may also be accomplished during the more acute stages, in addition to the above methods, particularly by giving alkaline waters before meals. Bickel (10), Sasaki (112), Rheinbold (106), and others have conclusively demonstrated that the natural alkaline waters of Carlsbad, Marienbad, Vichy, Tarasp, and other places decidedly reduce gastric secretion. This makes them very valuable in hyperacidity and justifies their systematic employment either at home or at the spa itself. Which place is best suited has to be considered for each individual case and depends to a certain degree on the general condition of the patient and on the condition of his bowels. The result gained in suitable cases at these places is sometimes very striking. Very good results are also obtained by having these waters taken at home for weeks and months. I know of patients who have for years taken a glass of hot Carlsbad or Vichy water in the morning before breakfast with great benefit.

In cases of constipation saline aperients may be added to the mineral water or taken in plain water before breakfast; phosphate of sodium, sulphate of sodium, sulphate of magnesium, etc. These salts can also be added to the alkaline mixture, taken before or after other meals. I have found, however, that strong salt solutions have an irritant effect on the

stomach in certain cases and I then prefer to add a vegetable cathartic (rhubarb, etc.) to the alkaline powder, if the latter itself is not sufficient to regulate the bowels, which is frequently the case. The array of alkalies used in hyperacidity is great and they may be combined in many different ways. Bicarbonate of sodium is by far the most effective and should be given when a quick result is desired. It has the disadvantage of producing CO_2, which not only stimulates secretion, but often annoys the patient by causing painful gas-distention, relieved only by belching, which is objectionable to most patients. While this disadvantage is less marked when forming part of a mixture of different alkalies, it is being more and more replaced by citrate of sodium and biborate of sodium. We have also the different calcium preparations (calcium carbonate and tribasic phosphate), principally used when a tendency to diarrhea exists. In cases of constipation we prefer magnesia preparations; calcined magnesia, ammonio-magnesium phosphate, magnesia perhydrol. Lately I have used extensively magnesia perhydrol in doses of 1, 2 to 3 grams (15, 30 to 45 gr.) with very good results. Investigations in von Leube's clinic by Poly (102) showed that magnesia perhydrol exerts its beneficial effect principally by stimulating the secretion of mucus. Poly furthermore demonstrated both experimentally and clinically that another peroxid, the hydrogen peroxid first recommended by Petri (100), also acts beneficially in hyperacidity by producing more mucus. Hydrogen peroxid was administered in ½ per cent. watery solution, 300 c. c. being given on a fasting stomach every other day and repeated in mild cases five times, in severe cases about ten times. The magnesia perhydrol seems the most practical preparation.

In choosing and combining the different alkalies we should always consider their effect on the bowels and on the secretion of mucus. We mentioned before that the value of bismuth is attributable to its power of increasing the secretion of mucus, which makes it a very useful constituent of alkaline mixtures.

The doses should be regulated according to the degree of the disturbance; severe disturbances require not only more frequent, but also larger doses. Of the magnesia preparations (particularly of the calcined magnesia) much smaller quantities are necessary to neutralize equal amounts of HCl than of sodium preparations. One gm. (15 gr.) of calcined magnesia is equivalent to 4 gm. (1 dr.) of bicarbonate of soda.

To all such alkaline mixtures may be added belladonna or codein when hyperesthesia or great pain requires sedatives. As with belladonna I prefer to give codein in doses of 0.02 to 0.06 gm. (1-3 to 1 gr.) separately for reasons given above. Morphin should be prohibited in chronic cases. In acute cases it is sometimes indispensable. Bromids, highly recommended by Steele (120) as sedatives against hyperesthesia, are better administered by rectum.

Some of my favorite formulæ are:

℞

Sodii bicarbonatis			
Bismuthi subnitratis	āā	15.0	ʒss
Magnesii		10.0	ʒiiss

M. ft. pulv.

Sig.—One-half to 1 teaspoonful in water one or two hours after meals.

℞

Sodii bicarbonatis			
Rhei	āā	15.0	ʒss
Magnesii		10.0	ʒiiss

M. ft. pulv.

Sig.—One-half to 1 teaspoonful in water at night.

℞

Magnesii	15.0	ʒss
Elæosacch. mentha. pip.	5.0	gr. lxx

M. ft. pulv.

Sig.—One-half teaspoonful in water one hour after meals.

℞

Calcii phosphatis tribasic			
Bismuthi subnitratis	āā	15.0	ʒss

M. ft. pulv.

Sig.—One-half to 1 teaspoonful one hour after meals.

To quote some other formulæ:

℞

Magnesii	15.0	ʒss
Sodii citratis	10.0	ʒiiss
Eumydrin	0.03	gr. ½

M. ft. pulv.

Sig.—One teaspoonful 2 or 3 hours after meals (Zweig).

℞

Sodii bicarbonatis			
Magnesii	āā	10.0	ʒiiss
Ext. belladonnæ		0.15	gr. ii

M. ft. pulv.

Sig.—One-half to 1 teaspoonful one hour after meals (Elsner).

℞

Magnesii carbonatis	10.0	ʒiiss
Sodii citratis	5.0	gr. lxxv
Codein. phosphatis	0.2	gr. iii

M. ft. pulv.

Sig.—One-half teaspoonful one hour after meals (Elsner).

℞

Magnesii	20.0	ʒv
Sodii citratis	10.0	ʒiiss
Sodii sulphatis (or magnesii sulphatis)	5.0	gr. lxxv

M. ft. pulv.

Sig.—One-half teaspoonful before meals (Tabora).

℞

Ext. belladonnæ	0.5	gr. vii
Bismuthi tannatis	10.0	ʒiiss
Magnesii carbonatis		
Sodii bicarbonatis āā	20.0	ʒv

M. ft. pulv.

Sig.—One-half teaspoonful every two hours (Ewald).

Lately some aluminium preparations have been recommended in the treatment of irritative gastric disorders; escalin by George Klemperer, neutralon by Rosenheim, and kaolin (aluminium silicate, the old bolus alba), by Hemmeter. Their value has still to be established.

Lavage.—Lavage plays a great rôle in the treatment of irritative secretory disorders. The abuse of lavage by incompetent hands has somewhat discredited this valuable method of treatment. I consider it, however, a great mistake, on account of such abuse, to abandon lavage altogether in hyperacidity or to restrict it to the most urgent conditions, as is advised by some writers. Personally I would not readily give up the employment of lavage, which, when judiciously applied, has yielded better results in the treatment of patients than any other method of treatment that has come to my knowledge. Authors who counsel against lavage often argue that Kussmaul, when introducing this method, wanted it employed only for removing stagnating food in cases of gastric dilatation. As a former assistant of Kussmaul I can positively state that this is an erroneous conception of Kussmaul's ideas in regard to the usefulness and availability of gastric lavage. My own experience at his clinic as well as the publications of other pupils (Malbrane, Cahn, Fleiner, etc.), bear witness that Kussmaul made a very liberal use of lavage in all the different disturbances and diseases of the stomach, employing it in atonic conditions to raise the motor and secretory tonus of the organ, and again in irritative disorders to combat gastric intolerance and hyperesthesia. His own first article (74), published in 1867, already reports his method of using lavage as a vehicle for the application of certain drugs and remedies. Furthermore, the argument that lavage is indicated only when stagnation is present should certainly not exclude it in chronic hypersecretion, a condition which is characterized by the stagnation of acid secretion. In fact, the removal of this stagnating fluid forms the most essential part of the

whole treatment. In cases of hypersecretion no other remedy (except surgical interference in given cases) compares in efficiency with lavage, no other treatment relieves pain and vomiting as quickly as the evacuation of the acid contents through the tube. In such cases lavage brings not only prompt and generally complete relief, but has also a decided curative effect. No other harmful influence proves more deleterious in this connection than the constant irritation of the gastric mucosa by the stagnating acid which perpetuates the disturbance. The removal of the acid fluid by lavage eliminates this most harmful influence, facilitates the evacuation of the stomach, and thus greatly reduces gastric secretion both in intensity and duration. In cases of pronounced hypersecretion, with severe pains occurring during the night, which are not sufficiently alleviated by alkalies, atropin, etc., it may become necessary to evacuate by lavage the acid contents of the stomach late in the evening. Patients who have learned to introduce the tube themselves obtain the quickest relief from the usually very severe night attacks by emptying the stomach by means of the tube. As a rule, however, it is far preferable to apply lavage in the morning before breakfast. Its beneficial effect upon the tolerance of the gastric mucosa will make itself felt for the rest of the day. We employ for lavage a weak alkaline solution, one teaspoonful of bicarbonate of soda to one quart of warm water. The natural alkaline waters, like Vichy, Carlsbad, are very useful and beneficial but too expensive for such a purpose.

The beneficial effect of methodical lavage can be enhanced by using remedies which we are accustomed to apply in the treatment of mucous membranes of other organs, principally zinc sulphate and silver nitrate. I was able to demonstrate that these solutions act mainly through their stimulating effect on the secretion of mucus (69). The well-known beneficial effect of silver nitrate was formerly attributed to its power to reduce gastric secretion. My own observations and those of others (Baibakoff, 3) showed that silver nitrate does not necessarily reduce the secretion of gastric juice. In certain cases I found a decided lowering of the acidity after employing silver nitrate. But I have seen more cases in which the acidity remained high; in fact, in some the acidity was higher after treatment than before. And yet these patients were freed from their annoying symptoms by the use of silver nitrate and many of them were promptly relieved from severe pain. Examination of the stomach contents proved that the unmistakable change of tolerance of the mucous membrane to the irritating effect of the acid was accomplished by an increased secretion of mucus. This is particularly valuable in cases which show a lack of mucus (amyxorrhea), when the insufficient covering deprives the mucosa of its protection against the irritant influence of its own acid secretion. This is a condition which often accounts for hyperacidity symptoms in cases with normal or only slightly increased amounts of acid. The power of the silver nitrate to induce an increased secretion of mucus had been demonstrated in Pawlow's experiments (99). It can be turned to advantage as a therapeutic agent in all cases of gastric irritability in which the gastric mucosa is subjected to the irritating effect of its own acid secretion. This applies not only to cases of continuous hypersecretion or gastrosuccorrhea where lavage is indicated for the removal of stagnating acid fluids, but in the same manner to all irritative secretory disorders without stagnation, to plain hyperacidity, etc. The indication

for this treatment is based much more upon the degree of the subjective suffering than upon the objective findings of gastric analysis. When people suffer from severe discomfort and pain they are entitled to the benefits of this treatment, even when gastric analysis shows moderate hyperacidity without stagnation. On the strength of an experience gained by the treatment of many hundreds of cases I can positively state that no treatment more quickly removes all the so-called hyperacidity symptoms than the application by lavage of solutions of zinc sulphate and silver nitrate.

Many of my patients who for some reason or other periodically have attacks of hyperacidity report at the outset for treatment, knowing by experience that when applied at an early period a few applications are often sufficient to quickly reduce the irritability and intolerance of the stomach and that afterwards the treatment by diet and medication yields prompter and better results. When the introduction of the tube is not feasible silver nitrate may be given by mouth, one tablespoonful of a solution of 0.2:100.0, three times a day before meals. The probability of argyrosis prohibits its continuation for long periods. The application by the stomach tube permits the removal of the silver after its action and thereby makes it possible to employ much larger quantities. For the same reason this method of application is preferable to others, for example, by spray as recommended by Einhorn, the more so since the spray apparatus also has to be introduced into the stomach. The silver solution is best applied after a short washing with an alkaline solution; the latter is also used to remove the silver after it has remained in the stomach for a few seconds to one minute. I long ago gave up the sodium chlorid solution, which is usually recommended for washing out the silver nitrate, because I found the sodium chlorid solution very apt to produce nausea and vomiting, which is avoided by using an alkaline solution. When applied through the tube about 300 c. c. are given of a solution of 1:5,000, gradually increasing to 1:1,000. Zinc sulphate is given in the same quantity and concentration. It acts in the same way as the silver, only in a milder degree. As a rule I start the treatment with the weaker zinc sulphate solution, which often suffices to alleviate the condition; if not, it is followed up by the silver treatment. In order to have the solutions come into thorough contact with the mucous membrane it is necessary to apply them on an empty stomach. The best time is in the morning before breakfast. When conditions make it preferable to have the treatment before the other meals a lengthy interval after the previous meal should be allowed in order that the stomach may be empty. The number of treatments depends partly on the severity of the condition, partly on the individual tolerance. With certain patients it is the hyperesthesia, either of primary neurotic origin or the result of continued hyperacidity, which produces the pain or discomfort on the mere contact of food. In such cases a few treatments are frequently sufficient to alleviate the hyperesthesia. In other cases with more pronounced disorders, and particularly when associated with organic changes (gastritis acida, gastrosuccorrhea, etc.), more is required than relief for the moment only. If an attempt is to be made to remedy the condition of the mucous membrane and change its faulty tendencies to secretory disorder, persistent treatment is in order. It may be necessary for a while to give the treatment daily, later, with improved condition, every other day, gradually prolonging the interval, yet continuing the treatment once a week for a considerable period. The subjective feeling of the patient is always a good guide for regulating the duration of the treatment.

Finally, I should mention some of the physical methods employed in hyperacidity.

Hydrotherapy.—Of hydrotherapeutic measures wet compresses around the abdomen, especially the so-called Priessnitz compress, when applied at night often diminish the irritability of the stomach by relieving the congestion of the organ. Severe pain requires hot applications, hot compresses, or hot water bags. In chronic cases with persistently recurring pains the methodical application of flaxseed or mud poultices proves very helpful. Their place may be taken by the electric pad when the facilities of the house permit its use.

Electricity.—Electricity has been recommended in different forms. Our method is anodization of the vagus in the neck to reduce the irritability of this nerve in cases where this plays a prominent rôle in the disturbance. Here in this country intragastric galvanization and faradization have found many followers since Einhorn and others praised their usefulness. In recent years high frequency currents have been more exploited in the treatment of hyperacidity. Opinions in regard to the value of all these methods are divided.

Summary of Conditions in Which Hyperacidity and Hypersecretion Are Observed

The principal methods of treatment have been more fully discussed because of their greater reliability in all the different forms of irritative secretory disorder. To what extent they should come into play depends on two factors; first, on the degree of the disturbance as shown in the objective findings, and, second, on the amount of subjective suffering. The two factors by no means run parallel. We find great suffering with mild degrees of hyperacidity and should advise in such cases the stricter forms of treatment, which are ordinarily employed in the more severe forms of secretory disturbance. In giving a short summary of the various conditions in which hyperacidity and hypersecretion are observed, we do well to keep this in mind.

Hyperacidity.—In not a few cases it is sufficient to eliminate errors in diet and mode of life. When not possible or sufficient, alkalies should be given and a mixed diet arranged, consisting principally of albuminous food, vegetables, and fat, excluding starches according to the state of starch digestion. Patients who habitually suffer from hyperacidity should adhere to the form of diet which proves most suitable; others require dieting only during an attack.

With severe suffering a strict milk diet may be advisable for a number of days. Codein and belladonna should be prescribed according to needs. Very annoying symptoms call further for lavage with zinc and silver solutions and eventually for the use of oil before meals.

Amyxorrhea (*Amyxia*) **Gastrica.**—The latter methods are particularly indicated when lack of mucus is the essential feature. In this con-

dition of amyxorrhea the lack of mucus (with or without hyperacidity or hypersecretion) accounts for the hyperesthesia which is greatly ameliorated by the increase of mucus following the application of zinc and silver solutions. For the same reason other remedies known to increase the secretion of mucus are especially indicated: bismuth, magnesia perhydrol, hydrogen peroxid, etc.

Careful attention should be paid to causative derangements of the nervous system and other etiological factors. When hyperesthesia is caused by anemia iron preparations are in order and helpful, but they are poorly tolerated in ordinary cases of hyperacidity.

Gastritis Acida.—Here hyperacidity is associated with an increased amount of mucus containing cellular elements, which indicates a pathological change in the gastric mucosa. Since this form often leads to the development of atrophic gastritis every effort should be made to remedy the condition by local treatment. This is best accomplished by lavage or by the methodical use of alkaline waters at home or at the spa (Carlsbad, etc.), by the employment of alkalies after meals, by strict dieting along the lines described above, which should be adhered to for long periods, in order to avoid recurrences and to give the mucosa a chance to return to a more normal condition.

We have now to consider secretory disorders when they are associated with motor disturbances.

Hyperacidity with Hypermotility.—When alkalies prove ineffective hydrochloric acid may be tentatively administered with or after meals, conforming with Best and Cohnheim's (7) suggestion. They argue that in these cases hypermotility is the direct cause of hyperacidity, inasmuch as the rapid evacuation of the stomach brings about a high percentage of acids in the comparatively small amount of remaining contents. Hydrochloric acid may have a good effect in regulating the rhythmic activity of the pylorus and antrum pylori, which is lacking and is the actual cause of the hypermotility. The subjective feeling of the patient will immediately tell whether hydrochloric acid has the desired effect of retarding the evacuation and thereby preventing the formation of hyperacidity. If it does not relieve the annoying symptoms of hyperacidity it should be discontinued and alkalies given instead.

Alimentary Hypersecretion.—While the treatment is that of hyperacidity in general, special attention should be paid to the gastric atony, which is the characteristic feature of this group of cases. The atony permits the accumulation of the increased secretion. Food should be selected and prepared with a view of having it pass through the stomach in the shortest possible time. For details the reader is referred to our discussion of dieting given above, but we must discuss the question of fluids here. As a rule it is better to avoid adding fluids without nutritive value to meals, such as water, tea, etc., because they unnecessarily increase the

total amount of a meal. There is, however, no objection to giving meals of fluid food of high nutritive value such as milk, leguminous soups, etc., which have the advantage of quickly leaving the stomach. As a rule these patients are asthenic and underfed, and while it is well to avoid overloading the stomach with a given meal, yet a sufficient amount of carefully selected and prepared food should be given to raise the state of nutrition, which in turn will raise the gastric tonus. A methodical rest cure is often the best form of treatment and should be furthered by hydrotherapeutic measures, massage, and faradization of the abdomen, in fact, by all the methods which will be described for the treatment of gastric atony. Measures intended to directly reduce gastric secretion (atropin, alkalies, etc.) have much less effect here.

Acute or intermittent hypersecretion, coming on in attacks of severe pain and violent vomiting, lasting a few hours or days, may be an early phase or acute exacerbation of chronic hypersecretion, and should then be treated accordingly. When occurring with an otherwise normal stomach it may be caused by over-excitement, fatigue, or tobacco poisoning. It may precede or follow the menstrual period, appear in the form of a gastric crisis of locomotor ataxia, as a syndrome of cerebral tumor, as a postoperative syndrome, and in children as paroxysmal vomiting, probably due to metabolic disturbances.

Between the attacks the individual underlying cause should be made the object of treatment; faulty habits in eating corrected (children); excessive smoking and drinking forbidden; mental overstrain and overworking avoided; all derangements of the nervous system, the pelvic organs, etc., attended to.

During the attack the quickest way of relieving the pain and vomiting is lavage with a weak alkaline solution, repeated several times every four to six hours. If lavage is not possible, alkalies (bismuth, magnesia) should be freely administered every few hours to neutralize the excessive acid. In some cases frequent drinking of moderate quantities of hot (alkaline) water relieves the great strain of retching and vomiting; in others this is accomplished by atropin injections or belladonna suppositories. When all these measures fail morphin injections may become necessary to stop the excessive vomiting and excruciating pains, particularly in cases of locomotor ataxia, cerebral tumor, and other organic affections. In the majority of cases the suggestion of food is impossible and altogether inadvisable. In some cases, however, with an attack running over several days, small quantities of milk with Vichy or limewater, albumin water, or grated hard boiled eggs are tolerated. After the attack the diet should always be restricted for a few days to milk and eggs before the patient gradually returns to his ordinary diet.

Continuous Hypersecretion (*Gastrosuccorrhea; Reichmann's Disease*).—This condition, chiefly characterized by the presence in the fast-

ing stomach of acid secretion, is observed in patients suffering from more or less severe gastric pains coming on regularly several hours after meals, and particularly during the night, and usually associated with vomiting of highly acid matter, often of severe character. Ever since Reichmann (103), in 1882, first described gastrosuccorrhea, an extensive and lively discussion has been going on in regard to the nature of the disturbance, a discussion which is very active at present and which we have to take up briefly, because the treatment depends entirely on the conception which one forms of the pathogenesis of the disturbance. It was the opinion of Reichmann and his followers that the disturbance was in the main a secretory perversion of nervous origin. They explained the presence of acid fluid in the fasting stomach by the fact that the irritative secretory disorder caused a continuation of secretion not only during meals, but also during the intervals when the stomach of a normal individual should be empty. Subsequent investigations showed that increased secretion alone was not sufficient explanation for the clinical picture. The presence of acid fluid in the fasting stomach invariably means stagnation, caused either by spastic or organic obstruction at the pylorus. The writer (68) took part in demonstrating that the clinical picture of continuous hypersecretion meant a motor as well as a secretory disorder, and at present it is generally held that the motor disturbance at the outlet of the stomach is an essential part of the condition.

Indication for Operative Treatment.—This conception of the rôle which the pylorospasm plays in the development of the syndrome is responsible for the advice so frequently given to perform gastroenterostomy in such cases if they do not yield readily to medical treatment.

Formerly I was myself an ardent advocate of early operative treatment, particularly because I convinced myself, like so many others, that gastric and duodenal ulcers are frequently present in cases of gastrosuccorrhea. Lately I have become more conservative in advising gastroenterostomy, since I have had patients return to me with renewed gastric disorders after a period of freedom from discomfort, which impressed the surgeon as having effected a cure. I had to realize that pylorospasm, while an important part of the condition, is only a part of it, and that the secretory disorder must not be underestimated.

Hypersecretion and pylorospasm are closely interlinked, both are at the same time cause and effect of each other. In not a few cases both phenomena are simultaneously provoked by irritation of the vagus nerve, either as a manifestation of an inborn disposition (lately described by Eppinger and Hess as vagotony, 38), or by chronic intoxication (tobacco, etc.), or by reflex action from various centers of irritation. At present there is a tendency to consider, next to gastric and duodenal ulcer, chronic appendicitis and gall-stones as the most frequent centers of irritation and causes of the irritative gastric disorder. This view, which is based on findings at operation, is held by many eminent surgeons,

particularly by William Mayo in this country and by Paterson in England. The facts are undoubtedly correct; the problem, however, which is still to be solved is given in the question, what is cause and what is effect? Opinions regarding gastric and duodenal ulcer have already undergone a change. Formerly considered the most common cause of continuous hypersecretion, they are now described as a result of this disorder. I quote Fenwick (42) who, among medical men, is the most emphatic exponent of the theory "that chronic hypersecretion is not a disease, but merely an expression of an organic lesion of some part of the digestive tract or of those organs that pour their secretions into it." He states that "whatever be the immediate cause of the hypersecretion the continued existence of the latter not only excites inflammation of the stomach and duodenum, but also produces hemorrhagic erosions, which occasionally increase in size and depth and finally acquire all the characteristic features of chronic ulcers. In this manner both gastric and duodenal ulcers are apt to ensue from hypersecretion due in the first instance to gall-stones and appendicitis, while the chronic colitis that develops in so many cases of hypersecretion may eventually lead to inflammation of the appendix." The last part of the sentence shows that Fenwick is inclined to reverse the order not only for gastric and duodenal ulcer, but also for appendicitis. Thus he considers under certain conditions hypersecretion as the cause and appendicitis as its sequel—a view which I fully endorse. Some years ago the author (67) pointed out that hyperacidity and hypersecretion, while often caused by gall-stones, may themselves provoke cholecystitis and gall-stone attacks. Undoubtedly there is a close connection between these various anatomical lesions and the continuous hypersecretion of gastric juice. The question is what is the primary, what the secondary disturbance. With hypersecretion and an anatomical lesion once developed a vicious circle is formed which makes it difficult to answer this question. The finding of the lesion at operation is not sufficient proof that it is the primary factor. I am convinced that the further study of these conditions, particularly in the earlier stages of their development, will demonstrate that in the majority of cases the inborn or acquired disposition to irritative gastric disorders is the primary factor. Taking this view we cannot conceive that surgical interference is an essentially causative treatment of continuous hypersecretion. It is true that during the later stages of the condition the removal of a diseased appendix or a diseased gall bladder may prove very effective treatment, particularly in those cases where the irritation emanating from these centers has become the predominant feature, the elimination of which breaks the vicious circle. Some patients derive a lasting benefit from such operations provided that there is no other center of irritation and that the original underlying cause, the irritability of the vagus nerve, etc., has subsided. In many cases, however, the underlying causes, the inborn

or acquired irritability of the vagus nerve and the tendency to irritative gastric disorders, remain unchanged by the removal of the gall bladder or the appendix, and they are apt to create renewed symptoms when provoked from some other center of irritation, already existing or developing after the operation. If these patients want to remain free from trouble they have to undergo medical treatment for the irritative gastric disorder after the operation and eventually follow it for a long period of time. Now, if these patients submit to a thorough and persistent medical treatment from the beginning, good and lasting results are often obtained and many a contemplated operation becomes unnecessary.

With growing experience I become more and more inclined to first thoroughly try medical treatment along the lines already discussed. I am still in favor of operative treatment when chronic appendicitis or cholecystitis give enough trouble on their own account to warrant surgical interference. And, further, I am still in favor of operations on the stomach in those cases of continuous hypersecretion associated with gastric and duodenal ulcer which do not yield to medical treatment, which have become intractable (cicatricial, pyloric obstruction, etc.), or when the circumstances do not permit of a long continued dietetic and medical treatment. With patients of the laboring class the indication for operative treatment comes sooner than with patients who are in a position to continue the dietetic and medical treatment for a long period of time. In no case have I seen harm result from a thorough and long continued medical treatment. If, on the contrary, such patients finally come to be operated, they are better prepared for it and derive better results. One condition, however, should be clearly understood, i. e., that the medical treatment be controlled by a physician experienced in the handling of such cases.

It is generally stated that certain operations, i. e., gastroenterostomy, yield far better results when done by experienced operators than when done by others. Lockwood (86) figures the mortality in uncomplicated gastroenterostomy performed by a skilled surgeon at from 2 to 3 per cent., by the average surgeon 6 to 8 per cent. We claim a greater difference in the results of medical treatment when directed by the experienced specialist and the general practitioner respectively. The greater experience will prevent the specialist from dallying too long with medical treatment in cases which require operation. He will be able to judge whether his patient is yielding to a carefully laid out treatment with a fair prospect of ultimate recovery, or whether he is dealing with a case which is not amenable to his methods on account of anatomical alterations which call for surgical proceedings. The determination of a proper indication for operative treatment is essentially within the domain of the internist. Certainly he must know the limitations of his methods of treatment, and after carefully weighing the pros and cons in each individual case should not hesitate to hand the patient over to the surgeon when he becomes convinced that his methods do not avail. Yet, while it is certainly unjustifiable to continue unsuccessful medical treatment beyond a reasonable

period of time, it is, on the other hand, just as unjustifiable not to give the patient a fair chance to get rid of his trouble by following conscientiously a strict and prolonged medical treatment. There is still a certain percentage of mortality connected with the operation, and those who recover from the operation are by no means all permanently cured. In those cases with a pronounced tendency to hypersecretion we should particularly keep in mind the danger of peptic ulcer developing in the jejunum after performing gastroenterostomy—to mention only one of the many possibilities connected with operative treatment.

Medical Treatment.—The medical treatment of Reichmann's disease should be strictly enforced in every respect. It should, in the first place, make use of every method known to reduce gastric secretion. The condition represents the most severe type of irritative secretory disorder, complicated with pylorospasm, which greatly aggravates the disorder. In nearly all cases of this type gastric or duodenal ulcer is present, irrespective of the nature of the original cause of hypersecretion. The treatment is therefore based on the same principles as the ulcer-treatment, which best fulfills the most essential indication of setting the stomach and its secretion at rest; in fact, in gastrosuccorrhea we usually have to enforce a strict ulcer treatment for longer periods than in uncomplicated ulcers on account of the complication with pylorospasm.

Whenever the patient can afford it he should stay in bed from two to six weeks. Securing complete rest of body and mind is the safest method of reducing gastric secretion when properly supported by strict dieting and medication. In aggravated cases it may be necessary to start with a few days of exclusive rectal feeding in order to give the stomach a complete rest. After this, or from the beginning, a strict milk diet is in order. Gastric lavage and the methodical use of zinc sulphate and silver nitrate solutions are essential. They should particularly be insisted upon with patients who cannot afford to stay in bed. In these conditions gastric lavage relieves the suffering quicker than any other method of treatment, by removing the irritating gastric secretion. Large doses of atropin should be given for several weeks, when possible hypodermically with patients staying in bed, otherwise internally. Liberal use should be made of bismuth and the different alkalies before meals, after meals, and whenever pain and discomfort call for amelioration. In many of these cases one or two tablespoonfuls of olive oil given before meals proves very beneficial.

This strict form of treatment should be kept up for several weeks, if possible. It is on the whole a difficult matter to lay down exact rules and figures in regard to how long a patient should stay in bed, how long he should keep up lavage, how long he should continue the use of atropin, when he should change the diet, etc. It is wiser not to determine upon these points beforehand but to be guided by the symptoms and by the run

of the case. In any event it is best to proceed slowly. The longer the period of comparative rest the better the prospect of keeping the secretory disorder subdued. Before we can let up on the strict treatment the patient should have been entirely free from all discomfort for some time, the fasting stomach must contain no acid fluid, and the stools must be free from occult blood.

He must further remain free from all these symptoms when with a steady improvement we gradually drop the atropin and lavage, and carefully add to the diet list. Alkalies should always be continued for a long period of time. It is often very beneficial to give natural alkaline waters (Vichy, Carlsbad, etc.) methodically in the morning after lavage has been stopped, or, instead of lavage, when it is altogether omitted.

In regard to the diet we should gradually add eggs, meat-free soups made of leguminous and similar flours, vegetable purées, etc., following the rules given in the above discussion on diet in hyperacidity, to which we must refer for details. The leading idea is to select food which is prepared in such a way that it quickly leaves the stomach without making much demand on secretion. We should always proceed slowly, trying one kind of food at a time and so finding out whether it agrees with the patient. With cases of long standing I prefer to have the patient stick to the milk-egg-leguminous soup diet for a long time. It is an erroneous idea that such a diet does not offer enough nutritive material. These patients are usually highly emaciated and the loss of weight is caused by the hypersecretion, by the pains, and most of all by the sleepless nights. As soon as all these symptoms disappear under the treatment described above such patients thrive even with a plain milk diet, so that I have seen them gain 20 and 25 pounds within a number of weeks.

As a rule we are dealing here with cases of long standing and it is essentially a question of persistency whether the improvement gained during the first period of strict treatment will be a lasting one. Among my present patients there is a physician who came to me eight months ago with all the symptoms of gastrosuccorrhea and from the first pronounced stagnation of food, indicating that there was probably more than a mere spastic obstruction of the pylorus. His own personal experience made him very chary in regard to gastroenterostomy and he preferred to try a long continued medical treatment, not minding how long it would take. With lavage, silver nitrate treatment, and the use of alkalies he lost all subjective and objective symptoms, and, although from the start attending to his practice, which keeps him active from morning till night, he has gained 25 pounds on a diet consisting of milk, eggs, leguminous flours, and vegetable purées, a diet to which he is only now occasionally adding chicken or fish. I could write of a long series of similar cases. When such people have the patience and persistence necessary to adhere to the diet and treatment laid out for them, and have periods of more active treatment again when symptoms of irritation recur, they not only lose the symptoms of pyloric obstruction but the tendency to hypersecretion as well. Of course, there must be a pronounced tendency to steady improvement if we are to continue with medical treatment, otherwise we have to consider operative interference.

GASTRIC ULCER

We discuss gastric ulcer in connection with the irritative secretory disorders because for all practical purposes the treatment of ulcer is essentially that of hyperacidity and hypersecretion. In the foregoing chapter we have already dealt with continuous hypersecretion as one of the forms under which gastric ulcer presents itself. In another group of cases the presence of ulcer creates merely symptoms of hyperacidity. Whatever ideas one may harbor in regard to the pathogenesis of gastric ulcer there can be no doubt but that the irritative secretory disorder plays a prominent rôle here. Whether the secretory disorder is the underlying cause of the whole process or merely accompanies the formation of the ulcer, its presence is responsible for the development and the chronicity of the ulcer and its successful treatment is a *conditio sine qua non* for a permanent cure of the ulcer. The treatment of hyperacidity and hypersecretion means prophylactic treatment of the ulcer. We do well to keep this in mind when the advent of hemorrhage (either in occult or profuse form) has manifested the presence of the ulcer. Erosions and ulcers, when uncomplicated, have a tendency to heal under appropriate treatment, but new ulcers are liable to develop on the same basis unless the irritative secretory disorder is properly attended to. The inclination of patients and physicians to attend to this indication thoroughly and for longer periods after a very profuse hemorrhage probably accounts for the fact that many of the cases who once experienced severe hemorrhage get a good final result. On the other hand, many a failure after operative treatment is caused by the disregard of the secretory disorder, the patient being made to believe that the new opening will permit him to indulge in forbidden fruit to his heart's content and will make him immune against harmful influences of every kind. Before and after operations, no matter what form of ulcer we are dealing with, latent forms, or those with manifest symptoms of hemorrhage, of pyloric obstruction, etc., we should never forget that the irritative disorder is a factor which has to be eliminated if we want to obtain lasting results. All these patients suffer from a tendency to irritative gastric disorder, and it should therefore be a general principle to clear up for each individual case the causative factor of the gastric irritation and arrange accordingly his mode of living, dieting, and medication. For further details we refer the reader to our elaborate general discussion of these points in the chapter on the treatment of hyperacidity. We now turn to the treatment of the incidents which occur with the development of the ulcer and discuss first gastric hemorrhage.

Gastric Hemorrhage

When occult bleeding, as first described by Kuttner (76), later by Boas (20) and others, indicates the presence of erosions and ulcerations in cases which are suspected of ulcer on account of hyperacidity, hypersecretion, and other symptoms, it is always a wise proceeding to put such patients to bed, restrict their diet to milk or milk and eggs, and have them undergo in a somewhat milder form that treatment which we shall describe for cases with manifest hemorrhages in the form of more or less profuse hematemesis and melæna. In thus giving erosions and ulcerations a chance to heal during the earlier stages of their development such a timely treatment means true prophylaxis in that it prevents the occurrence of profuse hemorrhages with a further development of the ulcer. Particularly with patients who have already experienced large hemorrhages the demonstration of occult bleeding should always form an immediate indication for a rest cure in bed with strict treatment in order to prevent the occurrence of profuse bleeding. The examination of the feces for occult bleeding, when performed under the necessary precautions, serves as an excellent guide in following up these cases. Its result must be negative for a number of days before we can let up on the treatment, that is, before we can allow the patient to get up, to enlarge his diet list, etc. In cases with occult bleeding the rest cure is usually of shorter duration than in cases with more pronounced hemorrhage. On the whole, however, the treatment should be conducted along the same lines; naturally it has to be more strictly enforced and followed up for longer periods in cases with profuse hemorrhage. It should further be stated that the principles of treatment are essentially the same in cases of so-called acute ulcer as in chronic ulcer.

Manifest Gastric Hemorrhage[1]

The treatment of fresh hemorrhage should have as its paramount object the cessation of the bleeding and should then direct all its efforts toward preventing a recurrence of the bleeding. This is best accomplished by securing complete mental and bodily rest. The patient should be kept strictly upon his back with an icebag on the epigastrium to control the movement of the stomach and facilitate its contraction. With severe hemorrhage it is often necessary to have the patient keep the same position for days in succession. A full dose of morphin and atropin at repeated intervals greatly helps to quiet the patient and at the same time makes it easier for him to stand the fasting of the following days. It is essential

[1] Part of this chapter is taken from an article by the author: "The Treatment of Hemorrhage from Gastric Ulcer" (70).

to give the stomach absolute rest by abstaining from nourishment. With profuse hemorrhage it is usually better even to omit rectal feeding during the first few days, because nourishing enemata may provoke gastric peristalsis and are said to stimulate gastric secretion (Umber, 131). For the same reason the customary taking of ice pills should be forbidden. We must remember that with any functional activity of the stomach a freshly formed thrombus may easily be dislodged or dissolved. The danger arising from such an accident is certainly greater than the danger from starvation.

In the majority of cases the bleeding comes to a standstill during such a period of complete rest. Unluckily physicians are often inclined to give too much active treatment and disturb rather than assist the natural tendency to thrombus formation. In dealing with gastric hemorrhages we find it necessary to point out the dangers connected with various methods of treatment, which are sometimes greater than the danger from the hemorrhage itself. Often the advent of hemorrhage frightens not only the patient, but the physician as well. The physician, however, should remember that fatal hemorrhage from gastric ulcer is comparatively rare, probably not more than 1 to 3 per cent. of the patients dying during hemorrhage. This is shown in statistics of men who personally have followed a large series of ulcer cases (Fenwick, 43; Leube, 137; Ewald, 40; Jacoby, 64; for further statistics see 4 and 84). The physician does well to keep this in mind, particularly when confronted with hemorrhage of a severe type. With moderate hemorrhages the immediate danger to life is not great, although they may become dangerous when often repeated, thereby gradually undermining the vitality of the patient. The special indication for treating surgically cases with repeated bleeding will be discussed later on. Since we are dealing here with the *direct* treatment of active bleeding I merely want to point out that moderate hemorrhages have a natural tendency to stop. The same tendency is observed in cases with very profuse bleeding. The severe anemia resulting from the sudden great loss of blood brings about changes in the system which, if undisturbed, of themselves tend to arrest the bleeding. The vasoconstriction which goes with the advent of sudden anemia and with syncope allows the bleeding vessel to contract, and the low activity of the heart permits the formation of a thrombus.

The formation of a thrombus is particularly necessary in those cases of chronic ulcer "where the eroded artery lies like a rigid pipe in the fibrous wall of the ulcer, and being unable to contract can only become occluded by the process of clotting" (Fenwick, 43). When the clotting is not quickly and efficiently accomplished such patients may bleed to death very rapidly. A post-mortem examination may show that the ulcer, after penetrating through the whole gastric wall, had eroded a larger branch of the arteria pancreatica or lienalis, or one of the main

arteries itself. The finding of the anatomical conditions demonstrates that probably no medical treatment could have checked the bleeding and, on the other hand, leaves it often very doubtful whether surgery could have accomplished it. Owing to the rapid course in most of these cases we usually find the patient so exsanguinated that the result of an operation becomes very problematical, especially when we consider the great difficulties that are often met with even post mortem in trying to locate the bleeding. We must remember that excessive bleeding not only originates from eroded arteries at the base of the ulcer, but also from ruptured veins around the ulcer, or from minute erosions at distant points, so that even resection of the ulcer may fail to remove the source of bleeding. Without denying the possibility of checking the bleeding by surgical means the conditions present are, as a rule, unfavorable for a successful operation. We must therefore resign ourselves to the fact that a certain number of cases are lost, no matter what treatment we may try. Luckily these cases are not frequent, as we learned from the small total percentage of fatal hemorrhages already stated.

In dealing with excessive hemorrhage we should not be influenced too much by such experiences. We do far better to base our plan of treatment on the knowledge of what actually happens when the bleeding comes to a standstill. As we have argued before, it is either vasoconstriction or the formation of a thrombus which brings about hemostasis, both processes developing with the effect of anemia and the weakened action of the heart. Nothing seems, therefore, more out of place than the routine treatment usually met with, which directs all efforts toward overcoming the depressed condition of the circulation. The attempt to strengthen the weakened heart by administering heart tonics, infusions of salt solution, etc., is greatly overdone by most physicians, in fact, it dominates as a rule the whole plan of treatment. When the desired effect of energetic stimulation has been reached, the vigorous action of the heart will eventually result in freeing a freshly formed thrombus and thus cause a renewal of the bleeding. Since the continuation of the bleeding forms the main danger of such situations, it is obvious that energetic stimulation may increase the danger by bringing about exactly what we should try to prevent. It is therefore unwise to resort indiscriminately to vigorous stimulation. We should be very reluctant with stimulation, employing it only in case of stern necessity, and even then cautiously and judiciously. We are all the more justified in abstaining from energetic stimulation, as general experience teaches that most cases with profuse hemorrhage, when not ending fatally on account of uncontrollable bleeding, overcome anemia and disturbance of circulation surprisingly well.[1] I could quote a number of

[1] It may sound paradoxical, yet it is a fact that just those cases of chronic ulcer, which at one time or other have a very profuse hemorrhage, give the best end results both in regard to the palliative and the curative treatment of the ulcer.

instances which confirm the experience of other observers that such patients recover from apparently hopeless conditions once the bleeding has come to a standstill. Since the stoppage of the bleeding is the paramount issue of the situation we should avoid disturbing it by undue stimulation. Physicians of a former generation actually performed venesection when confronted with uncontrollable hemorrhage, expecting to have the bleeding stopped by the resulting syncope and its effect upon the circulation. I saw my teacher, Kussmaul, successfully carry out this principle in a case of extreme hemoptysis. We find the same principle in another method, which, less heroic than venesection, tries to imitate its effect by applying elastic ligatures to the four extremities, thus causing anemia of the internal organs by the accumulation of great quantities of blood in the limbs. This method has been successfully employed in cases of severe gastric hemorrhage. Thus we see that methods which for a time depress the circulation and lower arterial pressure permit the formation of a thrombus and are therefore of greater advantage than heart tonics and vasoconstrictors.

When the thrombus is not formed and hemorrhage continues, the question arises: "What can we do to check the bleeding?" The general tendency is to give local treatment aimed at stopping the hemorrhage.

Drugs

Of the many remedies employed for that purpose the so-called *styptics* (*acetate of lead, perchlorid of iron, oil of turpentine, tannic acid,* etc.) are very unreliable hemostatics, while, on the other hand, they are apt to increase the ever present and annoying nausea and excite vomiting. The same must be said for the internal use of more modern preparations like *ergot, gelatin, escalin,* and others.

Escalin.—Escalin (*aluminium glycerin paste*) was introduced and highly praised as a local hemostatic by Klemperer (72). Others counsel against its use on account of the bad results which they have observed. All these preparations when given per os are just as likely to cause nausea and vomiting as to stop the hemorrhage.

Ergot.—Neither have I ever seen any benefit from ergot given hypodermically, which, when given in sufficient quantity, acts as a circulatory stimulant and is as such contraindicated for the reasons given above.

Gelatin and Calcium Chlorid.—As for the results derived from *gelatin* preparations, when given per os and per clysma, the reports are very doubtful, and given subcutaneously it may cause tetanus unless the preparation is absolutely reliable. As several days are required to obtain a freshly sterilized preparation it is likely to arrive too late. Since the styptic effect of gelatin is attributed by many to the calcium which it contains, *calcium chlorid* has been recommended in its stead, best admin-

istered by clysma, 10 to 20 gm. (2½ to 5 dr.) of a 5 to 10 per cent. solution every two hours (Boas, 17). Calcium chlorid can do good only after absorption by rendering the blood more coagulable, and when given in full doses may prove of value in cases with repeated hemorrhages. But its action is slow and it will hardly exert any influence in profuse bleeding.

Adrenalin.—Adrenalin has the great disadvantage that the vasoconstriction produced by this drug is followed by a period of vasodilatation which may eventually cause a renewal of the hemorrhage. Still it may prove effective when a thrombus becomes sufficiently fixed before the time of secondary vasodilatation.

Serum Treatment.—The serum treatment of hemophilia does not promise much for gastric ulcer cases where severe bleeding is usually caused by erosion of a blood vessel.

Bismuth.—The most reliable of the internal remedies is bismuth, which has been extensively employed in the treatment of gastric ulcer since Kussmaul and Fleiner's recommendation (46, 47). The crystalline bismuth subnitrate is preferable because, as Matthes (90) has shown, this salt sticks to the surface of the ulcer, accumulates there, and by making a protective coating for the ulcer allows the blood to agglutinate to the bismuth mass. While not sufficiently astringent to cause constriction of the blood vessels bismuth aids in the coagulation of the blood and at the same time is soothing to the stomach. Thus its effect is opposite to that of the more active astringents. Bismuth should be given in large doses (1 to 2 teaspoonfuls) in every case. It acts best, however, when administered after the stomach has been cleaned out by lavage.

Naunyn (96) reports a case in which lavage of the stomach, followed by the administration of bismuth, stopped a profuse gastric hemorrhage; but the patient, who at the same time suffered from excessive diarrhea, died. Autopsy showed that the ulcer was filled by a clump of bismuth about 20 gm. in weight, almost the total amount taken before death. This experience, which demonstrates the efficient action of bismuth when the stomach is previously emptied by lavage, leads us to the discussion of the method which I consider of greatest importance in the control of gastric hemorrhage, namely,

Gastric Lavage

Since I first saw lavage performed in cases of bleeding ulcer at Kussmaul's clinic more than twenty-five years ago, I have employed this treatment in a series of cases of profuse hemorrhage, in almost every case with favorable result. I have no hesitation therefore in recommending gastric lavage as the most expedient means in the treatment of severe hemorrhage, provided it is carefully applied.

As I am well acquainted with the aversion which most physicians harbor against this procedure I shall discuss the pros and cons in detail. The most

frequent objection raised against lavage is that it may cause perforation. Perforation, however, only takes place after the ulcer has penetrated the different layers of the stomach and has led to necrosis of the serosa. This is evident when we examine the anatomical features of the opening. As a rule the opening is small and circular, showing the defect produced by necrosis. I have found this condition in a case that I reported (68) in which perforation set in one hour after the stomach was washed in order to prepare the patient for the previously planned gastroenterostomy. The same condition was found in similar cases. To my knowledge nobody has ever reported that the perforation opening was a lacerated tear through non-necrotic tissue, a finding which would prove that the perforation was a direct result of lavage. This, too, could occur only by forcibly overdistending the stomach with a great quantity of water, a possibility which we may well ignore if ordinary precautions are observed. With lavage carefully performed the danger of causing perforation by overdistention is out of the question. On the contrary, lavage exerts its greatest benefit by doing away with the real cause of overdistention, by removing the large quantities of accumulated blood, acid secretion, food remnants, and gas which are usually present in such cases, often producing an enormous distention of the stomach. We can therefore dismiss the objection that gastric lavage may cause perforation. If it should happen incidentally that lavage is undertaken just before the threatening perforation actually occurs the cleaning of the stomach will prove very beneficial in preventing the escape of stomach contents through the perforation, thereby greatly improving the prognosis. In my case, cited before, the good result obtained by resecting the perforated ulcer must to a great extent be credited to this fact. It is well known that the prognosis is better when perforation takes place at a time when the stomach is empty.

A further objection to lavage is that it disturbs the complete rest of the stomach, which, as we have seen before, is essential in order to firmly secure the freshly formed thrombus. This is perfectly correct, when the hemorrhage has ceased and we may assume that an efficient thrombus has been established. However, conditions are altogether different when the bleeding continues, because then either no thrombus has developed, or, if formed, it does not completely fill the opening of the vessel. We know from general surgical experience that such a partially occluding thrombus is often the cause of continued bleeding. The removal of such inefficient thrombi is not only not dangerous, but on the contrary it is a necessity in order to give the bleeding vessel a chance to contract or to form a more efficient thrombus. From what I have seen this explanation holds true for gastric hemorrhage, because I have observed in several instances that the bleeding ceased suddenly during the act of lavage. This shows how unjustified is the traditional rule handed down in all text-books, that lavage is absolutely forbidden in gastric hemorrhage. It should certainly not be condemned in such general fashion, because lavage may prove the best procedure to stop the bleeding.

Finally comes the objection that the introduction of the tube is difficult and exciting for the patient. When lavage is given by a physician experienced in this method he will overcome the difficulties in inserting the tube, particularly when he wins the patient's confidence by his assurance.

As a rule I have been able to insert the tube even with the patient lying on his back without causing excitement or great exertion. It is advisable to insert the tube just far enough to secure siphonage and to limit the quantity of water used each time to about 300 c. c.

As for the advantages of lavage, I have already mentioned the release of partially occluded thrombi. A further very striking advantage is the benefit of

lavage when the stomach is distended by large quantities of contents. These stagnating masses are usually very sour and fermenting, and their presence not only causes nausea and pain, but acts very harmfully by constantly irritating the mucous membrane to intense hypersecretion, thereby further increasing the amount of gastric contents. Again, the fermentation always connected with such conditions invariably leads to pronounced and sometimes to enormous gas distention of the stomach, so that when the tube is introduced the contents shoot out at high pressure, even, as I have experienced, with an explosive sound. It seems hardly necessary to explain how detrimental such a distention is in every respect. No doubt it is frequently the direct cause of the continuation of the bleeding. The removal of the fermenting masses not only relieves annoying symptoms of gastric irritation, but eventually brings about a direct cessation of the bleeding by allowing the emptied vessel to contract and this aids in the occlusion of the eroded vessel. The evacuation of the stomach and the contraction which follows it are of the greatest importance for the improvement of circulatory disturbances. I have seen cases of gastric hemorrhage in which the pronounced symptoms of insufficiency of the heart were due in part to anemia, but to a much greater extent to the pressure of the gas-distended stomach against the diaphragm and heart. In these cases circulation was at once improved when the stomach was emptied, while the anemia remained unchanged. I had a very instructive case of this type fourteen years ago. The patient was a woman aged thirty years. After excessive gastric bleeding the pulse rose to 160, became fluttering, and the heart action was so weak and irregular that several physicians connected with the case considered her at the point of death. The stomach was full and so distended that it almost reached the level of the axilla. After the stomach was emptied the pulse rate immediately came down to 116, the heart action became stronger, and the patient recovered.

The understanding of such conditions has been greatly advanced by the recent study of acute gastric dilatation. Acute gastric dilatation is frequently associated with gastric hemorrhage. It is generally admitted that the most rational and the most effective treatment of acute gastric dilatation is promp evacuation by lavage. This holds true for cases of acute dilatation in connection with hemorrhage. I hope that this discussion will encourage physicians to resort more frequently to lavage in gastric hemorrhage than heretofore.

Of the cases of severe gastric hemorrhage which I have successfully treated by lavage I wish to report as an illustration one which is particularly interesting. The patient, aged thirty-nine years, had suffered for sixteen years from the gastralgic form of chronic ulcer without hemorrhage. In June, 1906, an abscess in the pyloric region was opened, the gall-bladder was found normal, and it is probable that the abscess had formed after a perforation of the ulcer. Soon after the operation severe gastric symptoms recurred with evidence of pyloric stenosis. Since these symptoms persisted in spite of prolonged medical treatment we advised operation. In June, 1907, Dr. Willy Meyer performed a posterior retrocolic gastroenterostomy by means of sutures. At the pylorus a hard mass was found, producing partial obstruction. Eight hours after the operation hematemesis set in, which in the following twenty-four hours recurred five times, causing such a very great loss of blood that the condition of the patient became alarming. We decided to evacuate and

wash the stomach. At first we obtained large quantities of dark bloody material; then the washings became bright red, showing that the bleeding was still active, when suddenly the water returned clear. Before withdrawing the tube a large dose of bismuth subnitrate was poured into the stomach. The bleeding ceased and an uninterrupted convalescence was followed by a perfect cure.

Surgical Treatment

In the case cited before, gastric lavage stopped an attack of severe bleeding which followed a gastroenterostomy, an interesting fact, when we consider that surgeons advise this operation to check excessive hemorrhage. Nor is this experience anything unusual. A number of surgeons in this country and abroad have reported the occurrence of severe hemorrhage following gastroenterostomy. I mention Mayer (92), Busch (26) (reporting from Körte's clinic), Clairmont (30) (from von Eiselsberg's clinic), and others. Kocher (73), in discussing his own similar experiences, confirms Clairmont's view, that the possibility of causing a hemorrhage forms one of the main dangers of gastroenterostomy, because in certain cases this operation not only fails to stop the bleeding, but on the contrary it may be the direct cause of its occurrence. Kocher therefore advises more radical operations like excision of the ulcer, etc., whenever possible.

In contemplating operative measures we should distinguish more clearly between operations performed for the purpose of perfecting a final and complete cure of the ulcer and those operations which are undertaken for the immediate control of hemorrhage. We shall later on discuss the advisability of radical operations in cases in which the ulcer, not yielding to medical treatment, causes frequent hemorrhages, and thereby greatly undermines the vitality of the patient. In such cases, however, it is decidedly better not to operate at the time of acute bleeding. Here the purpose of the operation is not to check a given hemorrhage, but to prevent the recurrence of bleeding. The radical operation necessary to accomplish this certainly promises better results when performed after the patient has recovered from a hemorrhage. On the other hand, when an operation is undertaken for the very purpose of checking the hemorrhage, it has to be done while the bleeding is active. This surgical indication naturally arises only with very profuse hemorrhages. Unfortunately just in these cases in which we should expect most success from the operation the conditions as a rule are such that the operation forms a greater danger than the hemorrhage itself. I have already pointed out the fact that, with the rapidly developed exhaustion of these patients, a prolonged operation must become a hazardous experiment. If we want to be reasonably certain of accomplishing anything at all we must under-

take radical, that is prolonged, operations. The quickly performed gastroenterostomy does not answer; it is, as we have seen before, entirely unreliable. As Deaver states, gastroenterostomy in acutely bleeding ulcers is worse than useless. Prolonged operations, however, are decidedly more dangerous, the percentage of mortality after radical operations being considerably higher than after gastroenterostomy, particularly when the operation is undertaken under the unfavorable conditions resulting from excessive hemorrhage. When we further consider that even a radical operation does not always succeed in checking the bleeding we cannot conceive that this uncertain and risky procedure lessens the danger of the situation. On the contrary, in profuse hemorrhage the patient stands a better chance of recovery if treated in the conservative manner above described. It is not probable that radical operations undertaken at the time of the bleeding will reduce the 3 per cent. mortality usually observed in excessive gastric hemorrhage.

Medical Treatment

We should try, however, to reduce the mortality by improving the methods of medical treatment.

In this connection I wish to plead once more for the frequent employment of gastric lavage as a direct means of checking the bleeding. It is certainly not superfluous to emphasize the advisability of gastric lavage, when we realize that now-a-days physicians can be more easily persuaded to perform a laparotomy than to use the stomach tube. At all events lavage should be tried before an operation is decided upon. While it can do no harm, lavage will frequently check the bleeding and postpone an operation, which may prove necessary for other reasons. I have no doubt that the good results derived from lavage will do away with the deeply rooted prejudice against using the tube in bleeding ulcer.

When the bleeding has come to a standstill all efforts should be directed toward preventing a recurrence. This necessitates absolute immobilization of the patient for several days, eventually prolonged according to the severity of the case. With profuse hemorrhage the patient should not change his position for many days, and he should be forbidden to sit up when he wants to urinate or defecate.

The ice bag or an ice coil on the epigastrium should be continued as long as it is well tolerated and comforting. It is usually more effective when applied intermittently. It should never be too heavy, and, if it annoys the patient although light, cold dry compresses may be applied instead.

Nutriment.—The more profuse the hemorrhage the longer should the patient abstain from taking anything by mouth. In cases of very profuse hemorrhage it may be advisable to even abstain from *nutrient enemata*

until one feels reassured that no further bleeding is threatening. The feeling of hunger is usually relieved by morphin and becomes blunted within a few days. When thirst becomes very annoying saline enemata may be given, about 5 to 6 ounces every four hours. Later on they may be given alternately with nutrient enemata. In order to avoid irritation of the bowels nutrient enemata should not be given more often than three or four times during the day at intervals of four hours. During the night the patient should not be disturbed.

One hour before the first nutrient enema is given in the morning the bowels should be cleansed by thorough but gentle lavage of the colon with normal saline solution or with a weak alkaline solution (about 1 teaspoonful of bicarbonate of soda to each quart of water). One must avoid the so-called high enema with large quantities of water, which unnecessarily distends the intestine and causes irritation and, better, wash the bowels in the same manner as gastric lavage is given, evacuating the rectum and the higher portions of the large intestine by a number of repeated irrigations, each of which should not be in excess of one quart of water at a time. When successfully carried out one cleansing irrigation is sufficient for the day. There is no indication for repeating the cleansing before each nourishing enema, as is so often advised. Each procedure of that kind means a disturbance for the patient and, furthermore, the frequent cleansing interferes with the absorption of the nutrient enemata. In case a nutrient enema causes irritation of the rectum with gas distention and pain it is usually sufficient to let the rectal contents pass through a tube, which is inserted into the rectum, and to make the interval before the next nutrient enema is given longer. When the contents show pronounced putrefaction it is necessary to cleanse the colon thoroughly by lavage and then omit nutrient enemata for twenty-four hours, eventually altogether. In order to avoid irritation of the rectum it is in the first place necessary to have the nourishing enemata composed of substances which are non-irritating and to eliminate those which become irritating by undergoing fermentation.

Alcohol, particularly when given concentrated in the form of whiskey, as is usually done in this country, is liable to irritate and should be avoided. Spiro (119) demonstrated that all drinks containing 7 to 10 per cent. of alcohol when given per rectum provoke an abundant flow of gastric secretion. This is another reason for not using alcohol with nourishing enemata. For the same reason proprietary peptone foods, all of which contain alcohol, are not suitable. Otherwise peptones and albumoses are most suitable ingredients; unchanged albumin (for example, native egg-albumin) is not readily absorbed and often undergoes putrefaction and becomes irritating. Peptones and albumoses are quickly absorbed, and these are not irritating provided they are not given in large quantities. As S. Lambert (78) puts it, "all albuminous food—eggs, milk, and meat

broths—should be predigested to a degree of complete peptonization by means of pancreatic extracts and bicarbonate of soda. There is a widespread habit in practice of using this peptonizing process only for milk, and of adding to it only the preparations of meat-peptones which are on the market. The freshly prepared peptonized broths and eggs are as easily made as is peptonized milk and leave no uncertainty as to the amount given."

Meat broth, milk, and eggs are used in different combinations with saline solution and with an addition of sugar or amylum. Amylum is recommended by Ewald (41), Boas (16), and others, and is said to be less irritating than sugar. But since amylum has to be converted into sugar before it can be absorbed it seems better to give sugar right off, preferably grape sugar, because all sugar has to be changed to grape sugar before it can be used in the economy of the system. The concentration of the grape sugar solution should not exceed ten per cent. (of the total amount of fluid used in the enema); higher concentrations easily irritate the rectum and cause diarrhea.

Ewald (41) recommends the following formula: 2 tablespoonfuls of amylum mixed with 150 c. c. of lukewarm water or milk, to which are added one to two eggs, 50 to 100 c. c. of a 15 to 20 per cent. grape sugar solution and a pinch of salt. Boas' (16) formula is the following: 250 gm. of milk, yolks of two eggs, 1 tablespoonful of red wine, 1 tablespoonful of amylum, and a pinch of salt. Leube (134) gives a number of modifications: (a) 250 c. c. of milk and 60 gm. of peptone; (b) 250 c. c. of milk, 3 eggs, 3 gm. of salt; (c) 250 c. c. of milk, 60 gm. of amylum; (d) 250 c. c. of milk, 60 gm. of grape sugar.

I usually proceed in the following fashion: First, I give plain saline enemata. I then add one tablespoonful of a concentrated grape sugar solution to each enema, gradually increasing the dose to two and three tablespoonfuls. When the first grape sugar solution is well tolerated I add one, later two, eggs, meanwhile changing the medium by using meat broth instead of saline solution, or taking half of each, or substituting peptonized milk for both fluids. The total amount of the enema, at first five to six ounces, may gradually be increased, but not beyond 8 ounces for each of three enemata in 24 hours. Such a maximum enema may contain 6 ounces of milk (or meat broth and saline solution), two eggs, and two tablespoonfuls of concentrated grape sugar solution. The addition of five to ten drops of tinctura opii greatly lessens the irritation. I abstain from quoting further formulæ given by different authors. We have to try in each case which of the above ingredients is best tolerated and should rearrange the combination according to the individual tolerance.

Von Leube's meat-pancreas enemata are rarely given nowadays. Pancreas preparations, however, are again recommended to facilitate the absorption of cream which some authors (Meyer, 93; Baum, 5; Strauss) add to the nutrient enema. On the whole, fats are poorly absorbed by the rectum.

That the skeptical attitude on the part of many physicians in regard to rectal feeding is unjustified was lately demonstrated again by exact experimental work done by Gompertz (53) in Lafayette Mendel's laboratory in New Haven. Gompertz found that the rectum is capable of absorbing water, sodium chlorid, and dextrose, and that these substances when absorbed are helpful in nourishing the body and supplying fluids and salts to the tissues. Enemata composed of water, sodium chlorid, and dextrose are thus proved to be rational and, although inadequate for continued nutrition over any considerable time, they are useful in preventing the untoward effects of complete starvation while nothing is taken by mouth. When applied by the Murphy-drip method, one to two quarts of normal saline plus 5 per cent. dextrose solution may be absorbed within 24 hours.

When nutrient enemata are not tolerated at all and we wish to prolong the starvation period some nutritive material can be given hypodermically. Lately W. Kausch (71) and others have been adding 50 grams of grape sugar to a quart of normal saline solution, giving this by hypodermoclysis. It provides a sufficient amount of fluid, which some authors consider the most essential feature of rectal alimentation, preferring to use only saline enemata instead of full nourishing enemata. When nourishing enemata undergo putrefaction and irritate the bowels we have to be satisfied with giving only saline solution (eventually plus grape sugar) either by rectum or hypodermically. When, however, full nourishing enemata are well tolerated and absorbed, as is often the case, they are of great assistance in the management of gastric hemorrhage and with gastric ulcer, not only during the period of exclusive rectal feeding, but also later on when feeding by mouth is taken up. Usually at first only very small quantities of food are given by mouth, and therefore it is advisable to continue rectal alimentation for a number of days, gradually decreasing the number of nutrient enemata as the amount of food taken by mouth is increased.

The period of exclusive rectal feeding differs; in cases of moderate bleeding one, two, or three days may be sufficient; after profuse hemorrhage it is decidedly better to continue rectal feeding for five to eight or ten days, and even longer when nourishing enemata are well tolerated and absorbed. It is true that the amount of food which can be given by rectum and the amount of it which is absorbed are not sufficient to maintain a nutritive equilibrium, but in cases with profuse hemorrhage the danger of starvation is considerably less than the danger of uncontrollable bleeding. We should further consider that during the enforced complete rest a comparatively small amount of nutritive material is required. Naturally one should not have fixed rules in regard to the period of exclusive rectal feeding. We have to be guided by the state of general nutrition and by the condition of the pulse. It is certainly unjustifiable to continue with

exclusive rectal feeding when a patient is greatly underfed and keeps on showing signs of weakened heart action. On the other hand, it is just as unjustifiable to generalize on the method of Lenhartz, who abstains altogether from rectal alimentation and gives food by mouth within the first twenty-four hours after the hemorrhage. Reports to the effect that early feeding by mouth according to the Lenhartz method is apt to cause a recurrence of the hemorrhage and so violate the most important indication, that of preventing further bleeding, are becoming more numerous. Bamberger (4), in summing up, states very correctly that the Lenhartz method of feeding by mouth immediately after the advent of hemorrhage is a risky undertaking. The fact that it was employed in many cases without causing renewed and fatal hemorrhage does not prove anything against the danger connected with early feeding, but merely corroborates the finding of general statistics, that even profuse hemorrhages have often a tendency to come to a standstill. Most physicians who have taken up and reported about the Lenhartz treatment realized its danger and modified it by letting one, two, or three days pass before starting it. We are confronted here with two dangers, that of fatal hemorrhage and that of starvation. The mistake is not any smaller if we overestimate the one instead of the other. As always in such situations we have to judge each case on its own merits and act accordingly instead of strictly following the same method for all cases, which is not any more recommendable for the Lenhartz method than for any other. When, in carefully watching a case, we observe that the starvation period is well tolerated, that nutrient enemata are absorbed without causing discomfort, that the general condition and circulation remain comparatively good, then it is certainly to the advantage of the patient to continue exclusive rectal alimentation for a period stated above as suitable for the individual case.

In breaking entirely with the usual period of starvation and rectal alimentation Lenhartz (80, 81, 82) and his pupil Wagner (138) put forward a number of reasons which induced them to plead for the advantages of early feeding by mouth. In the first place, they claim that early feeding is imperative, because only with improved nutrition has the ulcer a chance to heal, and it takes a liberal amount of suitable food to raise the state of nutrition in these anemic patients, who are often greatly exsanguinated. But it is not only the state of nutrition that is said to be of importance. According to Lenhartz, food given immediately after the hemorrhage has the great advantage of binding acid secretion, and thus preventing it from dissolving a freshly formed thrombus and from irritating the ulcer. Lenhartz further maintains that early feeding prevents distention of the stomach and, on the other hand, that the binding of acid secretion brings about a state of rest for the stomach, because it is the presence of acid secretion which frequently causes peristaltic unrest of the organ. Undoubtedly cases occur in which hypersecretion continues

in spite of profuse hemorrhage and greatly annoys the patient by causing pain, gas distention, nausea, and vomiting. I have observed such cases and have always found it helpful to combat the acidity by giving atropin, bismuth, alkalies, albumin water, and eventually milk and eggs, in spite of the hemorrhage.

It is just in such cases that gastric lavage by evacuating the stagnating and fermenting acid contents proves the best method of stopping the tendency to hypersecretion, of fighting gas distention and acute dilatation, and of thus giving the stomach a chance to contract and rest. When the stomach is once emptied in these cases and, furthermore, in the numerous other cases where no distention exists, it seems to us a more rational proceeding to keep the stomach in a contracted condition by avoiding all intake of food and fluid by mouth. When this state of contraction remains unchanged for a number of days it not only is the best means of stopping the bleeding, but also materially adds to the healing of the ulcer, provided the ulcer is not too much indurated. It is certainly of the greatest importance for the safety of the thrombus as well as for the healing of the ulcer that for a number of days the ulcer should not be irritated at all by the acid secretion. In cases where, as mentioned above, hypersecretion continues in spite of complete rest, of full use of atropin, of bismuth, and of alkalies it may indeed be of advantage to neutralize the superfluous acid by giving milk and eggs notwithstanding the recent hemorrhage. Such cases, however, form only a certain percentage and it is not advisable to recommend for general use in all cases a method which is at best considered only permissible in a certain type of case. In most cases by far the safest and the most effective method of avoiding gastric secretion is to set the stomach at rest by avoiding all food intake. Since secretion is invariably provoked when food enters the stomach it is a questionable proceeding to first provoke gastric secretion and then neutralize its acidity by giving more food. The lively discussion which followed Lenhartz's recommendation has shown that the views upon which Lenhartz bases his advice are erroneous in many respects. While under certain conditions early feeding may be permissible, as a general rule it is safer to adhere to the old principle of having the patient fast after the hemorrhage. How many days and, further, how carefully to feed afterward should be decided in each individual case. In determining the amount of food which should be given when nourishment by mouth is taken up again we follow the same principles as those on which the treatment of the non-bleeding ulcer is based. Since the treatment is identical for each condition we shall discuss them under the same heading.

The After-treatment of Bleeding Ulcer and the Treatment of the Non-bleeding Ulcer

The main principle in the treatment of the non-bleeding ulcer is the same as that which governs the treatment of the bleeding ulcer, i. e., to give the ulcer a chance to heal by procuring a most complete rest for the stomach and its activity. It is therefore customary with most physicians to have patients with non-bleeding ulcers undergo a rest cure in bed for several weeks and to start the treatment by a period of starvation and exclusive rectal feeding, such as described for the treatment of gastric hemorrhage. The intention is to give the stomach, and with it the ulcer, a chance to contract and remain free from the irritation of gastric secretion. This principle of securing the greatest possible rest for the stomach must remain the guiding one when nourishment by mouth is taken up again. In arranging a *diet* we should always keep in mind that we set out to secure healing of the ulcer by giving the stomach as much rest as possible. For this reason, only such *food should be given as makes the smallest demand on gastric secretion, binds the greatest possible amount of secretion, and leaves the stomach in the shortest possible time.* In the section on diet in Hyperacidity we thoroughly discussed different foods and their preparation with regard to the above indications. We refer to this chapter for details both in arranging a diet during the early period of the ulcer treatment and for the continuation of the treatment over longer periods. We pointed out there that the two foods which best answer the indication are milk and eggs. Next to milk and eggs we found suitable for our purpose soups made of leguminous and other flours, gelatin, oil, butter, and a certain amount of sugar. Various combinations can be made of these different foods in getting up a diet for gastric ulcer cases.

A number of formulas have been given by different authors prescribing for each successive day exactly the kind of food and its quantity. Most of these diet schemes are considered obsolete nowadays (as the diagrams given v. Leube, by Penzoldt, etc.), so that I can abstain from quoting them. For the sake of reference I quote the Leuhartz formula, which has been discussed so extensively of late.

However, I wish to state most emphatically that the Leuhartz formula is as little suitable for every case as were the older formulas (v. Leube, Penzoldt, etc.). In fact, I consider it a fundamental mistake to follow any of these formulæ, each one of which has its distinct disadvantages. In adhering strictly to the program of one or another author and in trying to make the case fit the régime, we meet with greater and more difficulties than when we arrange the diet in each instance according to the needs of the individual case. In doing this we should follow certain principles which are safer guides than a prearranged diet list, which rarely fits the individual case from the start.

THE LENHARTZ DIET SCHEME

(According to Wagner, 119)

	Days After Last Gastric Hemorrhage																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Eggs (beaten up)	2	3	4	5	6	7	8 4 beaten up 4 boiled	8	8	8	at 8	the	most											
Milk (cold and taken with a teaspoon)	200 c. c.	300 c. c.	400 c. c.	500 c. c.	600 c. c.	700 c. c.	800 c. c.	900 c. c.	1000 c. c.	1000 c. c.	1000 c. c.													
Sugar			20g.	20g.	30g.	30g.	40g.	40g.	50g.	50g.	50g.													
Scraped meat						35g.	twice 35g.	twice 35g.	twice 35g.	twice 35g.	twice 35g.											II Form		
Milk and rice							100g.	200g.	200g.	200g.	300g.											4 eggs		
Zwieback								20g.	40g.	40g.	60g.		80g.	100g.										
Raw ham										50g.	50g.													
Butter										20g.	40g.													
Calories	280	420	637	777	955	1135	1588	1721	2138	2478	2941	2941	3007	3073										

The foremost principle, as stated several times, is to secure for the stomach a most thorough and prolonged rest; it forms the keynote for all diet rules in gastric ulcer. In following this principle we should select only such food as taxes neither the secretory nor the motor activity of the stomach. However, not less important than the proper selection of food is the determination of the quantity to be given. It is essential to decide for each case the amount of nourishment which is tolerated by the stomach without taxing it and at the same time is sufficient to prevent unnecessarily prolonged malnutrition. Lenhartz claims that in most cases the ulcer does not heal on account of malnutrition, that these patients, who are underfed and highly anemic when the treatment is started, require more nutritive material than is usually offered them if a reparative process and the healing of the ulcer are to be expected. It is to the credit of Lenhartz to have been the first to emphasize and clear up this point. The proclamation of his method caused a revision of the former diet rules and induced most physicians, including von Leube himself, to increase the quantity of food somewhat more quickly than heretofore. On the other hand, the Lenhartz formula prescribes an increase of food which proves decidedly too much for many cases. Starting on the day of the hemorrhage it provides at the end of the first week for eight eggs, 800 gm. of milk, 40 gm. of sugar, 35 gm. of meat, and 100 gm. of rice, and keeps on increasing the amount of food with each succeeding day. Such quantities of food may make great demands on the activity of the stomach, and the steady secretion and motor activity which go with the disposal of so much food interfere with the principle of giving the stomach a rest and chance to contract. Authors who have tried the Lenhartz method report that it is often poorly tolerated, particularly in cases with hypersecretion. In these cases it is of the greatest importance to reduce the secretory activity as far as possible, which is certainly not accomplished by constantly taxing the secretory organ. The binding of the acid secretion in these cases is just as well accomplished by frequent smaller feedings consisting of milk and eggs. Thus we see that the Lenhartz treatment in emphasizing the necessity of a sufficient quantity of food often violates the other essential principle of securing a rest for the stomach. While we admit the great importance of a sufficient food supply we prefer to regulate the quantity according to the needs in each individual case. When we observe a pronounced state of low general nutrition and asthenia, with poor response to treatment and little tendency to recovery, we should try in every way to improve the state of nutrition by increasing quickly the amount of such food as is well tolerated, and make use at the same time of rectal and hypodermic alimentation. Even in such cases we should not follow a printed formula, but in adding to the diet we should carefully feel our way, basing the plan for each day on the results of feeding on the previous day. For the majority of cases, however, it

seems to us infinitely better for the final result, to consider the principle of giving the stomach a rest as of greater importance than the state of nutrition. Even when the patients lose in weight during the first few weeks they finally gain in weight, even on a restricted diet, once they are freed of their annoying symptoms such as pain, sleepless nights, etc. In the majority of cases the irritative secretory disorder is a greater obstacle to the healing process than subnutrition, which is usually well borne and overcome when the rest given to the stomach brings about the healing of the ulcer. We pointed out before that cases with very profuse hemorrhage often obtain a good final result, probably for the reason that in such cases, in spite of the extreme anemia, rectal alimentation is kept up for long periods and nourishment by mouth is given only very carefully and is increased in quantity very slowly.

In another type of case which is characterized by frequently repeated hemorrhages, and which proves intractable to the ordinary method of treatment, such men as Boas (16), encouraged by the good reports of English physicians (Fenwick, 44; Anderson, 2; Donkin, 34), have enforced exclusive rectal alimentation and total abstinence from nourishment by mouth for periods up to three weeks, and claim that this very heroic treatment has yielded good results by allowing the ulcer to granulate and heal during the long rest given to the stomach. Similar cases are reported by other authors (Bamberger, 4). I had occasion to observe such a case, in which exclusive rectal alimentation was kept up for four weeks with a splendid and lasting result. These are extreme cases, yet they demonstrate that in regulating the diet we should not be influenced too much by the consideration of subnutrition. The majority of ulcer cases tolerate subnutrition well for a period, and when, during this period, the ulcer is given a chance to heal by complete or comparative rest of the stomach, the final result is better and more lasting, due to the securing of a more solid scar. The prolonged enforced inactivity of the secretory organ is further the best means of breaking the tendency to hypersecretion, which is so often the cause of recurring ulcerations. Particularly in those cases, mentioned before, where repeated hemorrhages occur is the renewed formation of ulcers often due to the fact that the irritative disorders were not sufficiently subdued by previous milder ulcer cures. In some of these cases only a prolonged enforced inactivity of the secretory organ will avail and should always be taken into account even when such patients are submitted to operations. Such and similar considerations make it at once obvious how impractical it is to follow the Lenhartz or any other formula which gives a set prescription for the quality and the quantity of food to be taken for each day, irrespective of the nature of the case.

The rate of increase of suitable food should in the first place be regulated according to the type of the ulcer. In recent cases and in cases of

mild type, although observing all the strict rules given below, we may on general principles progress somewhat more quickly than in a chronic case of old standing, where a prolonged rest of the stomach is really the essential feature of the treatment, particularly in the cases mentioned before, which show a tendency to recurring ulcerations and to repeated hemorrhages. We should proceed very slowly after excessive bleeding.

These general rules should be modified according to the manner in which the individual patient reacts to submutrition; a poor reaction demanding a more rapid addition to the food. A still more important general consideration on which to base the ratio of increase is the individual tolerance of the quantity of food, which varies greatly with different patients. While some tolerate only moderate quantities at any time and regularly experience discomfort with every attempted increase of food which is otherwise suitable, others get along nicely with every increase which the conditions permit us to offer them.

In arranging and rearranging a diet for gastric ulcer cases we must pronounce as the most important rule, which should be observed under all conditions, that whatever food is given, and in whatever quantity, it should be well tolerated and not cause the patient the slightest discomfort or distress. This paramount rule should always be enforced not only during the early period of the ulcer treatment but also later on, and when strictly observed by the patient will serve him well to prevent a relapse during the course of the treatment and afterward.

In order to comply with this rule it is necessary first to give only one kind of food at a time. The usual procedure is to start with milk, which, as stated before, is the most suitable type of food and which should form the staple diet in every case of ulcer. Since the success of the ulcer treatment depends so much on the milk diet great pains should be taken to select the form of milk which agrees with the patient. If plain milk causes discomfort it should be modified. The usual advice to prepare peptonized milk by the so-called "cold process" invariably proves a failure. I fully agree with S. Lambert (78), who states that there is no method of furnishing a quickly prepared, palatable, peptonized milk, and I can only endorse every detail of what he says on this topic in his very lucid article on the "Treatment of Gastric Ulcer." "To peptonize milk requires the constant application of moderate heat for two hours for its preparation, and the product has a disagreeably bitter, unappetizing taste. The modification of milk, by the dilution of top milk or cream, can furnish milk of any desired composition. Milk can be so modified that low percentages of casein can be combined with normal or high percentages of sugar and butter fats. And such modified milk, either raw or peptonized, can be made to agree with any stomach, however peculiar the idiosyncrasy of the patient may be. The popular modification of milk by mixing it with lime water or Vichy water gives a clew to a method which

has been most successfully used with children. It is not so much the addition of the alkali, though that is a help to modify the curd formation, as it is the mere dilution which is the essential part. Cow's milk has an average constitution of fat 4 per cent., sugar 4 per cent., casein 4 per cent., and its casein has the peculiarity of curdling in large lumps. This last peculiarity is usually considered the cause of the milk's disagreeing, but the abundance of the curd is an equally important factor in causing milk indigestion and gastric irritation.

"Simple dilution of the milk removes the cause of the trouble, and the use of an alkali as a diluent tends to modify the size of the curd, but there is a loss by the same process in nutritive value by a like dilution of both the butter fats and the milk-sugar. It will be found that stomachs which are the seat of ulcer will often bear fats well, and although cane sugar is at times a source of acid fermentation, it is found that milk-sugar is usually well borne. The problem to secure a milk which will not irritate is therefore the same as that which has been solved for the artificial feeding of infants, namely, to diminish the proteid and still keep the sugar and fat percentages the same as in normal cows' milk." A definite milk formula should be selected for the individual case and modified as often as necessary. I have often given with advantage first a mixture of half cream and half Vichy water, from which gradually a suitable milk mixture can be formulated.

Milk should always at first be given in small doses at long intervals and the temperature regulated to suit the taste of the patient. We begin with one tablespoonful every one or two hours, gradually increasing the dose or shortening the interval, so that the patient gets at the end of the first week about 250 to 300 c. c. of milk in 24 hours. This slow increase is indicated in all severe cases and also when gastric feeding is taken up during the period of rectal alimentation, the latter being gradually reduced as the amount of food taken by mouth is increased. On general principles and when conditions permit it is advisable to follow this slow increase also in milder cases, although under certain circumstances it may be permitted to progress more rapidly, provided the milk is well tolerated. But even under more favorable conditions the increase should not be made quicker than to raise the total amount for twenty-four hours up to 2 quarts at the end of the second week, the single dose at that time not exceeding 250 to 300 c. c., with regular intervals of 2 to 2½ hours. The necessity of giving the stomach a chance to contract after evacuation forbids the administration of large quantities of milk during the first few weeks. Even later on, when the patient is on the fair way to recovery, and partakes of other food, it is usually better not to give more than 2 quarts of milk per day in order to avoid overdistention of the stomach. I wish to state, however, that I have seen a number of patients who tolerated milk well from the beginning and were fond of taking it,

and who were able to take larger quantities (up to 3, 3½, and 4 quarts per day) over long periods with great benefit and a good final result. These are special cases in which the milk cure is a success from the beginning and in every way. For a general rule it is better to stick to the two-quart limit. When a greater amount of nutritive material is desired we can furnish it in different ways; lessening the dilution of the milk, if permissible, or by adding cooked cereal gruels to the milk; by selecting those articles of food which are less voluminous than milk, yet are capable of binding acid, without provoking secretion, such as eggs and gelatin, and further giving pure cream or butter. Finally soups made by boiling fine flours, and particularly leguminous flours (without, however, using meat broth), which are always a good substitute for milk, and very useful during the latter stages of the treatment, may be taken up during the earlier periods. As a general rule we prefer to start adding such foods after a straight milk period of several weeks, but the necessity for doing so may turn up sooner, during the first few weeks, when milk is too badly tolerated and can be taken only in small quantities or not at all, or when the amount prescribed above seems insufficient nourishment for the case.

Lenhartz combines milk and eggs from the beginning, starting with two eggs on the first day, and adding one egg every day up to 8 eggs at the end of the first week, an amount well tolerated by most patients, but soon becoming repulsive to others. Senator (116) starts with cream, small lumps of frozen butter and gelatin, prescribing:

℞

Gelatin. alb. puriss.—15.0 : 200.0 ℥ss : ℥viss
Eleosaccher. pulv. 50.0 ℥iss
M. et Sig.—1 tablespoonful every half hour.

The addition of sugar is recommended by several authors, particularly Strauss (124) and Lenhartz, and is useful provided it does not cause fermentation and gastric irritation. Again, others combine from the start milk, eggs, sugar, and butter (Elsner, 37)—an impractical plan, since it does not permit of judging which article agrees with the patient and which causes the discomfort. We would point out once more that at whatever time other foods than milk are administered, whether during the first few weeks or only after a period of straight milk diet, it should always be a strict rule to add only one other kind of food at a time, so that if it causes any distress the new article of diet or a new method of administration may be ascribed as its probable cause. Whether such articles as we just mentioned are taken up from the start or added after a period of straight milk diet they should be continued for weeks in succession if possible. We must abstain from giving strict rules in regard to specified periods for the one or the other type of food just mentioned.

Instead of consulting a tabulated formula it is a far more reliable and more profitable way of proceeding if we consult the records of the previous day and base the continuation and modification of the diet list on our knowledge of what agrees and what disagrees with the individual patient. In case we find that milk and eggs are tolerated in sufficient quantities we may continue this combination, gradually adding the one or the other kind of fluid or semifluid food, always consulting the taste of the patient. If from the beginning milk makes trouble, and has to be restricted in quantity, we are more liberal with eggs, gruels, and the different flours, etc., so that different patients gradually get an individual diet list, while on the whole restricted to those articles of food mentioned above.

The same general rules should prevail when, after a more or less protracted period, restricted in diet to milk, eggs, gruels, flour-soups, gelatin, etc., it is deemed time to allow solid food. First of all we should again observe the rule to invariably make only a single change at a time, no matter how simple, because by strictly adhering to this rule we are always in a position to correct quickly any mistake and prevent relapses in the course of the treatment. It has further been urged, and justly so, that with every more radical change, and the change from fluid and semifluid to solid food must be considered radical, the stools should be examined for occult blood, an excellent control in addition to the one furnished by the subjective feeling of the patient.

In selecting solid food, suitable for the first attempt, and in adding others, when increasing the number, we should always keep in mind the indication, given at the beginning of this chapter, that the food must be of such a character and be prepared in such a way that it taxes the stomach as little as possible. For details regarding the articles of solid food, as well as for the articles of the second group (eggs, gelatin, gruels, and leguminous soups), we must refer to the chapter on diet in Hyperacidity, where we fully discussed the different articles of food and their methods of preparation. However, we would state here once more the two most essential conditions which have to be fulfilled. First, that whatever kind of food is selected, whether from the animal or the vegetable kingdom (meat, fish, poultry, vegetables, etc.), it should be boiled, in order to deprive it of its extractive substances which we have learned to know as exciting agents of gastric secretion not only in meats, but also in vegetables. Secondly, all such food, after being boiled, should be finely divided and puréed, if possible. In relieving the stomach of the task of dividing up food we spare its activity in every direction, since less secretion is required, and all food which enters the stomach finely divided makes a quicker egress, thereby shortening the period of digestion. Lenhartz's celebrated diet scheme violates this important rule in allowing raw meat from the fifth day on. A. Schmidt and others have correctly pointed out

that the digestion of the undissolved fibrous parts of raw meat means a hard task for the stomach, thus defeating our own purpose.

Personally, I am decidedly in favor of postponing the addition of meat in any form or shape as long as possible. When I am ready to add solid food, I prefer to start with vegetable purées, gradually adding thoroughly boiled rice, purée of potatoes, custards and similar egg desserts, putting fish, poultry, and meat courses at the end of the list.

The time when solid food can be given varies greatly. With recent cases of mild character, who undergo a moderately strict treatment, it is customary and sufficient to keep the patient for two or three weeks on a diet consisting of milk, eggs, gruels, etc., and to start with carefully prepared solid food during the third, fourth, or fifth week according to the nature of the case. I wish to make it clear, however, that with very chronic cases, particularly those which have a tendency to relapse, the diet may with advantage be restricted to fluids and semi-fluids for much longer periods.

In cases with pronounced chronicity a result can only be expected from medical treatment if the principle of sparing the activity of the stomach is adhered to as long as possible. And the most effective means of sparing the activity of the stomach is strict dieting. This applies not only to cases with frequently repeated hemorrhages, but equally as well to those without hemorrhages. My own experience puts me fully in accord with those authors (Boas, 19; Fleiner, 46; Best, 6, and others), who find the best results of a long-continued strict dietetic treatment, carried out even at the cost of subnutrition, in eminently chronic cases running without hemorrhages. The most stubborn forms of chronic ulcer are those located near the pyloric outlet and causing the clinical picture of continuous hypersecretion. If we expect to make an impression at all in these cases the usual course of treatment, covering a period of three to four weeks and allowing the patient after this time a more liberal diet including solid food, will hardly avail. We discussed this special form of chronic ulcer under the heading of gastrosuccorrhea, and I mentioned there that as a rule these patients gain in weight even on a very restricted diet once they are freed of pain and sleepless nights. I wish to add another observation, which I have made frequently, namely, that there is usually no difficulty in persuading the patient to adhere to the restricted form of diet. Once they find out what it means to be entirely free from discomfort and pain they are only too willing to adhere to the strict regimen. In fact, in a number of such cases I met with objections when I proposed a change after the patient had been on a very strict diet for many months, and in some cases for years. The following case will serve as an illustration: The patient, a man at the age of 60, who had suffered for over 25 years from all the symptoms of chronic ulcer, including a number of hemorrhages, claimed when I first saw him that his circumstances did not permit him to undergo any medical or surgical treatment requir-

ing a rest cure in bed, but promised to adhere strictly to the prescribed dietetic treatment. When I saw him again a year later he was still on his diet, consisting of several quarts of milk, cream, eggs, gruels, and leguminous flour soups, on which he had gained 35 pounds, while, at the same time, losing all the pain and discomfort which had marred his life for a quarter of a century. On the occasion of his annual visit, repeated a number of times, I gradually persuaded him to add purées of some vegetables, rice, custards, and chicken or boiled fish once a week. I succeeded, however, not without difficulty, always meeting with the same objection, that he did not desire to give up a diet which was fully sufficient to sustain his strength and which, on the other hand, had cured him of his chronic and very annoying affliction, so that he was able to attend to his business in proper form and meet his obligations.

To those who are persistent in strictly dieting comes the reward of a cure in not a small percentage of chronic ulcer cases. On the other hand, many failures of the so-called medical treatment must be attributed to the short time given to the dietetic treatment, and to the laxity shown by patients and physicians alike in regard to the dietary after the regulation treatment of four to six weeks is finished. This applies not only to severe and very stubborn forms of the chronic ulcer. No matter how mild a case we are dealing with, a patient who has once shown symptoms of ulcer should be impressed by the possibility that he may develop ulcers in new situations or suffer a relapse in the old unless he makes up his mind to adhere to strict dieting for at least one or two years and possibly longer. The tendency of this disease to recur can be fought successfully only on the condition that the patient is taught to observe a prophylactic diet, avoiding all the errors which we enumerated in the chapter on hyperacidity as possible causes of irritative gastric disorders; overindulgence in eating and drinking in general, and in particular, in quantity and in quality (coarse and tough food, spiced and highly seasoned, excess of common salt, alcohol, tobacco, etc.). The prophylaxis should further extend to a revised mode of living, avoiding over-fatigue, both physical and nervous, and undue excitement. Sometimes it is necessary for the patient to change his occupation. A very instructive case is that of a young lawyer who, after several years of suffering from hyperacidity symptoms, had his first very excessive hemorrhage while pleading a case in court. A year later, after full recovery, although advised to stop court work, he tried another case and again in court in the midst of the trial suffered a second, almost fatal, hemorrhage. This time the warning lasted for two years, when he took chances again and for the third time experienced a profuse hematemesis during an exciting trial in court. The last convinced him that he had to give up pleading in court.

Drugs and Other Remedies.—During and after the rest cure, which, in mild cases, should last three weeks, and in more severe cases up to six

weeks, treatment by resting and dieting can be supported in different ways.

The application of *hot flaxseed poultices* (or electric pads) proves very helpful in all cases which show neither signs nor tendencies of bleeding (occult blood), particularly in all chronic, indurative forms. Von Leube (136) praises the effect of poulticing, which he considers an important part of the ulcer treatment, and only lately urged its application, claiming that the effect of the treatment actually depends on the regularity and persistency with which the hot poultices are applied. They produce active hyperemia of the stomach and provoke a quicker granulation of the otherwise atonic floor of the ulcer. Before applying the poultices the skin should be soaped and rubbed with alcohol and table salt. After that it is protected by a compress covered on the inner side by a thick layer of borax ointment, for which the following formula is recommended:

℞

Spermaceti			
Ceræ albæ	āā	5.0	gr. lxxvii
Petrolati albi		30.0	℥i
Glyceriti boroglyceriniæ		15.0	℥ss

The poultices should be applied as hot as tolerated, and should be changed every ten to fifteen minutes. The constant changing can be avoided by using an electric pad.

The treatment by drugs is to a great extent directed against hyperacidity and hypersecretion, so regularly associated with ulcerations of the stomach, and is therefore essentially the same as that recommended for these disorders. Referring to the above chapters in regard to their administration we wish to give here only a few special points.

Alkalies should be used very liberally at all times, because they not only relieve pain by neutralizing acid, but act curatively by reducing gastric secretion (Bickel, 12). Like others, I have made it part of the routine treatment to give alkalies from the very first day when anything at all is given by mouth, and even during the starvation period whenever the presence of acid fluid in the stomach requires neutralization. Thus in all cases associated with continuous hypersecretion frequent doses of alkalies are a necessity and should be given day and night. Particularly in those cases does the effect of the alkalies support the acid-binding influence of such food as milk and eggs. The systematic use of alkalies should be continued for long periods of time in all cases of ulcer which show symptoms of hyperacidity and hypersecretion. Alkalies are frequently used in the form of natural mineral waters. A small tumbler of warm Carlsbad water taken in the morning is part of von Leube's

ulcer treatment. It can be taken for long periods of time by ulcer patients. Its decidedly beneficial effect, attested to by very conservative observers (Ewald, Strauss, etc.), is in the first place attributed to its inhibiting effect on gastric secretion (Jaworski, 65). One should avoid distending the stomach by giving unnecessarily large quantities.

I wish to state, however, that I have seen some excellent results from a regular "Cur" at Carlsbad in patients who had tried in vain by all other methods of ulcer treatment to get rid of their irritative gastric disorder with recurrent ulcerations. I should not like to dispense with the beneficial effect of the Carlsbad water, and often advise my patients to take a tumbler of warm Carlsbad water in the morning in a course of treatment lasting a few weeks and repeated several times during the year, or to continue its use for months in succession.

Atropin, which Riegel (107) and his pupils consider the most powerful inhibitor of gastric secretion, was used successfully by Tabora (127) in a series of severe chronic ulcers with hypersecretion. Tabora gave hypodermically 1 to 3 mg. (1-60 to 1-20 gr.) daily for four to ten weeks in connection with a strictly observed rest cure and dietetic treatment, as described above. He claims that the systematic atropin treatment better than any other method fulfills the most important indication of every ulcer cure, i. e., to set the stomach at rest. It accomplishes this by its inhibitory effect on the vagus nerve, thereby not only reducing gastric secretion, but also relieving the spastic contraction of the gastric musculature, particularly at the pylorus.

I have used atropin very extensively and can only confirm Tabora's statements, at least for cases which show greatly increased irritability of the vagus nerve. These patients usually show a marked tolerance for large doses of atropin, which may be taken for many weeks in succession without creating any ill effects. This, however, is not true for all ulcer cases. In not a few patients I have met pronounced intolerance for atropin, small doses provoking annoying dryness of throat, disturbance of accommodation, and sometimes creating mental excitement and unrest. Hence, I always start with small doses, beginning with five drops of a one to one thousand solution (0.01:10.0), three times a day, and increase the dose one drop each following day until I obtain a full physiological effect. I have found the internal administration more suitable for this purpose and just as effective as the hypodermic application.

The *bismuth treatment* has been extensively employed in ulcer cases since Kussmaul and Fleiner (46) proposed its systematic administration. The action of this agent is manifold and its benefit is derived from chemical as well as from physical effect. Fleiner, Schüle (117), and others have shown that it reduces gastric secretion, while Matthes (91) demonstrated that bismuth provokes a more profuse secretion of mucus than can be provoked by any other agent. The writer (69) has pointed out the great and important rôle which the increased secretion of mucus plays in

the healing of the ulcer. Not less important is the physical effect of the bismuth treatment, inasmuch as it, particularly the subnitrate, when given in large doses settles on the uneven surface of the ulcer, thus giving it mechanical protection. It protects it in the first place against the harmful influence of acid secretion, thus not only preventing pain, but at the same time all the reflex symptoms which go with the irritation of the ulcer and lead to the formation of a vicious circle (hypersecretion, peristaltic unrest of the stomach, pylorospasm, vomiting, etc.). Further, acting as an astringent, bismuth facilitates the healing of the ulcer and its antiseptic qualities inhibit the fermentation of carbohydrates. These many qualities do not come into play in every case and bismuth is by no means a panacea, yet the result of the extensive trial given the bismuth treatment leaves no doubt but that its administration benefits and greatly assists in the healing of the ulcer in a large number of cases.

Fleiner considers the bismuth treatment particularly indicated:

1. During any treatment for ulcer, when the change from fluid to semifluid and from semifluid to solid food causes the slightest discomfort or hyperacidity symptoms.

2. In all cases which suffer relapses after going through a regular ulcer treatment. In these cases it should begin as soon as symptoms appear.

3. In all cases of long standing, in which we may presume the existence of induration and a poor tendency to granulation.

When used methodically it should be given for several weeks, at first every day, after a week every other day, then at gradually prolonged intervals.

The bismuth treatment displays its action to its fullest extent when administered as originally advised by Kussmaul-Fleiner, that is, in doses of 10 to 20 gm. (2½ to 5 dr.) suspended in about 200 c. c. (6 oz.) of water and applied through the tube after a thorough cleansing of the stomach by lavage. When lavage is not indicated one teaspoonful of bismuth suspended in a tumbler of water may be taken by mouth, preferably ¾ to 1 hour after internal lavage has been performed by the drinking of warm Carlsbad water. In cases where a starvation period is observed the best time to begin the use of bismuth is coincident with the return of gastric feeding. Lenhartz starts the bismuth on the day of the hemorrhage, giving 1 to 2 gm. (15 to 30 gr.) 3 times a day instead of the larger dose in the morning. When given on a fasting stomach by mouth the dose is usually not to exceed a teaspoonful. A number of authors recommend an even smaller dose. I prefer the larger doses and, as mentioned before, find the best results when applying it after gastric lavage. I further favor the subnitrate. I cannot convince myself that it is more constipating than bismuth carbonate, while, on the other hand, the subnitrate sticks more readily to the uneven surface of the ulcer.

In place of bismuth Klemperer (72) recommended *escalin,* and Pariser (98) a considerably cheaper mixture of prepared chalk and talcum.

Silver nitrate is a drug time honored in the treatment of gastric ulcer. Its effect is twofold. In the first place, it is expected to act directly on the ulcer in stimulating granulation. Much more important seems to us the second indication, that of combating by its use the irritative gastric disorder invariably associated with gastric ulcer. We could show that gastric irritability in ulcer cases is to a great extent caused by lack of mucus, a frequent finding, which we have mentioned before as a causative factor in the development of the ulcer. We claim that the beneficial effect of the silver nitrate must be attributed to its power of inducing an increased secretion of mucus. Pawlow (99) demonstrated on dogs with gastric fistulæ that mucus is secreted in very large and at times in enormous quantities, when a 10 per cent. silver nitrate solution is brought into the small stomach. My clinical observations corroborate the result of the experiment and show that the power of silver nitrate to induce and increase the secretion of mucus can be turned to advantage as a therapeutic agent. The most pronounced effect which follows the administration of silver nitrate is that it reduces gastric hyperesthesia.

My examinations showed that this is accomplished by an increase of mucus, not, as was formerly held, by reducing gastric secretion. We discussed this topic fully under the heading hyperacidity, to which we refer for details in regard to technique and indications for the silver nitrate treatment. I can only repeat what I emphatically stated under that heading, that the increased secretion of mucus, which follows the application of silver nitrate, especially by lavage, is the most reliable means of reducing gastric hyperesthesia.

However, the increased secretion of mucus means more than merely the reduction of pain and discomfort. The lack of mucus which so often is observed with irritative gastric disorders is an important factor in the development of the ulcer. I published my views on this point in an article on Amyxorrhea Gastrica (69) from which I quote: "With a normal stomach the layer of mucus protects the gastric mucosa against mechanical, thermic, and chemical insults, and it is further the best protection against the action and invasion of bacteria. Without sufficient covering of mucus the gastric mucosa becomes more easily injured by the many insults to which it is constantly subjected. When once injured, even though slightly, the damaged part becomes more prone to the invasion of bacteria and to the digestive action of the gastric juice. Again, the thinner the layer of protective mucus the easier will these secondary deleterious insults to the injured mucous membrane take effect. Under such conditions the digestive activity of the gastric juice must be particularly pronounced when hyperacidity is present. I consider it probable that such occurrences are the primary disturbances in the develop-

ment of gastric ulcer because we find both lack of mucus and hyperacidity during the early stages of such cases, which run with the development of ulcerations. That in such cases the first superficial lesion may gradually grow and get deeper becomes plausible, when we consider the chronic nature of the gastritis which, whatever may be its original cause, brings about both the lack of mucus and the hyperacidity. The persistency of both these disturbances explains the development of the ulcer and also its eminently chronic character. We should bear this in mind when dealing with a gastric ulcer, and should try to treat all disturbances which cause the development of the ulcer and account for its chronicity. One of these disturbances is the lack of mucus. A treatment which brings about an increase of gastric mucus helps to cure the ulcer. How important an increased secretion of mucus is for the healing of a gastric ulcer is demonstrated by the clinical experience that the development of a mucous gastritis proves more conclusively than anything else that the ulcer has healed. Türck (130), who studied the factors concerned in the healing of artificial gastric ulcers produced in the dog, noted among the changes during the process of repair a great increase of mycogen cells, in fact, to such a degree that even zymogen cells were transformed into mycogen cells." We thus understand that the silver nitrate treatment, in bringing about an increased secretion of mucus, is not only an excellent palliative, but a distinct curative measure, when properly administered. Referring to the discussion of hyperacidity for details regarding method of administration I merely state here that, when given by mouth, it becomes partly inert before reaching the stomach, and that it can be given then only for a short time because of the danger of argyrosis. Although I admit the relief that usually follows the administration by mouth in patients who, for some reason or other, cannot submit to treatment by lavage, nevertheless, in order to get a full effect, we should apply the silver nitrate solution by lavage and repeat it as often as is considered necessary.

The treatment is not only given for relief. A few treatments which may bring relief are insufficient when we intend to change the condition of the mucous membrane and to cure if possible the gastritis which is the underlying cause of the formation of ulcers. By continuing silver nitrate treatment by lavage over long periods, gradually increasing the intervals from one day to a week, I have obtained good results in chronic ulcer cases which had stubbornly resisted other methods of treatment, including repeated rest cures and well-arranged dietetic treatment.

The *oil treatment* was suggested by Cohnheim (31, 32), who prescribes 100-150 c. c. (3 to 5 oz.) of warm oil to be taken in the morning and smaller quantities (1 to 3 tablespoonfuls) before the mid-day and evening meals. Cohnheim claims that by forming a protective coating to the ulcer the oil not only relieves pain, but also vomiting and the ten-

dency to pylorospasm, that, while thus allowing the patient to eat, it acts itself as a food, and that finally it reduces gastric secretion.

Not all these claims could be corroborated by other investigators, yet the use of oil has yielded good results in the hands of many. The most constant effect is the relief of pain. This is satisfactorily explained when we consider the frequent lack of mucus in gastric ulcer cases to which we have referred several times. Oil taken before meals spreads quickly over the gastric mucosa and provides it with an artificial protective covering when the natural protective layer of mucus is insufficient. I found that this is just as well accomplished by giving smaller doses, one tablespoonful about ½ hour before meals. To most patients it is a hard task to swallow the large quantities of oil advised by Cohnheim, and to many it is actually repulsive, so that they refuse to take it.

When it is intended to use larger quantities it is decidedly better to introduce the oil through the tube into the stomach after lavage has been performed. Especially in those cases in which large quantities are said to be particularly indicated previous gastric lavage is in order for other reasons. Cohnheim recommended the oil treatment as particularly effective in cases with pyloric obstruction. He and his pupils, as well as others, report cures accomplished by the oil treatment in cases where operative treatment for the pyloric obstruction seemed unavoidable.

When we discussed the value of oil in hyperacidity we pointed out that, with gastric stagnation present, oil easily undergoes fermentation, the acid products of which may create severe gastric irritation. Ewald (40) reports such an experience followed by a profuse hemorrhage. It is therefore essential to thoroughly clean the stomach of all stagnating and fermenting masses before putting the oil into the stomach. Aside from providing a protective covering and thus preventing irritative secretion oil provokes regurgitation of duodenal contents, which are alkaline and neutralize acid gastric contents.

Gastric Lavage.—In describing the bismuth, the silver nitrate, and the oil treatment we found for each of these methods that the best results are obtained when these remedies are administered through the tube. In nearly all text-books the general rule is handed down that the introduction of the tube is contraindicated in gastric ulcer. In this general form the rule is unwarranted. We had occasion before to state this when we discussed the great value of lavage in the direct treatment of excessive hemorrhage, where it may prove the best means of stopping the hemorrhage. After the hemorrhage and, furthermore, in cases which show a tendency to hemorrhages the indication of procuring for the stomach a complete rest makes it advisable to omit gastric lavage, provided we accomplish the task of setting the stomach at rest. Otherwise, for instance, when there is present pyloric obstruction with continuous hypersecretion, the removal by lavage of the stagnating acid fluid is the best method of setting the

stomach at rest, even in cases with a tendency to hemorrhage. Instead of provoking hemorrhage lavage will be instrumental in preventing bleeding in such cases. After having employed gastric lavage for over twenty-five years in numerous ulcer cases I can state that I have never seen any harm result from its use. In the first place, I have never observed that it directly brought about hemorrhage of any importance. Small hemorrhages from superficial lesions of the mucous membrane, as frequently found in cases of chronic gastritis, are without significance. Like others, I have occasionally siphoned from the stomach blood which was present before the introduction of the tube, usually unknown to the patient. In every such case I obtained good results from a careful but thorough cleansing of the stomach, followed by the introduction of a bismuth suspension before the tube was removed.

My experience encourages me to ask for the abolishment of the firmly rooted prejudice against lavage in gastric ulcer. In doing so, I find myself fully in accord with Sahli (111), Wagner (139), Bamberger (4), Rutimeyer (110), and others, who claim that lavage is altogether too little employed in the treatment of gastric ulcer. In excluding methodical lavage we deprive ourselves of one of the best methods of treatment, which, if judiciously employed, will bring about good results in cases which seem intractable to other methods of treatment. The indications for its employment are many. We mentioned its usefulness in directly combating excessive bleeding and as a means for the administration of remedies (bismuth, silver nitrate, and oil). We further discussed at length the great value of lavage when we are dealing with that group of ulcer cases which presents itself as the clinical picture of continuous hypersecretion (Reichmann's disease). The removal of the stagnating acid masses is not only palliative, but curative in effecting rest for the stomach. I agree with Rutimeyer (110) and Schmidt (114), who correctly pointed out that continuous hypersecretion is often provoked by the irritating effect of small food remnants sticking to the surface of the ulcer. Lavage removes this source of irritation. Not less important is the methodical employment of lavage in all cases with more pronounced stagnation and pyloric obstruction. By removing the stagnating and fermenting masses lavage eliminates a constant source of irritation of the ulcer and the gastric mucosa; and, furthermore, by cleaning the ulcer, lavage allows us to bring into full play all those methods of treatment which we have enumerated as devised for promoting the healing process. Finally, the cleansing as well as the medical treatment connected with lavage are the most efficient means of treating the chronic gastritis, which is the underlying cause of the whole process. If we thus succeed in curing the gastritis and the ulcerations we often cure the pyloric obstruction, not only in cases where the obstruction is of a spastic nature, but also when the obstruction is partly caused by inflammatory swelling. When the swelling disappears with the healing of the ulcer, the pyloric opening becomes patent. This leads us to the discussion of the surgical treatment.

Surgical Treatment

Surgical treatment, the topic of an extensive literature during the last decade, has been urged by many as the more rational and reliable way of treating gastric ulcer. The topic has always been one of deep interest to me, since I first 25

years ago witnessed a series of gastroenterostomies performed on the advice of Kussmaul. The latter immediately took up this new method of treatment, which apparently promised such splendid results. For many years afterwards I enthusiastically advocated early operative treatment in a large number of ulcer cases. But following up my own cases and studying the statistics reported in the literature have gradually made me more and more conservative, for I find that surgical treatment not always fulfills the promise of a cure, while, on the other hand, in the majority of cases medical treatment yields excellent results if only properly and persistently carried out.

In discussing the indications for surgical treatment, I wish therefore first to state that gastric ulcer is essentially a disease for medical treatment. No operative procedure, not even the resection of the ulcer itself, removes the pathological condition which caused the formation of the ulcer and which may give rise to the development of new disturbances after the operation. On the other hand, the various methods of medical treatment which we described are aimed at combating the irritative gastric disorders, which are the main obstacle to the healing of the ulcer, if not its very cause. When properly administered these methods of medical treatment bring about the healing of the ulcer in the vast majority of cases and, if followed up sufficiently by prophylaxis in diet and mode of life, prevent further trouble, thus accomplishing a real cure. No one can doubt but that the great majority of ulcer cases are curable by properly applied medical treatment. On the other hand, while surgery gives splendid results in certain cases, yet in others its results are far from satisfactory. In discussing and comparing medical and surgical treatment the question should not be whether to prefer one or the other on general principles. Both have their field, both their justification and their limitations. By choosing judiciously in each individual case we best advise our patients.

Where medical treatment is sufficient, surgical treatment is at least superfluous. Broadly speaking, then, the indication for surgical treatment comes up when medical methods fail, when the ulcer proves intractable to medical treatment, irrespective of what form of ulcer we are dealing with. I consider it a more correct way to give intractability as a general indication for surgical interference than to arrange indications to meet the different types of ulcer and their so-called complications and sequelæ. Take, for example, the complication usually described as invariably requiring operative measures, pyloric obstruction. When taking hold of such a case, it is not at all obvious from the start whether the obstruction is part of the active process (caused by pylorospasm and inflammatory swelling), or whether it is effected by the scar of a healed ulcer, now properly speaking a sequel of the ulcer. When part of the active process it not infrequently yields to a thorough and persistent medical treatment, so that we are not in a position to decide on the necessity of operating before we have given a serious trial of thorough medical treatment, eventually applying successively and rigorously different methods. Like others, I have frequently seen pyloric obstruction disappear entirely under appropriate and persistent medical treatment in cases which at first impressed me as in urgent need of operation. Nor is this experience unusual or new. Anyone who gives himself the pleasure of reading Kussmaul's first article (74) on the treatment of pyloric obstruction and gastric dilatation by gastric lavage will find the report of cures accomplished by his new method in cases of such severe type as we rarely have occasion to observe nowadays. When amenable to medical treatment pyloric ulcer with obstruction should be thus treated. The patient is better off when cured with anatomical conditions unchanged.

And so it is with another group of cases, which is often pointed out as

especially adapted to and in need of surgical treatment, the group characterized by frequent hemorrhages. These frequent hemorrhages are apt to create a profound anemia and to greatly undermine the patient's vitality, a prognosis which should make the question of timely operation one of earnest consideration. Yet we had occasion to point out that even these stubborn cases finally yield to persistent medical treatment, although it may require such heroic measures as prolonged starvation and long-continued treatment in its strictest form. In these and similar conditions it will be found that success depends on a conscientious application of medical methods, rigorously carried on for a reasonably long period. Personally I have become more and more convinced that the many failures of medical treatment must be attributed to superficial application of these methods during an insufficient period of time. Many surgeons have learned the necessity for long-continued medical treatment and insist upon it *after* operations. In not a small percentage of cases, particularly in all cases with an active ulcer still present, operative treatment yields satisfactory results only when followed by a strict medical treatment. If the same strictness be observed before an operation is undertaken not infrequently cures are accomplished which make operation unnecessary.

I have no intention of advocating stubborn persistence in medical treatment in cases where we observe no response to the treatment or in cases where we find the patient losing ground. Certain cases do not present themselves for treatment until the ulcer has developed far and created not only local complications but also a low state of nutrition. In such cases it requires large experience and ripe judgment to decide where the greater danger lies, in immediate operation or in trying first to improve the patient's condition by medical treatment. In cases which are less advanced and permit of deliberating we invariably start with medical treatment and decidedly favor its continuation even over long periods, when we observe improvement and succeed in raising the patient's nutrition and strength. The admonition of the surgeon frequently heard, not to continue the trial of medical treatment beyond a stated number of weeks, cannot be taken literally. Not the time given to a form of treatment is the deciding point, but the result gained by the treatment. When we get improvement by medical treatment we are justified in continuing it. No harm can come from a treatment which relieves the patient from suffering and improves his general condition even if no final cure is accomplished by the further continuation of the treatment. In such cases the general effect of long-continued medical treatment stands the patient in good stead, when after all an operation becomes necessary, for example when medical treatment accomplishes the healing of the ulcer and the gastritis, but leaves a pyloric obstruction caused by scar tissue. It is the general consensus of opinion that operations undertaken under such conditions give the best results. Since following these views, I have had reason to be satisfied with the results of operations, suggested and performed after medical treatment has been carried on over long periods of time (in some cases a full year and longer). While, on the other hand, in thus acting the originally contemplated operation has become unnecessary in not a few cases.

We are all the more justified in taking this conservative stand since we have learned that surgical treatment is neither without danger nor always productive of satisfactory results. In the first place, there is still a high average mortality in gastric operations. The simplest method of operating—gastroenterostomy—shows an average mortality of 10 per cent., although it is true that particularly gifted and skilful surgeons have a smaller percentage of mortality. Secondly, various complications are apt to follow this operation: the formation of adhesions, vicious circle, peptic ulcer, causing the formation of fistulæ and perfora-

tion, closure of the anastomosis, etc., conditions which may prove very annoying and disturbing, and eventually necessitate other operations. And finally, even in those cases which recover successfully from the operation, the result is often far from satisfactory. My own experience corroborates reports in the literature, that many continue suffering after one and even after several operations, and that a certain number of these patients find their only chance of getting well in observing a long-continued rigorous internal treatment.

Without going into the details of statistics, we can sum up this discussion by stating that surgical treatment in gastric ulcer is not a treatment of choice but of necessity and should be taken into consideration only after a conscientious and persistent treatment by one or more medical methods has failed. The time when operation may be considered necessary differs according to the patient's walk in life, and, furthermore, according to the nature of the case. With patients of the working class the necessity for operating turns up at an earlier time than with those who are in a position to carry out for a long period of time the exacting prescription of a strict medical treatment.

Another consideration which I have always found weighing heavily when contemplating surgical measures is chronic suffering. In the so-called gastralgic form of ulcer, which runs with constantly returning pains, interfering with the patient's capacity for work and marring his enjoyment of life, we often find the patient willing rather to take the chances of an operation, even with a limited prospect of cure, than to submit patiently to a long period of internal treatment. Under such conditions I put the decision up to the patient, after giving a full exposition of the pros and cons both of the medical and surgical treatment.

We meet persistent suffering in different types of ulcer, in pyloric ulcer with gastrosuccorrhea (Reichmann's disease) which forms a high percentage among my own series of ulcer cases treated by operation, further in the so-called callous ulcer of the fundus, and finally in cases causing malformation of the stomach and adhesions. While intense suffering may lead to an earlier decision in favor of operation, yet we should even in these cases adhere to our principle of first thoroughly trying medical methods. In these conditions, as in others, intractability should form the indication for surgical interference, rather than the type of the ulcer itself. In making intractability the main issue, we get a clearer view of the situation and a more precise and sharper indication. *Defining intractability in its broadest meaning as an indication for surgical interference, it applies equally to all forms and types of gastric ulcer and to all its complications and sequelæ.* It applies to those cases in which the tendency to bleeding is not controlled by medical treatment; to the callous ulcer, which remains a constant source of pain in spite of various "cures"; and to those cases where the suffering is due to pylorospasm uninfluenced by energetic medication. It further applies to all conditions of obstruction, pyloric obstruction and hour-glass stomach, both in cases where the obstruction is partly caused by an indurated ulcer which does not yield to medical treatment, and still more in cases where the stenosis is the effect of scar tissue which is beyond the reach of medical treatment. The less the condition is the effect of disturbed function, which may yield to medical treatment, and the more it is caused by permanent anatomical changes, the more is surgical interference indicated. Taking this view I have had excellent results from the operative treatment of cases where the suffering has been caused by the scar of a healed ulcer.

The choice of the kind of operation to be done should be left to the surgeon for decision, according to the merits of the case and the findings at operation. Only one word about the advisability of *resection.* Resection of the ulcer is recommended as the more reliable method in certain conditions and in others is favored

because of the claim of surgeons that about 70 per cent. of cancers of the stomach originate from ulcers. If this were so, resection of the ulcer would mean prophylaxis of cancer for many cases. However, clinical experience does not corroborate this claim. I fully agree with Lockwood (86), who states that in the majority of cancer cases no previous history of ulcer is found. Furthermore, my experience in observing ulcer cases under my care corresponds with his, that the late development of cancer on an old previous ulcer is rare. As long as the high percentage of cancer developing on old ulcers is not sufficiently proved, its consideration should not weigh too heavily when deciding in favor of resection, which as the more radical operation carries a greater immediate danger. When, however, the anatomical conditions encountered at operation suggest the possibility of a developing cancer, resection should be performed if possible.

When *perforation* occurs, immediate operation is absolutely necessary. General peritonitis is almost invariably fatal, when allowed to develop after the perforation. The shorter the interval between perforation and operation the better the prognosis. It is therefore imperative to hand the patient over to the surgeon as soon as the diagnosis is made.

Gastric Tetany

Gastric tetany is discussed here because, in the majority of cases, it occurs as a complication of gastric ulcer and may call for prompt operative treatment.

Various theories have been advanced to explain this syndrome. The writer (81) suggested one which, although discussed in several articles, has not been taken up in the literature. I repeat the suggestion because it offers a basis for rational treatment. Kussmaul (74), who first described gastric tetany, observed that it occurs in greatly emaciated patients with pyloric stenosis after the frequent vomiting of large quantities of fluid has brought about the diminution of the water in the organism, and as a result of this the drying out of the nerves and muscles, which appealed to him as the probable cause of the convulsions. The removal of great quantities of fluid from the body is actually the only objective finding regularly observed in cases of gastric tetany. That the syndrome occurs only in cases of pyloric obstruction after large quantities of stomach contents have been removed from the body speaks against the theory that decomposition products formed in the stagnating masses are the cause of the convulsions, aside from the fact that no such toxin has ever been demonstrated.

It is, however, not only fluid which is lost by the frequent vomiting. Bouveret and Devic (22) claim that gastric tetany is observed exclusively in those cases of pyloric obstruction which are accompanied by excessive hypersecretion. While this is not absolutely true, yet in the majority of cases gastric tetany is associated with gastrosuccorrhea. The removal by vomiting of excessive amounts of gastric juice deprives the system of a great amount of chlorin by preventing its resorption in the intestines. The

impoverishment of chlorids in the system is demonstrated in these cases by the disappearance of chlorids from the urine, and it seems to me that it plays some part in the development of tetany. This theory is corroborated by experiments of Alonzo E. Taylor (128), who observed "Tetanic seizures in dogs, in which the duodenum is cut across and the ends brought into external fistulæ, so that the gastric contents leave the body; the results might be explained by the assumption that there is in the gastric secretion some substance, a constituent necessary to the intermediary metabolism that should return to the circulation by intestinal resorption." That this substance is chlorin seems probable to me, because gastric tetany is met when excessive amounts of acid secretion are removed from the body by vomiting. If this be so the proper treatment of gastrosuccorrhea means prophylaxis of tetany. When tetany appears we should try to overcome the chlorin starvation by the injection of large quantities of normal salt solution subcutaneously or by the rectum. Of greater importance is the prevention of recurring attacks by removing the cause of the trouble. To our conception the underlying cause of the whole trouble is the spastic or organic pyloric obstruction which hinders the passage of the more abundantly secreted hydrochloric acid into the intestine, thus preventing its resorption. This obstacle must be removed, and when we find medical methods ineffective it should be overcome by operation. Tetanic attacks are of serious import and often lead quickly to a fatal issue.

Against the warning of some authors, not to operate in cases with tetany, I would advise that one proceed to operation without losing much time. When Albu (1) claims that therapy offers no remedy which can either check or prevent a recurrence of the tetanic attacks, our theory deserves consideration, since it gives a basis which may prove of great assistance for the treatment of that peculiar and dangerous condition.

DEPRESSIVE DISORDERS OF GASTRIC SECRETION

Achylia Gastrica and Subacidity

We observe complete lack of gastric juice (*achylia gastrica*) or diminished secretion in various conditions. They are either the result of destructive changes in the gastric mucosa, caused by inflammatory or toxic processes (acute and chronic gastritis, carcinoma, pernicious anemia, etc.), or they appear as an independent functional disturbance. The latter form (*achylia gastrica simplex*) may be caused by deranged innervation, as first described by Einhorn (35), or it may represent a congenital constitutional shortcoming.

The principles of treatment regarding diet and medication are in many respects identical for the different forms and will therefore be dis-

cussed here in a general way, applicable to all the different conditions as far as the secretory disturbance is concerned. Further indications for treatment of inflammatory processes, carcinoma, etc., will be found under the respective headings.

The finding of the secretory disorder in itself does not necessitate the institution of treatment. Complete lack of gastric secretion, as found in cases of achylia gastrica simplex (Martius, 88), is often remarkably well borne, particularly in the numerous cases in which the functional defect in all probability is an inborn constitutional shortcoming. In these cases the activity of the pancreas and the intestines makes up for the missing digestive activity of the stomach, often so perfectly that in spite of persistent achylia the patient is able to partake of all kinds of food without experiencing any discomfort and further to digest everything to such a degree as to keep in an excellent state of general nutrition. I have been thoroughly convinced of this in following up a large series of such cases over a number of years.

As long as these people feel well on an ordinary mixed diet, and this applies in the same manner to patients with subacidity, there is no reason whatsoever for putting them on a restricted diet or treating them in any other way. The constant attention going with strict dieting is liable to make them unnecessarily self-centered hypochondriacs. The lack of secretion becomes an object for treatment only when it causes gastric discomfort or, what happens frequently, when the compensatory activity of the intestines proves insufficient, and intestinal putrefaction of poorly digested food particles causes diarrhea and other disturbances.

During such periods of treatment the individual tolerance of the patient should be studied and he should be taught what errors in diet and mode of living to avoid in order to prevent the recurrence of disturbances. If successfully carried out this plan will put many of these patients in condition to keep their digestive tracts and general nutrition in good shape in spite of continued lack of secretion. Some have to observe a more restricted diet than others, particularly during periods when the stress and strain of work and worry reduce their power of resistance. During and after the periods of treatment full use should be made of all the help which medication offers, always preferring those drugs which have proved particularly helpful in given cases. The individual tolerance varies greatly in regard to diet as well as to medication and should be fully considered. It will enable the patient to learn what is best suited to his individual case.

A condition which requires particular attention in all cases of diminished secretion is the motor activity of the stomach. Where it is normal the effect of the secretory disorder is easier counterbalanced by the compensatory activity of the intestines. With gastric atony and motor insufficiency the undigested stagnating masses irritate the stomach mechanically

and chemically by products of fermentation and further irritate the bowels when delivered in unfit condition.

The treatment of achylia and subacidity should be based on the following principles. The secretory activity of the stomach should be taxed as little as possible, and when still present should be stimulated. Sparing and stimulation are the object of dieting and medication, both of which further intend to overcome whatever effects follow the gastric secretory depression.

Dietetic Treatment

A diet arranged with a view of sparing secretory activity calls in the first place for a thorough mechanical preparation of all articles of food. When discussing the same indications in the chapter on irritative secretory disorders we stated that the stomach is given the task of dividing up food by dissolving all enveloping substances, such as the fibrous tissue of meat, the gluten of bread, and the pektin and other layers of raw vegetables. When gastric juice is missing this task cannot be accomplished, and it is therefore essential in the first place to eliminate from different foods all these substances, which are only dissolved and digested by the activity of the gastric secretion, and which, when they enter the intestines unchanged, are not affected by the pancreatic and intestinal secretions, but pass undigested with the feces. These undigested tissues are frequently the cause of intestinal trouble by undergoing putrefaction; they further prevent the intestinal secretions from reaching the enveloped elements (meat fiber, starch globules, etc.). Where the latter remain undigested they are another source for intestinal putrefaction and fermentation. Food should therefore not only be freely divided, but also properly prepared by cooking, which partly dissolves these enveloping tissues, as Bickel has demonstrated for vegetables, A. Schmidt for meat, etc.

Meats.—This consideration shows that the popular advice of offering patients with low gastric secretion raw scraped beef has no justification. Scraped raw beef should be entirely eliminated from the dietary of such patients, further, for the same reason, raw ham and other raw uncooked meats, sausages, etc. All meats should be given well done and after their fibrous tissues have been removed as much as possible. In aggravated cases they should be hashed and puréed. In milder cases, when allowed in natural form, preference should be given to those types which have tender meat fibers and little fibrous tissue, such as lamb, lean fish (cod, halibut, haddock, striped bass, red snapper, smelt, perch, etc.), lean poultry (chicken, turkey, capon, the white meat preferably), while all fat meats (pork) and those with a coarser fiber (roast beef, duck, goose, and other fowl), oily forms of fish (salmon, mackerel, eel, bluefish, pompano, shad, etc.), should be altogether prohibited. For further details in regard to lean and fat types see the corresponding list in diet for hyperacidity.

The above albuminous foods, however, are only permitted with normal activity of the bowels. When intestinal putrefaction prevails all these articles of food should be eliminated, even when not causing gastric discomfort, because they are particularly prone to intestinal putrefaction.

Eggs.—Eggs, ordinarily permitted, should also be forbidden when intestinal compensation is disturbed. When poorly digested, egg albumin very readily undergoes putrefaction in the bowels, particularly raw egg albumin, which, if not dissolved by gastric secretion, is just as little digested by trypsin as raw fibrous tissue.

Milk.—The tolerance of milk also depends to a great extent on the condition of the bowels. With normal activity of the bowels milk is usually an excellent food in these conditions, and should be given in the form which best agrees with the patient. The digestion of plain milk is aided by adding some salt. Fermented milks, kumyss, matzoon, sour milk, buttermilk, etc., are often beneficial in cases with constipation. When intestinal disturbances are present milk should be given tentatively. In certain cases milk proves a good intestinal antiseptic and the patient is cured of his intestinal putrefaction and diarrhea when put on an exclusive milk diet. Not infrequently, however, milk increases the intestinal disorder in cases where all albuminous substances fall a prey to putrefaction.

Starch.—In such cases all albuminous foods (meats, eggs, milk, etc.) should be entirely eliminated for a while and the patient put on an exclusive diet of carbohydrates, particularly starches.

In any event, even when albuminous foods are tolerated, starchy foods should form the staple diet in these cases for the good reason that the conditions for the digestion of starches are particularly favorable here, and for the further reason that the predominance of carbohydrates in the dietary is the best counterbalance to the tendency of these patients to develop intestinal putrefaction of albuminous matter. Even with the so-called starchy foods, however, we must be aware of the necessity for removing enveloping substances, which, as a rule, are of an albuminous character. Bread, for instance, is not a good food on account of the gluten which, like all enveloping tissues of albuminous character, interferes with the action of saliva and intestinal secretions. Starchy foods are therefore best given in the form of gruels, of thoroughly boiled cereals, as soups made of fine flours, as purées of potatoes and other vegetables. Very valuable in particular are soups or purées made of leguminous flours, on account of their high nutritive value.

Preparation of Foods.—This very important indication of having all foods as far as possible mechanically finely divided need not interfere with the palatability of the food. Yet special care should be taken to prepare these and other foods in a palatable manner and to serve them in

a way enticing to the appetite of the patient, which, as Pawlow has taught us, is a strong provoker of gastric secretion.

Butter.—Butter is very useful here and should be given liberally as long as the motor activity is normal and neither gastric nor intestinal fermentation forbids its administration. It is always preferable to add it raw to the different foods.

General Rules.—While it is necessary to rule out all complicated dishes and heavy sauces in the preparation of plain courses, such articles of food should be employed as are known to stimulate gastric secretion. In the first place, the extractive substances of vegetables as well as of meats, which are either used in preparing soups, purées, etc., or taken pure in the form of broths of different kinds, should be employed. Another valuable ingredient is table salt, which may be added to almost any kind of food. It acts beneficially, however, only in small quantities, and in the concentration of a normal saline solution. Other constituents should be used very sparingly. v. Korcynski demonstrated that most condiments, instead of stimulating secretion, irritate the mucosa and produce a transudation of alkaline fluid which dilutes whatever digestive secretion is present.

Stimulation of gastric secretion is also pleasantly accomplished by alcoholic drinks of different kinds, which often aid digestion directly and indirectly by stimulating the appetite, provided they are taken in moderate quantity and in diluted form. When chronic gastritis is the cause of diminished secretion all alcoholic drinks should be avoided. Mildly carbonated waters often act as a stimulant. Of other beverages weak tea, cocoa, and coffee are allowed when tolerated.

In arranging a diet for patients of this type we should be aware of the necessity for stimulating digestive activity. While adhering to the general rules laid down here we must provide for a frequent change of dietary. In a case with pronounced disturbances it may be indicated to restrict the patient for a period of time to only one kind of food, gradually adding one or another in order to find out what really agrees with him. It may further be advisable to restrict each individual meal to one or only a few different kinds of food. Aside from this, however, we should try to make the diet list as liberal as possible, in order to allow a frequent change. Copious meals should be avoided; it is preferable to give a greater number of small meals.

Medical Treatment

Hydrochloric Acid.—Among all medical means hydrochloric acid ranks foremost and is really *the* drug in the treatment of all depressive secretory disorders. It should be administered regularly, liberally, and over long periods of time. To secure its effectiveness, however, larger

doses should be given than are ordinarily prescribed, about twenty drops of the diluted hydrochloric acid with each meal, 3 to 5 times a day, bringing the total daily amount up to about 100 drops. In order to avoid irritation of the mucosa it must be well diluted, the 20 drops in 250 to 300 c. c. of water, to be taken through a glass tube partly before, partly during, and partly after meals. While even these doses are very small when compared with the amount secreted under normal conditions, and while the acid is not so thoroughly mixed with the chyme as the natural secretion, nevertheless modern investigations by Leo (83), Bickel (11), Tabora (126), and others have clearly demonstrated that hydrochloric acid is useful and effective in many different ways.

1. It is an excellent appetizer, in many cases surpassing in effectiveness bitters and similar drugs.

2. Although the quantities taken are too small to replace the missing natural secretion they nevertheless directly aid gastric digestion by dissolving to a certain degree the enveloping tissues, particularly gluten, and less efficiently fibrous tissue. This is partly brought about by the activating effect of hydrochloric acid on gastric ferments, which are rarely completely absent even in cases of achylia gastrica.

3. It displays its antiseptic influence on gastric and intestinal contents.

4. It regulates the pyloric activity, preventing too rapid evacuation of the stomach and overloading of the bowels with undigested food.

5. Not less and probably more important than the direct results of hydrochloric acid medication on gastric digestion are its indirect effects. It has been shown that, where glandular activity is still present, hydrochloric acid taken by mouth greatly stimulates the gastric glands in answer to the ingestion of food with a more profuse secretion. Medicinal doses further stimulate the secretion of the pancreas, which means not only improved intestinal digestion, but also diminished intestinal putrefaction.

The result of scientific and experimental work fully substantiates the time-honored custom of administering HCl in all cases of diminished or missing gastric secretion.

Ferments.—The result of investigation in regard to the administration of ferments which have been and still are extensively used in these conditions is much less favorable. Aside from the fact that most of the preparations in the market quickly lose their effectiveness, it has as yet not been demonstrated that when given in an effective state they really aid the digestion in the stomach. This applies equally to the different preparations of pepsin, pancreatin, pancreon, and papain, all of which have been recommended for this purpose. We have already mentioned that the gastric enzymes are rarely totally absent, so that the administration of HCl is much more important than that of pepsin and other fer-

ments. Still, while a scientific explanation is yet wanting, we must admit the empirical fact that the addition of pepsin (or some other ferment) increases the effectiveness of the hydrochloric acid mixture, not in all, but in certain cases. However, it is necessary to add the ferment in its original form as a powder to the HCl mixture, about 10 to 15 gr. (0.75 to 1.0 gm.) being given as the dose.

The suggestion of French authors to give the natural gastric secretion of dogs (gasterine—Mathieu and Laboulais, 89) or of pigs (dyspeptin —Hepp, 63) has found little favor, principally because the efficiency of these preparations could not be corroborated by other investigators (Erb, 39; Fleiner, 48, etc.); so that there seems little justification for prescribing these very expensive remedies instead of the effective and inexpensive HCl.

Bitters.—Science says little in favor of bitters, which from time immemorial have been given with the intention of stimulating gastric secretion. The literature on the action of bitters is full of contradictions, probably because most investigators have examined their effects in animals.

Reichmann (105), who studied their effect in human digestion, states that bitters act directly on the glandular apparatus and when given half an hour to one hour before meals greatly increase gastric secretion. Pawlow and his pupils give a different explanation and attribute to the bitters a very important action. Considering appetite the most powerful instigator of gastric secretion they claim that the bitters cause a reflex secretion by their effect on the sense of taste. According to Pawlow's ideas the bitter taste provokes pleasant impressions of food by contrast and thereby increases the appetite which, in turn, acts as a stimulant of gastric secretion.

To get the full benefit of this reflex action bitters should be given shortly before meals, which corresponds with the popular custom when administered with the intention of increasing the appetite. The effect would then not be due to any real action of the drug, but in part to suggestion produced by the impression which the bitter taste makes upon the patient. However this may be, the consensus of opinion among physicians is that the administration of bitters is usually followed by a distinct improvement in gastric digestion and often by an increase in weight, which fully justifies their liberal employment. Since their effect in all probability must be attributed to the one property common to all these drugs, their bitter taste, it is merely a matter of personal preference which one is selected. The following are used: quassia, columba, condurango, hops, and others administered in the form of infusions, tinctures or extracts of different composition.

As effective stimulators of appetite and gastric secretion we further mention the different tinctures of *cinchona bark* and *tincture of nux*

vomica, which may be given alone (from 10 to 15 drops per dose) or in connection with the bitters.

Carbolic Acid, Creosote, and Other Aromatic Substances.—Very useful in these conditions are carbolic acid, creosote, and other aromatic substances obtained from wood tar. When given in small quantities they stimulate appetite and gastric digestion, which is probably aided by the antiseptic action of these drugs as they prove particularly valuable when motor disorders are associated with a depressive state of secretion. Carbolic acid is best administered in silver-coated pills in doses of 0.03 to 0.05 gm. (½ to ¾ gr.), creosote in similar doses in connection with oil (cod liver oil) in capsules, or in fluid form in connection with the tincture of gentian [creosote, 1.0 gm. (15 gr.); tincture of gentian, 5.0 gm. (75 gr.), 5 to 15 drops, well diluted in sugar water or sherry, and administered before meals].

Orexin Hydrochlorate.—Orexin hydrochlorate was recommended by Penzoldt in doses of 0.3 gm. (5 gr.) in powder or tablets as a very powerful stimulator of appetite and gastric secretion. Opinions as to its value vary greatly. It often irritates the stomach and is poorly tolerated.

Sodium Chlorid Waters.—We have already mentioned the stimulating effect which weak salt solutions have on gastric secretion. They may be advantageously employed in the form of natural sodium chlorid waters, which usually contain CO_2, another stimulator of gastric secretion. Waters belonging to this class are those of Saratoga in this country, Bourbonne in France, and Wiesbaden, Kissingen, and Homburg in Germany. It is true that many patients get better results from a treatment at a spa because they are free from work and care and submit more readily to the strict régime which goes with the treatment, but, as a rule, there is no necessity in cases of plain subacidity, for the patient to undergo the exertion and expense of a long journey. The waters can be taken systematically at home, using either the imported natural waters or waters prepared by dissolving the salts gained from the different springs. They display their stimulating action best in cases of subacidity connected with chronic gastritis and we shall discuss this special indication in the chapter on chronic gastritis. Even with plain functional subacidity they often prove beneficial, while little result can be expected from their employment in cases of complete achylia gastrica. The waters should be administered warm. In every case, whether taken at the spa or at home, great care should be taken to give only small or moderate quantities, about four to seven ounces before breakfast, and from three to five ounces before the other meals, leaving thirty to forty-five-minute intervals.

In cases where the secretory depression is associated with muscular atony and motor insufficiency only small doses should be allowed, and these only when they act beneficially; otherwise all these waters should

be prohibited. Where myasthenia is present the taking of large quantities of any of these waters may have a very deleterious effect.

Gastric Lavage

Gastric lavage is a decidedly more powerful means of stimulating gastric secretion than internal lavage by the drinking of these waters. We shall see later on that the stimulating effect of lavage is displayed to best advantage in all cases of chronic gastritis, with and without impaired motility. Yet it should be clearly stated that even in cases of pure functional subacidity lavage, when properly administered, often proves the most efficient method of stimulating the inactive glandular apparatus. This effect is due partly to the improved state of the circulation which follows repeated moderate distention and contraction of the stomach, and partly to the direct chemical influence of the fluid used for lavage. The great advantage of lavage is that the fluid, after acting, can be removed from the stomach. Even so not more than 300 c. c. should be poured into the stomach at a time, and this should be completely siphoned off in order to avoid over-distention.

Solutions may be administered by the so-called stomach douche, as first recommended by Kussmaul-Malbranc (87), instead of by ordinary lavage. In using a special douching tube, as devised by Rosenheim (108) and others, the irrigation under high pressure increases the stimulating effect by striking the walls of the stomach in many fine currents with considerable impetus.

We use for stimulating purposes solutions of sodium chlorid (one teaspoonful to one quart of water), or solutions of bitter tonics. Kussmaul (74) described the benefit of solutions of hops and quassia in his first article on gastric lavage, and Fleiner (45) thirty years later confirms the observations of Kussmaul made on an unusually large clinical material. Although not conforming with Pawlow's ideas, who believes that the bitters act only through their bitter taste, the application by lavage of solutions of bitters often has an unmistakable effect in improving appetite and gastric digestion. This clinical observation was corroborated by Hemmeter (61), who tried infusions of gentian and cinchona, and by others who employed these and other bitters (fluid *extract of condurango* 5.0:1,000.0 water). With me the application by lavage of solutions of bitters is one of the routine methods of treatment.

Gavage.—I wish to mention here another method of treatment which I learned in Kussmaul's clinic, and which I have employed ever since in suitable cases, often with striking benefit. In cases where depressive secretory disorders are the result of anemia and general asthenia, following acute or chronic infectious diseases and general nervous breakdowns, a vicious circle is created inasmuch as the diminished secretory activity interferes with digestion and consequently with

nutrition. It is particularly the lack of appetite, and not seldom an aversion to all kinds of food, which make it so difficult for patients of this type to take and digest an amount of food sufficiently large to raise the state of their nutrition. In such cases, and after gastric lavage, a meal consisting of a thick gruel or a soup of high nutritive value should be poured into the stomach before the tube is withdrawn. The stimulation of gastric secretion and of gastric activity as a whole, occasioned by lavage, puts the stomach in good condition for the digestive act, which sets in immediately and without the need of swallowing food on the part of the patient. Once this food is taken care of, it serves the system well not only by improving the state of nutrition in general but by raising the secretory activity of the stomach in particular. It is often remarkable how quickly in such cases the appetite returns for the other meals of the day, after lavage and forced feeding in the morning set the digestive activity agoing. The French have recommended and extensively used this method (gavage) in tuberculous patients, when the attempt to increase the state of nutrition meets with difficulties on account of depressive secretory disorders and lack of appetite.

ACUTE GASTRITIS

Various classifications have been made in regard to different forms of acute gastritis. The principal forms are: (1) The simple acute gastritis, usually caused by errors in diet; (2) the secondary acute gastritis, accompanying a great number of acute infections and febrile diseases; (3) the so-called toxic gastritis, following the ingestion of exogenous poisonous substances; (4) the phlegmonous gastritis.

We are dealing here exclusively with the first form of simple acute gastritis, which occurs as an original primary disease. The treatment of the secondary infectious gastritis is discussed in its respective chapter and the treatment of toxic gastritis under the heading of the different toxic substances.

It should be said, however, that in treating acute infectious gastritis the same rules obtain as in the treatment of primary gastritis and, furthermore, that the principles of after-treatment in toxic gastritis are essentially the same as those applied in severe cases of simple primary gastritis.

The phlegmonous gastritis, if a diagnosis could be made, should be treated surgically.

Simple Acute Gastritis

The treatment of simple gastritis must, in the first place, be prophylactic in all persons who are predisposed to the disorder and have had repeated attacks of it. They should avoid all the injurious influences which may affect the stomach from within and from without: Excessive indulgence in food and the overloading of the stomach with plain and, still more, with heavy and indigestible substances, exposure to rapid

changes of temperature with insufficient protection of the body; fatigue and undue excitement. Especially such patients as have enfeebled digestive organs should exercise discretion and avoid all these possible harmful influences.

The causes for acute gastritis vary greatly. With some people the taking of a different water is sufficient to bring on an attack. Every person susceptible to such disturbances should learn to avoid what is most harmful in his individual case.

In treating the attack itself we should keep in mind that acute gastritis undergoes spontaneous cure by the operation of two natural factors, namely, the evacuation of the stomach by vomiting and the period of rest which is imposed upon the organ by the suppression of appetite. In the majority of cases it is sufficient not to disturb the activity of these two factors.

When we find that the stomach still contains noxious material we should support the natural tendency of the organism and assist the stomach to rid itself of irritating contents. If emesis does not occur spontaneously it is the custom of many physicians to bring it about. With some patients the drinking of hot water or the tickling of the palate suffices. Some practitioners favor the administration of *emetics,* either given by mouth [20 gr. (1.3 gm.) of powdered ipecacuanha, followed in a few minutes by a tumblerful of hot water], or hypodermically in the form of ¼ gr. (0.016 gm.) of apomorphin. All substances like mustard, sulphate of copper, tartar emetic, which cause vomiting by direct irritation of the gastric mucosa, must be avoided, as they tend to increase the existing inflammation.

But even the more rational emetics (ipecac and apomorphin) should be used very reluctantly and only in case of great urgency, because all emetics have the great drawback that they produce a very depressing effect on some individuals and, furthermore, that vomiting, no matter in what way brought about, never completely removes the stagnating and irritating gastric contents.

Gastric Lavage.—All these disadvantages are avoided when, instead of employing emetics, we make use of the most effective means of thoroughly evacuating the stomach, namely, gastric lavage. The flushing of the stomach with plenty of warm water (containing some bicarbonate of soda) not only removes remnants of food, but also the thick and tenacious mucus which usually sticks to the mucosa and is a constant source of irritation, causing nausea, retching, and repeated vomiting, even after all food has been removed from the stomach. No other form of treatment subdues all these symptoms more quickly than lavage, and we should employ this most excellent remedy in all cases where persistent nausea or recurring vomiting of small quantities of mucus indicates the presence of irritating contents.

Repeated vomiting may prove very exhausting; therefore we should not readily dispense with this most effective method, persuading, if necessary, the patient to give up his prejudice to the procedure. The cleansing with plain (weakly alkaline) water may be followed by washing with a mild antiseptic solution when feasible. Hemmeter recommends for this purpose the following formula:

Thymol	0.5	gr. vii
Boric acid	16.0	ʒiv
Warm water	500.0	Oi

Evacuation of the Bowels.—The cleansing of the stomach should be followed by a thorough evacuation of the bowels. In trying to rid itself of its irritating contents the stomach expels some into the intestines, where they undergo fermentation, the products of which provoke diarrhea and frequently are the cause of continued gastric irritation and vomiting, only ceasing when the putrefying intestinal contents are removed. Energetic purgation has always been considered essential in the treatment of acute gastritis. Purgatives, however, should not be given before we are convinced that the stomach is empty in order to avoid forcing more fermenting gastric contents into the bowels. We should further avoid undue irritation by giving cathartics which the patient knows will cause irritation of the stomach.

Ordinarily castor oil is considered the most efficient drug; others prefer calomel, which is said to act directly as a gastric sedative in cases with persistent nausea and vomiting. Calomel is given in single doses of from 0.2 to 0.32 gm. (3 to 5 gr.), or in doses of 0.016 to 0.03 gm. (¼ to ½ gr.), repeated every hour until purgation takes place. In either case it should be followed by a saline cathartic, seidlitz powder, sulphate of sodium or magnesium, etc. Some authors prefer saline cathartics altogether.

The removal of the intestinal contents may also be effectually accomplished by thorough colon irrigations which follow the purgation by mouth or take its place when great irritability of the stomach makes it advisable to avoid purgatives. Colon irrigations are often of great assistance when used correctly at the beginning of the attack before the purgatives begin to act.

When nausea and retching persist, or when pyrosis is annoying, alkaline powders are indicated, and usually relieve the symptoms. Various mixtures may be made up by combining either magnesia or bismuth preparations with bicarbonate of soda, adding some resorcin or menthol preparations.

℞

Resorcin		0.1	gr. iss
Menthol		0.03	gr. ½
Mag. carb.		0.2	gr. 3
Sod. bicarb.		0.3	gr. v

M. ft. pulv.
Sig.—One powder every three hours.

℞

Bismuth subnit.			
Sodii bicarb.	āā	15.0	ʒiv
Magnesii (calcined)		10.0	ʒiiss

M. ft. pulv.
Sig.—½ teaspoonful every three hours.

℞

Sodii bicarb.		0.5	gr. vii
Resorcin		0.1	gr. iss

M. ft. pulv. d. tal. dos. No. X.
Sig.—One powder every two hours.

℞

Magnesii (calcined)			
Sodii bicarb.	āā	10.0	ʒiiss
Menthol		2.0	gr. xxx

M. ft. pulv.
Sig.—½ teaspoonful pro re nata followed by ʒiii of water (Hemmeter).

℞

Magnesii (calcined)	15.0	ʒiv
Elæosach. menth. pip.	5.0	ʒiss

M. ft. pulv.
Sig.—½ teaspoonful every three hours.

Alleviation of Pain.—Abdominal pain is best alleviated by the application of hot-water bags, hot poultices, turpentine stupes, or alcohol compresses. In febrile cases cold compresses or the ice bag are preferred. The pain is rarely so intense that it requires the hypodermic administration of morphin, 0.016 gm. (¼ gr.), and 0.0005 gm. (1-50 gr.) of atropin. Since morphin is liable to increase the tendency to vomiting *ext. opii,* 0.03 to 0.05 gm. (½ to ¾ gr.), in suppositories, or *codein,* also preferably in suppositories, 0.05 gm. (¾ gr.), per dose are more suitable in such cases, the dose to be repeated several times if necessary. Aside from this all medication should be omitted.

Diet.—The very important indication of putting the stomach completely at rest and thus giving the inflamed organ a chance to return to its normal condition necessitates total abstinence from food. A starvation period of one or two days is curative in these cases, and the more strictly the rule is observed the quicker the recovery. Even fluids should, if possible, be avoided. When thirst is very excessive cracked ice may be given in small quantities. In many cases small quantities of hot water are better tolerated and at the same time serve as an internal lavage.

With great exhaustion it may be necessary to add some champagne to the ice pills or some brandy and carbonated water in small quantities. It may further be advisable to supply some fluid and nutritive material by enemata consisting of saline solution and glucose.

After one or two days, according to the severity of the case, nourishment by mouth may be resumed. At first only fluids in small quantities should be allowed. When milk is tolerated it is a very suitable food, and is best given diluted with carbonated water; in other cases gruels, mutton broth, bouillon, or weak tea are preferable. In further enlarging the diet list preference should be given to soft, starchy foods. For several days the rule should be observed to have all food mechanically well prepared and free from fibrous and stringy parts, on the whole following the dietetic rules given in the chapter on depressive secretory disorders. Patients who are subject to attacks of acute gastritis should proceed slowly in returning to ordinary diet, in order to prevent the development of subacute or chronic gastritis. They should abstain from taking coarse food for several weeks.

If, after the acute attack, symptoms of gastric irritation (soreness, pyrosis, etc.) continue, alkaline powders or an alkaline water (Vichy) may be of great aid and may be continued with benefit for several weeks.

In other cases with failing appetite and protracted weakness hydrochloric acid is of greater service. Not infrequently, however, hydrochloric acid, when given on an empty stomach, provokes pain by irritating the hypersensitive mucous membrane and should therefore be given well diluted and after meals. Before meals we give tinct. nucis vomicæ (5 to 15 drops) or some of the bitters; tinct. aurantii, tinct. gentiani. comp., tinct. cinchona comp., fluid extract of condurango, of each from 15 to 25 drops.

As a general rule, however, it is better to abstain from overstimulating gastric activity, but to allow the stomach to rest and so return unaided to its normal condition.

CHRONIC GASTRITIS

The term chronic gastritis, formerly much abused and applied to the most varied gastric disorders, comprises only cases in which gastric

analysis demonstrates an increased secretion of mucus usually carrying cellular elements as a sign of anatomical alterations of the mucosa. The secretion of hydrochloric acid is diminished or absent.

Chronic Mucous Gastritis.—In a certain group of these cases during an earlier stage the increase of mucus is associated with hyperacidity and hypersecretion (acid gastritis). The treatment of this special form is discussed under irritative gastric disorders. It is frequently observed in alcoholics and, although in some of these cases the irritative secretory disorder may remain unchanged during many years, there is a tendency in others to develop into mucous gastritis, the secretion of acid and ferments gradually diminishing with a progressive destruction of the peptic glands until finally complete atrophy of the glandular mucosa is established. This state of chronic atrophic gastritis is also observed in nonalcoholic forms of chronic mucous gastritis. When this state is reached it presents principally complete lack of gastric secretion. The treatment of this condition is discussed under achylia gastrica.

We are then dealing here with the treatment of chronic mucous gastritis only.

Primary and Secondary Chronic Gastritis

It is customary to distinguish between primary and secondary chronic gastritis. While for purposes of description the separation into primary and secondary forms may be practical, yet we should remember that in many cases of so-called secondary chronic gastritis the same harmful influence which causes the disease of the remote organ also provokes a primary gastritis by direct deleterious action on the stomach, so that we have a combination of primary and secondary gastritis, for instance, in alcoholic affections of the heart, liver, and kidneys, in gout, diabetes, chronic nephritis, etc. This shows the necessity for treating many cases of secondary gastritis not only indirectly by attending to the disease of any other organ which is one causative factor in its development, but also by dealing directly with the diseased stomach.

For both forms, primary and secondary gastritis, we have to consider first of all the causative treatment, which means at the same time the best method of prophylaxis when undertaken during the earlier stages of development.

We should eliminate, if possible, the causative factor which has caused the disease: Constant abuse of alcohol is responsible for the majority of cases; next to alcohol ranges tobacco, both when smoked (particularly when inhaled) and when chewed. The individual tolerance for these toxic substances varies greatly; a quantity which acts deleteriously with one person is harmless for another. The same feature of different individual tolerance will be observed in regard to other direct causes of

chronic gastritis; habitual overindulgence in highly seasoned and rich courses, frequent overloading of the stomach with indigestible and fermentable articles of food, hurried eating and bolting of poorly masticated food, especially when meals are taken while under high mental pressure or during periods of great excitement; abuse of iced water and iced drinks of different kinds, so common in this country; habitual or long-continued use of drugs (iodids, salicylates, quinin, mercury, arsenic, silver, cubebs, sandalwood, etc.). We must mention as a very frequent cause the abuse of purgatives, in particular of concentrated saline cathartics which I have found as a causative factor in a high percentage of my cases. In another group we have to put the blame on overindulgence in strong tea or coffee. All these causes prove particularly harmful in people who are predisposed on account of anemia or when general weakness and neurasthenia lessen their power of resistance. Among the direct causes of chronic gastritis we further count diseases of the teeth and gums, which act by the harmful influence of swallowed products of decay and pus and not less so by preventing proper mastication.

Secondary Chronic Gastritis

In secondary chronic gastritis the treatment of the primary disease is of the utmost importance and should always be combined with the direct treatment of the gastric disorder.

Chronic gastritis is frequently associated with other diseases of the stomach, as cancer, the latter stages of peptic ulcer, motor disorders, displacement of the organ, especially by the effect of adhesions, etc. In arranging a plan of treatment we have to take these factors into account.

The most frequent occurrence of secondary gastritis is observed in all diseases which lead to chronic venous congestion of the stomach by disturbances of circulation, diseases of the heart, the lungs, and the liver. The direct treatment of these diseases often proves the best means of combating chronic gastritis as, with improvement of circulation, the state of engorgement of the gastric mucosa is removed or diminished. Thus we understand the very beneficial effect which often follows the use of digitalis, even when this drug temporarily aggravates the gastric condition. In such cases the hypodermic administration of modern digitalis preparations is preferable and of great value. Great improvement follows the action of digitalis and other heart tonics in those cases of secondary gastritis which are caused by chronic nephritis.

The treatment of the underlying cause plays a great rôle in all cases where chronic gastritis is secondary to metabolic derangements as the uric acid diathesis, gout, diabetes, to diseases of the urinary tract, or to chronic infectious diseases. We must particularly mention here tuberculosis, in which the symptoms of chronic gastritis are often so prominent

that in incipient cases they completely overshadow the primary disease. While the proper attention to the gastric disorder will invariably assist us in improving the state of nutrition great care should be used to avoid in such cases a diet which leads to underfeeding of the patient. On the other hand, in such cases we should be very careful with forced feeding, which, as a rule, is indiscriminately recommended for all tuberculous patients. I have frequently seen disregard of an existing gastritis greatly aggravate the digestive disturbance and so lead to dismal failure of the attempt to improve the general nutrition.

The consideration of the causative factors should always be combined with the direct treatment of the diseased stomach in secondary as much as in primary gastritis. Too often the physician is satisfied with directing all attention to the treatment of the primary disease of the heart, the lungs, the kidney, etc. It should be expressly stated that in improving the condition of the stomach by direct treatment we greatly assist the causative treatment of the underlying disease.

Gastric Lavage.—The treatment *par excellence* is gastric lavage. Its advantages are many. It answers the most important indication of removing the mucus, which when adherent to the mucosa prevents its secretory activity and, when mixed with the ingesta, prohibits the intimate contact of gastric juice and food. Lavage further directly stimulates the sluggish gastric secretion and improves the state of the mucosa, by promoting its circulation. The beneficial action of lavage can be greatly enhanced by the use of different solutions. Mucus is not very soluble in ordinary water. We have to add one teaspoonful of bicarbonate of soda to a quart of warm water, or one teaspoonful of a mixture corresponding to the ingredients of the water of Ems (2 parts sodium chlorid and one part sod. bicarbonate). Mucus is more effectually removed when lavage is given under high pressure. After washing two or three times with such solutions, I often employ lime water with very good results (one part of lime water diluted with one to four parts of distilled water; total amount of mixture, 300 c. c.). Lime water acts as a solvent of mucus and as an astringent. Harnack (55) states that it is the only drug which combines both qualities. Solutions of sodium bicarbonate and of sodium chlorid merely dissolve the mucus. Other astringents, instead of dissolving, coagulate mucus. Lime water has the great advantage of first dissolving the layer of mucus and then reaching the deeper layers of the mucosa and acting as an astringent.

When the amount of mucus is not excessive dilute solutions of zinc sulphate are useful as astringents (1:5,000, gradually increased to 1:1,000). The application of *silver nitrate* (in similar solutions) is recommended in cases which show gastric hyperesthesia and frequent pain. Some authors attribute the pain to the presence of erosions and ulcerations, which develop in certain cases of chronic mucous gastritis (ulcerative chronic gastritis). The great vulnerability of the mucous membrane in chronic gastritis is often manifested by the appearance in the wash water of small pieces of mucous membrane detached by the traumatic

effect of the tube. There is no justification for basing on the finding of these fragments of mucosa a special form of gastritis [Erosions—Einhorn (35); gastritis exfoliativa].

When chronic gastritis is associated with motor disorders lavage is especially indicated for removing stagnating and fermenting masses. In such cases we may use for final lavage antiseptic solutions: salicylic acid 1:1,000; boric acid 5:1,000; resorcin 2:1,000; thymol 1:2,000; hydrochloric acid 5:1,000. The removal of irritating substances is further an indication for lavage in chronic nephritis, when the stomach eliminates urea and other products of metabolism. I have frequently observed great improvement result from gastric lavage, when the presence of these substances in the stomach caused persistent nausea, vomiting, foul tongue, etc. There are many other conditions in which the stomach serves as an *excretory* organ and where the excreted substances are the cause of gastric irritation and of chronic gastritis. In all such conditions lavage is an excellent form of treatment. When lack of appetite is a prominent feature we use weak solutions of hops, quassia, and other bitters for final lavage, of which some may be left in the stomach.

The frequency of lavage depends on the severity of the case and on the progress effected by the treatment. When much mucus is formed, and particularly when stagnation of food is present, daily lavage is indicated and best performed in the morning, when it prepares the stomach for the day's activity. In cases of severe character with stagnation and pronounced fermentation it may be advisable to perform lavage before the evening meal; or both on a fasting stomach and in the evening. We diminish the frequency of the treatments with symptoms of improvement, giving lavage every other day, then every third day, and finally once a week. In many cases the improvement which follows lavage sets in remarkably soon after a few applications, manifested by the greatly diminished amount of mucus, the lessened discomfort, the increased appetite, and other signs of improved gastric activity.

The drinking of suitable natural and artificial mineral waters is often described as internal lavage. Its effect is increased when the patient, after drinking the water, rolls around to get the water thoroughly in contact with the stomach wall. Even used in this way it is only a poor substitute for lavage by means of the tube. Still the drinking of these waters is helpful and should be recommended for days when no lavage is given and after lavage is stopped altogether. They may be taken for long periods of time. Considering the diminished state of secretion the sodium chlorid waters are indicated as described under depressive secretory disorders, to which we here refer. Under this heading will also be found the rules for regulating the diet and for medication, which, with chronic gastritis, are essentially those given for depressive secretory disorders in general.

We wish to point out here the great importance of regulating the activity of the bowels. In many instances the chronic gastritis proves intractable as long as intestinal disturbances prevail. Under the heading depressive secretory disorders we described the diet which is indicated when diarrhea is present, avoiding in the first place all albuminous food, which is liable to undergo intestinal putrefaction. The effect of proper dieting can be greatly supported by systematic colon irrigations, which prove of high value particularly at the beginning of the treatment in thoroughly removing all putrefying intestinal contents.

Constipation should be treated dietetically by increasing the amount of well-prepared vegetables and stewed fruits, by adding honey or milk-sugar to breakfast foods, by giving buttermilk, sour milk, and other fermented milks. If not efficient, enemas, colon irrigations, or oil enemata are in place. Cathartics per os should be omitted. When they cannot be avoided the very mildest are indicated, preferably small doses of vegetable cathartics, cascara, rhubarb, etc. Strong saline cathartics are permitted only when chronic gastritis is associated with a state of pronounced abdominal plethora (congestion and cirrhosis of the liver, cardiac insufficiency with intense abdominal congestion). In all other cases strong saline cathartics only aggravate the inflammatory changes of the gastric mucosa and should be forbidden.

Very helpful in the treatment of chronic gastritis, especially when combined with constipation, are different methods of gymnastics, of general and abdominal massage, and of various electric and hydrotherapeutic measures. They are all applied with the intention of improving the circulatory conditions in the abdomen and its organs with the effect of raising the tonicity of the abdominal wall as well as of the stomach and intestines. They often accomplish this task when judiciously employed. Too frequently, however, these methods are overdone, with the result that they lower instead of raise abdominal circulation and tonicity. The general advice given to patients to use one or the other or several of these methods is inadequate; there should be an exact dosage prescribed and regulated according to its effect.

CARCINOMA OF THE STOMACH

The only possible curative method of treatment for cancer of the stomach at present is its removal by the knife. In every case when a diagnosis is made the question should be considered at once whether the state of nutrition and the blood condition permit of an exploratory laparotomy. Before opening the abdomen it is not possible to say whether complete resection of the affected area is still possible. The size of the tumor is not the decisive factor, it is the existence of adhesions to other organs and the presence of metastases.

Personal experience gained at operations has convinced me that certain tumors which appeared large on palpation were still removable, occasionally with a good deal less difficulty than anticipated. Large size of the tumor therefore should not influence us too much against undertaking operation, particularly when we consider that the anatomical conditions of the stomach are very favorable for a complete removal of the growth in so far as the arrangement of lymph ducts and glands does not tend to a rapid spread of metastases.

The statement frequently quoted that it is too late for a successful operation once a tumor is palpated should not be taken literally. When the general condition of the patient permits, exploration is permissible. As a rule, however, at this period we find the tumor fixed by adhesions to such an extent that its removal is out of the question.

We must operate at an earlier date and in order to accomplish this I would speak very emphatically in favor of exploratory laparotomy when the suspicion of a developing cancer is sufficiently substantiated by some objective findings and before a positive diagnosis is made by the palpation of a distinct tumor. I am far from advocating laparotomy in every case presenting persistent dyspepsia and malnutrition. The suspicion of a gastric cancer must be based upon some objective finding, which often could be had if only looked for. This is not the place to discuss the early diagnosis of gastric cancer. It is, however, not superfluous to state that in the majority of cancer cases which have come to my personal knowledge no previous examination of stomach contents had been performed, although the whole course of the case must have suggested the possibility of a cancerous growth for many months.

If gastric analysis were done more regularly physicians would more frequently be in a position to strengthen the suspicion of a cancerous growth. When corroborated by findings of gastric analysis, by the result of X-ray examination, or by any other objective symptoms, suspicion is sufficient indication for an exploratory laparotomy. The suspicion of carcinoma should furthermore be entertained in every case of chronic ulcer proving intractable to medical treatment. This point is discussed under the heading surgical treatment of gastric ulcer and, while not ready to admit that 70 per cent. of all gastric cancer cases develop on the base of chronic ulcer, yet the cancerous degeneration of ulcers is frequent enough to justify the suspicion of cancerous development in every case which does not yield to persistent medical treatment. Here, too, the suspicion warrants early exploration.

It is true that the percentage of cases is small in which we find resection still feasible. We further find the percentage small when figuring the number of cases which, after successful resection, remain free from metastases for a more or less protracted period of time. Considering, however, that cases have been reported with a period of freedom amounting to from 10 to 12 years and more, an attempt at early resection should always be the main object in dealing with gastric cancer.

Radium and other means aiming at a radical cure have not been sufficiently tried out.

All other attempts at treatment are of necessity merely *symptomatic* and *palliative*. The fact that he is dealing with an incurable case leads the physician too often into the mistake of leaving the management of his case to the patient himself, or to nurses and members of the family. We should remember that these patients are sadly in need of our moral support and, further, that a great deal can be done by the conscientious physician to alleviate the suffering of his charge and eventually to prolong his life. While this task is not an easy one, and may become very trying in cases of long duration, yet it is worthy of an experienced mind and has its rewards in spite of the hopelessness of the condition.

Diet.—We must, in the first place, try to properly feed the patient, in order to keep up as long as possible his strength and the state of his nutrition. The arrangement of a diet, particularly in cases of prolonged duration, is often the most difficult part of the treatment. Complete lack of appetite and aversion to food may greatly tax the resources of the physician. We have to resort to advising all kinds of delicacies, to constant changes in the bill of fare, and must continually find other ways of preparing foods. In doing so we should always consult and follow the tendencies and even the whims of the patient rather than adhere strictly to a preconceived plan of dieting. Proceeding in this fashion we are often surprised to find certain foods, generally excluded from an invalid's diet, better tolerated than those recommended in such diet schemes. It is wise, however, to stipulate as a general rule that all food be mechanically well prepared and, if possible, finely divided so as to tax the activity of the stomach as little as possible and to facilitate its quick egress from the stomach. The selection of different types of food depends to a great extent on the state of gastric secretion. In cases which develop on the base of a chronic ulcer, acid hypersecretion often continues up to a very late stage of the cancerous growth. In such cases the diet should be arranged according to the rules given for irritative gastric disorders, permitting in particular the different kinds of lean meats, fish and poultry, milk, eggs, vegetable purées, etc. This kind of a mixed diet should further be advised in cases without hyperacidity as long as no aversion arises for meat and similar foods.

Aversion to meat and other animal food is frequently an early symptom of that type of carcinoma which is usually located at the fundus of the stomach, causes atrophy of the gastric peptic glands and complete lack of secretion. Here meat and similar food should be eliminated and a diet arranged conforming with the rules given in the chapter on depressive secretory disorders, consisting principally of milk, farinaceous and starchy foods, purées of vegetables and of fruits, etc. Whatever type of

food is chosen, it must be thoroughly prepared and should be presented in a palatable form. The individual meal should not be bulky and an interval of sufficient length should be allowed to facilitate the evacuation of the organ.

Drugs.—In prescribing drugs also we have to distinguish between the two different states of secretory disorder. As long as hyperacidity and hypersecretion are present alkalies are indicated and often are of great value in relieving pain and discomfort. When lack of secretion is noted liberal use should be made of hydrochloric acid, the bitters, in particular the different condurango preparations, nux vomica, and all other drugs meant to stimulate appetite and gastric activity, as described in the chapter on depressive secretory disorders, to which we refer for details.

Lavage.—The most effective stimulator of appetite and gastric activity in general is gastric lavage, which, when properly handled, is by far the most valuable method of palliative treatment in gastric cancer. All the advantages which we described as going with gastric lavage when applied in cases of chronic gastritis, with irritative as well as with depressive secretory disorders, are observed in the same manner in cases of carcinoma. By removing stagnating and fermenting masses lavage relieves discomfort, pain, and vomiting, it stimulates sluggish gastric secretion and increases the appetite, it facilitates the egress of chyme from the stomach, all of which greatly helps to raise the state of nutrition. Lavage proves beneficial further by removing toxic products of fermentation and putrefying masses from decaying tumors, often distinctly reducing the symptoms of severe autointoxication.

According to the type of fermentation we employ either alkaline or sodium chlorid solutions; we further make use of antiseptic solutions or of infusions of bitters when attempting to stimulate secretory activity. These methods of lavage are described in the chapters on irritative and depressive secretory disorders.

The frequency of lavage depends on the degree of stagnation and on the severity of the subjective suffering. In most cases daily lavage of the fasting stomach is sufficient. Patients who are disturbed by pain and vomiting during the night are greatly relieved and secure sleep after evacuating the stomach late in the evening or during the night. In some cases we have to do lavage twice a day. Most of these patients learn to lavage themselves, and once they realize the great relief which follows it they insist upon its systematic application. Since no harm can be done the patient should be given a free hand in employing this valuable method of treatment. Not infrequently the effect of methodical lavage seems to go further than relieving suffering and improving nutrition. From my own experience I can endorse the statement of Fleiner (45), who observed a slower development of the cancerous growth in patients who systematically continued lavage for a long period of time.

Gastroenterostomy.—Similarly we may meet with an arrest of cancerous growth after gastroenterostomy. When pyloric obstruction is pronounced and symptoms of gastric dilatation continue to be annoying in spite of lavage and dietetic treatment gastroenterostomy should be performed, if feasible. The relief of symptoms after successful gastroenterostomy is sometimes so marked, and the gain in weight so great, that doubt may arise regarding the correctness of the diagnosis. Still, however great the immediate result of gastroenterostomy or methodical lavage may be, these palliative methods do not prevent the development of metastases, which usher in the final state of the condition.

Alleviation of Suffering.—During the last period treatment can have only the object of relieving the patient of all possible suffering. To accomplish this we must make liberal use of narcotics, preferably given by rectum or hypodermically. Codein, opium, chloral hydrate, veronal, and, most important of them all, *morphin,* given hypodermically. Morphin not only relieves pain, but it has the wonderful effect of deceiving the patient about his condition and thereby proves such a powerful help that the physician should never hesitate to administer it, even when gradually larger and larger doses are required. The probability that with a long-protracted course of the disease the patient may become a confirmed morphin fiend should not interfere with the liberal use of a drug which, in these cases, means a blessing for hopeless sufferers.

SYPHILIS OF THE STOMACH

The Wassermann test will probably help to clear up the question whether syphilis of the stomach is rare, as Chiari's (29) thorough anatomical investigations would indicate, or of frequent occurrence, as some authors (Neumann, 97; Einhorn, 35; and others) would have it, who base their claim on clinical data. The mere fact that the patient has had syphilis is certainly not sufficient to settle the diagnosis. For practical purposes, however, we do well to remember Hayem's (58) proposition: always to think of syphilis when confronted with serious stomach trouble of obscure nature. The good results obtained in such cases by antiluetic treatment, after they had resisted all other forms of treatment, justify the application of antiluetic treatment not only when a positive diagnosis is made, but also when the suspicion is sufficiently corroborated. Aside from the specific treatment by salvarsan, mercury, iodid, etc., the gastric disorder may call for special local treatment.

Syphilis of the stomach presents itself in the form of chronic gastritis, gastric ulcer, gumma, and fibrous-hyperplastic infiltration.

Chronic Gastritis.—According to Neumann (97), chronic gastritis is the most frequent manifestation of visceral syphilis, occurring during all

the different stages of the disease. It differs symptomatically in no way from gastritis of other origin and should be treated along the same lines. When it is present the administration by mouth of antiluetic remedies, particularly of mercury, should be omitted. Great care should be exercised in prescribing iodids when hyperacidity is noted. The excess of hydrochloric acid, by freeing iodin, is liable to provoke iodism. It is therefore advisable to give iodids only when the stomach is free from acid contents and to administer them always in connection with large quantities of alkalies (bicarbonate of soda or magnesia preparations).

Gastric Ulcer.—Gastric ulcer of syphilitic origin shows identically the same symptomatology as an ulcer caused by other factors. While the general principles of treatment remain the same in every way for the syphilitic form as for others, yet the antiluetic treatment may be of paramount importance. Particularly in cases of uncontrollable gastric hemorrhage we should always think of a possible syphilitic origin. Fournier (50), Dieulafoy (33), and Hayem (58) have reported cases of uncontrollable hemorrhage in which all other treatment failed and complete cure was established by giving mercury and iodids. *Perforation* calls for immediate surgical interference. With pyloric obstruction, however, a thorough antiluetic treatment should be instituted before proceeding to operate.

When the obstruction is caused by the inflammatory swelling of an active syphilitic ulcer the specific treatment may yield a complete cure.

Pyloric obstruction caused by the scar tissue of a healed ulcer requires surgical interference in syphilitic cases exactly as in others. The indication for operative treatment is also the same for syphilitic as for other forms of indurated chronic ulcer of the fundus when it proves intractable to medical methods of treatment.

Gumma.—Gumma of the stomach is rarely diagnosed. When the tumor is palpated it arouses the suspicion of carcinoma. If a diagnosis of syphilis is made, or even with a well-supported suspicion, energetic antiluetic treatment is imperative. When the diagnosis is doubtful exploratory laparotomy and excision of a small piece may clear up the situation, as it did in a case reported by Lafleur (77), who found a gummatous ulcer causing an hour-glass stomach, and thereupon administered mercury.

Pyloric obstruction caused by a gumma may be perfectly cured by antiluetic treatment. If the obstruction is pronounced and the patient greatly reduced in weight it may be advisable, according to Brunner's (24) views and statistics, to first perform gastroenterostomy and then follow it up with energetic antiluetic treatment.

Fibrous-hyperplastic Infiltration.—The same indication for surgical interference may turn up when Fournier's (51, 52) syphilitic fibrous-hyperplastic infiltration causes pyloric obstruction, as in cases published by Gross (54), Hemmeter-Stokes (62), and others. How far salvarsan

treatment will permit the postponement of surgical interference in pyloric obstruction of that and other types remains to be seen.

MOTOR DISORDERS OF THE STOMACH

Motor disorders are frequently symptoms of other diseases of the stomach (hypersecretion, gastritis, ulcer, cancer, etc.), and should then be treated in connection with the disease with which they are found associated. Motor disorders of this type have been classified as secondary when compared with another group in which they form the main disturbance and appear to be of independent character. Upon closer examination, however, it will be seen that even these so-called primary motor disorders are almost invariably symptoms of other conditions, of systemic diseases, of diseases of the blood and of the nervous system; so that it is always essential to clear up the underlying cause if treatment is to be successful.

The attempt to classify more completely the different types of motor disorders has created a good deal of confusion, inasmuch as one author bases his differentiation upon disturbances of function (for instance, lack of tone and diminished peristalsis—atony), another upon the result of the disturbed function (delayed evacuation—motor insufficiency of first degree; stagnation—motor insufficiency of second degree), while a third classification describes anatomical conditions (dilatation of the stomach, etc.).

Although it is of great importance for the understanding and for the treatment of the individual case to analyze the different features of the disturbance, for our purposes of description it is more practical to adhere to the old classification of "Atony" and "Dilatation." Both terms represent well-defined clinical pictures, observed in distinct groups of patients, and, while named according to the rule, "a potiori fit denominatio," each picture in a different degree presents on closer inspection, combined or successively, the different features of disturbed motor function, its effect on evacuation, and eventually anatomical changes, all intimately related.

Gastric Atony

(*Myasthenia Gastrica*)

Fenwick characterizes gastric atony as "a diminution of the elasticity and strength of the muscular coat of the stomach, whereby the organ is rendered unduly distensible and is prevented from emptying itself within the normal period of time."

Lack of tonicity may cause a great deal of discomfort and is the most frequent disturbance encountered in cases of so-called nervous dyspepsia.

The effect of diminished peristalsis on the evacuation of the viscus varies greatly in different patients and with the individual patient at different periods. Some patients experience periodically a state of more pronounced motor insufficiency, either caused by undue overloading of the stomach or as an effect of constitutional derangements (for instance, in migraine). During such periods it may happen that the stomach does not empty itself over night, while ordinarily "stagnation" does not occur in gastric atony.

Gastric atony, when not associated with other gastric diseases (gastritis, ulcer, etc.), is not a strictly local disease of the stomach. It is either caused by anemia and subnutrition, particularly when connected with acute and chronic infectious diseases (tuberculosis, syphilis, etc.) or intoxication, or it is the effect of derangements in the nervous system (neurasthenia). In the vast majority of cases in which gastric atony is the predominant disturbance it is the symptom of a condition which Stiller (121) first described as "congenital general asthenia," usually observed in patients showing the habitus enteroptoticus.

The knowledge of the nature of the underlying cause is of paramount importance for a proper treatment. We shall discuss here in the main the last-named form, which is caused by a derangement in the nervous system. The general principles of treatment are the same for other forms which, in addition, require treatment of the concomitant chlorosis, tuberculosis, etc.

When a tendency to gastric atony is inherited, its treatment should begin during infancy. Children of this type should be educated with a view of developing the physical rather than the mental activity of the system.

During the later periods of life these patients are often greatly handicapped by frequent attacks of dyspepsia and consequent malnutrition, unless they make up their minds to live strictly within the limits of their inherited means. They must be taught to realize that the disposition to weakness and relaxation of the muscular system in general, and of the stomach in particular, is with them a constitutional shortcoming, which they have to reckon with in arranging their mode of life and diet. They must avoid overtaxing the system by physical and mental strain, undue excitement or worry, overindulgence in sexual affairs, in eating, drinking, smoking, etc. Not only the patient, but the physician as well, should bear in mind the constitutional limitations of his patient when advising treatment for him. These patients are usually undernourished, and on consulting physicians are generally urged to first of all increase their weight by liberal eating. While it is undoubtedly an important part of the treatment to raise the state of nutrition, yet this should not be done at the cost of aggravating the motor disturbance of the stomach. Especially when a "rest cure" is prescribed for these patients, which in itself may

be needed and advisable, the mistake is often made of ordering large quantities of food, and particularly of milk. The large and frequent meals prescribed in the routine scheme of a rest cure tend to exhaust the muscular power of the stomach, and it thus frequently happens that these patients date the beginning of their gastric suffering from the time when they underwent a rest cure. Similarly we find that patients refer the onset of gastric ailments to the time when they were convalescent from an operation or from an acute infectious disease and had an atonic stomach overloaded by large quantities of fluid and semifluid foods.

Diet.—In arranging a diet in gastric atony we have to meet two indications, first, to provide nutritive material in sufficient quantity to improve the general nutrition and, secondly, to give it in such a form that it will tax the muscular activity of the stomach as little as possible. A diet consisting principally of nutritive fluids such as milk, thick soups, etc., has been recommended as particularly suitable on account of the observation that fluids leave the stomach quicker than solids. In selected cases such a diet is well tolerated and helpful if not continued for too long a period of time. As a rule, however, the quantities required for improving nutrition in these cases are so large that they are apt to overdistend the stomach and thereby still further weaken the enfeebled walls of the viscus instead of raising their tonicity. In order to avoid over-distention another device proposes to exclude fluids altogether, putting the patient on a so-called "dry diet." This form of diet is especially recommended for patients who have to go about working; for patients who can afford to rest there is less danger from over-distention by fluids when in a recumbent position. Occasionally I have had good results from putting suitable cases on a dry diet for a limited period of time. As a general principle, however, it is not advisable to enforce a "dry diet" for long periods of time. Moritz (94) has shown that all solid food has to be liquefied by the secretions of the stomach, so that no great gain is derived from a dry diet which, on the contrary, may make great demands on the activity of the stomach in calling for the secretion of the necessary fluid.

In the majority of cases it is therefore better to avoid both schemes, a diet consisting only of fluids as well as a dry diet.

I would say, however, that it is often a good plan to have the individual meal consist either only of fluids or of dry food.

In regard to *fluids* we would stipulate the following rules: Milk and thick soups of high nutritive value may be tried and, when tolerated, allowed in moderate quantities, not exceeding 6 oz. at a time. They should not be given together with other (solid) food, but as a meal by themselves. Fluids without nutritive value should be avoided as far as possible, although in milder cases small quantities of weak tea or cocoa for breakfast often act as a stimulant. Water is either omitted altogether for

a certain period or given in moderate quantities between meals, but under no condition with meals. Particularly harmful are waters charged with CO_2 which, when freed, greatly distends the enfeebled wall of the stomach. For the same reason are forbidden all fermentable drinks (beer, lemonade, etc.).

All *solid* food should be thoroughly prepared, mechanically finely divided, and, if possible, puréed so that it may leave the stomach in quick order. In selecting and preparing different types of food due consideration should be given to concomitant secretory disorders of the stomach, according to the rules given for irritative and depressive secretory disorders.

Preference should always be given to those articles of food which have comparatively high nutritive value in a small volume. When permitted, well selected lean animal food (meat, fish, poultry, eggs) properly prepared is the most suitable food in this respect. When vegetables are indicated those which are voluminous without being nutritive should be avoided altogether (cabbage, tomatoes, salads, etc.). Starchy vegetables and cereals are especially well tolerated in cases of subacidity. Butter, cream, and oil add greatly to the nutritive value of the meal when not contraindicated on account of acid fermentation. They further prove valuable in cases with sluggish activity of the bowels. When constipation is present we should further add purées of stewed fruits, honey, milk-sugar, and malt extract. Whatever food is permitted, should be taken in moderate quantities; the rule should further be observed not to give too many different courses at an individual meal.

Some of these patients feel more comfortable when taking three principal meals of about equal size, giving the stomach between the meals the necessary periods of rest. In other cases it is preferable to give meals consisting of moderate quantities at shorter intervals. The atonic stomach disposes of its contents in shorter time when the patient rests after meals, preferably in the recumbent position.

Medicinal Treatment.—Medicinal treatment plays an inferior rôle in gastric atony. Drugs are recommended for various purposes. It should be stated, however, that good judgment must be exercised lest they do more harm than good. The secretory activity of the stomach deserves full consideration; when hyperacidity is noted we prescribe alkalies, in cases of subacidity hydrochloric acid. Adequate treatment of secretory disorders always benefits the motor activity.

A good deal of restraint should be exercised when atony is associated with gastritis, inasmuch as most drugs are apt to act deleteriously on the gastric mucosa and thus indirectly aggravate the atony of the muscular coat. Dietetic treatment and lavage prove a much better stimulant in such cases than drugs. This applies particularly to most of the so-called *antiseptic* and *antifermentative remedies* which produce very small results

unless the motor disorder is effectively combated by the methods of treatment and a quicker evacuation of the stomach accomplished. Prevention of stagnation is the most reliable antiseptic. Of drugs usually recommended as *antiseptics* I mention: salicylic acid 0.32 to 0.65 gm. (5 to 10 gr.), salol 0.32 to 0.65 gm. (5 to 10 gr.), resorcin 0.32 to 0.65 gm. (5 to 10 gr.), creosote, carbolic acid pills 0.03 to 0.065 gm. (½ to 1 gr.).

For *flatulency* peppermint, aromatic spirits of ammonia, ol. cajuputi, charcoal mixtures, validol (5 to 10 drops), etc., are much in use.

As a direct stimulant of the muscular coat we employ *strychnin* or *nux vomica,* either alone or combined with bitters (gentian, columba, etc.). Although some authors maintain that strychnin merely improves the appetite, and that its direct effect upon the musculature is nil, yet it seems to be the general consensus of opinion among practitioners that it has a decidedly beneficial effect in gastric atony. Other drugs advised as directly stimulating the musculature (*ergot, hydrastis*) are not recommendable on account of their harmful action on the gastric mucosa.

Gastric Lavage.—By far the most powerful and the most reliable stimulant of motor activity is gastric lavage, particularly in the form of the stomach douche. Its application is absolutely necessary whenever, during the course of these cases, stagnation occurs and food remnants are found in the fasting stomach. Even in cases without stagnation lavage always proves beneficial when properly applied. When giving lavage by the stomach douche under high pressure, somewhat cooler water may be employed. Alkaline or sodium chlorid solutions are used according to the state of secretion, antiseptic solutions in case of fermentation, and infusions of bitters when we intend to stimulate secretion.

Evacuation of the Bowels.—As in most cases of gastric disorder regular evacuation of the bowels is of great importance. We must, however, warn against the employment of concentrated saline cathartics and of drastic purgatives, which almost invariably do more harm than good in gastric atony. We should always select the mildest remedies, which are usually the most effective. While methodical drinking cures of natural mineral waters are not indicated, yet the taking in the morning of a small glass of Vichy, Kissingen, or some other appropriate natural water is frequently effective in promoting evacuation. Or we advise cleansing enemas, or small doses of cascara, rhubarb, sulphur, and similar drugs. Only the smallest dose which is effective should be given.

Mechanical Treatment.—As a rule the activity of the bowels is simultaneously benefited by a number of mechanical methods of treatment which are employed in these cases with the intention of improving the muscular activity of the stomach. We refer to different outdoor and indoor forms of exercise and gymnastics, hydrotherapeutic measures of general and local character (hot and cold compresses, Priessnitz bandages, abdominal douches, etc.), to general and abdominal massage, to vibration,

and to different electrical treatments. The main effect of all these measures is this, that they promote the abdominal circulation, thereby indirectly improving the muscular activity of the stomach and intestines. It is claimed that massage directly stimulates the muscular coat. Whether faradization exercises any direct influence upon the muscular coat is more than doubtful, whether given intragastrically or percutaneously. Personally I have always preferred the percutaneous application of the faradic and of combined faradic and galvanic (sinusoidal) currents, since it permits of administering stronger currents and this, at all events, produces a decided improvement of abdominal circulation. When judiciously employed any of these methods may improve gastric atony. However, we wish to point out here once more the absolute necessity of properly considering the constitutional element which is the predominant factor in these cases. In prescribing and administering mechanical methods of treatment we must always bear in mind the constitutional limitations of the patient. A great deal of harm is done by advising the patient in a general way "to take exercise" or by having him undergo vigorous treatment, which overtaxes his resources, with the result of still further weakening the muscular activity instead of strengthening it. All these methods of treatment require careful dosage just as much as the administration of drugs. We should particularly avoid employing several of these methods at one time.

Acute Dilatation of the Stomach

Although long known to internists, acute dilatation of the stomach has recently become a topic of great interest, since its frequent occurrence after operations has been noted. Paresis of the stomach, accompanied by excessive secretion of gastric juice, is observed as an effect of the toxic action of the anesthetic after operations of every kind, and may be aggravated by mechanical insults to the upper abdominal cavity during the operation. When this post-narcotic paresis is not carefully watched, errors in diet, particularly early feeding and overloading of the stomach by fluids, may have a marked influence in developing a pronounced and eventually enormous paralyzing dilatation of the stomach, a dangerous and not infrequently fatal condition. In a certain group of these cases gastromesenteric ileus is produced by the pressure of the mesenteric root on the third part of the duodenum. This was first discovered by Kussmaul (74, 75), who considered this mechanical obstruction as secondary to and caused by the traction of the primarily dilated stomach, which occurs particularly with downward displacement of the overloaded viscus. Peyer (101), in a recent study of this subject, differentiates between this form of primary paralysis of the stomach and a second form, in which the obstruction by the pressure of the mesenteric root is in evidence before the

paralytic dilatation of the stomach has developed. The latter form is clinically characterized by setting in with shock, increased peristalsis, stiffening, and delayed dilatation of the stomach. Whatever the primary factor may be, when once developed acute dilatation presents a vicious circle, which must be broken.

The treatment calls in the first place for prompt evacuation of the stomach by means of the stomach tube. This affords immediate relief by removing often enormous quantities of gastric contents. Lavage should be repeated at short intervals without waiting for vomiting to indicate that the stomach is full again.

The excessive secretion usually continues, and with the paralyzed condition of the stomach it is quite common for no vomiting to occur in these cases. So, from the beginning, we should not wait for this symptom as an indication to evacuate the organ.

To avoid frequently repeated introduction of the stomach tube Westermann (141) secured *permanent gastric siphonage* by passing a tube through the nose into the pharynx and down into the stomach, where it was left *in situ* for several days. Other surgeons have employed this method of permanent drainage with equally good results and have pointed out as particularly in its favor that it permits the patient to drink unlimited quantities of fluid, thereby greatly adding to his comfort, even when employed in hopeless cases. Without permanent drainage fluids and nourishment by mouth should be omitted, but they should be given by rectum or hypodermically.

Of great assistance is the proper position of the patient. Peyer considers it of even greater importance than the emptying of the stomach. To have the patient lie on his right side is the most effective position, and when this is started at an early date may act prophylactically. The value of this position was first recorded in 1880 by Malbranc, an assistant of Kussmaul, who recommended it to relieve the compression of the duodenum by the root of the mesentery, which he had observed as causing acute dilatation in cases of chronic dilatation of the stomach. In severe cases the knee-chest position may be tried when the position on the right side is not effective.

Drugs have little influence. Eserin, 0.001 to 0.0015 gm. (1-60 to 1-40 gr.), was recommended, but was found to be without value and usually caused depression. Better results may be expected from adrenalin, particularly in cases in which the symptoms of collapse point to a deficient activity of the chromaffin system. Operative measures are contraindicated; they can accomplish nothing and are apt to further aggravate the condition.

Besides the postoperative we mention the following types of acute dilatation of the stomach:

(a) A type first described by Naunyn (95) occurring in persons ap-

parently perfectly well and which is brought about by the *ingestion* of large quantities of easily fermentable substances. Here the intense fermentation of the stomach contents is the primary factor, and therefore prompt evacuation of the fermenting masses by means of the tube is the most rational and effective treatment. After being cleansed thoroughly by lavage the viscus should be given a chance to contract by prohibiting the intake of food and fluid by mouth, and by following this later by careful feeding with small quantities of mechanically well prepared articles of food. This type of acute dilatation is more liable to befall people with an atonic stomach and to supervene in chronic dilatation.

(b) Acute dilatation in *infectious diseases* (typhoid, pneumonia, etc.) is one of the manifestations of toxemia. Here, as after operations, acute dilatation is a very serious matter, and the advent of pronounced tympanites should always be a warning against the indiscriminate feeding of such patients with large quantities of fluid. The fluid necessary to flush the system should be given by enteroclysis and hypodermoclysis. In these cases paralysis of the vasomotor nerves, especially in the splanchnic area, is one of the most striking effects of the toxemia, and *adrenalin* may therefore prove of great value in raising the blood pressure, particularly in the abdominal cavity.

(c) I wish to single out a form of acute dilatation which I find rarely mentioned, that is, acute dilatation in cases of sudden severe gastric hemorrhage. Under the heading gastric hemorrhage we discussed the use of gastric lavage in such cases and the great benefit derived from its application.

Chronic Dilatation of the Stomach

We apply the clinical term "Chronic Dilatation" to all conditions in which remnants of food and fluid are found in the fasting stomach, i. e., at a time when the organ ought to be empty. This stagnation of stomach contents represents a functional disturbance—a motor insufficiency. It may occur in a comparatively small stomach and again in a viscus which is greatly distended and dilated. The small as well as the enlarged stomach, when showing stagnation, may be in normal position or be displaced either upward or downward. In diagnosing dilatation of the stomach we must separately consider three things: the size of the stomach, its position, and its mechanical ability. Neither the size nor the position is the important factor. A stomach may be deeply situated (*gastroptosis*), and it may be very large (*megalogastria*), and yet perform its motor function perfectly well. On the other hand, a stomach may be high and small and its mobility be insufficient. The salient feature is the evidence of motor insufficiency, i. e., stagnation.

In treating this condition all efforts are directed toward overcoming

stagnation. Stagnation is the cause of fermentation, thus provoking discomfort, pain, and vomiting, and furthermore it prevents food from reaching the intestines, and so leads to subnutrition and emaciation. Any treatment must aim to remove stagnation and all the suffering connected with it and, still more important, it must succeed in making the stomach pass to the intestines an amount of food sufficiently large to raise the state of nutrition and increase the patient's weight.

We have two principal methods of treatment: first, medical treatment, consisting mainly of gastric lavage combined with dietetic and medicinal treatment of the underlying disease which causes the stagnation; and, secondly, surgical treatment, which should be employed when medical treatment proves inefficient.

Whether medical treatment will be efficient or not does not depend so much on the degree of motor insufficiency and stagnation encountered when we first meet the patient as on the nature of the primary disease which caused the stagnation.

We wish to recall here that Kussmaul (74), when he first recommended gastric lavage as a treatment for chronic dilatation, had succeeded in curing by its application stagnation of such high degree as rarely comes to our observation nowadays. At the same time, however, when he introduced his new method of treatment to the medical world his genius had recognized its limitations. He clearly pointed out that lavage will bring relief, but will not effect a cure, when unalterable organic changes of the gastric wall are the cause of stagnation, or when obstruction of the pylorus is the result of contraction by scar tissue or carcinoma. In a prophetic way Kussmaul suggested 40 years ago that the surgeon would invade this realm of therapy.

In considering medical and surgical treatment respectively the one point to be decided is, whether the stagnation is caused by conditions which will yield to lavage, or whether there are present unalterable organic changes which are not amenable to lavage treatment. It is therefore essential first of all to clear up the nature of the disease which is causing the stagnation.

Stagnation is observed in various diseases of the stomach. In the foregoing chapters we frequently took occasion to point out the treatment indicated in various diseases (gastritis, gastrosuccorrhea, ulcer, carcinoma, etc.) when associated with motor insufficiency and stagnation. In regard to the details of treatment regarding methods of lavage, dietetic, and medicinal measures, we must refer to the respective chapters, since the treatment of the underlying primary gastric disease is the paramount object in the treatment of chronic dilatation. In this chapter we must confine ourselves to a general survey of the principles of treatment of the different forms of stagnation.

We distinguish between two types of stagnation, one caused by muscu-

lar inactivity of the fundus, and the other—which is more frequent—due to obstruction at the outlet of the viscus.

Atonic Dilatation.—Muscular inactivity may be functional in character. We have mentioned the occurrence of acute dilatation in cases of gastric atony. It is usually a temporary condition which disappears under appropriate treatment. Some authors claim that *gastric atony* never leads to a state of chronic dilatation. Contrary to this view I believe that chronic dilatation does develop from plain gastric atony, but in comparatively few instances. The treatment is, in every respect, that given for cases of gastric atony. That is, a prolonged rest cure, during which we must try to raise the general nutrition by dietetic measures and by bringing into play different mechanical methods of treatment: gastric lavage, hydrotherapeutics, massage, electrical treatment, etc. When gastric atony has once led to such a serious state of affairs treatment is usually very tedious and only slow progress, if any, may be expected. To gain quicker and better results different operative methods have been proposed: shortening of the ligaments when the dilatation is associated with gastroptosis; gastroenterostomy; gastroplication (Bircher, 14; Weir, 140); and even resection of the stomach has been performed (Bloodgood, 15). My personal experience with operative treatment has not been very encouraging. We must not forget that it is not so much the mechanical condition of the stomach as a state of advanced asthenia of the whole system which causes the stagnation. In such cases the great insult of a major operation usually does not help to improve the asthenia. In my own cases it took the patients a very long period of time to recover from the effects of the operation. We must admit, however, that in cases which do not improve at all under medical treatment operative treatment is justified, particularly when we consider that the pronounced motor inactivity of the stomach may be due to degenerative atrophy of its muscular coat.

Stagnation caused by muscular insufficiency is further observed as the result of *destructive and indurative processes in the wall of the stomach* occurring in the course of peptic ulcer, carcinoma, syphilis, etc. The indications for the medical and for the surgical treatment of this type of gastric dilatation are discussed in the foregoing chapters. We wish to repeat here, that in *carcinoma* the radical operation of resection should be attempted at an early date, the palliative operation of gastroenterostomy, however, only when stagnation is pronounced and not sufficiently controlled by lavage.

In *chronic indurative ulcer* of the stomach wall resection, if feasible, is indicated when persistent medical treatment yields poor results.

Special mention should be made of the stagnation found in *chronic gastritis.* In spite of statements made to the contrary I must insist that there is a form of chronic dilatation caused by chronic gastritis, and I could quote histories of cases which would demonstrate that this form is

curable by appropriate methods of medical treatment. In more recent and milder forms, in which enlargement of the organ is caused by inflammatory paresis of the muscular coat, excellent results may be obtained by methodical lavage, dietetic and medicinal treatment, as described in the chapter on chronic gastritis. In advanced cases of long standing, stagnation may be associated with a shrinkage of the viscus, caused by indurative changes of the gastric wall (Brinton's "Cirrhosis of the Stomach," 23), a most serious condition, as a rule hardly influenced by medical treatment, and a poor object for surgical interference, except, perhaps, in those rare cases in which the interstitial process provokes hypertrophy of the pyloric end (Lebert, 79). On the whole it is a sad fact that in such conditions neither medical nor surgical methods of treatment are of great avail. When lavage relieves the patient its employment should be allowed without restriction; dietetics and drugs should be administered along the lines given in the chapters on depressive disorders of secretion and chronic gastritis.

Pyloric Obstruction.—Much better results are obtained in every way, both by medical and by surgical treatment, when gastric dilatation is the outcome of *pyloric obstruction.* Here again we must differentiate according to the underlying cause.

When *carcinoma* is the cause of pyloric obstruction it leads to early recognition, thus giving a far better prognosis for operative treatment, which should be considered in every case as soon as a diagnosis is made. As a rule, it is advisable to prepare the patient for operation by a period of medical treatment which should, in the first place, provide a better state of nutrition. We often accomplish this by methodical gastric lavage, which removes stagnating and irritating masses and allows greater quantities of well-digested food to reach the intestines. At the same time we supply the system with large amounts of fluid and some nutritive material (sodium chlorid, sugar, etc.), by nourishing enemata, and by hypodermoclyses. When operation is not possible, or stagnation recurs after operation, gastric lavage is the only reliable method of treatment at our command. In the chapter on carcinoma we described how this useful method helps to relieve the patient of his suffering and how it sometimes prolongs his life.

With *gastric ulcer* as the cause of pyloric obstruction we have to consider whether the obstruction is caused by pylorospasm, by inflammatory swelling, or by scar tissue. Pylorospasm is especially encountered in that group of gastric ulcer cases which present the clinical picture of continuous hypersecretion (gastrosuccorrhea). We claim that in these cases the presence in the fasting stomach of large quantities of acid secretion means a state of pronounced stagnation and gastric dilatation. In the chapter on continuous hypersecretion, as well as in the chapter on gastric ulcer, we dealt at length with the question whether this form of pyloric obstruc-

tion should be treated medically or surgically. We stated it as our opinion that in the majority of cases medical treatment brings about the healing of the ulcer and thereby cures the pyloric obstruction, as far as it is caused by spasm of the sphincter muscle and by inflammatory swelling. I have seen large pyloric tumors disappear, which undoubtedly must have been of an inflammatory nature. Therefore an honest attempt should be made to perfect a cure by medical treatment in all cases of pyloric obstruction which are caused by an active ulcer. For how long a period of time we shall continue medical treatment depends on many different points. We proceed to surgical treatment at a comparatively early date (1) when the patient belongs to the laboring class; (2) when intense suffering continues in spite of strict medical treatment, an indication which appears especially in cases of gastrosuccorrhea; (3) when the state of general nutrition has greatly suffered and the progress of improvement with medical treatment is too slow to promise an early recovery.

On the other hand, we may continue more patiently to pursue medical methods when we observe a steady improvement, even if it be slow. Conditions are altogether different when the cicatricial tissue of a healed ulcer produces such narrowing of the pyloric ring that it interferes with the passage of food into the intestines. Here surgical treatment is imperative. It is the general consensus of opinion that these cases give the best end results when operated on. From this observation we may derive the consolation that in these cases no harm was done by waiting until the actual process of ulceration had subsided.

Hour-glass-Stomach.—Similar considerations as in pyloric obstruction should lead us when confronted with a central stenosis, i. e., an *hour-glass-stomach.* The X-ray and other modern methods of examination have demonstrated that hour-glass stomachs are much commoner than was known heretofore. In a certain percentage of these cases the disfiguration of the stomach is due to inflammatory hyperplasia and to spastic muscular constriction, which disappear when the active ulcer which provokes these disturbances has healed under appropriate medical treatment. In a greater number of cases, however, the constriction is caused by destructive processes that result in the development of scar tissue, which does not change under the influence of medical treatment. When the obstruction interferes with general nutrition surgical interference is indicated. How apt operative measures are to remove the obstruction is a question which must be decided individually for each case. The surgeon will have to choose his method of operating after inspecting the anatomical conditions when the abdominal organs are exposed.

Finally, we have to consider chronic dilatation provoked by diseases outside of the stomach. We mention here, in the first place, adhesions to the stomach which develop with inflammatory processes in neighboring organs, particularly in the gall bladder; secondly, compression of the out-

let of the stomach (pylorus, upper part of duodenum) by tumors or constricting adhesions. The treatment is essentially that of the underlying disease, which usually requires early operative measures on its own account. When adhesions continue to interfere with the motor activity of the stomach after the original disease has subsided, their removal by operation often yields splendid results in improving and curing the gastric dilatation.

During the last few years the observations of surgeons, in particular of William Mayo, have clearly demonstrated that *chronic appendicitis* or *cholecystitis* is frequently the instigator of pylorospasm and hypersecretion, causing stagnation of acid secretion (continuous hypersecretion, gastrosuccorrhea). In such cases the removal of the appendix and the operative treatment of the gall-bladder trouble are indicated, and often bring about a cure of the gastric disease. While fully admitting the great progress achieved by these observations we must at the same time point out that the excellent results thus obtained have caused an overestimation of the frequency of this connection, which is responsible for a great many unnecessary and unsuccessful abdominal operations. We refer to the discussion of this topic in the introductory remarks and in the chapter on continuous hypersecretion.

To give a short summary of *medical methods* we state that its principal function consists in gastric lavage, which removes the stagnating, fermenting, and irritating masses. As a rule, it is best employed in the morning to prepare the stomach for the day's work. When the patient is greatly disturbed during the night it is preferable to clean out the stomach in the evening. In aggravated cases (gastrosuccorrhea, carcinoma) it may be necessary to apply lavage in the morning and in the evening.

Solutions of alkalies or of sodium chlorid are used, according to the presence of hyper- or of hyposecretion; of antiseptics (salicylic acid, resorcin, thymol, etc.), with pronounced forms of fermentation; of bitters (hops, quassia, condurango, etc.), when we intend to stimulate glandular activity. The same kinds of drugs are given by mouth in the respective conditions. Of other drugs we mention strychnin to stimulate the atonic stomach, and belladonna or atropin when spastic contractions of the pylorus and peristaltic unrest of the hypertrophic fundus prevail.

In regard to *mechanical methods of treatment* we wish to emphasize that abdominal massage, local applications of electricity, gymnastics, and vigorous forms of exercise are strictly forbidden for all cases which present symptoms of active ulcerative or inflammatory processes. We must recommend great restraint in advising the use of these methods. They are of value only when judiciously employed in cases in which the stagnation is principally the result of atony.

The form of *diet* depends on the nature of the underlying disease. The general principle, which applies alike to the different primary dis-

eases, is this, to select that particular form and type of food which least taxes the activity of the stomach and leaves it quickest in the given condition. No such general rules should be given as the following: to give only fluids in cases of stagnation or only dry food. A modified form of dry diet may be of great value in atonic dilatation, while in gastric pyloric ulcer, particularly when associated with hypersecretion, a fluid diet (milk) may be indicated. Here, as in all other conditions, the proper consideration of the underlying disease will assist us in arranging the details of treatment.

GASTROPTOSIS

Gastroptosis, the downward displacement of the viscus, is either inherited or acquired. Although the congenital type of gastroptosis was clearly described by Kussmaul, it is to the credit of Stiller to have first demonstrated that inherited gastroptosis associated with dislocation of other abdominal organs (enteroptosis) is only part of a peculiar constitution which he designated as "asthenia universalis congenita." This constitutional anomaly is met with in the vast majority of cases.

The development of the acquired form is attributed to attenuation and stretching of the abdominal wall after frequent confinements, the removal of ascites, and abdominal tumors; to the flattening of the diaphragm by pneumothorax and pleuritic effusions; to the downward pressure of an enlarged liver and pancreas; and to the debilitating effect of acute and chronic diseases causing emaciation.

Gastroptosis of itself need not give rise to any symptoms whatsoever either in the acquired or in the inherited form. As long as no symptoms are present the displacement itself does not require treatment.

Symptoms appear when the viscus becomes atonic. In both forms there is a pronounced disposition to develop atony. When the latter occurs treatment should be conducted along the lines described in the chapter on gastric atony. Symptoms caused by gastric atony are apt to irritate the nervous system and interfere with the result of the general treatment, especially in cases of the congenital form which show a great tendency to nervous disturbances.

A great deal of confusion still prevails regarding the relation of gastroptosis and disturbances of the nervous system so frequently encountered in these cases. Some firmly believe that neurasthenia develops secondarily to the gastroptosis, a conception especially held by surgeons who proposed operative measures to correct the displacement of the organ [Rovsing (109), Beyea (8), and others]. This conception is certainly erroneous in so far as it considers the displacement of the organ as the paramount factor. The neurasthenia which almost invariably exists in these cases is constitutional and is part of the general asthenia which

Stiller describes as typical for cases showing inherited gastroptosis. Patients who present the habitus enteroptoticus (with gastroptosis) are predisposed to neurasthenic disturbances and to gastric atony. The mere correction of the displacement of the stomach in no way changes this constitutional asthenia, and operations undertaken for such a purpose are therefore unwarranted. Surgical procedures in these cases are liable to do great harm by insults to the nervous system, which it takes the patient a long time to overcome.

On the other hand, a tendency seems prevalent to underestimate the importance of the local gastric disturbance. It is undoubtedly correct to direct the principal attempts of treatment to the organism as a whole, trying to improve the condition of the nervous system by regulating the mode of life and the diet, and by prescribing *sedatives* (bromid, valerian, etc.), and *tonics* (strychnin, arsenic, iron, etc.). Yet we should not forget that the subjective symptoms directly provoked by the effects of gastric atony have a very harmful influence upon the nervous system in such cases and may establish a source of constant irritation which interferes with all attempts at general treatment. The proper consideration and direct treatment of the gastric atony, and of the secretory disorders usually associated with it, are of great value in cases of asthenia universalis congenita with gastroptosis and neurasthenia.

Looking at it from this point of view, we must admit that in these cases the question of operative treatment may turn up when gastric atony has led to the development of atonic dilatation which proves stubborn to all medical methods of treatment and steadily interferes with the proper nutrition of the patient. We discussed this indication in the chapter on chronic atonic dilatation. It is of comparatively rare occurrence. A stomach which does not constantly show stagnation should never be operated upon for gastroptosis.

Aside from the general treatment of the whole system and the special treatment of gastric atony we have to mention as the only measure directly prescribed for the gastroptosis the application of an abdominal belt. Numerous varieties have been devised for this purpose, but none of them will suit every patient, and it is therefore necessary to have a belt made which will be comfortable to the patient and at the same time answer the purpose of supporting the stomach and holding it in position.

NEUROSES OF THE STOMACH

(*Nervous Dyspepsia*)

In taking up this chapter we wish to emphasize that the term "nervous dyspepsia" is abused in a most unpardonable way. Without any exaggeration I can state that the vast majority of ulcer and cancer cases which

have come to my knowledge were previously diagnosed nervous dyspepsia, not to mention the cases in which organic diseases of other organs were found as the cause of the so-called gastric neurosis. The fault lies to a great extent with the ever changing definition of nervous dyspepsia given by different authors since von Leube introduced this unlucky term into medical literature. Von Leube's (133, 134) own original definition is anything but clear. He describes as "nervous dyspepsia" cases in which apparently no anatomical changes of the stomach are present, and which show subjective symptoms of dyspepsia (alterations of appetite and taste, nausea, vomiting, heart-burn, etc.), combined with symptoms of a deranged nervous system (mental depression, phobias, headache, dizziness, etc.). This general and very vague definition of nervous dyspepsia is coupled with another definition given for what von Leube terms "neuroses," comprising all diseases which are due to a disturbance of the nervous mechanism of the stomach, without showing anatomical alterations in the viscus. We shall see later that, according to another nomenclature, these very disturbances represent functional disorders of the stomach. Here then are different distinct features, all of which are claimed as being characteristic for nervous dyspepsia: (1) The absence of anatomical alterations of the stomach; (2) the presence of symptoms of derangement of the nervous system; (3) the presence of functional disorders of the stomach; (4) the combination of disorders of the stomach and the nervous system. According to the importance given to the one or the other of these features the most divergent definitions of nervous dyspepsia have been given.

The absence of anatomical changes is a negative feature, an assumption which is not supported by actual facts. As no direct examinations of the stomach are made, it is usually based on the interpretation of gastric analysis. Thus the same finding (i. e., hypersecretion), read by one as the expression of a pure neurosis, means to another the result of marked anatomical lesions. The author could demonstrate that hyperesthesia, usually considered a pure neurosis, is in certain cases caused by a lack of mucous covering. We must, therefore, dismiss as unjustified the claim that anatomical alterations are absent when it is merely based on interpretations of gastric analyses which are liable to be faulty.

With some authors the essential feature of nervous dyspepsia is the presence of subjective symptoms associated with the activity of the stomach. Following v. Leube's view they consider the morbid increase in the irritability of the sensory nerves of the stomach the decisive factor. Strictly speaking, this means sensory neurosis, gastric hyperesthesia. When observed in cases which show no other disturbance of the stomach gastric hyperesthesia is usually caused by an increased irritability of the whole nervous system and then represents a symptom of neurasthenia and psychasthenia. In such cases the treatment is essentially that of the

underlying general derangement of the nervous system. Gastric hyperesthesia, however, is also observed in cases with distinct organic alterations of the stomach (gastric ulcer, etc.), and it is found associated with other disorders of gastric function (hypersecretion, etc.). We consider it a pernicious habit to classify all cases as nervous dyspepsia in which hyperesthesia is noted. It is bound to evoke an erroneous conception of the whole condition and, emphasizing the importance of hyperesthesia, prevents too often the direct treatment of the underlying gastric disease which causes the hyperesthesia.

It is altogether a grave mistake to consider every case as one of nervous dyspepsia in which simultaneously disorders of the stomach and of the nervous system are present. The relation of the stomach and nervous system is a most intimate one, and simultaneous disorders in both organs may turn up with various diseases. We are liable to overlook serious organic diseases if we are satisfied with the diagnosis of nervous dyspepsia whenever symptoms of nervous disorder are coupled with gastric disturbances. It would be infinitely better if the term nervous dyspepsia were abolished altogether. The understanding and the treatment of the conditions in question will be helped greatly if we differentiate between disturbances of the nervous system caused by gastric diseases and disturbances of the gastric function caused by diseases of the nervous system.

Disturbances of the Nervous System Caused by Gastric Diseases

Diseases of the stomach of functional and of organic character, by causing increased irritability of the vagus and of the sympathetic nerves, may provoke various disturbances of the nervous system: in the first place, localized sensations of gastric discomfort and pain; further, reflexly, disorders in remote parts of the nervous system [*mental depression, phobias, dizziness* (vertigo e stomacho laeso, Trousseau, 129), *neuralgias* (especially intercostal), *migraine, asthma dyspepticum,* etc.[1]]. In all such conditions it is necessary to clear up the nature of the primary gastric disease and treat it directly, according to the rules given in the respective chapters. At the same time we advise appropriate treatment of the nervous disorders according to their character, administering sedatives and antispasmodics (valerian, bromid, cannabis indica, etc.), heart tonics and stimulants (strychnin, nux vomica, strophanthus, etc.), or narcotics and antineuralgics (codein, opium, veronal, aspirin, phenacetin, etc.). Among the milder drugs which act beneficially both on the stomach and the general (vasomotor) system I mention: validol, aromatic spirits of ammonia, compound spirits of ether (Hoffman's anodyne), sweet spirits of niter.

[1] Tetany, which is usually enumerated among the neuroses of gastric origin, has been discussed under a separate heading.

The symptomatic treatment of nervous disorders should be supported by a general treatment, aiming at improving the general tone of the nervous system and the state of nutrition; especially in all those cases in which the harmful influence of the gastric disease on the nervous system is brought about by subnutrition and general asthenia.

Disturbance of Gastric Functions Caused by Diseases of the Nervous System

All diseases of the nervous system, of organic as well as of functional character, may provoke gastric disorders, which frequently precede the development of other symptoms characteristic of the nervous lesion. Such is the case with *gastric crises* in locomotor ataxia, and when *cerebral vomiting* is an early symptom of meningitis or brain tumor. It is needless to say how important it is to recognize the primary disease of the nervous system and treat it directly, as described in other parts of this book. This causal treatment can often be supported by appropriate treatment of the gastric disorder. In cases of depressive psychoses, showing *psychic dyspepsia* with complete lack of appetite and aversion to food, we may employ with benefit a method described in the chapter on depressive secretory disorders of the stomach, i. e., feeding through the stomach tube after a previous short lavage. In *gastric crises* the vomiting may be greatly relieved by lavage, although in severe cases morphin hypodermically is the only reliable remedy. When arranging diet and medication the proper consideration of secretory and motor disorders will always assist in the management of these cases.

The same influence of the nervous system is noted when diseases of other organs, in particular of abdominal and pelvic organs, reflexly provoke disorders of the stomach: pain, vomiting, hypersecretion, atony, pylorospasm, peristaltic unrest, etc. Since the development of the gastric disorder is due to a derangement of the nervous mechanism of the stomach some authors classify all such disturbances as gastric neuroses and group them together as nervous dyspepsia. Following v. Leube's diagram they distinguish the following neuroses: Irritative and depressive states of motility, secretion, and sensibility. They may be observed singly or combined in various ways.

It seems to us decidedly more correct to call a functional disorder merely what it is and what it designates, i. e., hypersecretion, achylia, atony, pylorospasm, etc. Functional disorder and nervous disorder are by no means identical, even when the derangement of the nervous mechanism of the stomach plays a rôle in the development of the condition. If treatment is to be successful we have to decide for each individual case by what the functional disorder is caused. We have followed this plan in the foregoing chapters, describing separately the different disturbances of gastric function, always laying stress upon the necessity

of clearing up the etiological factor. Undoubtedly increased secretion is as a rule the result of irritation of the secretory nerves. If we are satisfied to consider it on that account as a secretory neurosis, we shall miss our opportunity of successful treatment, which on the other hand is offered, when we clear up the fact that the irritation of the secretory nerves is due in one case to chronic tobacco poisoning, in another to the presence of gastric or duodenal ulcer. Pylorospasm is caused by irritation of the vagus nerve. On closer examination we find as the source of this irritation erosions of the mucosa, in another case chronic appendicitis. And so it is with all other functional disorders. Without going into further details, we claim that the *general classification of functional disorders as neuroses is misleading and should be abolished.* The term neurosis carries with it the conception that the condition demands only general treatment of the nervous system. No better illustration can be given of the fallacy of classifying functional disorders as neuroses than the long-continued custom, obstinately defended by many authors up to the present, of considering continuous hypersecretion as a typical secretory neurosis. It has been demonstrated that, in the vast majority of cases of chronic hypersecretion, distinct anatomical lesions in stomach and other organs (gall bladder, appendix, etc.) are present, which require a more direct treatment than is provided by a general treatment of the nervous system.

After excluding all functional disorders which are caused by anatomical lesions of the stomach proper, of the nervous system, and of other organs there remain as *gastric neuroses only those functional disorders of the stomach which are the result of functional derangement of the nervous system.* The more thoroughly we examine our patients and the more knowledge we gain by future investigations the smaller will become the number of these neuroses, which are usually described as follows:

Idiopathic or Primary Gastric Neuroses

For the sake of reference I quote from Hemmeter (61) the classification of neuroses which is usually given in text-books:

I. Neuroses of Motility.
- (a) *Irritative States.*
  - (1) Cardiospasm (cramp of the cardia).
  - (2) Pylorospasm (cramp of the pylorus).
  - (3) Gastrospasm (cramp of the entire stomach).
  - (4) The peristaltic unrest of Kussmaul.
  - (5) Nervous eructation.
  - (6) Nervous vomiting.
- (b) *Depressive States.*
  - (1) Insufficiency of the cardia, including rumination and regurgitation.
  - (2) Insufficiency or incontinence of the pylorus.
  - (3) Atony or insufficiency of the entire gastric musculature (gastroplegia).

II. Sensory Neuroses.
(a) *Irritative States.*
(1) Hyperesthesia.
(2) Gastralgia.
(3) Bulimia and Polyphagia.
(b) *Depressive States.*
(1) Acoria.
(2) Anorexia.

III. Secretory Neuroses.
(a) *Irritative States.*
(1) Hyperacidity.
(2) Hypersecretion.
(b) *Depressive States.*
(1) Subacidity.
(2) Achylia.

There is a good deal of artificiality in all such diagrams. In the first place, functional disorders are described as individual diseases which, in reality, are only symptoms of a general neurosis (neurasthenia, psychasthenia, hysteria). Furthermore, while they may appear singly, yet, as a rule, we find a combination of several of these disturbances, in fact, the individual patient is liable to present at different times a changing picture of various combinations.

We do well to keep in mind when prescribing for these patients that the treatment must, in the first place, be directed against the underlying general neurosis and that we should make use of all those methods which aim at improving the general condition of the patient. It is often advisable not to pay too much attention to the local gastric disorder. Particularly when it is noted that psychic influence plays a prominent rôle in the development of the disturbance is it far better to divert the patient's mind from the gastric disorder. Some of the disturbances, described as primary gastric neuroses, *regurgitation* and *rumination*, are nothing else but bad habits which gradually develop in neurotic people who have their attention habitually directed to the digestive act. The treatment of these and similar conditions must be general and psychic.

Direct Treatment.—Direct treatment of the local disorder is in place when it is annoying by causing pain and discomfort (hyperacidity, etc.), and when it interferes with proper nutrition. Not infrequently these functional disorders of the stomach, even when originally symptoms of a general neurosis, become the predominant feature of the clinical picture, and it is essential that they be dealt with directly since they often form a center of irritation for the nervous system which steadily interferes with all attempts at treating the general condition. Pronounced secretory and

motor disorders (hyperacidity, achylia, atony, etc.) should be treated according to the rules given in the respective chapters on these functional disorders. In arranging a *diet* according to these rules we must always keep in mind that most of these patients are better off when well nourished. Very often they are underfed, partly because they are afraid to eat, on account of the discomfort connected with the digestive act. When we regulate the selection and preparation of food articles with a view to meeting the requirements of the secretory and motor disorders present we usually enable the patient to partake more freely of nourishing food without discomfort. Yet strict enforcement of diet rules is not always advisable; particularly in cases with a decided psychic note it is often better to be liberal and permit variations with an intention of educating the patient to overcome unpleasant sensations. At all events, whatever form of diet is chosen, we must see to it that the amount of nutritive material is large enough to support the patient in good balance and eventually to make him gain in weight. We wish to state that this task can be accomplished by a properly selected diet, and that there is no justification for the general advice so frequently given to patients of this class to eat liberally all kinds of food without any restriction.

Drugs.—When *secretory* and motor disorders are present we should administer accordingly: *alkalies, hydrochloric* acid, bitters, etc. In *irritative disorders* we prescribe *sedatives, narcotics, antineuralgics,* giving preference to the milder preparations of valerian, validol, menthol, bromid, codein, opium, cannabis indica, belladonna, atropin, phenacetin, aspirin, veronal, etc. In *depressive* disorders stimulants are in order: strychnin, nux vomica, bitters, etc.

Gastric Lavage.—We further make use of all the different mechanical methods of treatment, in the first place, of gastric lavage, which we have learned to know as the most powerful stimulator of gastric activity in depressive states, and as a most effective means of calming irritative disorders. In cases of pure gastric hyperesthesia lavage is often the most reliable way of reducing the sensory irritability.

Hydrotherapy.—We employ hydrotherapeutics in irritative as well as in depressive disorders; Priessnitz bandage, hot water bags, alternating hot and cold water coil, ice bags, etc. Abdominal *massage* and the local application of *electricity* should be avoided in all irritative disorders, but they are often of great value in the depressive states of functional disorders.

We have purposely restricted ourselves to these general rules. It seems impractical to describe in detail a set form of treatment for conditions which are protean in appearance. The physician who wants to handle neurotic patients with gastric disorders must be familiar with the different methods of treatment and be ready to change according to the exigencies of the moment and according to the effect of the method em-

ployed. It will rarely do to adhere strictly to a preconceived plan of treatment, and while on the whole following general principles, yet we must always be on the alert to do the proper thing at the proper time, *ne quis idem.*

Conforming with the scope of this book we give in this chapter a summary of the methods of treatment directed toward the disorders of the stomach proper. The direct treatment of the gastric disturbance is, however, only part of a general treatment which is aimed at improving the general neurosis. How much this direct treatment of the stomach should be emphasized or restricted must be decided in each individual case. Under no condition must the direct treatment of the stomach disturb the general conditions. If it is to be continued it must have a decidedly beneficial effect not only on the gastric, but also on the general, state of the nervous system. The effect of a treatment is always the best guide when deciding whether to continue it or not.

Finally, I wish to add a word of warning against undertaking operations in these cases without urgent need and well-founded indication. The warning is not superfluous when we consider the tendency of our days, when almost anything is expected of surgical interference. I could present many interesting illustrations from my records, i. e., a case of rumination, in which gastroenterostomy was performed, needless to say without affecting any change in the condition. As a rule nothing is accomplished in these cases by surgical interference except that the insult of the operation to the nervous system still further undermines the patient's power of resistance. It is worthy of note that surgeons of large experience are the most emphatic in advising against operating on neurotic patients for functional disorders.

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CHAPTER VI

DISEASES OF THE INTESTINES

HENRY WALD BETTMANN

ENTERITIS

ACUTE ENTERITIS

The treatment of acute enteritis is very simple. The indications are to empty the bowel, to give it rest, and to allay the irritation.

Nature has often emptied the bowel and removed the offending material before the advent of the physician. The presence of irritating substances is shown by the recurrence of crampy pains and by distention of the abdomen. A simple warm enema or a soapsuds enema is then useful in ridding the colon of gas, mucus, and food remnants. It is generally advisable to administer a purgative. If there is no nausea, castor oil is the best remedy. One tablespoonful or two may be taken plain, or mixed with whiskey, sarsaparilla, or peppermint water. A hot water bag applied to the abdomen is useful in allaying spasm. When nausea is present the castor oil will in all probability be vomited. Under these circumstances calomel is preferable. A single smart dose of three to five grains or more (0.2 to 0.3 gm.) is better than broken doses. For all but the mildest attacks the patient is better off in bed. In general terms we may say that all acute intestinal symptoms are an indication for bed rest. Rest for the intestine is obtained by abstinence from food or by a very simple diet. Hot tea containing a small quantity of milk and sugar is almost invariably well tolerated. Milk as a beverage should be avoided for the first few days. Boiled milk is often recommended for its constipating effect, but is always a treacherous food in acute bowel complaints. Clear bouillon is permissible, though not as reliable as hot tea. Toast or crackers may be taken with the tea. Browned flour soup has a deserved reputation for overcoming diarrhea. Cold drinks must be avoided. After the initial purgative has acted it is generally wise to give soothing or astringent drugs.

One-half a cup of hot water, to which a teaspoonful of paregoric and

a tablespoonful of brandy have been added with a little sugar, is an exceedingly grateful remedy which can be improvised in most households. This dose can be repeated in an hour and again in two hours, and is usually followed by sleep and relief from the symptoms. When pain is severe and the symptoms more urgent, the stronger preparations of opium may be used. Tincture of opium may be given in ten-drop doses every one to three hours until the bowels quiet down; or one-quarter grain (0.015) extract of opium combined with ten grains (0.6 gm.) of bismuth may be given every two to four hours until the desired result is obtained. Cohnheim advises the use of belladonna in preference to opium in the earlier stages.

It is usually advisable to push the remedies to their full constipating effect in order to avoid relapses. In the moderate cases more liberal feeding may be permitted six to twelve hours after the cessation of the symptoms.

The albuminous foods are to be given preference during the following forty-eight hours. Soft-boiled or poached eggs, scraped beef, broiled steak, stewed or roasted chicken are all suitable. Toast, crackers, zwieback, and holland rusk may be eaten with impunity. Boiled rice or farina as well as macaroni and spaghetti are usually well tolerated. The vegetables must be added one by one. Boiled, baked, or mashed potatoes should be the first to be tried. Then follow asparagus tips and carefully prepared spinach. The patient must avoid the coarser vegetables and all fruits for four or five days after even moderate attacks, and for a week or ten days after the more severe ones. When the initial diarrhea has been intense it is frequently advisable to give some astringent for a week after the acute symptoms have subsided. The bismuth preparations are all useful in doses of ten grains (0.6 gm.) three to four times a day. The patient should not be dismissed from observation until the physician is assured that a return to the normal diet is not followed by a recurrence of symptoms. In this way relapses are avoided. This is especially important, as every attack leaves the bowels in a vulnerable condition and predisposes to later attacks. The treatment of the more violent attacks of acute enteritis often calls for nice judgment. When the stools are copious and watery, and when the patient is in a very prostrated condition, it often becomes necessary as a first consideration to check the diarrhea and stimulate the patient. A hypodermic injection of morphin, gr. ¼ (0.015 gm.), is indicated under these conditions; brandy or whiskey may be freely used, preferably in the form of a hot toddy. Jamaica ginger is an agreeable addition, or the compound tincture of cardamom or other carminatives may be employed. Hot applications to the abdomen are always beneficial; it is not wise to use enemas under these circumstances except on the rare occasions when, notwithstanding the copious discharges, the bowel remains distended. The employment of drugs or chemicals

in the washwater is rarely of advantage, except when the lower end of the colon is affected (see Colitis and Proctitis).

After the initial prostration is overcome, there remains the original task of getting rid of the irritating material. Broken doses of calomel are now exceedingly useful, 1/10 to 1/12 grain (0.006 to 0.005 gm.) being given hourly for ten successive hours. It is often of great advantage to combine minute doses of morphin with the calomel, giving gr. 1/24 (0.0025 gm.) every hour. Colon irrigations may now be ordered twice daily for two or three days.

The return to normal dieting must always be cautious after these severe attacks.

The fulminating attacks of acute gastroenteritis, known under the names of cholera morbus and cholera nostras, yield to the treatment just described. Morphin is indispensable, and may be administered hypodermically or by mouth. Emetics are never needed, as the stomach is always emptied before the arrival of the physician. If a hypodermic syringe is not at hand, laudanum may be given in ten-drop doses every half hour, or an initial dose of morphin, gr. ¼ to ½ (0.015 to 0.03 gm.), may be placed dry on the tongue. If these remedies are vomited, they should be immediately repeated. If vomiting again follows, a starch enema containing 20 to 30 drops of laudanum should be employed, and this may be repeated every half hour for two or three doses if it is expelled. The physician must be on the lookout for signs of narcosis, and must grade the doses and the intervals between them accordingly. Brandy should be given if necessary. The patient must not be allowed much water. Cracked ice is permitted.

This treatment has come down to us from a former generation. Austin Flint says "that no apprehension need be entertained with respect to the sudden cessation of the vomiting and purging; the more quickly the arrest is made the better, after a free evacuation of the stomach and bowels. Mercury is, to say the least, superfluous. The success of treatment without it is all that could be desired."

The after-treatment, after the control of the diarrhea, has been described above.

Certain peculiarities distinguish the acute diarrheas of old people. Free discharges are harder to control than in younger patients, and they lead more readily to fatal exhaustion. The use of opiates in the aged is also far more dangerous. For these reasons every acute diarrhea in an old person must be taken seriously. Reliance must be placed on hot applications, hot enemas, warm alcoholic stimulants, and astringent drugs, such as dermatol, tannigen, tannalbin, and bismuth subnitrate. Opiates are indispensable, but must be used with caution. Laudanum and the deodorized tincture of opium are to be preferred to morphin. Paregoric is an excellent remedy.

Dieting must be strict, but the total exclusion of food and drink is not warranted. Brown-flour soup, thick barley gruel, crackers with hot water poured over them may be allowed from the start. Rice cooked in milk, hot spiced claret, and hot tea are all useful and safe. Great care must be exercised in preventing relapses. The avoidance of chilled and all irritating foods must be insisted on for weeks following the attack.

Chronic Enteritis

(*Catarrh of the Small Intestine*)

Our knowledge of the pathological conditions affecting the small intestines is in a transition stage. In the past we have grouped under the one term catarrh, or enteritis, a number of different processes affecting different parts of the small bowel. The newer methods so ably developed by Schmidt and others are gradually bringing a clearer insight into the dark field. Already we are able to recognize certain intestinal disorders which are due to deficiencies of the gastric secretion (gastrogenic diarrhea) and of the pancreatic secretion (pancreogenetic diarrhea). The distinction between enteritis on the one hand and colitis on the other is more and more sharply defined, and treatment is becoming more rational and more direct in its application. At the same time we must not fail to recognize the fact that our knowledge concerning intestinal disorders is in a far from satisfactory state, that no really revolutionary facts have been established, and that our treatment of ten years ago remains for the greater part and with only minor variations the treatment of to-day.

The first step in the successful treatment of chronic enteritis is to discover, so far as possible, the etiological factors, and to remove them. Chronic enteritis is so often dependent upon venous congestion due to heart or kidney lesions, pulmonary emphysema, or hepatic congestion that a complete physical examination of the patient is called for in every case. The chemical examination of the gastric juice should never be omitted. The symptoms of enteritis are often the direct result of deficient gastric secretion, especially in cases of achylia gastrica, and many errors are made in the treatment of the symptoms by not recognizing the underlying cause. In achylia gastrica the amount of albuminous food must be greatly reduced; vegetable foods, on the other hand, are usually well tolerated. All foods must be finely subdivided; all coarse foods must be entirely avoided. The reader is referred to achylia gastrica for further details. In cases of gastric catarrh or marked hypochlorhydria the intestinal disturbance will never be successfully combated without attention to the primary condition; this is equally true of the other underlying conditions above named.

Following the lead of Cohnheim, we may divide the cases of essential intestinal catarrh into three clinical groups:

1. The mild cases without diarrhea, but with numerous symptoms, such as meteorism, abdominal pains, loss of strength, flatulence, etc.
2. The moderately severe cases with much intestinal fermentation and frequent attacks of diarrhea.
3. The severe cases with persistent diarrhea.

Certain hygienic measures must be adopted in all cases. The patient must take extra precautions against becoming chilled. He should use warm underclothing and socks, the usual abdominal flannel bandage being a useful addition. He must avoid exposure; the feet must not be allowed to be wetted in rainy or snowy weather; the baths should be of tepid water. Excitement of all kind must be avoided; business care and fret should be reduced to a minimum, and all violent exercise should be prohibited. For the aged and debilitated bed rest is a decided advantage, and this should be insisted upon whenever practicable in all acute exacerbations.

Mild Cases

The mild cases require neither a very rigid diet nor any very active medical or mechanical treatment, but, as in all other cases of intestinal disease, *the treatment must be continued for many months.*

Three principles underlie the dietetic treatment, viz.:

1. The food must be especially well prepared, i. e., soft, free from fibers and indigestible particles.
2. Coarse and irritating foods must be omitted.
3. Foods which easily ferment or putrefy must be prohibited.

Soft-boiled eggs are especially well adapted to this disease; the softer meats (sweetbreads, brains, boiled mutton, stewed chicken, whitefish, haddock) are equally useful. White bread, cornbread, whole wheat or Graham bread are all permissible. Various preparations of gelatin are well tolerated. Too much sugar must not be used. Cocoa and tea are the best beverages; white wines, beer, champagne, ginger ale are unsuitable, though a dry sherry or claret may be beneficial. Blackberry cordial has a deserved reputation when an astringent effect is needed. Only the soft vegetables should be taken, such as asparagus tips, spinach (chopped fine and passed through a colander), purée of potatoes or peas. If flatulence or meteorism is a marked symptom starchy foods, such as cereals, cereal soups, and string beans or lima beans, must not be allowed. If these symptoms are not present the cereals are a valuable addition to the dietary. Farina, well-steamed rice, oatmeal prepared over night in a fireless cooker, spaghetti, and macaroni are all suitable. The coarser vegetables must under all circumstances be omitted. In this class we include cabbage, cauliflower, turnips, radishes, onions, tomatoes, horse-

radish, celery, celery root, oyster plant, etc. All fruits are objectionable. Sweets, such as honey, candy, preserves, jellies, marmalade, and sweet cakes, must be omitted.

The regulation of the bowels in the mild cases must be closely attended to. All strong purgatives must be strictly interdicted. In some cases a simple enema taken daily answers every purpose. As a matter of fact, the bowel movements in many cases are not particularly irregular. We must prevent our patients becoming addicted to the regular use of any laxatives, if possible. The salines dissolved in hot water and taken once or twice daily are preferable to other laxatives. Carlsbad salts in doses of one teaspoonful in a cup of hot water taken one-half hour before breakfast is suitable. Phosphate of sodium, sulphate of sodium, and sulphate of magnesium may be used in various mixtures combined with sodium chlorid or sodium bicarbonate. A trip to one of the well known mineral springs, such as Harrowgate, Carlsbad, Kissingen, Vichy, Neuenahr, Wiesbaden, French Lick, Saratoga, Tate Springs, Tenn., is often curative.

The use of the necessary reconstructive drugs, such as iron, arsenic, strychnin, quinin, should not be omitted in appropriate cases.

Moderate Cases

The moderate cases of chronic enteritis are treated along the same lines as the mild cases, only the treatment must be more rigid and the use of drugs is a necessity. In addition to a study of the gastric digestion the physician must now attempt to determine the digestive activity of the intestines themselves. The test diet of Schmidt has been widely adopted and forms the basis of many similar dietetic tests which are designed to measure the digestive capacity of the bowels. The diet of Schmidt is given for three days or more (19). It consists of the following foods:

In the Morning.—0.5 liter milk (1 pint), 50.0 grams of zwieback (1 2/3 oz. zwieback or rusk).

In the Forenoon.—0.5 liter of oatmeal gruel (made from 40.0 grams oatmeal, 1 1/3 oz.); ten grams butter (1/3 oz.); 200 grams milk (6 2/3 oz.); 300 grams water (10 oz.); one egg.

At Noon.—125 grams (4 oz.) chopped beef (raw weight), broiled rare, with 20.0 grams (2/3 oz.) butter, so that the interior remains raw; to this 250 grams (8 oz.) mashed potatoes are added.

In the Afternoon.—As in the morning.

In the Evening.—As in the forenoon.

After the third day the stools are systematically studied for mucus, the remains of connective tissue, meat fibers, undigested starch, fat drops, and fatty acid needles and soaps; also for parasites, ova, etc. Other tests

determine the degree of carbohydrate digestion, the presence of bile pigment (bilirubin), and blood.

It is obvious that the findings after this test diet will largely determine what dietetic restrictions are necessary. Schmidt lays down several general laws.

Where there is marked intestinal fermentation the diet must be predominatingly albuminous. When the putrefactive changes are marked the diet should be composed largely of carbohydrates. In catarrhal conditions the food must be unirritating, easily digestible, and non-putrefying.

These three requirements, according to Schmidt, are best met by gruel soups, to which gradually a larger and larger quantity of milk is added. Milk has the minimum amount of putrefactive material, and is the one best food. When milk is found not to agree with patients, cocoa may be substituted. But Schmidt is unwilling to accept patients' statements that milk does not agree with them. By adding milk gradually to the other foods (cereals), a tolerance for it is usually established. When the milk actually produces fermentation the addition of salicylic acid overcomes this tendency. To the daily quantity (1.5 liters) 0.3 gm. (5 grains) of salicylic acid is added in the following manner: the salicylic acid is stirred thoroughly in a little cold milk, then this is added to the daily portion, stirred well, and boiled once. The milk does not thereby lose its character or taste, nor does it coagulate (loc. cit., p. 15).

Notwithstanding the conclusions of Schmidt, there is a rather widely accepted opinion that milk is a treacherous food in intestinal disturbances. When raw it is apt to cause flatulence, a sense of heaviness in the stomach, and frequently a coated tongue and a bad breath. Boiled milk is apt to be constipating, to form lumpy masses which lead to impaction of feces, and is very distasteful to many patients. As a rule, we can dispense with milk altogether, except as an addition to tea or gruels, and nourish the patient with a variety of the lighter foods enumerated before.

The medicines in the treatment of enteritis are selected chiefly from the list of sedatives and astringents.

Various preparations of opium are invaluable when there is much pain or a tendency to tenesmus. Opium must, however, be considered strictly an emergency drug to be given for definite indications and for a brief time. To continue the use of opium in the hope of "checking the bowels" over a long period is as unscientific as it is useless. Many patients afflicted with the milder forms of intestinal catarrh are made much worse by the long-continued use of opium, often self-administered in the form of paregoric or of some advertised nostrum. The various preparations of bismuth deservedly hold the front rank in the list of remedies. Subgallate of bismuth is especially valuable in doses of 0.5 to 1.0 gm. (7½ to 15 gr.) every three hours, or three times a day after meals.

The subnitrate and the subcarbonate are equally useful; tannigen, tannalbin, bismutose, and numerous other preparations are highly efficient astringents. It must be borne in mind that the medicinal treatment is secondary to the dietetic treatment, and that, when moderate doses of the above drugs are not effective in checking diarrhea, a change should be made in the diet and the doses of the drugs should not be inordinately increased. It is not an uncommon experience to see diarrhea progress unchecked while the patient is taking subnitrate of bismuth in teaspoonful doses every few hours. Some patients are even irritated and made worse by any insoluble astringents. Einhorn frequently prescribes the fluid extract of condurango and fluid extract of calumba, of each twenty drops (1.3 c. c.) three times daily.

The intestinal antiseptics are often useful. During acute exacerbations calomel in doses of gr. 1/10 to gr. 1/20 (0.006 to 0.003 gm.), repeated hourly, is often exceedingly useful, although calomel is no longer classified with the intestinal antiseptics, as it is known to increase the number of bacteria in the stools. Salicylate of bismuth, betanaphthol, creosote, and especially benzosol are of marked value. Cohnheim says that in cases in which the stools are persistently of a pulpy semisolid consistency with marked fermentation calcium salts combined with bismuth are most effective. He recommends the following prescription:

℞	Calcii carbonat			
	Calcii phosphat .....āā	ʒvi		25.0
	Bismuth salicylat.	gr. lxxx		5.0

Sig.—One teaspoonful three times daily after meals.

Cohnheim especially advises the physician not to jump from one remedy or one line of treatment to another with undue impatience, as the best lines of treatment are slow in their effects and must be persistently carried out.

Severe Cases

The severe forms of intestinal catarrh constitute an obstinate affection, the successful treatment of which extends over many months or even years. The danger of relapses is ever present and the least indiscretions in diet or in the habits are apt to be followed by exacerbations. Bed rest is one of our most efficient means of combating the acute attacks and tiding the patient over into the full convalescence. Several weeks in bed is not too long a course, and this prolonged bed treatment will usually be rewarded by a long period of well-being, especially if combined with Priessnitz compresses, colonic irrigations, massage, and other hygienic measures. The dietetic rules have been outlined above. No other chronic

complaint requires more skill and tact on the part of the physician, who must individualize his treatment to an unusual degree and know how to keep his patient in line under the many vicissitudes to which he may be subjected. A comprehensive and very valuable description of the methods which are used to prepare appropriate diets on a large scale for hospital patients will be found in the Zeitschrift für physikalische und diätetische Therapie, 1911, Band xv. H. Strassner describes in detail the diet kitchen of Professor Schmidt in Halle, and gives many valuable dietetic suggestions and diet lists, worked out according to their indications and their caloric equivalents.

Enteritis in Infancy

No perfectly satisfactory classification of the diarrheas of infants has yet been made. Keeping as closely as possible to the purely clinical point of view, we recognize diarrhea due to overfeeding, due to improper feeding, and the result of infectious processes. A class due to insufficient feeding also exists, but is comparatively uncommon. As is well known, infantile diarrhea is far more common in summer than at any other season, and predominatingly in bottle-fed children. This is due chiefly to the use of contaminated cows' milk and other substitutes for mothers' milk, but partly, also, to the heat itself, which reduces the infants' vitality and their powers of resistance. The prevention of summer diarrhea includes, therefore, several factors. The infants should be protected from the heat of, and especially the direct rays of the sun; they should be very lightly clad; they should be frequently bathed, and should have cool drinking water offered them freely. Most important of all, the milk supply should be protected in every possible way, beginning at the dairy and ending with the care of the empty nursing bottles. Lastly, the special quantity of milk and its method of preparation must be specified for each individual child, according to its own requirements.

The treatment of the acute attacks, whether due to improper or excessive feeding, is based on very simple principles. The offending material must be expelled, and the bowel given rest. The old plan of administering an initial purgative has been much criticized of late as being often superfluous, and sometimes even harmful. Nevertheless, as a clinical procedure it has stood the test of time and is almost always beneficial. The two drugs most commonly used are castor oil and calomel. If the stomach is upset, calomel should be preferred. To an infant under six months, 1/10 grain (0.006 gm.) may be administered hourly for five or six doses; to older children, the medicine should be continued until 1 grain (0.06 gm.) has been taken. When the stomach will tolerate it, castor oil, in doses of one teaspoonful for the younger infants to two teaspoonfuls for the older ones, is an excellent remedy. In general terms, we may say that

the presence of fever indicates the use of an initial purgative; in the absence of fever, the purgative, though usually useful, may often be dispensed with. When the bowels are distended with gas, or when there is straining at stool, or much mucus in the stools, a simple enema with physiological salt solution is of advantage. It is not ordinarily advisable, in the simple cases, to flush out the colon with large quantities of fluid, as much discomfort is often caused thereby. One pint is usually sufficient.

A certain number of hours of starvation is demanded in nearly all cases. When the stomach is filled with sour milk curds, lavage with a soft catheter to which a funnel has been attached is of immense benefit. In the non-infectious cases without fever, however, this practice can usually be dispensed with. The modern tendency is to limit the starvation period as much as possible. Prolonged starvation (36—48 hours) often reduces the resistance of the child, and frequently causes the continuance of the diarrhea. It must not be forgotten, however, that in the large majority of cases the good effects of starvation far outweigh the disadvantages. No food at all is infinitely better than food which disagrees with the patient. Within the last few years the opinion of Finkelstein that sugar is the commonest cause of diarrhea in bottle-fed children has met with wide acceptance. Dennet (5) has reported his results in a large series of cases of summer diarrhea treated without initial purgation or starvation, but merely by diluting the milk with water and omitting all sugar. He advises absolutely no preliminary treatment; the infants are placed at once on boiled milk and water *with no sugar added.* The younger infants receive one-third milk and two-thirds water, the older infants half and half. This is given every two hours in normal quantities. "In the vast majority of cases," says Dennet, "the stools become more solid within one or two days. When the sugar is added we should begin with small quantities, say one-half ounce (15.0 gm.) of sugar to the 24-hour amount of food, and gradually increase it up to one or one and one-half ounces (30.0-45.0 gm.). Rarely does a baby who has had diarrhea stand more than that amount of sugar."

Those who cling to the older plan of initial purgation and starvation urge that the return to normal feeding be very gradual. It is better to avoid milk for the first few days. Nestlé's food is especially valuable at this stage. It should not be begun in too concentrated a form, one tablespoonful to six ounces of water making a good starter. If well tolerated it should be used to the exclusion of all other foods for several days, the return to milk being a gradual one. Cereal decoctions of various kinds are also invaluable. Strained barley or rice gruels, mutton broth thickened with rice and strained, are well borne. Albumin water, which is widely used, does not seem to me a suitable food, as it greatly heightens intestinal putrefaction. I have seen many bad results from its use. Boiled milk well diluted with barley gruel forms a good bridge

over which to return to the normal milk feeding. Extreme vigilance must be exercised lest the return to milk be followed by a recrudescence of the symptoms.

Drugs are often necessary to control excessive peristalsis. Bismuth remains the favorite. The doses should be large. Ten grains (0.6 gm.) of the subnitrate may be rubbed up in chalk mixture and should be given every two or three hours. Ladd (13) strongly recommends the so-called "milk of bismuth" in one or two-teaspoonful doses with each feeding. The various bismuth preparations have little or no advantage over the subnitrate. Preparations of opium are sometimes indispensable. The one use to which they should be absolutely restricted is to *check excessive peristalsis, after the fever has subsided and all toxic material has been removed from the bowels.* The younger the infant the more caution must be exercised. The tincture of opium in one- or two-drop doses may be given every two to four hours. It should never be pushed to narcosis. Unsleeping vigilance is necessary to safety. Dover's powder, in doses of ¼-½ grain (0.015-0.03 gm.), may be given every few hours to a child one year of age. The use of opium in young infants must always be considered dangerous. Occasionally it is a life-saving device, when the child is relaxed and watery stools seem otherwise uncontrollable.

Other drugs may be necessary to meet special indications. Brandy or whiskey is useful in combating collapse. Fifteen to 30 drops may be given well diluted every two to four hours to infants from eight months to one year of age. Strychnin is occasionally needed. Doses of gr. 1/300 to 1/200 (0.0002 to 0.0003 gm.) may be given hypodermically every few hours. Tincture of strophanthus in ½-drop doses is often highly beneficial in strengthening the heart. Not much reliance can be placed on the old-fashioned aromatic infusions or teas for overcoming colic. Hot applications to the abdomen are useful; a catheter inserted into the rectum, small rectal injections, a few drops of paregoric or whiskey in hot water, all are efficient when appropriately used.

Infants do not always respond well to the treatment outlined above. The bowels continue to be loose, the children are restless, and do not regain weight, the stools are offensive, irritating, and contain mucus or curds. In these cases Finkelstein strongly advocates his so-called Eiweiss milk (casein milk). It is prepared as follows, according to Dennet:

"One quart of milk is heated to 100° F. and two teaspoonsful of rennet or essence of pepsin added. This is allowed to stand 15 to 20 minutes until jellied, then heated to 150° F., constantly stirring. The whey is then drained off through a wire colander and thrown away. Enough cold water is added to make a pint in all. The curds and water are then pressed through the wire sieve or colander with a wooden spoon two or three times, until the curds become soft and fine. To this pint of curds and water one pint of real buttermilk (from the churn) is added. It

should be used in the same amounts and at the same intervals as the boiled milk for a period of three to seven days, or until the stools are hard and dry. Then the boiled milk and water are substituted for it and the sugar is gradually added to the food as above described. This feeding will rarely fail us in stopping the most resistant diarrhea. Finkelstein's theory of its action is that, the milk sugar being soluble in the whey which is discarded, the food is almost sugar-free."

The use of buttermilk in these subacute cases was first strongly advocated by a Dutch physician, Teixera de Mattos. According to Friedlander (8), it is prepared as follows: To a quart of fresh buttermilk one tablespoonful of wheat flour and two tablespoonsful of cane sugar are added; the mixture is then boiled over a slow fire under constant stirring. It should be allowed to boil up three times and is then to be strained. This forms the exclusive diet of the infant for days, and is almost always followed by most gratifying results.

INFECTIOUS DIARRHEAS AND CHOLERA INFANTUM

The effort to classify the acute intestinal infections according to the infecting organism (Shiga bacillus, colon bacillus, gas bacillus, bacillus pyocyaneus, *et al.*) has not as yet led to practical results, which can be applied therapeutically. In fact, the difficulties of classification are as yet insurmountable. The persistence of fever is supposed to distinguish the infectious diarrheas from attacks of simple intestinal indigestion. At the present state of our knowledge it is wiser to neglect the bacteria and to treat the child. The treatment of the milder forms of infectious diarrhea has been outlined above. Cholera infantum is becoming a rare disease in this "century of prophylaxis."

Cholera infantum is characterized by continuous vomiting and purging, rapidly leading to collapse. The babies are comatose, have cold skin, subnormal temperature, incontinence of feces, and pronounced ischuria or anuria. The very severe cases are apt to prove fatal under any treatment. Energetic means are necessary if the baby is to be saved. The hot mustard bath is a valuable stimulant; a tablespoonful of mustard should be used in each gallon of water. The baby should be wrapped in warmed flannels. Morphin is an invaluable though dangerous remedy. A child one year old may have gr. 1/50 to 1/100 (0.0012 to 0.0006 gm.) combined with atropin sulphate, gr. 1/500 to 1/800 (0.00012 to 0.000075 gm.), hypodermatically, and this may be repeated in one hour and then at greater intervals. Hypodermoclysis is frequently of great help in warding off a crisis due to the loss of fluids and the inability to swallow any. Four to eight ounces (120.0 to 250.0 c. c.) of physiological salt solution may be administered every four to six hours under the most

rigid aseptic precautions. Even smaller quantities (1 to 2 ounces, 30 to 60 c. c.) may have to be given at first, and more frequently repeated. Caffein is a most valuable stimulant. The sodio-benzoate may be given hypodermically in doses of gr. ¼ to ½ (0.015 to 0.03 gm.). Camphor may help sustain the heart. External heat is necessary.

Should the child survive the early collapse there is hope of saving it, but extreme vigilance and attention to details are necessary. The nourishment at first may have to be limited to sips of warm water. Very thin strained barley water is the safest food to begin with. In some instances ice-cold milk is advisable; it is sometimes retained when all warm liquids are rejected. The buttermilk mixture described above may be given ice cold. The eyes should be protected during the stage of collapse by means of boric acid compresses. The mouth must be frequently but gently washed out with a warm borax or soda solution. Even apparently hopeless cases may occasionally be saved by sudden change of climate. Removal to Michigan, or, better, to the sea, may have most astonishing results during excessively hot weather.

COLITIS

It is customary to consider the inflammations of the small and large intestines together under the designation enterocolitis. This is entirely proper for these conditions as they occur in childhood, for at this period of life the two parts of the intestinal canal are usually affected together, although in different degrees. But in adults the matter is entirely different. A mild degree of colitis nearly, if not quite, always accompanies the acute and chronic inflammations of the small intestine, but the reverse is far from true. Not only do various forms of colitis occur as independent affections, but our therapeutic efforts gain enormously in directness and efficiency when we recognize the fact that we are dealing with five feet of intestine instead of twenty-five, and that the diseased tissues are readily accessible to medication from below.

The treatment of that form of colitis which accompanies acute enteritis has already been considered. Washing out the colon with physiological salt solution (roughly, one teaspoonful to each liter of warm water) has a most soothing influence. This may be repeated once or twice every twenty-four hours. Other solutions are also suitable, such as one teaspoonful of tannic acid in two quarts of water; weak solutions of boric acid; 5 to 10 per cent. aqueous solution of fluid extract of krameria; weak infusions of chamomile tea. If there is much straining or tenesmus, rectal suppositories containing opium and belladonna are useful. An injection of weak starch solution containing 20 drops of tincture of opium is an old and approved remedy to allay irritation of the lower end of the bowel.

Chronic Mucous Colitis

Nothing in medical literature is more confusing than the conflicting descriptions of those diseases of the colon which are characterized by the discharge of mucus. There is a rapidly growing tendency to recognize a catarrhal process as the underlying basis in all cases and to ascribe the protean character of the clinical course to various complicating pathological conditions, such as neurasthenia and hysteria, adhesions (pericolitis), appendicitis, visceroptosis, etc.

The clinical history of mucous colitis runs the gamut from the simplest abdominal distress with slight mucous discharges on the one hand to the severest attacks of mucous colic, or "myxoneurosis intestinalis" on the other. Between these two extremes we encounter all degrees of discomfort, pain, nervous debility, and constipation or diarrhea in confusing association.

I think that we shall profit greatly in our treatment of these cases if we divide them into two groups:

Group I presents the combination of pain along the colon and a tendency to diarrheal discharges.

Group II occurs in nervous individuals who suffer from chronic constipation and who have periodic attacks of "membranous colitis" or "mucous colic." This distinction, while clinically useful, cannot always be made with certainty. We must also clearly recognize the fact that a proportion of these patients cannot be cured by medical means alone, but that the symptoms are kept up indefinitely by adhesions, appendicitis, or other conditions which can only be removed by surgical procedures.

Cases of Colitis with Colonic Tenderness and Diarrhea

The principle underlying the treatment of these cases is to spare the bowels from irritation from above and to apply soothing remedies from below. The proper diet is the one already described as suitable for cases of chronic enteritis. Albuminous foods (meat, eggs) must predominate; the coarser vegetables and fruits must be altogether excluded. The reader is referred to the article on enteritis for further details. Drugs by the mouth play an important rôle. The various preparations of bismuth are the most generally useful; benzosol in 5-grain (0.3 gm.) capsules, ichthyol in 3-grain (0.2 gm.) pills, and other intestinal antiseptics and astringents are helpful. We should avoid constipating our patients; on the other hand, purgative medicines all do harm, with the possible exception of castor oil. Castor oil can often be administered with great benefit in tablespoonful doses on alternate nights, or daily before breakfast (method of Hale White), for a period of two or more weeks. The use of salines, even in small doses, or in the form of medicinal spring waters, is not

to be countenanced. An occasional dose of Epsom salts may be necessary in some cases.

An important factor in the treatment is the use of proper enemas. X-ray examinations have clearly shown that small quantities of fluid administered with the patient in the knee-chest position readily find their way along the whole colon into the cecum. The nozzle of the syringe need not be introduced further than just within the sphincter. The use of large or long so-called colon tubes is becoming obsolete, as it is now well known that these tubes rarely, if ever, pass beyond the rectum. The fluids should be slightly above the body temperature. The quantity need rarely exceed one liter; in fact, one-half liter (one pint) is usually as efficient as larger quantities. To distend the bowel with large quantities of fluid (2 or more liters) has no obvious advantage and many disadvantages, as it often seriously disturbs the patient's comfort, and in some cases keeps up the irritation or inflammation. Nitrate of silver is an excellent remedy. To avoid causing pain one pint of a 1-10,000 aqueous solution should be used the first night before the patient retires; the strength may be rapidly increased to the point of tolerance (burning pain), which will usually be reached when the solutions have a strength of 1-1,000 or 1-2,000.

Mummery recommends 0.5 per cent. solution of protargol or argyrol. Other useful injections are salicylic acid, 1-1,000, and tannic acid, 1-200. The injections should be given daily at first, then on alternate days, and should be kept up until mucus no longer appears in the stools. The chronic nature of this ailment and its tendency to relapse should be remembered and the vigilance of the physician should not be too early relaxed.

Constitutional treatment will be required in most cases, as the majority of patients belong to the neurotic class. Iron, arsenic, bromids, and other tonics or sedatives must be administered according to indications. One warning is in order: Many patients form the habit of inspecting their stools and keeping sharp lookout for food remnants, mucus, or other abnormalities. They develop a characteristic type of hypochondriasis, which must be actively combated. In such cases it is best to omit all local treatment in order to divert the patient's mind from the local condition, and it is often necessary to allow an unlimited diet, paying no attention to the intestinal discomfort until the general health of the patient is properly built up.

The Treatment of Membranous Enteritis or Mucous Colic

Membranous enteritis is now recognized as a form of catarrh of the colon associated with constipation. The so-called mucous colic is an

acute exacerbation in the course of membranous enteritis, often due to nervous influences, but frequently dependent upon anatomical or inflammatory complications. Nothnagel's theory of the purely nervous origin of mucous colic must be dropped. A post-mortem examination or an operation will reveal some abnormality in nearly all cases. In 66 cases reported by Mummery (16), in which a definite lesion was found, the following conditions were present: adhesions causing kinking or obstruction, 14; coloptosis, 5; chronic appendicitis, 5; inflammation or displacement of the uterus or appendages, 2; previous operation on the colon, 2; chronic inflammation of the colon, 30; cancer, 7; fibrous stricture of the sigmoid, 1. We thus observe that in nearly or quite one-half of all cases some surgical measures will have to be employed if a permanent cure is to be effected. In the other half a cure can be brought about by purely medical and dietetic methods.

The treatment during the attack is purely symptomatic. If the pain is intense the patient must remain in bed until the "membranes" are discharged. Hot applications to the abdomen are useful. Hypodermics of morphin may be required. Belladonna may be given internally, or, better, atropin may be given hypodermically with the morphin. The bowels should be thoroughly washed out. Very warm salt solution is the best fluid to inject, although a pint of warm olive oil is often effective in relieving the pain. The olive oil enema must be followed in an hour or more by a salt water injection. This may have to be repeated, and sedatives may be required for 24 to 36 hours. Mummery recommends the following mixture:

℞

Tr. hyoscyami	2.0	(ʒss)
Tr. belladonnæ	0.4	(min. 6)
Sod. bicarb.	1.3	(gr. xx)
Tr. zingiberis	1.0	(min. xv)
Spt. chloroformi	1.3	(min. xx)
Aq. menth. pip. ad	30.0	(ʒi)

M Sig.—One ounce three times daily to relieve intestinal spasm.

After the attack is over the patient is treated dietetically and by injections into the bowel.

To Von Noorden belongs the credit of pointing out the correct principles for the dietetic treatment of these cases. He recognized the rôle that constipation played in the symptomatology, also the necessity of keeping the colon full instead of empty, and the further necessity of nourishing the patient as fully as possible. Von Noorden ordered a diet very rich in cellulose, copious in quantity, and more or less indigestible in

quality. Coarse bread should be taken in liberal amount; the cruder vegetables, such as cabbage, celery, tomatoes, radishes, turnips, carrots, are to be eaten freely; fruits must be consumed in quantity; the smaller fruits, such as berries, currants, grapes, are to be preferred. Sweets must be avoided, also too much starchy food, tea, cocoa, coffee, and alcoholic beverages. Fats are a necessary part of the régime. Their general utility in nervous patients is now well recognized. They also help to make the feces soft and copious. Butter must be taken as freely as possible; cream is a useful adjunct. The fatty meats, such as pork and bacon, are valuable. Care must be taken not to overload the patient's stomach with fat, and thus interfere with the digestion. Olive oil may be taken inwardly, also liquid petroleum and albolene.

The advantages of the Von Noorden diet promptly show themselves. The bowels soon begin to act spontaneously, the patient gains in weight and strength, the nervous symptoms grow less. Sometimes, however, the sudden change to the Von Noorden diet brings a series of new symptoms in its train. The intestines are not able to cope with the coarse foods; the patient feels bloated, uncomfortable, and may have a regular "bilious attack." After a few days the bowels may "rise to the occasion" and take up their functions more adequately. To tide the patient over the first week or two it is often advisable to keep him in bed, to apply Priessnitz compresses to the abdomen, and to order mild abdominal massage daily. Einhorn overcomes the difficulties of the Von Noorden method by making the transition from the sparse to the robust diet a gradual instead of a sudden one. He does not consider the indigestible residue an essential part of the treatment, but insists merely that the patient be slowly trained to take the foods of an ordinary healthy individual. The goal sought is a good state of nutrition, and, therefore, meat, eggs, and cereals should be taken freely. The coarser foods should be added only so fast as the digestive capacity of the individual will permit.

My own experience has led me to cling to the Von Noorden method. A suitable diet to begin with will be described later in the chapter on constipation. This diet rarely disagrees with the patient, very seldom causes marked symptoms of indigestion, does not require bed rest or local applications, and is usually followed at once by normal fecal evacuations.

Fleiner introduced the use of systematic oil injections in the treatment of this disorder, and they have been universally adopted as the best remedial agent we possess. The injections are given every night for three weeks, then every other night for three weeks; from the sixth to the tenth week they should be given twice a week, and may be continued at longer intervals for several months more. Olive oil should be employed. Cheaper oils, such as sesame and cotton seed oil, have been recommended, but they are more irritating than pure olive oil. About eight ounces (250 c. c.) of olive oil, warmed to the body temperature, should

be introduced at bedtime with the patient in the knee-chest position, and the patient is instructed to retain the oil overnight. In some patients there will be a disagreeable leakage of oil during the night, and the bed linen will be soiled. This may sometimes be avoided by raising the buttocks of the patient for one-half to one hour after the injection, but this is not always effective, and a rubber sheet may be found useful in protecting the bed. By reducing the quantity of oil to four ounces or even less (120 c. c.) this leaking may usually be avoided; the quantity should then be increased gradually until the full quantity, eight to sixteen ounces (250 to 500 c. c.), is taken nightly. Eight ounces (250 c. c.) usually answers every requirement, and there is rarely any advantage in using the larger quantities.

Upon awaking in the morning the patient should try to evacuate his bowels and should make the effort at the same hour daily. Occasionally salt enemata will be required during the first few days, but if the above-mentioned dietetic rules are carried out the enemata can usually be dispensed with. Nearly all patients will benefit by constitutional treatment. Iron, arsenic, the bromids, and other remedies, such as strychnin and quinin, will be required as indicated. General massage and hydrotherapeutic measures can often be employed to advantage. Castor oil may sometimes be necessary at the outset of the treatment. Wylie has recommended a one-ounce (32 c. c.) mixture of castor oil and glycerin three times daily for several weeks to produce soft, copious stools. While the chief object of the treatment is to overcome the constipation by natural means and bring about daily evacuations without drugs, Wylie's mixture will be found very useful in some obstinate cases.

When medical measures fail to bring the necessary relief, surgical interference should be considered. The severity of the symptoms will usually be the deciding point in regard to the advisability of surgery. When the symptoms are only moderate the neurotic state which most of the patients present would weigh against the expediency of an operation. In the presence of severe and health-destroying symptoms, however, an operation should be undertaken. An exploratory laparotomy should be made, the necessary adhesions severed, and the appendix removed if diseased. Right-sided colostomy has been performed for this condition, also ileosigmoidostomy. The former is open to the objection that the patient is worse off with his artificial anus than he was with the colitis; the latter is too serious an operation for the disease in question. Appendicostomy would seem to be the operation of choice when the only lesion found is a catarrhal colitis. Mummery has collected 20 cases; 13 of the patients were permanently cured. As abdominal surgery progresses probably other operations will be found useful for this condition.

Ulcerative Colitis

The general use of the sigmoidoscope has revealed the fact that various mild degrees of ulceration of the colon are by no means uncommon. Formerly only the more serious forms of ulceration were recognized, and ulceration of the colon, except when due to chronic dysentery, was considered a practically hopeless disease. Chronic catarrhal and chronic follicular ulcers are usually amenable to medical treatment, and can be entirely cured in the majority of cases. The treatment does not differ essentially from that already described as applicable to cases of chronic catarrhal colitis. Irrigations of the colon play a more important rôle, and more attention must be paid to the general care of the patient. Sea air, cold baths, general tonic medication, are all important. The diet at first should be strictly limited (see diet for chronic enteritis), but far greater liberty should be permitted as soon as the ulcers take on a healthy appearance. Bed rest is desirable early in the treatment; hot Priessnitz compresses are useful in relieving the pain and in stimulating the healing.

The colon irrigations may be performed twice daily in the beginning of the treatment and once daily after the first week. I have had most favorable results with injections of tannic acid (1-200) and nitrate of silver, 1-10,000 to 1-1,000. Other authors advise fluid extract of hamamelis or hydrastis, 2-5 per cent.; fluid extract of krameria well diluted, boric acid, 1-100, and other antiseptics. Instead of the old-fashioned injections which the patient is instructed to retain as long as possible, colon irrigations with a tube and funnel have gained in popularity. The patient takes the knee-chest posture; the tube is introduced just within the anus, and the irrigating fluid is allowed to run into the bowel and out until it returns clear. Various irrigating devices and instruments have been invented. The water should never be too cold, and the weaker solutions should be given preference at first, the strength being gradually increased as the tolerance of the patient permits.

Internal remedies will frequently be useful. Small doses of opium are invaluable early in the treatment to allay the pain and the irritability of the bowels. Care must be taken not to constipate the patient. The concomitant use of opium and castor oil is to be recommended. Opium may be given during the day and the castor oil at bedtime. The various preparations of bismuth are of little value. Tonics and stomachics will be needed during the first few weeks of treatment.

The severer forms of ulcerative colitis are due to many causes, which are only partly understood. Many cases run a rapid course with uncontrollable diarrhea, progressive emaciation, and exhaustion. Some ulcers perforate, leading to fatal peritonitis. The chief symptoms are pain, diarrhea, and the appearance of pus and blood in the stools. The sig-

moidoscope reveals the presence of ulcers in the sigmoid and upper part of the rectum. A rare form is the hemorrhagic colitis, which is usually acute in onset and accompanied by profuse hemorrhages, which rapidly exhaust the vitality of the patient. The tuberculous and dysenteric ulcerations will be considered elsewhere.

The treatment of all forms of ulcerative colitis should at first be medical and on lines already described. The hemorrhagic form, which is exceedingly rare, must be actively combated; the patient should be absolutely starved for forty-eight hours; very hot colon irrigations with salt solution or tannic acid should be tried; tincture of opium should be given in large doses (20 to 30 drops); morphin may be necessary hypodermically; ice bags and cold applications do no good and should not be tried. Mummery strongly urges that no time be lost with palliative measures; that an immediate appendicostomy be performed, and that the colon be irrigated through the appendix with a 1 per cent. solution of argyrol or hazelin until the bleeding stops. The irrigations should be repeated every 3 to 4 hours. Zweig advises the internal use of fluid extract of hydrastis in doses of 20-30 drops, or of the fluid extract of hamamelis, one-half to one teaspoonful several times daily. In life-threatening hemorrhages he also recommends the subcutaneous use of gelatin. Gelatin may be given internally according to either of the following formulæ:

℞ Gelatini ..... ℥iss 45.0
Eleosacchari citri 3xi 40.0
Suprarenin (1-1,000 sol.)..... gtt. lxxx
Aq. dest. ..... ℥xvss 450.0

M Sig.—One tablespoonful every 3 hours (Cohnheim).

℞ Decoct. gelatin alb. puris. .....15.0-200.0 3iv-℥vii
Eleosacchari citri .....50.0 c. c. 3xii

M Sig.—One or two tablespoonsful every hour (Zweig).

When medical treatment is not producing good results and the patient is losing ground, recourse may be had to operative treatment. The only operations which are now performed for ulcerative colitis are cecostomy and appendicostomy. Both operations have a good record.

APPENDICITIS

The pathologists describe many forms of appendicitis. The clinician may content himself with the simple classification into two varieties—the acute and the chronic. He may, if he choose, subdivide the acute

into two classes, the apparently mild and the apparently severe. The chronic cases fall into three divisions—the recurrent, the relapsing, and the residual.

Acute Appendicitis

Acute appendicitis would be considered exclusively a surgical disease were it not for the fact that most patients recover from their attacks under proper medical treatment, and some of them remain permanently well thereafter. The plea for immediate surgical interference in every case is based upon the treacherous nature of the disease, the great difficulty of estimating the severity of any given attack, the low mortality of immediate operations, the prevention by surgical intervention of tedious complications, and the shortening of the convalescence. A patient recovering under surgical treatment may be considered permanently well; recovering under medical treatment he must still be considered subject to the danger of a relapse or of recurrent attacks.

Many objections have been raised to the radical surgical point of view. It is not always possible to make an exact diagnosis. Operating "on suspicion" will lead to many mistakes and be the cause of many unnecessary operations. Even in many cases in which the diagnosis is unmistakable operative interference is in no sense necessary. The operative mortality in acute cases is always something. Post-operative complications due to weakening of the abdominal wall or adhesions occur in a small proportion of cases.

The following preliminary generalizations seem permissible:

1. In mild cases in which the diagnosis is doubtful surgical interference should be rejected.
2. In unmistakable cases of mild character immediate surgical interference is justifiable, but in no sense a necessity. The experience and judgment of the attending physician are presupposed.
3. In severe cases, with a good surgeon available, an immediate operation is preferable to medical treatment. Watchful medical treatment with surgical consultation rarely results fatally.
4. Emergency cases demand immediate surgical intervention.

The Medical Treatment of a Mild Attack

We are justified in making a diagnosis of acute appendicitis when the patient has pain, fever, local tenderness, and muscular rigidity. In addition there may be vomiting and other gastric symptoms. Constipation is almost invariably present. The severity of the attack is measured by the intensity and persistence of the pain, the general condition of the

patient, and the pulse rate. The temperature is a poor guide, and the degree of leukocytosis is sometimes misleading.

The one absolute indication in every case is perfect physical rest in bed. The dorsal position with the head slightly raised is the favorite one. If the initial pain is severe a hypodermic injection of morphin is indicated. One-sixth or one-fourth grain (0.01 to 0.015 gm.) may be given at once and repeated in a few hours if required. After the initial hypodermic injection it is usually advisable to continue the narcotic treatment, if such is needed, by moderate doses administered by mouth. The one principle to follow is to take the edge off the patient's suffering without narcotizing him.

The exact dose which will accomplish this result is the exact dose to give. The surgeons are right in demanding that the symptoms be not masked by overdosing with morphin. On the other hand, the patient demands relief and is entitled to the maximum relief which can be given within the bounds of prudence. The careful use of morphin masks nothing, lessens the shock, quiets peristalsis, reduces the tendency to vomit, and is indicated in almost every case. To withhold it on theoretic grounds is not good medicine. While internists agree on the necessity for opium in the early stage, there is some diversity of opinion regarding the best method of administering it.

Personally I favor an initial hypodermic of morphin gr. 1-6 to 1-4 (0.01 to 0.015), followed by a solution of morphin containing gr. 1-12 (0.005 gm.) in each teaspoonful, one teaspoonful to be given by mouth every one to three hours if required. Einhorn strongly recommends Sahli's method of giving 10 to 15 drops of tincture of opium every hour until the pain materially subsides, then five or six drops every two or three hours until the pains are gone. They prefer opium to morphin on the ground that it allays peristalsis more completely.

Forchheimer advises minimal doses of morphin or opium and calls attention to the fact that minute doses are often sufficient to reduce the pain. As a general rule, small doses suffice to quiet the patient in mild cases without early peritoneal involvement. The patient must lie absolutely quiet. Turning in bed is strictly prohibited. The bedpan or bed urinal must be used for evacuations. The legs may be held in any position comfortable to the patient. If he is more at ease with the knees flexed, pillows may be advantageously used to keep them in the desired position.

Nearly all clinicians agree upon the advisability of absolute abstinence from food during the first twenty-four hours. Ice pellets may usually be permitted. Gastric lavage is rarely indicated. There is little justification for its routine use. Nature usually promptly empties the stomach when the attack begins within a few hours after a meal. Gastric sedatives, with the exception of morphin, are out of place, and morphin should not be used until the stomach contents are completely evacuated.

An ice bag should be applied immediately to the right iliac region. The ice bag reduces local congestion and inflammation; it lessens the pain and tends to reduce the pulse rate. It also antagonizes shock. If there is much distention two ice bags may be used, one on each side of the median line covering the lower half of the abdomen.

The bowels must be let severely alone. This principle, I believe, is now universally adopted. What the patient needs is absolute rest and the absolute cessation of intestinal peristalsis. To move the bowels is to invite trouble. Neither low nor high enemas are in order. An ineffectual enema is often taken by the patient before the arrival of the physician. The absence of any relief by the enema is in fact a good diagnostic feature of appendicitis. The first twenty-four hours' treatment is, therefore, clearly mapped out. It may be thus summarized: Enough morphin to control pain, absolute physical rest in the dorsal position, an ice bag over the right iliac region, starvation, and the avoidance of laxatives and enemata.

In mild cases the patient will be reasonably comfortable on the second day. Fever will be moderate, the pulse rate will be under ninety, regular, and of good quality, and the need for narcotics will be either greatly diminished or altogether gone. There will still be tenderness at McBurney's point and some rigidity of the muscles on the right side of the abdomen. The chief duty of the physician at this stage is to be cautious. The treacherous nature of appendicitis is in part due to lack of vigilance on the part of the medical attendant. While it is true that perforation and diffuse peritonitis may occur insidiously and progress while the patient seems to be doing well, nevertheless, this course of the disease under the watchful care of an experienced clinician must be considered decidedly exceptional. A good pulse rate, the absence of general abdominal distention, the patient's mental and physical comfort, a desire for food, must all be considered favorable signs and indicate that the inflammation is receding. So long, however, as local tenderness persists, and so long as even the least muscular rigidity remains on the right side, the utmost caution is in place. Liquid food may be given in favorable cases on the second day. Only small quantities must be taken at a time. Broths, tea, and toast should be preferred to milk or cereals. Milk is an unreliable food in all intestinal conditions. On the third day cereals may be taken; ice cream is often well tolerated, especially in children. A light, easily digested diet may gradually be resumed after the fifth day if the symptoms and signs have all disappeared. So long as pain or muscular rigidity remains absolute quiet must be insisted on. Many fatalities have been due to the violation of this rule. To try to hasten recovery is to create danger.

The bowels may be moved by a low enema on the third or fourth day,

depending on the progress of the case. Sometimes it is advisable to give a preliminary injection of four or six ounces of olive oil. The nurse must exercise due caution in giving the enema; the patient is to move as little as possible, and under all circumstances must avoid straining; naturally a bedpan must be used.

A successful enema which produces no pain or special discomfort may be taken as a good sign, and the enema should be repeated daily thereafter until the patient leaves his bed. Should the enema produce much distress or markedly increase the pulse rate, or should the patient experience great difficulty in expelling the water, there is need of increased caution on the part of the physician. Every patient who is doing well should improve without interruption. Exacerbations of pain or of bloating are danger signals. The ice bag may be removed when the fever has been absent twenty-four hours and when the local signs have disappeared. In the mildest cases convalescence should be fully established between the seventh and the tenth day, when the patient may leave his bed part of each day and increase his diet. The physician must explain to the patient the probability of a relapse or a recurrence. Precautions must be taken for six months to a year after the attack. The patient must avoid all gymnastic or athletic exercises; he must regulate his bowels, with laxatives if necessary. He must avoid coarse vegetables and raw fruits, and must be careful not to "spoil his stomach." He should report the least pain in the abdomen to his physician. Many patients prefer to undergo a "preventive appendectomy" rather than to submit to the doubtful prophylactic measures just outlined, and the best practice is in accord with this decision. A patient who has had an attack of appendicitis is liable to have others, and it is safer for him to undergo an "interval operation" at the hands of an expert surgeon than to take his chances with a new attack. Some patients, however, refuse the operation after the first attack. A certain proportion of these remain well; others suffer from recurrences. Some attain good health after numerous attacks, the appendix finally becoming quiescent, but this is the exception rather than the rule. Frequently adhesions form about the appendix, the patient becomes the "residual legatee," and suffers from various chronic symptoms on the part of the digestive system without ever having new frank attacks. All of these facts should be laid before the patient. Patients who lead guarded lives and remain constantly within the reach of surgical assistance run less risk in postponing an operation. Those who travel much or live in secluded sections take a correspondingly larger risk in retaining their appendices.

In cases which have been so mild that some doubt is felt regarding the diagnosis the physician is warranted in advising against an operation. In all other cases, however, he should throw the weight of his authority on the side of a prophylactic appendectomy.

The surgeons are not yet of one opinion regarding the time which should be allowed to elapse after an attack before the "interval operation" should be performed. After a fairly smart attack it seems wiser to wait at least several weeks until any still active virulent bacteria in the neighborhood of the appendix (pus pockets, lymphatics, etc.) may have either died out or at least have lost their virulence.

The Treatment of Severe Attacks of Appendicitis

Immediate operation is indicated in all severe attacks. But immediate operation by an experienced surgeon is not always practicable, and, while it is highly desirable, it is not ordinarily a necessity. Internal treatment may be decidedly preferable to an operation by an inexperienced surgeon. Finally, proper early medical treatment is of enormous importance in safeguarding the life of the patient until an operation can be performed.

The severity of an attack is usually revealed by the intensity and persistence of the initial pain, the degree of shock, the rapidity and quality of the pulse, the facial expression of the patient, and the amount of muscular rigidity. The temperature is a useful but a deceptive indicator. Early peritoneal involvement is characterized by intense muscular rigidity, severe pain, rapid pulse, and an expression of anxiety.

As in the milder attacks, the first indication is to administer a sufficient dose of morphin to relieve the pain and shock. One-quarter grain (0.015 gm.) may be given hypodermically, and may be repeated in a short time. The attending physician must not be deterred by the fear of masking the symptoms.

Yates (26) pithily asks of what good to the patient are symptoms after the alarm has been sounded and the diagnosis made?

The patient must be starved for at least twenty-four hours. Ice pellets may be permitted in some cases, but the patient must swallow little fluid. The best position is the dorsal. The thighs may be flexed on the abdomen if the patient wishes it. A semi-reclining posture, or the so-called Fowler's position, is not ordinarily an advantage. Where shock is severe it may be even contraindicated, and the patient does better with the head and chest low. Hot bottles to the extremities are useful. An ice bag over the right iliac quadrant should be maintained in position from the start. A second ice bag on the other side is sometimes required. Some clinicians still advise a small low enema carefully given to empty the lower bowel. On the whole, it is safe to omit the enema for fear of starting undesirable peristalsis.

With the patient thus launched on his perilous journey, the further treatment will depend entirely on circumstances. If good surgical intervention is available, it is always better to operate than to await results.

Formerly surgeons did not like to operate after the second day, if the patient could be safely tided over to the interval. The factor of safety, however, is so hard to determine that the tendency is more and more to operate as soon as the diagnosis is made, no matter what the stage. Kelly (12) thinks that no hard and fast rule can be laid down. Halsted says: "If a case is on the rise, operate! if it is on the fall, you may wait; if a case is falling, but not fast enough, one is prone to operate to relieve anxiety."

Kelly divides the cases seen after the second day into three groups:

1. Cases which are manifestly getting worse, as shown by quickening pulse, rise of temperature, increase of swelling, pain, and tenderness.
2. Cases in which the patient, though not growing worse, is not distinctly improving, and there is a suspicion of latent trouble. Classes one and two should be operated on without delay.
3. Cases which are undoubtedly on the mend.

This group causes the consulting surgeon serious anxiety, and the decision to operate will often be determined by external conditions, such as the distance of the patient from "emergency help," the judgment of the attendant physician, etc.

As emphasized above, eternal vigilance during the period of apparent improvement is absolutely essential to the safety of the patient. No physician should see a patient through an attack of appendicitis without the assistance and counsel at all stages of an experienced surgeon.

When peritonitis is more than localized an immediate operation offers the best chance of recovery. When an operation is for any reason not practicable, the patient should be kept deeply under the influence of opium. Hypodermics of morphin offer the surest means of narcotizing the patient. The number of respirations should be brought down to twelve or less a minute. If there is no vomiting, tincture of opium may be given in large doses by the mouth (v. Peritonitis). Rectal suppositories of the extract of opium have also been recommended. If there is vomiting the stomach should be washed out with warm water, and this process may have to be repeated every few hours. Hypodermoclysis is invaluable in overcoming shock and adding fluid to the system. Eight to sixteen ounces (250-500 c. c.) of physiological salt solution should be introduced every six to eight hours. The patient's extremities must be kept warm. Warm applications to the abdomen are often preferable to the ice bag. Every effort must be made to conserve the vitality of the patient until the surgical intervention is undertaken.

Introducing warm salt solution into the bowel by the Murphy process is often highly advantageous. The physician must bear in mind that, while the treatment of this form of peritonitis is essentially surgical, the fate of the patient is often determined by factors which are not surgical;

that surgical intervention is an incident in the treatment, but does not constitute all of the treatment, and, finally, that exceptional cases clear up without surgical intervention.

Appendicitis in Typhoid Fever

The appendix is so frequently affected in the course of typhoid fever that the question of operative treatment will often have to be considered. So many cases of successful operative interference have been reported that a discussion of the desirability of such interference is in order. An extensive experience with "the typhoid appendix" both in the wards and as pathologist of the City Hospital has convinced me that an operation for the typhoid appendix is rarely called for.

Kelly gives a most enlightened discussion of this subject, and the following quotation from his monograph covers the question most conclusively:

"In a case of suspected appendicitis with an alternative diagnosis of typhoid fever the wisest course is to wait. The best general rule is not to operate for appendicitis in the early stages of typhoid fever—say up to about the tenth day—in the absence of exceedingly urgent symptoms; give the patient the benefit of the doubt, wait, and watch closely. The clinical history of the collected cases seems to show that, with the rarest exceptions, there is no more occasion for operating a true typhoid appendix than there is for cutting down upon the ileum and excising the affected Peyer's patches."

This rule of delay, except in extreme urgency of symptoms, accords with the established practice of some of our best operators. J. B. Murphy of Chicago, for example, in a personal communication, says: "It is my opinion that typhoid appendicitis should not be operated upon unless there is a perforation. All my cases recover, those operated and not operated. At the same time I feel that operation should not be performed except in special cases."

There prevails in some quarters a strong tendency to operate in typhoid fever as soon as symptoms of appendicitis appear, this course of action being encouraged by the swollen condition of the appendix as found, as well as by the favorable outcome of the operation. The surgeon in such a case congratulates himself that he has obviated a serious complication of the disease at what he considers little or no risk to the patient. This would be the case if the microscopic appearance of the typhoid appendix had the same significance as that of an ordinary inflamed appendix, but experience shows that this is not true. The inference that a swollen typhoid appendix must shortly advance to gangrene or perforation is not warranted by the well-established facts. *Per contra*, when, after a siege of pain in the right iliac fossa, the patient lapses into an

ordinary typhoid, with an entire subsidence of the severe local symptoms, the observer must not hastily conclude that he was wrong in suspecting an involvement of the appendix in the first instance. The autopsy records show, as I have said, that the appendix is often much swollen, but that this condition is a frequent accompaniment of the early stages of the disease.

When, however, the severity of the local symptoms is such that a perforation seems probable, the surgeon should not hesitate to operate without further delay. Under these conditions, says Kelly, minutes rather than hours should be counted as precious.

"If the operator is familiar with the endermic use of cocain in surgical operations, he will often do better to open the abdomen under a cocain or a cocain-adrenalin solution than risk the dangers of struggling and the depressing influence of a general anesthetic.

"It is best to make a free incision in the right semilunar line and evacuate all purulent and fecal material, after which the appendix can be tied off at its base and removed. If necessary other incisions may be made for more efficient direct drainage."

Appendicitis Complicating Pregnancy

Attacks of appendicitis during pregnancy are not uncommon. The earlier they occur in the course of the pregnancy the easier they are to recognize and the less dangerous to treat. Every woman who has appendicitis during the child-bearing period of life should have a prophylactic appendectomy performed. Should pregnancy ensue before this has been accomplished, the woman should be guarded most carefully, and upon the first signs of recurrent appendicitis an operation should be made. Appendicitis becomes more dangerous as pregnancy proceeds. During the first four months of pregnancy a prompt operation is safe, and has only a slight tendency to produce an abortion. If at all possible the abdominal opening should be closed, as drainage tends to cause premature labor. Delay in operating greatly increases the risk to mother and child. Suppuration in advanced pregnancy is very dangerous; the maternal mortality is about 50 per cent.; the fetus may die, but it is usually born alive. Medical treatment is entirely out of place. Even should the attack subside under medical care, the subsequent changes brought about by pregnancy and labor may cause serious or fatal complications.

A definite attack of appendicitis, therefore, occurring during pregnancy and recognizable as appendicitis, is an absolute indication for immediate surgical intervention. During the first few days of the puerperium appendicitis simulates puerperal sepsis. If a diagnosis can be made an operation is indicated. In the absence of certainty a conservative course is justifiable.

CHRONIC CONSTIPATION

Chronic constipation may be defined as a pathological condition characterized by insufficient fecal evacuation. The insufficiency may refer to the quantity evacuated or the frequency of evacuation. From a practical standpoint we may divide constipation into two groups: 1st, habitual constipation without anatomic abnormality; 2d, obstipation, in which the constipation is due to mechanical obstruction or to interference with peristalsis.

It is possible to subdivide these groups into many minor divisions, depending upon the underlying cause of the insufficiency, or the place in which the feces are delayed, or the quantity or quality of the feces themselves, or upon the particular nervous or muscular defects. For the present purpose, however, the simple classification will suffice.

Habitual Constipation

In the vast majority of cases habitual constipation is purely functional in character, i. e., absolutely independent of anatomical conditions or pathological changes in the digestive canal. It is nearly always an acquired disorder and due to causes which are very well understood. Certain general causes have led to the gradual increase of constipation, so that its prevalence is almost coextensive with civilization. Spivak (23) has pointed out that "the tendency of civilized life in general and of modern dietetics in particular is toward the production of lesser quantities of fecal matter and less frequent intervals of evacuation." He calls attention to the fact that at no time in history have civilized nations consumed so much meat and eggs, so much prepared and partially digested foods; and the greater efficiency of the dental art has contributed its share to the reduction in the quantity of fecal matter. City life is more conducive to constipation than the more active country life; and the great increase of the more sedentary occupations has led to the same results.

Aside from the general causes, constipation is usually acquired under conditions which are more or less directly under the control of the affected individuals themselves. Women as a class suffer much more frequently from constipation than men. This is the result of many causes. Many women eat too little food or too concentrated food; they drink too little water. They exercise little or not at all. Their style of dress inhibits the activity of the abdominal organs. Pregnancy weakens the power of the abdominal walls, and parturition often results in injury to those muscles which are actively concerned in the act of defecation. Many women are led by a sense of shame, or as a matter of convenience, to repress the calls of nature, so that the sensitiveness of the rectum and of

the sigmoid to the physiological stimulus of defecation becomes blunted. This cause is especially active during the school years and the adolescent period of life, and is probably more than any other one cause the predominating factor in the production of habitual constipation. Chlorosis and atonic states are also prevalent at this age, and not only blunt the sensitiveness of the nerves, but also reduce the muscular power of the individuals. Men often become constipated as the result of traveling, the inconveniences of a traveling life often leading to a suppression of the calls of nature. Overindulgence in tobacco may have a similar result, and the habit of reading while at the toilet, though often beneficial, sometimes so blunts the sensitiveness of the rectal nerves that they fail to respond properly.

The moderate irregularity in the periods of defecation brought about in the various ways described above would not of itself be of great importance, were it not followed by a chain of other events. The individuals under consideration follow one of two courses. They may at first pay no special attention to the irregularity which increases and brings in its train certain secondary symptoms, such as headache, biliousness, loss of appetite, fullness in the abdomen, etc. On the other hand, easily alarmed by the failure of the bowels to act, they resort at once to laxatives, choosing remedies which they see advertised or which are recommended to them by their friends. Finding themselves promptly relieved in this fashion, they again make use of the chosen remedy at the first suggestion of constipation, and thus very easily the "pill habit" is acquired. The bowels now refuse to act without the added stimulus of some drug and the habit assumed so easily becomes fixed upon the individual. In the course of time the strength of the pill has to be increased and the resort to stronger and stronger remedies often results in an uncomfortable state, in which natural unaided defecation becomes impossible.

It is necessary to discuss the etiology thus in detail because a consideration of these features suggests at once the proper prophylactic and curative measures. Like all functional troubles, constipation is far more readily remedied in the beginning than when it has become a fixed habit. It becomes the duty of the physician to find out which of the etiological factors is the most important, and to counteract its influence. In addition every constipated patient should be taught enough of the physiology of digestion to estimate rightly the necessity for regular evacuations and the means of bringing about this result. It is surprising what simple remedies will produce the desired effects in certain cases. Simply increasing the quantity of drinking water or taking a glass of cold water at bedtime and in the morning may suffice. Reducing the quantity of tea consumed or stopping it altogether, increasing the amount of fruit, the addition of stewed prunes or apples to the dietary, any of these means may bring about daily evacuations in the incipient cases. Other patients may re-

quire more active measures, such as outdoor sports, swimming, horseback riding, tennis, baseball, abdominal massage, and various gymnastic or calisthenic exercises. Others can correct the tendency to constipation by going to the toilet each day at the same time and making an honest and persistent effort to evacuate the bowels. [Suggestive measures are very useful and efficient in many of these patients.—Editor.]

While any of the just mentioned simple measures may suffice in the incipient cases to overcome the constipation and lead to daily evacuations, the more confirmed cases require far more systematic and active treatment to bring about a cure.

These confirmed cases of habitual constipation without anatomical defects are often divided into various groups, among which the spastic form is distinguished from the atonic, and among which can be recognized the types due to the overutilization of the food (Schmidt) and to imperfect digestion.

There is no doubt that a spastic form of constipation exists; that it can usually though not always be clinically recognized; and that it requires certain lines of treatment peculiar to itself. On the other hand, it is held, not without justice, that the spastic form has no absolutely pathognomonic signs or symptoms; that the dietetic treatment proper to the atonic form usually suffices to cure the spastic form, and, therefore, we are not warranted in putting the spastic variety in a class by itself. This will be discussed more fully later on.

Schmidt, who has done so much to further the scientific study of intestinal disorders, has advanced the theory that the term functional or essential constipation should be reserved for a class of cases in which the constipation is due to too little fecal residue on account of the overutilization of the food. In a recent publication he calls attention to the fact that different healthy individuals differ enormously in their ability to digest vegetables (20).

Many people digest without visible residue all sorts of raw and ordinarily indigestible plant foods, while others pass unchanged even well-cooked vegetable foods. Schmidt has furthermore demonstrated the great influence of the HCl of the gastric juice on the digestion of vegetables. The HCl loosens and partly digests the so-called "middle layer" within the cellulose sheath, but between the individual vegetable cells, so that the vegetable cells can the more readily fall a prey to the alkaline digestive juices of the intestine. The more HCl in the stomach the better the vegetables are prepared for intestinal digestion. Schmidt thus explains the well known association between hyperchlorhydria and constipation. Thorough cooking also tends to loosen up this middle layer, but never so thoroughly as do the chemical juices of the gastric and pancreatic secretions. The combination of good cooking and "too good" a digestion or even too good a digestion of and by itself is the cause of an important

type of functional constipation. Moritz, v. Noorden, Naunyn, and Einhorn have expressed the opinion that the insufficiency of fecal residue is not the cause of constipation, but the result, the food materials remaining in the bowel so long that they fall a prey to bacterial decomposition.

Schmidt answers this view by calling attention to the fact that the stools of constipated persons contain fewer bacteria than those of healthy persons, and that they likewise contain none of the products of bacterial decomposition. The practical points to be drawn from this discussion are the necessity for using large quantities of plant foods in cases of hyperchlorhydria if they are to be cured of their accompanying constipation by dietetic methods alone; and the advantage of adding substances to the diet (such as agar-agar, regulin) which will materially increase the bulk of the fecal residue.

On the other hand, Hale White (25) calls attention to a class of patients past middle life, who are of sedentary habits and who exercise too little and eat too much. These patients are apt to be constipated and are best treated by reducing the quantity of food while increasing the amount of exercise and fresh air. These patients often suffer from constipation during the winter months, but have regular evacuations during the summer when they indulge in golf or other outdoor sports. A regular annual or semiannual visit to a mineral spring is often of the greatest benefit to these patients.

Leaving these special types and all theoretic considerations aside for the present, we can group the vast number of cases of functional constipation into two clinical classes:

Class I includes those who are curable by an appropriate regulation of their diet.

Class II is made up of those who, in addition to dietetic rules, require treatment of a medicinal or mechanical kind to increase their muscular power, their nervous energy, and their general vitality.

The treatment of constipation by diet alone is successful in the large majority of instances. The methods by massage, hydrotherapy, electricity, etc., etc., described at great length in the textbooks and special treatises, are fortunately superfluous in the general run of cases. This fact should be distinctly understood, and every physician can hope to deal with this class of patients successfully without being armed with a great array of instruments and special devices. Only the minority of patients will fall under Class II, and these can usually be directed to adopt certain lines of home treatment which almost uniformly bring about the desired results.

The treatment by diet is based on the observation that certain foods and certain combinations of foods have a stimulating effect on intestinal peristalsis. In a general way all foodstuffs can be divided into two classes: those which tend to produce constipation, and those which favor the move-

ment of the bowels. As is well known, the albuminous foods tend rather to constipation, the vegetables and fruits to catharsis. Those foods which leave little residue after digestion have correspondingly little value in the treatment of constipation, and their use should be greatly limited or altogether excluded. Among these are meat, eggs, cheese, spaghetti, macaroni, milk, cocoa, chocolate. Certain foods have objectionable astringent properties, such as India or Ceylon tea, red wines, and blackberries, and they should be eliminated from the diet. The foods which favor catharsis may do so as a result of a laxative principle, or simply because of the bulk of their indigestible residue (chiefly cellulose). Those with a laxative effect are most of the fruits, especially oranges, grapefruit, apples, prunes, watermelon, grapes, peaches; some of the vegetables, such as tomatoes, cucumbers, potatoes, carrots, beets, garlic, onions, spinach. Certain foods, such as honey, buttermilk, cresses, syrup, cider, and certain acid wines are decidedly laxative. The foods with a large residue are the coarser grains, such as rye, oatmeal, and corn, cabbage, Brussels sprouts, turnips, string beans, kale, peas, rutebaga, oyster plant, squash, etc. Mineral oils are laxative; butter, vegetable oils, suet, and cream all favor peristalsis. Water, when freely taken, is an aid in overcoming constipation. Some people are constipated because they take too little fluid, or because they perspire so freely that the feces become hard and dry. In these cases plenty of water is curative. Hard water is constipating and must be avoided.

The judicious mixing of various foods is a valuable means of overcoming constipation. Buttermilk, for example, when taken by itself or as a sole article of diet, may be actually constipating; yet when taken in combination with other foods it may be decidedly laxative. It will not do, however, to allow an entirely unrestricted mixing of various foods. Experience has taught that certain restrictions are necessary, and that gastritis and enteritis can easily be produced by indiscriminate combinations. For example, ice cream and sour fruits, beer and fruits, cucumber and iced water, soda water and fruit acids (especially ice cream soda with acids) are all irritating mixtures and may be followed by vomiting or diarrhea.

For a number of years I have prescribed with gratifying success a diet along the following lines: On arising, one glass of cool water. Breakfast: Oatmeal, whole wheat or graham bread, butter, coffee with cream and sugar, raw or cooked fruit or marmalade. Forenoon: One glass of buttermilk. Luncheon: Fruit, at least two vegetables, coarse bread and butter. Afternoon: One glass of buttermilk. Dinner: Fruit, at least two vegetables, coarse bread and butter, salad, suitable dessert. Bedtime: One glass of buttermilk. The noon and evening meals are interchangeable. A small portion of meat or fish or seafood may be taken at either meal. Sardines, herring, mackerel, and shad are especially suitable. Cider may often be substituted advantageously for the buttermilk. It is surprising to note the immediate effect of such a diet. Many patients who for

years have not had an unaided movement of the bowels begin at once to have daily evacuations. The continuation of this diet for weeks will usually have the effect of accustoming the bowels to regular activity so that later the patients may adopt any diet without relapsing into a constipated state. Many persons are entirely willing to adhere to the diet indefinitely. Like all other therapeutic resources the anti-constipation diet must be "mixed with brains" and will require many modifications to suit individual needs and conditions. Some patients will not be able to take such a varied allotment of acid fruits without suffering from dyspepsia and intestinal flatus. It is remarkable, however, that many persons with marked hyperchlorhydria are able to adopt this diet without discomfort. Should the acids cause heartburn or gastric irritation an alkali can sometimes be taken with advantage one hour after the three principal meals. A mixture of calcined magnesia and sodium bicarbonate is especially suitable, and can be withdrawn gradually as the patient becomes accustomed to the diet. Delicate women cannot always manage to eat the varied assortment required.

In these subjects other methods, such as massage, exercises, and cold rubbings, must be used as adjuvants during the early weeks of treatment. A few diet schemes suggested by other authors are appended. E. I. Spriggs (24) recommends the following: Breakfast: porridge and golden syrup, fat bacon, whole meal bread, butter, marmalade or honey, coffee with cream. Luncheon: fish, potatoes, green vegetables, salad with plenty of oil, stewed apples or figs, water or lemonade, whole meal bread, butter, one orange. Tea: weak, freshly made China tea with cream, whole meal bread and butter, jam or honey, gingerbread. Dinner or supper: tomato or other vegetable soup, meat, spinach, French beans, asparagus, salad with oil, dry toast or biscuits, apple charlotte, stewed pears or prunes, water or lemonade, cheese, grapes, or other uncooked fruits.

Zweig (27) gives several excellent diets for spastic and atonic constipation. They do not differ essentially from each other. He advises the following diet to cure habitual constipation, and adds that in no other department of medicine are dietetic rules crowned with more uniform success. Upon arising: a glass of cold water containing a pinch of salt, or fresh fruit (orange, apple, melon). Breakfast: tea or coffee with milk, Graham bread and butter, honey or marmalade. Forenoon: one glass of sour milk, buttermilk, or one-day-old kefir, rye bread with butter, and a herring or Graham bread with sardelle butter. Noon: no soup; radishes with butter; a little meat or fish, salad, pickles, and a variety of vegetables, stewed fruit with a tablespoonful of sugar of milk, dessert with fruit juices, cider with a tablespoonful of sugar of milk. Afternoon: tea or coffee with milk, Graham bread and butter, marmalade. Supper: meat or eggs, pickles, salad or vegetables, raw fruit or preserves, Graham bread and butter, soft cheese, cider. 10 P. M.: stewed prunes or a glass of one-day-old kefir.

Naturally, these diet schemes must be adapted to each individual's tastes and digestive capacity. Almost all lists follow the same general plan. If the lists are suitably modified the result will be successful in

the large majority of cases. Failure to cure by dietetic means alone in the purely functional cases is due to a variety of causes. Chief among these is a general atonic state of the individual which prevents him or her from using so coarse or mixed a diet. In these cases the patient must be gradually toned up by constitutional treatment, by local and general massage, and by exercise, and during this period recourse must be had to mild laxative drugs or mineral waters.

For these patients Hale White has advised the following régime (25): A diet should be used which approximates as nearly as possible the ones advised above. Daily exercise in the open air is necessary. Every morning a simple aperient should be used in a dose just sufficient to move the bowels. Nux vomica is a desirable addition. Before arising the patient must have her abdominal muscles massaged thoroughly for 15 minutes, more or less; she may also train her abdominal muscles by certain exercises which will be described later. An abdominal supporting bandage is often advantageous. In two or three months the aperient may be gradually reduced until it is no longer necessary, but the massage and exercises should not be omitted until spontaneous movements of the bowels are obtained. If the feces accumulate in the pelvic colon or rectum simple enemata may be necessary, but one must guard against becoming addicted to their use. A glycerin suppository is often preferable to the enema. White says his successes are so uniform with the above method that he can scarcely recall a failure—though in severe cases many months of perseverance are required to effect a permanent cure.

Mechanotherapy

Many volumes have been written on the treatment of constipation by various mechanical means, such as massage, electricity, gymnastics, hydrotherapy, and surgical procedures. The general practitioner must learn to regard these numerous methods in a proper perspective. *In the general run of cases they are superfluous; in a large number of cases they are helpful, though not essential; in a small proportion of cases they play an indispensable rôle in the treatment; in not a few cases they are meddlesome and, therefore, contraindicated.*

In debilitated, neurasthenic, housebound, or bedridden patients they have their appropriate field of usefulness. They are largely empirical. "By no stretch of imagination," says Dowse, "can mechanotherapy be classed as an art or a science." Mechanotherapy acts by directly stimulating the muscles and nerves, by increasing the local circulation, and, indirectly, by suggestion.

Massage.—Massage is the most useful of the mechanical means of overcoming constipation. The movements embrace: (1) effleurage; (2)

petrissage; (3) friction; (4) tapotement; (5) vibration. The best time for the massage is in the morning before breakfast. For the technical details the reader must consult the special textbooks on the subject (see Vol. I, Sec. I, Chapter VI). The manipulations are made from the cecum to the sigmoid flexure. Especial attention must be given to the hepatic and splenic flexures, the left inguinal region, and to parts above the navel (Dowse). "The pressure movements," says Dowse, "to be effective must be gliding, slow, purposive, and well maintained."

Einhorn advises against massage in cases of spastic constipation. In the atonic variety he considers it useful. According to him, it should be given every other morning for at least six weeks. Other authors advise its use daily.

There is no doubt that treatment by massage, if persisted in for many months, is successful in many cases, but, as stated above, the massage should generally be considered merely an auxiliary to the treatment by diet and exercise. Automassage may usually be practiced by the patient with benefit. This may be performed with the hands or by means of the well-known cannon ball covered with leather or flannel, or left uncovered. The cannon ball was first suggested by Sahli; it should weigh between three and five pounds. The patient kneads the muscles in the direction of the colon, devoting most pressure and time to the cecum and the region of the flexures.

Physical Exercises.—Next to diet, physical exercises play the most important rôle in the treatment of functional constipation. In fact, it may be stated that very active persons are rarely constipated. Outdoor sports, whenever practicable, should be given the preference. Most authors extoll the virtue of much walking. It is my experience that walking of and by itself rarely brings about a cure. More active exercise is necessary. In young people baseball, tennis, rowing, swimming, and similar sports should be selected. In middle-aged and older patients no exercise excels golf in its beneficial effects.

Caution must be used against overexercising to the point of exhaustion. This is rarely helpful and is often decidedly harmful. The bad effects on the bowels of excessive sweating have already been noted. When outdoor sports are not available, calisthenic exercise and gymnastic training either in a regularly fitted-up gymnasium or at home are most helpful. The parallel bars, the jumping horse, and the pulleys are particularly appropriate. But many men cannot attend a gymnasium and many women are too weak to employ the ordinary apparatus. For them many forms of calisthenic exercises have been arranged. Their great utility is unquestioned. Aside from the general effect of all exercise in stimulating the general metabolism, stimulating the appetite and the digestive capacity, these special movements tend to strengthen the abdominal muscles and greatly increase the neuromuscular vitality of the whole di-

gestive canal. Gant (10) has excellently grouped the most useful of these exercises as follows:

(1) Stand erect with the legs together, and slowly bend the upper part of the body to the left as far as possible, and then to the right in the same manner.

(2) Assume the erect posture and rotate or turn the body upon the hip.

(3) Take the same position and, without bending the knees, slowly lean forward and downward until the tips of the fingers touch the floor in front of the toes.

(4) Lie flat upon a firm bed, table, or couch, with the legs held rigidly together, and raise the body until it is at or near a right angle to the limbs.

(5) Reverse the procedure by raising the stiffened limbs until they are at a right angle to the body.

(6) While still in the recumbent posture flex the knees and draw the thighs closely up against the abdomen.

(7) Kneel upon the floor and, with pelvis fixed, bend the body in succession forward, backward, from side to side, and then rotate it as far as possible first in one direction and then in the other.

(8) Standing erect, with hands crossed behind or extending fully above the head, quickly change to the squatting posture.

(9) Lean slantingly forward and repeatedly draw up the abdominal muscles, and then relax, taking deep respirations, to exercise the diaphragm and the abdominal muscles.

(10) Extend both arms at a right angle from the body, so as to form a straight horizontal line, and, with the arms held in this position, walk six or eight times on tiptoes from one end of the room to the other.

The above movements should be repeated from five times for the beginner to ten times for persons accustomed to the exercise, and are more effective when practiced systematically, the one after the other, and for a period of time varying from fifteen minutes to one-half hour.

In the beginning once daily is sufficient, but later on they may be carried out twice daily, and, as a rule, if persisted in, they become a habit, and the exercise is looked forward to with pleasure.

Electricity and Vibratory Massage

Of all the physical means used in the treatment of constipation electricity is the least reliable. In the hands of any but the most expert electrotherapeutists it is almost sure to fail. Even in their hands it must be looked upon merely as an auxiliary measure in connection with treatment

by diet and exercise. It is true that persistent treatment by electricity may succeed in bringing about normal evacuations in time, and even that remarkable success is achieved in a short time in exceptional cases, but these results in no way militate against the general conclusion that electricity is not to be considered a routine measure in the treatment of constipation. It is unfortunate that authors continue to reproduce at great length the various methods of treatment by electricity and to describe in detail the instrumentarium which is necessary. Personal experience over a period of many years has convinced me of the comparative inutility of electricity, except by way of suggestion. Gant (10), who devotes fifteen pages to the electrical treatment of constipation, says that when employed alone it will fail to give permanent relief in a large percentage of cases. Musser and Piersol state that electricity is the least useful of all the physical methods. Mummery says that the small galvanic and faradic batteries employed in the treatment of constipation are quite valueless, but he recommends the three-phase sinusoidal current, the continuous current with quick reversals, and the high frequency current, if properly applied. The small roller electrode, which is commonly used with either the faradic or galvanic current, acts in the same manner as simple massage or the cannon ball. The reader is referred to the numerous treatises on electrotherapeutics for a description of the great variety of methods recommended by different authors.

Vibratory massage acts partly by suggestion, partly like simple massage. The instrumentarium is cumbersome and costly, the technique exacting, and the treatment, to be successful, must be combined with other methods. When indiscriminately employed much harm may be done.

Hydrotherapy

Hydrotherapy is to be considered merely an indirect method of treating constipation. It acts by its stimulating effects upon the nerves and muscles of the abdomen and the general system. Cold plunges, cold rubbings, spinal douches, and other methods of application all have their appropriate indications. Enemata are useful for their immediate purpose of emptying the colon and rectum. They have no curative influence. Many patients resort to enemata daily for many months or years with entire satisfaction. As a rule, however, external conditions intervene to make this method inconvenient or impossible, or the enemata gradually lose their effect. Large colonic flushings should never be used for more than a few weeks, or at most months, at a time, as they tend to cause distention and relaxation of the bowel. Too hot water has the same effect. For ordinary use one quart of warm water or warm soapsuds is sufficient. For special enemata to meet particular conditions the reader is referred to the appropriate chapters.

Spastic Constipation—Enterospasm

Spastic constipation may be acute or chronic. In the acute form patients suffer from more or less severe abdominal pain; there is the desire without the ability to evacuate the bowels. The use of cathartics aggravates the symptoms, giving rise to severe cramps. If purgatives are pushed reflex vomiting may result, and the case may simulate one of intestinal obstruction. The abdomen is usually flat; there is no sign of colonic distention. These symptoms may persist for several days. The treatment must be directed toward relieving the spasm of the colon. Bed rest is a necessity. All purgative medicines are absolutely contraindicated. Hot applications in the form of Priessnitz compresses or the hot water bag are exceedingly useful. The colon should be flushed with large quantities of warm water or salt solution. Belladonna is by far the most useful drug. Five or ten drops of the tincture may be given in hot water every three hours. The following prescription is appropriate:

℞				
	Tr. belladonna.....		5.0-10.0	min. lxxv-cl
	Spt. menth. pip.....	āā	10.0	min. cl
	Spt. chloroformi.....			
	Tr. valerian qs. ad.....		60.0	℥ii

M Sig.—One teaspoonful in hot water every three hours.

Atropin in doses of gr. 1/100 or 1/150 (0.0006 to 0.0004 gm.) may be given by mouth or hypodermically two or three times a day. Small doses of morphin or tincture of opium are valuable.

The chronic form is not always to be recognized with certainty. The stools are either thin, flat, compressed, ribbon-like, or broken up into small nodular masses. When the bowels have moved the patient has the sensation that the evacuation has been incomplete. The ordinary purgatives are not effective in producing copious stools. The patient often has irregular pains along the course of the colon. The colon either in its entirety or in various segments can be palpated as a hard, cord-like mass. In very thin patients scybalous masses retained in portions of the colon can be felt. The patients belong to the atonic or neurasthenic type.

The treatment of this chronic type differs from that of the atonic form in various ways. All active mechanical treatment by massage, electricity, vibratory massage is here contraindicated. Physical rest and hot compresses are useful. Colonic flushings are indicated for a time. The oil enemas described in the treatment of mucous colitis are especially valuable. The diet need not differ essentially from that appropriate for the atonic form. General hygienic treatment, fresh air, sufficient relaxation are necessary for a permanent cure.

The Use of Drugs and Various Special Additions to the Diet

Drugs are of invaluable assistance in the treatment of many cases of chronic constipation. Many patients are not suitable subjects for treatment by diet or mechanical means. Persons of advanced years can often be made entirely comfortable by the regular use of aperient drugs. The presence of other diseases (cardiac lesions, emphysema, arteriosclerosis, et al.) may often contraindicate dietetic experiments to relieve constipation. People when traveling often have to resort systematically to drugs to regulate the bowels. Finally, many patients not living in their own homes may find it impossible or inconvenient to adopt a suitable dietetic or hygienic régime. All of these patients may be encouraged to obtain daily evacuations by medicinal means. There is a very widespread prejudice against the daily use of laxatives. This prejudice is well founded, but when erected into a principle is entirely without justification. Self-drugging, as pointed out above, leads almost inevitably to certain abuses, but the systematic use of drugs under intelligent guidance is objectionable in theory only. Persons object to "becoming enslaved to the use of drugs," but it is hard to choose between the liberal use of certain fruits on the one hand and the employment of the active principle of certain fruits on the other. While it is not ordinarily judicious to advise any young person to adopt the steady use of drugs for the relief of constipation, this advice in preference to any other may often be given to adults.

I know of several patients who have used the same aperient pill uninterruptedly for fifteen to twenty years with entire satisfaction. Many patients who adopt a dietetic régime for constipation may have to use aperients during the first few weeks until the exercises, the massage, and the diet become effective. The medicines may then be gradually withdrawn. For these and other reasons an intimate knowledge of the action of the usual laxative remedies is of the utmost importance. The drugs which have especially demonstrated their usefulness over a period of many years are senna, aloes, rhubarb, and cascara sagrada. Other popular remedies are podophyllin, phenolphthalein, and magnesia. Senna is very widely employed, and forms the basis of most of the teas in popular use. It has a decided tendency to gripe. When it does not gripe its continued use often produces a tender condition of and a sense of soreness in the bowels. Many patients get good results by chewing from 10 to 25 senna leaves before retiring; or the like number of dried leaves can be crumbled up in prune juice or other cooked fruit. The compound licorice powder is a preparation of senna which causes pain in some patients, but which acts favorably in others. It is especially suitable in old people, who often take it night after night for months or years. Compressed tablets containing 20 grains (1.3 gm.) of the compound licorice powder are useful.

Many of the widely advertised laxatives for children owe their potency to senna.

Aloes and aloin are widely employed. Aloin in doses of gr. ½ to 1/6 (0.03 to 0.01 gm.) is used in countless combinations in the ready-made pills on the market. The ordinary combination with belladonna and strychnin, though extensively used, does not seem a rational one, nor is it especially useful. The extract of aloes should be given in doses of gr. i to iv (0.06 to 0.24 gm.), and may advantageously be mixed with extract of hyoscyamus, gr. ss (0.03 gm.). The objection often raised against aloes and aloin, that they irritate the lower rectum, is not a valid one when they are given in moderate doses. Rhubarb has certain advantages and certain disadvantages. In large doses it often irritates the bowel if used for any length of time. In small doses it soon loses its effects. The powdered root may be given in doses of 4 to 6 grains (0.24 to 0.4 gm.) after each meal, preferably mixed with sodium bicarbonate. A formula especially useful in constipation associated with gastric atony is:

℞			
	Rhei	10.0	(℥iiss)
	Sodæ bicarbonatis	30.0	(℥i)
	Eleosacchari anisi	10.0	(℥iiss)

M ft. pulv. no. xxx.
Sig.—One powder after meals two to three times daily.

The pil. rhei composita may be given nightly in doses of gr. ii-iv (0.12-0.24 gm.) or in smaller doses, combined with other laxatives.

An excellent dinner pill is the following:

℞			
	Podophyllin	0.12	(gr. ii)
	Ext. colocynth co	1.2	(gr. xviii)
	Pil. rhei co	0.8	(gr. xii)
	Ext. hyoscyami	0.4	(gr. vi)

M ft. pil. no. xii.
Sig.—One immediately after dinner every evening.

This, like many other formulæ containing podophyllin, acts better when taken immediately after the evening meal than at bedtime.

Cascara sagrada enjoys a wide popularity with the profession and the laity. It produces stools of normal consistency, usually without pain; it does not easily lose its effects, and it has no contraindications. The dose may be gradually lessened without loss of effect, and in some cases it has been entirely withdrawn by slow degrees and the patient thus rendered independent of drugs. Success by this method is exceptional rather

than the rule. The bitter fluid extract is active in doses of 10 to 60 drops; the aromatic elixirs and fluid extracts require two to four times this dose. I have found the solid extract in doses of two to ten grains (0.12 to 0.6 gm.) quite unreliable. Podophyllin is an undoubted cholagog of merit. The best dose is from 1/6 to ¼ grain (0.01 to 0.015 gm.); larger doses should ordinarily be avoided; smaller doses are often ineffectual. It is best mixed with other remedies, as in the formula given above.

Phenolphthalein, though only recently introduced, has been extensively used. It is more valuable in children than in adults. It is apt to produce soft stools, and, in my experience, is not suitable for prolonged use. It has few or no advantages over other better established drugs. Magnesia is very valuable in cases of gastric hyperacidity. In fact, many cases of constipation are intimately associated with, if not dependent on, hyperchlorhydria, and may be cured by the treatment for that condition. Both olive oil and magnesia are especially useful under these circumstances. The chief objection to magnesia is that it tends to produce soapy stools with intestinal gurgling. Physostigmin is a powerful stimulant of intestinal peristalsis. It should be employed with extreme caution, as it is apt to produce enterospasm and congestion of the bowel. Eserin salicylate may be given hypodermically in doses of gr. 1/60 to 1/30 (0.001 to 0.002 gm.) to stimulate peristalsis, but its effects must be closely watched. The value of the recently introduced hormonal has not yet been definitely determined.

Sulphur is a laxative of value. It is usually combined with cream of tartar. It is easily taken stirred in a little cold milk, which disguises the sulphur taste. It is recommended by Hilton for patients afflicted with hemorrhoids. One or more teaspoonfuls may be taken at bedtime. It often produces griping when continued for any length of time.

The salines are useful for their temporary effects, but they are much abused by constipated patients. When taken in large doses they are usually followed by constipation. The best plan is to take small doses about one-half hour before breakfast, although some patients get better results by taking them at bedtime. Magnesium and sodium sulphate, sodium phosphate, potassium and sodium tartrate, and various combinations are ordinarily employed. Some patients can continue these remedies daily for years without increasing the dosage, but this is certainly exceptional. Usually the small doses lose their effect or cause gaseous distention of the bowel and much discomfort. While invaluable for specific indications, they cannot be considered in any sense curative. The same may be said of the ordinary mineral waters in common use. Rubinat, Carabaña, Hunyadi Janos, Apenta, Congress, Friedrichshall, Carlsbad, Pluto, and many others are in enormous demand by the laity; they relieve temporary conditions, are rarely, if ever, curative, and in the long run usu-

ally have to be abandoned because they produce unpleasant or pathological conditions.

Many unusual plans have been devised for stimulating intestinal peristalsis. Beechwood sawdust, pebbles, sand, flaxseed, mustard seed, and similar indigestible substances are taken in teaspoonful doses, and often produce the desired evacuations by stimulating or irritating the intestinal mucosa. Bran is a popular remedy and is taken by itself or mixed with cereals or made into biscuits. Sterilized bran is now readily obtainable in sealed packages. As much as several tablespoonsful of the bran mixed with water may be taken at bedtime or with the breakfast foods. Biscuits made up largely of bran to which have been added the watery extracts of senna or cascara are advertised under various trade names. They are all useful in mild cases. Oily substances are useful when taken by the mouth or administered by the rectum. Systematic injections of olive oil, linseed oil, or sesame oil, as described under mucous colitis (q. v.), are often successful in overcoming constipation, especially of the spastic variety. A simple way is to inject two to four ounces (60.0 to 120.0 c. c.) of olive oil every night with a hard rubber syringe into the lower bowel and to retain it over night. This is a simple method which is sometimes effective, though often useless.

Lipowski (14) has devised a method of injecting melted paraffin into the bowel at bedtime, which has the advantage that it does not soil the bed and that it usually produces a morning evacuation. Naturally, the use of rectal suppositories (glycerin, soap, cocoa butter, gluten, etc.) cannot be extended over a long period, as they soon lose their effect. When given by the mouth the mineral oils are more effective than the vegetable oils because they are less digestible. They act by lubricating the bowel, by adding bulk to the indigestible residue, and sometimes their decomposition products stimulate peristalsis. Olive oil must ordinarily be taken in large quantities; to overcome constipation one or more tablespoonsful after each meal is a moderate dose. Often half a tumblerful at bedtime or on the fasting morning stomach is effective, though a large proportion of patients cannot tolerate large doses, especially during the warm months. Sometimes the dose can be gradually reduced without losing its effect, though this is by no means the rule. Hale White thinks that nearly all patients can be trained to take one ounce of olive oil every four hours by beginning with small doses and gradually increasing them. He thinks this remedy especially valuable in the constipation associated with gastric or duodenal ulcers.

Corresponding doses of the mineral oils are more apt to produce evacuations. Liquid albolene or similar preparations can be taken in large doses at bedtime with gratifying results in many cases. One-half a tumblerful can often be swallowed without nausea or eructations.

Agar-agar has become a popular remedy during the past few years.

In this country its effects have been carefully studied by Louis Gompertz. He describes it and the method of its use as follows: "Agar-agar is a simple carbohydrate taken from seaweed. It has the property of absorbing water readily and of retaining it. It resists the action of the intestinal bacteria and enzymes. When eaten it passes practically unaltered to the intestines, where it adds to the bulk of the feces. It prevents the formation of scybalous masses. Agar-agar comes in long strips, which are ground into small pieces, resembling the consistency of a coarse granular cereal. It is to be taken morning and evening, the average initial dose being 15 grams (one-half ounce). It is eaten with milk or cream with the addition of salt or sugar. The dose may be increased or diminished, as the occasion requires." In a few cases diarrhea is produced. Gompertz does not class agar-agar as a cure, but states that it is a helpful and harmless remedy which may be continued indefinitely. In Germany agar-agar has been strongly recommended by Professor Schmidt of Halle. Mixed with an aqueous solution of cascara sagrada, it has been placed on the market under the name of Regulin, and it has been extensively advertised to the laity.

CONSTIPATION DUE TO OBSTRUCTION

It is obvious that the plans of treatment outlined above will not result in a permanent cure if some mechanical cause obstructs the passage of the feces somewhere between the ileum and the anus. The most common site of obstruction is the lowest portion of the rectum. Internal hemorrhoids, rectal ulcers, or fissures may cause obstruction by spastic contraction of the sphincters, or, in time, by actual hypertrophy of these muscles. Fecal impaction is a not infrequent cause of obstruction higher in the bowel. The rôle of splanchnoptosis, colonic adhesions, hypertrophy of the rectal valves, etc., is still a matter of discussion, and the problem awaits final solution in the future.

There is a tendency at present to exaggerate the importance of the mechanical factors in the production of constipation. The publication of books on constipation by surgeons is a suggestive sign of the times. Misled by the bulk of surgical literature, the general practitioner is very apt to lose a proper sense of proportion. It cannot be stated too strongly or repeated too often that the vast majority of cases of chronic constipation are purely functional in character, and can be cured by the dietetic and other simple methods already described. The case requiring surgical interference is the exceptional case.

It is a question if colonic adhesions can ever produce constipation without causing other symptoms, such as pain, dragging, signs of partial obstruction, etc. Putting the matter another way, we may say that constipation *per se* without the above symptoms is rarely, if ever, due to

colonic adhesions. Operations upon the large bowel for obstinate constipation without the signs and symptoms of partial obstruction are, therefore, rarely, if ever, justified. Hale White expresses himself very positively on this point. He thinks that the importance of adhesions has been greatly exaggerated; adhesions are so common that almost every one ought to be constipated; even when dense adhesions exist, as in chronic peritonitis, there is often very little constipation. He says that he has never seen a patient whom he should have wished to send to a surgeon for operation, because by diet, exercise, drugs, and massage "all cases can either be cured or, at any rate, made so much better that no surgical interference is necessary." Many surgeons take advanced ground on the other side of the issue, and advise operative interference in many cases of pure constipation which resist medical treatment. Mummery thinks even that certain cases of atonic constipation may call for an operation.

Three methods have been employed, viz.: appendicostomy, ileosigmoidostomy, and resection of the entire colon. W. Arbuthnot Lane says that, "if pain is not a feature, the division of the ileum within 4 or 5 inches of its termination and the establishment of a lateral anastomosis between the distal portion of this bowel and the sigmoid or rectum is sufficient. If there is much pain, it is better to take away the large bowel as well."

Lane reported 28 cases of excision of the colon for constipation, with a mortality of 33 per cent. Mummery doubts that this operation is justifiable, and prefers appendicostomy, which is a safe operation without risk. It is difficult to see what advantages appendicostomy has over ordinary colonic irrigations in cases of constipation without obstruction.

Section of Houston's valves or valvotomy, as originated by Martin, has been recommended in cases in which the evacuation of the fecal mass seems delayed or prevented by hypertrophy of the rectal valves. The occurrence of secondary hemorrhage or peritonitis has induced proctologists to devise clips or clamps for the severing of these valves by pressure necrosis. Pennington, Gant, and others have invented clips which are easily applied. Valvotomy is rarely followed by permanent results, and it is questionable if it is frequently called for. After the operation the patient must be treated by diet, massage, etc., in order to attain a lasting cure.

INTESTINAL OBSTRUCTION

Acute Intestinal Obstruction

Intestinal obstruction may be paralytic in character or may depend on a mechanical obstruction to the onward passage of the intestinal contents. The paralytic form may be reflex, toxic, or essential, in the latter

case being the result of shock or trauma during an abdominal operation. Toxic ileus is often a terminal symptom in acute infectious diseases, and is indicative of an approaching fatal issue; there is no successful treatment. Reflex ileus is usually temporary in nature and follows acute injuries to pelvic or abdominal organs. Paralytic ileus is always a grave condition. It comes on suddenly after the performance of laparotomy, and cannot always be distinguished from the beginning of peritonitis. Its nature can be suspected from the absolute cessation of peristalsis, the absence of sepsis, and its sudden onset during an apparently favorable post-operative course. It should be treated by gastric lavage, repeated as frequently as necessary; hot applications to the abdomen, and stimulating purgative enemata. The patient must be stimulated hypodermatically, the sodio-benzoate of caffein in doses of 2½ grains (0.16 gm.) every 3 hours being especially suitable. Atropin sulphate, in doses of gr. 1/30-1/60 (0.002-0.001 gm.), is often helpful. Of late eserin salicylate in like doses has come into much favor. [Adrenalin, because of its effects upon the splanchnic circulation, may also be tried. I have had good results follow its administration in two cases.—Editor.]

In cases which go from bad to worse a second opening of the abdomen and the performance of enterostomy may save life. After the enterostomy the eserin salicylate may be injected with a fine syringe directly into the wall of the small intestine, and this procedure is sometimes followed by copious purging.

Mechanical obstruction may be caused by blocking of the lumen of the bowel from within (fecal masses, gallstones, foreign bodies), or may be due to constricting bands, volvulus, intussusception, adhesions, slits, etc. The most favorable form is that due to obstruction from within, and by far the most frequent cause in this class is *fecal impaction.* The most common sites of the impaction are the cecum and the lower end of the rectum, though the flexures of the colon are sometimes the place of obstruction. In the majority of cases fecal impaction can usually be recognized as such. When the lower rectum is involved the patient usually has great local discomfort; he has the desire without the ability to empty the bowel; there is tenesmus and sometimes severe pain. The constitutional symptoms are mild or may be wanting. A finger introduced into the rectum will meet large putty-like masses which completely block the bowel; only rarely are the fecal masses dense and hard. Sometimes the finger can succeed in breaking down the mass into smaller bits. When this is not possible injections should be used to soften the fecal material. Six or eight ounces (180-240 c. c.) of olive oil, two ounces (60 c. c.) each of glycerin and oil, or mixtures of olive oil, glycerin, and turpentine may be used. The ordinary purgative enema, composed of water, one pint (500.0 c. c.); Epsom salts and glycerin, of each 2 ounces (60.0 c. c.); turpentine, ½ ounce (15.0 c. c.), is very useful. It is advantageous to

use hot soapsuds instead of water in the above formula. Another suitable combination is: glycerin, 1 ounce (30.0 c. c.); castor oil, 1 ounce (30.0 c. c.); sodium bicarbonate, 1 dram (4.0 gm.); water, 8 ounces (250.0 c. c.). These injections may be repeated every few hours until the fecal masses are softened and expelled. Sometimes it is necessary to introduce a rectal speculum and break down the hard feces with blunt instruments and scoop them out with a spoon or dull curette.

When the fecal impaction is in the cecum or at the flexures, the nature of the obstruction can nearly always be determined. A soft, boggy mass can be palpated at the site of impaction; when this is the cecum the tumor is sausage-shaped and quite characteristic; it can be indented by pressure, is more or less movable, and is not painful to manipulation. Very hard masses at the flexures are occasionally mistaken for tumors, though the history will usually be of assistance in the diagnosis.

Copious injections of cottonseed or olive oil in the knee-chest position followed by large colonic flushings are indicated. The patient may take inwardly large doses of olive oil, 2 to 4 ounces (60.0 to 120.0 c. c.), or one to two ounces (30.0 to 60.0 c. c.) of castor oil, twice daily. Little or no food should be taken until good evacuations are obtained. Under this treatment the impacted feces are softened and begin coming away on the first or second day. This is sometimes accompanied by severe pain and rarely by some shock. The treatment may have to be continued for a week or more, until the colon is completely emptied; after-treatment may be necessary for several weeks. The dislodgment of the hardened feces may sometimes be hastened by abdominal massage or manipulations, but caution must be used not to damage the bowel. In very exceptional cases it is impossible to overcome the obstruction by medical means, and surgical intervention becomes necessary.

Acute Obstruction Due to Strangulation.—This requires for its successful treatment a clear conception of the underlying pathology, a high degree of clinical skill in estimating symptoms, and uncompromising, aggressive surgical interference when it is called for. Unfortunately, these cases do not always come under observation with the diagnosis ready-made. A busy practitioner, unless eternally vigilant, is apt to overlook the nature of the condition in its early stages. Severe abdominal pain in any patient should always receive the most careful attention on the part of the attending physician. Intense pain associated with constipation and vomiting usually indicates a serious condition. The inability of the patient to evacuate the bowels, even with the aid of enemata, the partial or complete retention of the water, *the impossibility of passing flatus*, and a certain degree of collapse are the most striking symptoms. Meteorism is not always present; visible peristalsis is almost invariably absent; physical signs may be entirely wanting, while the disease insidiously advances. The diagnosis should always be made before the vomiting becomes feculent

and before the collapse is life-threatening. The physician should never neglect a careful search for hernia in every suspicious case.

The first need of the patient is relief from severe pain. Morphin should be given hypodermically in doses of gr. 1/4-1/6 (0.015-0.01 gm.); these doses rarely suffice to give entire relief, and they must be repeated once or oftener. The danger of inducing dangerous narcosis must not be overlooked. One one hundred and fiftieth grain atropin (0.0004 gm.) should be given along with each dose of morphin. Care must also be taken not to mask the symptoms by overdoses of narcotics, as a correct estimation of the symptoms is essential in indicating the need of surgical intervention. Some authors advise the administration of tincture of opium by mouth, but the hypodermic use of morphin seems preferable from every point of view. Morphin reduces shock, quiets peristalsis, stops or lessens the nausea and vomiting, and strengthens the circulation. By inhibiting the overviolent peristalsis above the site of obstruction it often prevents a bad condition from becoming worse, and may aid the spontaneous recovery from the strangulation. The comparative well-being induced in the patient by morphin must, under no circumstances, be allowed to deceive the attending physician. He must be guided by more objective conditions, especially the passage of flatus and fecal matter. Morphin should not ordinarily be given after the first 18 to 24 hours. By this time the nature of the case will be quite plain. Either the pain and vomiting will have subsided, the general condition of the patient will be good, gas or fecal matter will have passed from the bowel—under which condition further medical treatment will be permissible; or the patient will still be suffering or anxious, flatus will not have passed, the pulse will be accelerated, the shock still present—under which conditions surgical intervention is called for. In every case of suspected obstruction the physician should have early and continuous surgical counsel, so that the right time for an operation should not be missed.

Among all the rules for the correct treatment of acute obstructions one stands out preëminent. *All cathartics must be absolutely forbidden.* More harm is done by neglect of this rule than in any other way. Cathartics stimulate an overstimulated bowel above the site of obstruction; they increase the pain; they heighten shock; they aggravate the vomiting, and usually increase the degree of strangulation. The patient's chances for recovery decrease as the use of cathartics is pushed. All efforts to move the bowels should be from below. The simple enema should first be used; the so-called purgative enemata described above should then be tried at intervals of three or four hours. If the water is not returned, care must be exercised not to overdistend the colon by repeated injections. Treatment by massage or electricity is mentioned only to be condemned.

Atropin sulphate has been successfully employed in many cases of obstruction. Large doses are employed. If patients are under the in-

fluence of morphin, gr. 1/12-1/20 (0.005-0.003 gm.) may be given hypodermically twice in 24 hours; in non-narcotized patients the dose should not be larger than gr. 1/30 (0.002 gm.). Lately eserin salicylate has been used hypodermically in doses of gr. 1/20-1/50 (0.003-0.0012 gm.). Eserin is a powerful stimulant of intestinal peristalsis, and, in my opinion, is contraindicated in all cases of mechanical obstruction.

Gastric lavage is of great value in all cases in which persistent vomiting occurs, or in which the vomiting assumes an offensive or feculent character. It should be repeated every few hours. Hot applications over the abdomen, especially hot moist cloths (Priessnitz compresses), are often useful in allaying tension and pain.

The question is often asked how long it is justifiable to wait before resorting to surgery. Put in this bald way, the question cannot be answered. Ordinarily it is not safe to wait as long as 48 hours. If the initial symptoms do not subside under the judicious use of morphin, it is often advisable to operate within 12 hours after the onset. Were an immediate diagnosis always possible, an immediate operation would usually be in order. It is the uncertainty regarding the gravity of the case during the first day which causes delay. It is better to make this delay too short rather than too long. Many more lives are lost by waiting to be sure than by too aggressive an attack. The ability to estimate the symptoms accurately is often the determining factor. As Zweig says, so long as the general condition of the patient is good, the heart action strong, the pulse slow and of good tension, we may quietly proceed with non-surgical measures. But we must not be deceived by a merely apparent euphoria induced by opium, gastric lavage, or atropin. The nature of the obstruction is also of the greatest importance in considering an operation. Obstruction by a gallstone or by fecal masses does not require so early an operation as when volvulus or strangulation exists.

Intussusception and Volvulus.—These are more easily recognized than other forms of obstruction. Volvulus affecting the sigmoid often begins after a period of constipation; the pain is usually only moderate; tenesmus is frequent. Vomiting may be absent, though there is usually nausea and often hiccough. The constipation is absolute, neither fecal matter nor gas escaping even after enemata. Localized distention of the bowel in the left lower quadrant of the abdomen is very characteristic. Intussusception occurs usually under the age of ten; in addition to the violent tenesmus there is frequently a palpable tumor in the right iliac region which can be felt either through the abdominal wall or by the finger introduced into the rectum. The modern tendency is to resort to surgical interference with as little delay as possible in both volvulus and intussusception. Opium or morphin may be administered at the outset in moderate doses; large enemata of warm water may be given; it is even permissible to blow air into the large bowel with a double bulb attached

to a rectal tube or catheter in a child; but the physician must bear in mind that valuable time should not be lost, nor should the patient be allowed to become exhausted before recourse is had to operative intervention. An intussusception which does not yield to medical treatment within a few hours is more safely treated surgically than by further bloodless methods.

Volvulus is preëminently a surgical condition from the start. To delay operation is to increase the risk; the continuance of medical treatment is justified only by doubt as to the diagnosis. A presumptive diagnosis is ground enough for operative interference.

Chronic Intestinal Obstruction

Chronic intestinal obstruction is due to many causes. Adhesions and kinking of the colon or of the lower ileum are common, and are a frequent cause of obstructive symptoms of a chronic and variable nature. The various lines of treatment described in the chapter on constipation are often effective in reducing the symptoms to a minimum, and in course of time they may disappear altogether. Obstinate symptoms due to firm adhesions and permanent angulations can only be relieved by surgical measures.

The most frequent cause of chronic obstruction in the colon is cancer. In inoperable cases much can be done to alleviate the symptoms. The food should be selected with a view to leaving but little residue. Albuminous food is, therefore, to be preferred. Meats and eggs should be eaten freely. Broths, purée of vegetables, gelatins, jellies, and ice cream are all suitable.

The bowel should be emptied daily by simple enemas. When these fail any laxative which will produce a soft, easy motion is indicated. Regular doses of castor oil are well adapted for this purpose; one or more teaspoonsful may be taken every morning. Olive oil may be substituted, but is not so efficient. Preparations of senna and aloes are very useful. All drastic purgatives and all large doses must be avoided. As the tumor grows patients will be better off if their diet is materially reduced. They live comfortably on strained gruel soups, with a little bread, and gelatins. This reduction in the quantity of food will obviate for a long time the need of narcotics. When these become necessary, codein is to be preferred to opium; morphin in solution is better than opium because less constipating, and morphin by mouth is far preferable to its hypodermic use, which is to be avoided in every case, if possible. The addiction to the hypodermic use of morphin brings with it a train of suffering which is added to that of the malignant growth. Patients who take morphin by the mouth live longer and suffer less than those who use it

hypodermically. The value of palliative operations must in all cases be left to the judgment of the consulting surgeon.

VISCEROPTOSIS

Our knowledge concerning visceroptosis is in a constant state of flux. Many of the conclusions which seemed final a decade ago have been subject to critical revision since the advent of the X-ray and of corrective abdominal surgery. It is generally conceded that cases of gastroenteroptosis fall into two groups: the one acquired, the other congenitally predetermined.

Glénard originally laid great stress on the etiological importance of the normal kinks of the intestines. The usual kinks make stagnation of the intestinal contents a frequent occurrence. As a result, the overloaded portion of the bowel drags on its peritoneal attachments; these in time yield and allow a descent of that portion of the bowel. The hepatic flexure of the colon is usually the first to prolapse; this in turn drags down the pylorus and indirectly the liver and the right kidney. A condition ultimately ensues characterized anatomically by a descent of all the viscera just named, and clinically by symptoms of atonic dyspepsia and constipation, leading gradually to menstrual troubles, debility, emaciation, and insomnia, and finally to pronounced neurasthenia. Glénard has gradually relinquished his earlier conceptions and now believes that splanchnoptosis is the expression of a constitutional diathesis, the so-called "diathèse hépatique." This view has not been generally accepted. Clinicians who studied this condition between 1885 and 1895 discovered that prolapse of the abdominal viscera (stomach, right kidney, colon) is very rare before the age of 12 to 14, that it is far more common in the female sex, and that its incidence rapidly increases after the age of puberty.

Compression of the waist by the corset and skirt bands was generally recognized as the leading causal factor. Stiller in 1895 expressed the original view that enteroptosis is based upon a congenital predisposition which has definite anatomical stigmata.

His observations, which have been very generally accepted as explaining at least a large proportion of the cases of splanchnoptosis, are briefly these:

Enteroptosis occurs chiefly in persons of nervous type, who have a delicate muscular system, a long thorax, small bones, and a slight panniculus adiposus. Most people of this build have a mobile tenth rib, a narrow or flat chest, and by their congenitally vulnerable nervous system are predisposed to symptoms of nervous dyspepsia and neurasthenia. Furthermore, the symptoms of enteroptosis are not due in the main to the anatomic displacements, but chiefly to the neurasthenic disposition of the individual. The complex known as splanchnoptosis rests upon a

vitium primæ formationis, and all the so-called causes (corsets, skirts, childbirth, etc.) are merely *Gelegenheitsursachen* or incidental causes. Expressed tersely, enteroptosis is a form of nervous dyspepsia.

R. H. Smith (21; 22) has reached similar conclusions after a most painstaking and exhaustive study by means of the X-ray.

Smith examined 109 female children ranging in age from birth to 13 years. He found that the enteroptotic habit of the adult was definitely predetermined by certain physical characteristics in the growing child—viz., slenderness of physique, lack of fat and muscle, and delicacy of form and feature. Actual prolapse of the viscera very rarely occurs in childhood, but the muscular insufficiencies of later life in enteroptotic women are common in frail children. Smith believes that in the vast majority of instances the *habitus* is of far greater importance to the enteroptotic women than the prolapse of the viscera which accompanies it. He further states that the symptoms which are associated with visceroptosis are in reality due in most cases not to the prolapse, but to a genuine fatigue neurosis. In the vast majority of cases the patient is suffering not because her organs are out of place, but because she has been under some strain and is fatigued or is neurotic from other causes.

Smith's broad conception of visceroptosis is the one which has found the most general acceptance by internists. Smith recognizes in addition to the congenitally predetermined enteroptosis an acquired type which occurs in women who were originally of vigorous frame, but who have acquired prolapsus of the abdominal viscera as the result of child-bearing, hard work, or other influences involving muscular and nervous strain. Prolapse in these women is never excessive, and is readily distinguishable from the severer constitutional form.

Many clinicians, especially those with surgical tendencies, take decided exception to this conception of visceroptosis. Rovsing (18) rejects Stiller's hypothesis and ascribes the occurrence of visceroptosis to two factors only: (1) the misuse of corsets and skirt bands, (2) the changes which pregnancy and childbirth occasion in the intraabdominal pressure. Rovsing takes the radical position that "all the morbid symptoms and conditions which we find typical in patients with enteroptosis allow themselves naturally and spontaneously to be explained as a result of the ptosis." Rovsing classifies gastrocoloptosis in two divisions: 1st, virginal; 2d, maternal. The virginal type begins at puberty and results from the abuse of the corset, etc. Gastric symptoms predominate, but are followed by a long chain of nervous and nutritional disorders, which, in extreme instances, may lead to death by inanition. The maternal cases result from childbearing, have few or no gastric symptoms, cause little suffering from nervous disturbances, but have most of their symptoms determined by the prolapse of the colon, which causes constipation, autointoxication, and, finally, emaciation and a breakdown of the general health.

No experienced clinician can read Rovsing's elaborate presentation without finding much in it which is fanciful and not critically considered. Three common observations make it obvious that the symptoms associated with visceroptosis cannot be due solely to the abnormal position of the viscera: (1) Many persons whose viscera are prolapsed have no symptoms of any kind. (2) These persons may acquire gastrointestinal symptoms when subjected to physical or nervous strain. (3) The symptoms may be made to disappear in many instances without paying any attention to the position of the viscera.

All we can say with anything like assurance is that many nervous and debilitated patients have gastrointestinal symptoms which seem in some way to be associated with and aggravated by a prolapse of one or more of the abdominal organs. We are unable to say in any given case just which symptoms are dependent on general causes and which are due to the abnormal position of the affected viscera. Because a prolapsed stomach is atonic or muscularly weak, we are by no means justified in saying that the prolapse is the cause of the atony. Because a prolapse of the transverse colon is associated with constipation we may not *eo ipso* conclude that the prolapse causes the functional disturbance. In the first place, many cases of gastroptosis exist without gastric atony; in the second, many cases of atony exist without ptosis. Their coexistence in any given case is no argument at all for any causal relationship. In the same way coloptosis occurs in the unconstipated; constipation occurs in cases of normally placed colon. Just what kind of coloptosis or kind of constipation justifies the inference that they are causally related has not been made clear. To assume offhand that certain anatomical abnormalities have produced certain functional disturbances is a sure way of being led astray in a large number of cases. Even assuming a causal relationship to be demonstrable, we may not at once jump at the conclusion that a restoration to anatomical integrity will mean a disappearance of the previous symptoms. As a matter of fact, the whole subject of visceroptosis is a complicated one, many phases of which still require clarification.

When we come to study the symptomatology that arises in the course of gastrocoloptosis we are struck by the paucity of demonstrated facts and the lack of agreement among various authors concerning the symptoms actually due to the prolapse. From clinical observation we may assume in a general way that gastrocoloptosis is frequently accompanied by disturbances of the motor function of the stomach and colon, variations in the secretion of HCl, and various painful sensations within the abdomen.

Associated with these symptoms, and often overshadowing them, are a variety of complaints usually described as nervous dyspepsia. Constipation is rarely lacking, and the stools appear as small, hard lumps. Especially in the female do secondary nervous manifestations occur. Under

these conditions women have a tendency to undereat; they diet themselves and slowly lose flesh. Gastric fermentation is apt to be present; bloating and belching may become troublesome; neuralgic pains ensue, and the disease may advance to profound neurasthenia.

It is thus apparent that gastroenteroptosis rarely, if ever, comes to treatment as an uncomplicated entity. Patients present themselves with the protean symptoms of nervous dyspepsia, and on examination the physician finds the associated visceral prolapse. In some cases it is far better to conceal from the patient the fact that the abdominal organs are displaced, and to attack the symptoms entirely from the side of the nervous system (exercise, suggestion, overfeeding, tonics). In many cases, however, the symptoms cannot be overcome until some support is offered the displaced viscera. It should be borne in mind that every case is a law to itself, that infinite tact and much experience are required to treat this class of cases successfully, and, as Monteuuis has well said, many patients must be cured by the physician instead of by the physic—*"par le médecin plutôt que par la médecine."*

From the standpoint of prophylaxis much can be accomplished. Smith says that "the frail child" should be recognized as an entity, so that the tendencies of its development may be intelligently fought.

In 1899 I thus summarized the preventive measures which might reasonably be adopted (2):

> Children of neurotic disposition and those whose constitutional type predisposes to visceral ptosis should be encouraged to indulge in all out-door amusements. A rational system of physical exercises for growing girls is one of the needs of the day. Physical training for girls combined with dress reform in its true sense is the road along which progress is to be made. Compression of the thorax during the adolescent years must be reduced to a minimum. A great step in prophylaxis can be taken by the more careful management of convalescents from wasting diseases, especially typhoid fever. Emaciation tends to cause prolapse of the kidneys, the stomach and the bowels. A patient should not be considered recovered from an exhausting disease until he has nearly returned to his original weight. After confinement the abdominal walls should be guarded not for days, but for weeks and months.

In 1894 Glénard (11) said that the essentials for the successful treatment of enteroptosis were "an abdominal bandage, laxatives, alkalies, and a meat diet."

Monteuuis expressed himself less dogmatically, and says that the indications for treatment are:

1. To reëstablish the abdominal equilibrium.
2. To reëstablish the gastric functions.
3. To reëstablish the intestinal functions.

These indications are fulfilled respectively by the abdominal bandage,

a correct diet, and laxatives. It is impossible here even to summarize the treatment necessary to meet all the indications. The reader is referred to the various chapters dealing with nervous dyspepsia, secretory abnormalities, atony of the stomach and bowels, chronic constipation, and neurasthenia. General hygienic treatment combined with an appropriate diet will relieve a large proportion of these patients. In others, however, the symptoms cannot be treated successfully until their origin in displacement of one or more of the abdominal viscera is recognized.

Regarding the diet, no other rule can be laid down than that it should conform to the muscular and secretory power of the stomach. The hope of adding enough fat to the intraabdominal tissues to support the viscera is entirely illusory. The two objects of dieting are to restore the gastric and intestinal functions and to bring the patient up to a normal state of nutrition. No schematic dieting is possible. Success will depend entirely on the skill of the physician in adapting the diet to the needs and capacity of the patient. In my experience little is to be gained by abdominal massage, electrotherapeutics, vibratory massage, and other mechanical methods (see the article on chronic constipation). Active exercises for strengthening the abdominal muscles are of some use. Not too much must be expected of them.

By far the best single agent for overcoming the symptoms due to ptosis is an abdominal bandage so fitted that it offers support to the anterior abdominal wall and a lifting pressure exerted on the abdominal contents from below upward and backward. Three kinds of abdominal supporters have been successfully used: (1) straight-front corsets, (2) variously designed abdominal bandages, (3) strips of adhesive plaster. Of these the corsets are the easiest to employ, but the least beneficial; the bandages difficult to apply, but, when well fitted, the most satisfactory for permanent use; the adhesive strips of greatest immediate benefit, but unsuited for continuous employment.

The best way of applying the adhesive plaster is that of Rose. He uses zinc oxid moleskin adhesive plaster one yard long and eight inches wide. From the middle of the lower edge two lines are drawn extending obliquely upward to two points on the ends, two or three inches from the upper edge. The bandage is cut along these lines, and is then in three pieces. The point on the lower edge is now applied just above the symphysis pubis, the plaster carried around the body, and the ends overlapped in the back. The two side pieces are used to reinforce the lower edge of the larger piece on each side.

A much simpler adhesive bandage is described by McCaskey (15). Numerous other modifications of the Rose bandage are in general use. The chief objections to all bandages made of adhesive plaster are the irritation of the skin and the necessity of renewing the dressings frequently.

I shall not enumerate the various types of bandages designed to support the viscera. The simple Teufel bandage has many points of advantage. Making windows in the bandage where it passes over the iliac crests is a decided improvement (bandage of Einhorn). Aaron (1) describes a supporter which has many points of excellence. The Storm binder is very practical. Any bandage is useful which applies uniform pressure upward and backward over the hypogastrium and which stays in place.

Surgical Treatment.—Various surgical procedures have been devised to relieve the symptoms of gastroenteroptosis. In cases of relaxed abdominal wall Gallett (9), following the example of Depage, Rouffart, Thirar, and Sacré, resected a lozenge-shaped piece from the anterior abdominal wall. Duret (6) raised the prolapsed stomach by suturing its anterior surface to the abdominal wall by a single suture. Rovsing (17) used three rows of sutures passing through the anterior wall of the stomach; he has performed this operation 163 times to date. Coffee (4) stitched the greater omentum to the anterior abdominal wall, thus raising the stomach and the transverse colon. Beyea (3) elevated the stomach by plicating the gastrohepatic ligament.

All of these operations, in their original or in modified forms, have been performed by a large number of surgeons, but the results cannot be said to be satisfactory. Einhorn (7) tersely says that "ptosis as such does not require surgical intervention." Aaron (*loc. cit.*, 258) says that gastroenterologists have practically ceased to advise surgical treatment for gastroenteroptosis. Many surgeons are only too willing to try their hand when internal treatment has failed, on the general theory that what cannot be relieved medically must somehow be curable surgically, but Gibson has wisely said that any surgeon operating upon these cases of visceroptosis simply because the physician and patient are tired of each other is sure to do useless and harmful surgery. Discussing the operation for coloptosis, Gibson further says that we are at present apt to wander as far astray in the selection of cases for operation as we formerly did in the case of the kidney. Two difficulties lie in the way of every operation for visceral prolapse. In the first place, nearly all the patients for whom an operation would be considered are neurasthenics, and any operative interference in this class of subjects is apt to be harmful. In the second place it is impossible to state which, if any, of the symptoms are actually due to the ptosis. Thus, it is more than probable that coloptosis *per se* produces absolutely no symptoms, and that these, if present, are purely neurotic or are due to complications, such as adhesions, permanent kinks, bands, etc. To operate upon cases of gastroptosis and coloptosis, as is done by certain enthusiastic and uncritical surgeons, simply because the patient complains of abdominal symptoms which medical treatment has failed to relieve, is to bring abdominal surgery into sure disrepute.

INTESTINAL NEUROSES

As our knowledge increases, the number of conditions classed as pure neuroses diminishes. There is no doubt that purely nervous disturbances of the intestinal function occur (acute diarrhea, meteorism, peristaltic unrest); it is no less true that many disturbances formerly classed as nervous are due to catarrhal and other pathological conditions of the intestinal mucosa. Cohnheim urges that the diagnosis of neurosis should not be made unless (1) all evidences of organic disease can be excluded; (2) the symptoms are unaffected by dietetic treatment; (3) the symptoms vary with the nervous condition of the patient.

What we call intestinal neurasthenia is usually some pathological condition of the intestine in a neurasthenic individual, and the neurasthenia is often the result and not the cause of the intestinal symptoms. Chronic nervous diarrhea is usually a chronic enteritis or colitis in a nervous individual, and even simple peristaltic unrest and meteorism frequently have their origin in a catarrhal process in the bowel. A rigid and systematic study of the intestinal function should be made in every case before a diagnosis of neurosis is in order.

Very little is to be gained for the purpose of therapeutics by classifying the neuroses into groups, such as motor, sensory, and secretory. The indications for treatment are found not in the more prominent symptoms, but in the etiological factors. Just those symptoms which require specific treatment are due to pathological processes within the bowel, and are not nervous in origin. For example, nervous diarrhea has rather a large literature of its own. The acute nervous diarrhea resulting from fright or worry requires only the removal of the cause to effect a cure. Chronic nervous diarrhea also must be treated from the etiological side, and *dietetic and other restrictions are needed only so far as the disease departs from a pure neurosis and depends on a definite pathological state.* It is decidedly illogical to follow the example of many textbooks of designating a given symptom-complex as a pure neurosis, and then laying down a plan of treatment by strict diet, opium, and astringents. The "nervous diarrhea" which requires opium, bismuth, and a proteid diet is not a neurosis, but is due to some disease of the stomach, pancreas, or intestine.

Einhorn describes a case of chronic nervous diarrhea in a neurasthenic patient which was overcome by simply repressing the desire to go to stool. Nervous diarrhea due to pathologic states in the pelvic organs has also been described by various authors. A cure depends on the removal of the diseased organ. Some nervous patients have a desire to empty the bowels shortly after each meal. This is supposed to be due to an excessive neurotic stimulation of intestinal peristalsis. Brunton says it is particularly common in young subjects and highly recommends the use of

one or two drops of Fowler's solution before meals, or one-half to one teaspoonful of the liquor bismuthi et ammonii citratis. The so-called "morning diarrhea" is not a neurosis, but is due to a catarrhal colitis. Brunton's suggestion that the patient take no fluid after 5 P. M. is a valuable one, but in most cases it is necessary to treat the colitis by an appropriate diet and local irrigations.

Peristaltic unrest and meteorism may be purely nervous in origin, though they are usually the expression of a mild catarrhal enteritis or enterocolitis. Meteorism is sometimes the direct result of surgical shock and may follow abdominal operations or childbirth.

I have seen one neurotic young woman who after each of two consecutive easy and normal confinements had a most pronounced and alarming meteorism without the slightest disturbance of the pulse, temperature, or lochial discharge. The meteorism yielded to hot applications, warm water injections, and the internal use of belladonna. The same symptoms sometimes follow laparotomy and are to be treated as just described.

Peristaltic unrest may result from any disturbing emotional state; it frequently is an annoying symptom during the period of early adolescence. It is to be treated by general hygienic measures, fresh air, exercise, iron, arsenic, and other tonic remedies. It may depend on the ingestion of too many sweets, acid fruits, and badly prepared cereals or leguminous foods. All of these must be prohibited. Charged waters must be forbidden, as well as champagne, cider, soda water. Relief can be obtained by any of the well known carminatives, by menthol pills, valerian, asafetida, zinc valerianate, Fowler's solution, bismuth. The intestinal antiseptics are not particularly helpful. Charcoal is absolutely useless. Boas recommends the salicylate of magnesia in doses of 10 to 30 grains (0.6 to 2.0 gm.) after meals. Belladonna in various combinations is exceedingly useful.

INTESTINAL PARASITES

F. Forchheimer

Ascariasis

Ascaris Lumbricoides.—Infection takes place by means of the ova, which are produced in great numbers and which, by feeding experiments, have been shown to produce ascariasis in the human being. The ova retain their viability under conditions usually fatal to lower forms of life, and adhere to food for a great length of time; they have been found in water and upon various articles of food, especially vegetables that have been grown in manured soil. The temperature of boiling water destroys them.

The normal habitat of this nematode is the small intestine. But these worms are wanderers, being found in the esophagus, the mouth and the larynx, in hepatic abscesses, in the large biliary ducts, and in the appendix. Wherever they are found, they act as an irritant either mechanically or chemically, or in both ways.

Prophylaxis.—The prophylaxis is practically summed up in obtaining a pure water supply, and where this is not possible boiling of liquid foods and all vegetables given to children. Those who come in contact with stools should look to cleanliness of hands; carelessness frequently results in infection. Autoinfection from ova is not common in ascariasis.

Treatment.—As many symptoms are ascribed to intestinal worms, the diagnosis should invariably be established before treatment is instituted; this can always be easily done by a microscopical examination of the feces, for the ova, when ascarides are present, are plentiful and characteristic. Even when one worm has passed, a little time should be allowed to elapse, after which the feces are again examined, and the presence of the ova will show the necessity of treatment. In pursuing this method it is frequently found that further treatment is unnecessary because only one worm was present. As the Ascaris lives only in the small intestine, the treatment is applied by the mouth exclusively; the only remedy required is santonin. But santonin is not a harmless drug, and whoever, like myself, has seen fatal santonin poisoning in a case in which there were no worms will be very cautious in its use. In children as small a dose as 0.13 gm. (gr. ij) has been followed by death; in adults 0.3 gm. (gr. v) has produced symptoms of serious intoxication. In children the dose should be small, not to exceed 0.02 gm. (gr. 1-3)—not more than 0.065 gm. (gr. j) in twenty-four hours; in adults 0.065 gm. (gr. j)—not more than 0.3 gm. (gr. v) in twenty-four hours. The administration of santonin to children in the form of worm lozenges should not be encouraged; they are looked upon as delicacies by the little patients, with the result that too many are taken, to say nothing of the harm done by promiscuous domestic medication. Santonin has little taste, so that the addition of a little sugar suffices to make it palatable. It should always be given together with a laxative, as in this combination the local effect is not impaired and the general effects are, in a measure, diminished by it. The best laxative for our purpose is calomel; I always combine the two and always give a prescription calling for not more than three powders. Liebreich has recommended castor oil in combination with santonin; the objections to this method in childhood are quite obvious, though it is very efficient.

On account of the risks of producing unpleasant symptoms, santonin should never be given for diagnostic purposes, as is often recommended. Causal treatment is paramount, and for those symptoms due to the wandering of the Ascaris local therapy is necessary.

It is claimed that the ascaris produces a toxic body during its activity in the small intestine, which is absorbed and produces one or more symptoms, such as anemia, picking at the nose, nervousness, grinding of the teeth, convulsions, and many more. All this must be proven before it can be accepted. The primary etiological importance of worms has probably been much overestimated. Certainly, nowadays, no one is justified in treating patients for worms unless his diagnosis is absolutely certain, in that either worms or their ova have been found. When this is the case causal therapy should be applied in every instance, regardless of the presence or absence of symptoms. Symptomatic treatment may have to be given, either for local or general purposes.

Oxyuris Vermicularis.—Prophylaxis.—In addition to the measures described under *Ascaris lumbricoides,* and because of the life history of oxyuris, we find autoinfection and direct infection from man to man very common. Autoinfection is the cause of difficulty in curing this disease; the young female brood, filled with ova, lives in the colon, but eventually all the worms are found in the rectum; they produce local symptoms, especially itching, which on their part are followed by reactions resulting in the transportation of ova by means of the hands, towels, and sponges. Heller says that a microscopical examination of the accumulations under the finger nails of the patients will usually demonstrate the presence of ripe ova. Transmission of ova by fruit or vegetables, according to this observer, is of secondary importance, least of all by salad, as vinegar destroys the ova. To prevent transmission and autoinfection the most scrupulous cleanliness of the anus and vulva, as well as of the hands of the patient, is demanded. The latter is very difficult, in children especially, and not easy in adults, for infection takes place during sleep by scratching, rubbing, or mere contact with the anus or vulva. When the fingers are put into the mouth, which is done so frequently by children, a circulus vitiosus is established; the worms in the anus cause the scratching, in scratching the ova become attached to the fingers, these ova are put into the mouth, and we have renewed infection. Cleaning the finger nails should be looked to; according to Vix, the worms as well as their ova are easily destroyed by soap. Care must be taken to watch all infected members of the household; otherwise renewed infection will take place.

Treatment.—Because all pinworms are finally found in the rectum, the treatment is principally local, by enemata. In order to facilitate and hasten the cure, a cathartic should be given—calomel or a saline—so as to remove the worms from the large intestine. Santonin need never be given in a case of pinworms. The enemata should be administered in the proper way; their principal object is to distend the large intestine by the quantity of fluid injected and to remove the mucus in which both the worms and the ova are found. Many substances have been recom-

mended to be added to the water used for the enema; vinegar (1 to 2 of water); thymol, 0.05 per cent.; menthol, 0.5 per cent., in oil; weak sublimate solutions; boric acid; turpentine; garlic, a favorite remedy in Austria, and many other remedies. *Nil nocere* is the motto here; plain cold water or soap and water, when properly used, is as good as anything else. The enemata must be given once a day until the stools are free from ova; when necessary, injections into the vulva or vagina should also be employed. How long it takes to cure a case of pinworms depends entirely upon the methods of prophylaxis and treatment that are employed, as is shown by the different results obtained by different authors. Because of the difficulties met with in carrying out these measures, we frequently find that in private practice pinworms are not always cured.

Trichinosis

Prophylaxis.—As this disease is always due to infected swine, the indications for prophylaxis are perfectly simple, their execution, as in all food infections, rather difficult. If nobody would eat pork there would be no trichinosis. But general abstinence from eating pork is not to be looked for, and with proper precautions is practically unnecessary. In order to absolutely prevent the infection of hogs they should receive only grain or such food as has been cooked, and especial care must be taken so that they are not fed with offal from slaughter houses, as is frequently done. It has been claimed that rats in slaughter houses carry the infection, but it has not been determined whether they are carriers of trichinosis or are themselves infected. In Germany, as well as in some parts of this country, especially where pork is packed for exportation, the meat of slaughtered pigs is examined for trichinæ. The value of this method naturally depends upon the thoroughness with which it is carried out; one epidemic in Germany originated from pork that had been examined. The mode of preserving the pork seems to be most valuable for prophylaxis, as not a single case of trichinosis in Germany can be attributed to pork cured in the American manner. All food containing pig meat should be thoroughly cooked; neither ham nor pork sausages should ever be eaten raw. Trichinosis is most common where uncooked ham is eaten; with us in this country the disease occurs most frequently among Germans. But the cooking must be thorough; free trichinæ are killed at a temperature of from 145° to 155° F., encapsulated trichinæ at from 190° to 200° F.; as these temperatures must be applied throughout, not only upon the surface but also in the center of the article of food, it will be seen that this method is only a partial safeguard. Yet practically Wasserfuhr has demonstrated that epidemic trichinosis is prevented by cooking, for in those regions of Bavaria where

pork is always cooked no epidemic has ever occurred, while where ham is eaten raw epidemics have occurred.

The conclusions that follow the foregoing are very important. It would seem that the American manner of curing pork or boiling it is sufficient for destroying the trichinæ. This is proven by the absence of the disease in those who eat properly prepared swine's flesh.

In this country the disease is very rare; Stiles, quoted by Osler, states that 900 cases "would cover the total number reported" to 1898. It is more than likely that many cases have not been reported and many more have been overlooked. But, nevertheless, it must be accepted that the disease is rare, especially in view of the amount of swine's meat consumed in the United States.

Treatment.—In order to remove the trichinæ from the intestine, laxatives are given—calomel, senna. It has been frequently observed that in those cases in which initial gastrointestinal symptoms are violent the course of the disease is usually mild. In addition, the usual anthelmintics are also administered—turpentine, santonin, pelletierin, cortex granati, filix mas. Glycerin, on account of its hygroscopic qualities, was recommended by Fiedler to be given with laxatives and in large doses, a tablespoonful every hour. G. Merkel, of Nürnberg, has obtained good results with it. Many intestinal antiseptics have also been tried. The various ways which tend to make the trichinæ harmless in the intestine should be used as early as possible, for in some instances the further development of the disease is prevented, though in a large number of cases this is impossible, because the trichina has already penetrated the intestinal wall; even then the number that enter the muscles can be diminished. We have no remedy that acts upon the embryo when it is once outside of the intestine. Besides the intestinal treatment, the management of a case of trichinosis must be symptomatic. For the diarrhea the usual treatment should be applied. Pains in the abdomen and the muscles should be met with opium; for the latter the antipyrin group, too, is valuable. For sleeplessness the usual hypnotics are used. Upon the whole, the treatment resembles that of typhoid fever, for which this disease is often mistaken; the fever, the bronchitis, the profuse sweats or complications should be treated in the same way as recommended in the previous chapters on infectious diseases. The diet should be nutritious; it is necessary to take the same precautions as in typhoid fever, as lesions are at times, though not always, found in the gastrointestinal tract. In the milder cases very little treatment is required; in the severe cases the mortality is very great, do whatever we may. In the stage of convalescence the treatment is the same as in all other acute infectious diseases.

Tricocephalus Dispar (Whipworm)

It has not been established that *Tricocephalus dispar* is pathogenic in men. It is possible that symptoms may be produced by its presence in the colon when there is a large number of worms.

Prophylaxis.—For prophylaxis it is necessary to take into consideration the fact that the eggs may be found upon fruit, vegetables, and in water.

Treatment.—For the treatment the various anthelmintics have been recommended, but, it is asserted, with only moderate effect; thymol, santonin, and filix mas are especially recommended; in addition, thorough evacuation of the colon should be carried out, either by means of laxatives or by lavage of the colon.

Echinococcus Disease

As the Cysticercus cellulosæ and the Echinococcus are treated in the same manner, the two subjects are discussed under one heading. They differ only as to prophylaxis, that of the Cysticercus being the same as will be found in the chapter on tenia (q. v.); that of the Echinococcus being the prophylaxis of the larval form of the Tænia echinococcus.

Prophylaxis.—For prophylaxis the first consideration must be the host for the larval form, the dog. In order that the dog does not become infected, and this refers only to infected regions, his food should be looked after, as has been described in the chapter on Trichinosis (q. v.). For man the principle of prophylaxis is prevention of introduction of the embryos into his alimentary canal. These embryos are always found in the feces of the dog. Human hydatids could be prevented if the bladder worm in herbivora could be destroyed. As this is impossible, there remains the question of killing all the dogs, and this should be attempted in infected regions. For more than one reason, however, it will fail, so that we must resort to other preventive measures. The suggestion has been made to give tæniacides to dogs, as is done in humans, which might do good but would necessitate disinfection of the feces. The drinking water should be boiled, vegetables should be boiled, and fruits growing low should be thoroughly cleaned before being eaten. Dogs should not be allowed to lick human beings.

Treatment.—The treatment is surgical. A glance at the localization of the echinococcus will immediately show that individualization as to mode of operation is necessary. The visceral locations in the order of frequency are: the liver, the genitourinary apparatus, the lungs and pleura, the intestinal tract, the central nervous system, the heart and blood vessels, the bones, and then the remaining organs. For the various opera-

tions and methods of surgical treatment the reader is referred to works on surgery.

One of these procedures must be especially referred to—aspiration—as it usually is carried out by the physician as well as the surgeon. This operation is no longer considered harmless in this disease for the following reasons: 1. Infections of surrounding tissues may follow; sudden death may occur, supposed to be due to the presence of a ptomain (Brieger) in the cyst and which is absorbed. 2. Pus infection may take place so that the patient is in a condition rendering necessary a more serious operation. 3. The therapeutic results are dubious, only favorable in living simple cysts.

A certain number of cases have been cured, either by simple aspiration or by injection into the sac of medicinal substances, such as tincture of iodin (Boinet), alcohol (Richet), corrosive sublimate (Bacelli, Sennet). Whatever is connected with aspiration is no longer favorably looked upon in the treatment of this disease.

For other intestinal parasites the reader is referred to the section on Tropical Diseases.

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CHAPTER VII

DISEASES OF THE LIVER

HENRY WALD BETTMANN

DISEASES OF THE BILE PASSAGES AND GALL BLADDER

BILIOUSNESS

Biliousness is a term which indicates a well-recognized and well-defined group of symptoms without postulating any definite pathological process. It occurs after indiscretions in diet, such as injudicious indulgence in beer, spirits, or greasy foods; it may follow any excessive meal, or, in susceptible individuals, may result from so simple a procedure as taking a nap after a full meal. The attack usually begins in the morning after a restless night, and is characterized by complete anorexia, general malaise, giddiness, headache, muscæ volitantes, and often by nausea, followed by vomiting. The tongue is heavily furred, the urine is highly colored and scanty, the feces are usually scanty and may be ashy gray in color. In bad cases there may be a subicteric tinge to the conjunctivæ and the general prostration may be intense. Whatever the exact pathological condition present, certain features are prominent. As Wynter tersely puts it, "The digestive apparatus is on a strike." Food, instead of being digested, lies in the stomach until it sets up vomiting. Bile is apt to pass into the stomach and to be ejected by vomiting. The indications for treatment are very simple. The stomach and duodenum must be given rest; the intestinal contents must be evacuated; and, as experience has shown, the excretion of bile must be encouraged. The patient must abstain from all food and drink for twelve or twenty-four hours. Even sips of water and cracked ice do more harm than good. Calomel is the remedy par excellence. In mild cases it may be given in small broken doses, such as gr. ¼, gr. 1/6, or gr. 1/12 (0.015 to 0.005 gm.), every one-half hour or hour, until one or two grains (0.06 to 0.12 gm.) are taken; this is followed in four to six hours by a saline purgative, preferably Epsom salts. Other salines, such as citrate of magnesia, Hunyadi, or Rubinat water are less reliable and slower of action, but are often employed. Free purgation is usually followed almost immediately by marked

amelioration of the symptoms. After the bowels act freely the patient is usually greatly benefited by small doses of the usual coal tar analgesics, acetphenetidin, gr. v or viiss (0.3 to 0.5 gm.), acetanilid, antipyrin, or others. He may also partake of food, beginning with tea and unbuttered toast, this to be followed by simple gruels and clear broths.

Experience has made certain generalizations possible. So long as the patient is actively nauseated it is useless to prescribe analgesic remedies, such as the bromids or the coal tar preparations. The attack will not pass off until active peristalsis is set up, and the bile stream directed downward instead of upward. Mere emptying of the stomach, either through vomiting or by means of the stomach tube, does not relieve the symptoms, which depend for their continuance on conditions which are infragastric, i. e., in the liver itself or in the upper intestinal tract.

In many instances, especially where bilious vomiting is a prominent sign, it is advisable to begin the treatment with salines. The remedy par excellence is Epsom salts. This is best administered mixed with fresh lemon juice. A large tablespoonful or more of Epsom salts is mixed in a tumbler with a tablespoonful of lemon juice and not more than one and one-half to two ounces (50 to 60 c. c.) of cold water are added. The patient to whom Epsom salts is particularly obnoxious may overcome the taste by sucking the lemon before swallowing the draft, which is to be immediately followed by a large tumblerful of cold water. This mixture, which rarely causes vomiting, is usually followed by watery evacuations in one or two hours, and often is a short cut to recovery.

If the physician is summoned in the evening he may with advantage prescribe any of the well known "liver" combinations, to be followed by a saline the next morning. A good formula is the following:

		Gm.
℞	Podophyllin .....gr. 1/6	(0.01)
	Extr. hyoscyami .....gr. ss to i	(0.03-0.06)
	Extr. colocynth co.....gr. iss	(0.1)

Sig.—Take at bed time or immediately after the evening meal.

From one-half to two-thirds grain of calomel (0.03 to 0.04 gm.) may be advantageously added to each pill. Another excellent formula is the following:

		Gm.
℞	Pil. hydrargr. .....gr. iii	(0.2)
	Extr. aloes .....gr. i	(0.06)
	Extr. hyoscyami .....gr. i	(0.06)

Sig.—Take at bed time; follow with a saline in the morning.

Blue mass given in 5 or 10-grain doses (0.3 to 0.6 gm.) is useful, but not so reliable as the formulæ just given.

Persons who are subject to bilious attacks may usually prevent them by careful living. Avoidance of all dietetic excesses, of all alcoholic beverages, of all greasy or very acid foods must be insisted upon. Physical exercise in the open air is an excellent preventive. Golf, tennis, and horseback riding are especially useful. Biliousness often results from fretting and worrying. Late hours, highly spiced foods, mental excitement must all be avoided. The use of one of the above-mentioned "liver pills" immediately after an indiscreet dinner will often prevent biliousness on the following day. Persons who are predisposed to bilious attacks may with advantage take one of the above-mentioned liver pills regularly once or twice a week as a preventive.

Jaundice

Acute Catarrhal Jaundice

Catarrhal jaundice frequently begins with the symptoms of acute gastritis. There is no reason to disbelieve the general view that the jaundice is caused by a duodenal catarrh accompanied by a swelling of the mucous membrane of the papilla of Vater. Pain is occasionally a prominent initial symptom, and must be relieved by hypodermics of morphin. The treatment during the first few days is the same as for gastritis. The diagnosis is never certain until the jaundice appears. The patient must be prepared for a course of treatment lasting from three to six weeks. The more rigorous the early treatment the more likely the attack is to be mild and to run its course in a few weeks. Attention to small details is very important. Bed rest is rarely necessary, but it is advisable for the patient to remain at home for the first two or three days. After that he may attend to his usual duties, avoiding, however, every physical strain and limiting his exertions. The object of treatment is to nourish the patient as well as possible while establishing the most favorable conditions for the subsidence of the catarrhal duodenitis or papillitis.

Every patient during the first two or three weeks will lose from five to ten pounds body weight, and no particular attention need be paid to this fact. We expect him also to complain of a certain lassitude and weakness. No constitutional treatment is required at this stage, and none is in any way effective. Elsner (10) recommends 5 drops of tr. of nux vomica in one teaspoonful essence of pepsin every four hours. Care in diet and the use of proper laxatives bring about an uncomplicated recovery in most cases.

All drastic purgatives or cholagog cathartics are entirely out of place.

They do harm by congesting and irritating the already swollen mucous membrane of the papilla and the duodenum.

For many years, following the lead of Eichhorst, I have used by preference the compound licorice powder, ordering at first one teaspoonful stirred in water night and morning. After the first few days the morning dose can be omitted. The licorice powder seems to be especially well tolerated in this condition and to act without griping. Many clinicians prefer the saline purgatives, especially sodium phosphate, sodium sulphate, or Carlsbad salts. These are administered in hot water 20 to 30 minutes before breakfast; the dose may be repeated one-half hour before the evening meal. Calomel in minute doses is recommended by many clinicians at the outset of the disease. In my opinion it will sometimes do harm at this stage. Especially when there is bilious vomiting small doses of calomel often aggravate the symptoms. After the first few days, or at the end of the first week, minute doses of calomel, gr. 1/10 to 1/20, may be given every hour for one or two days, often with great benefit. Large enemata of physiological salt solution, which have proved of great value in chronic jaundice, are very useful; but they may usually be dispensed with in the acute disease. If enemata are used the water may be quite warm or even cool. Cold colon irrigations must be avoided, as they may produce collapse.

The diet during the first few days should consist of milk diluted with lime water or alkaline mineral water, such as vichy. Cereals are well tolerated, especially rice, farina, and the wheat foods. Excess of cream must be avoided. Patients usually have a distaste for fats, and these should be excluded from the dietary. Milk toast is an excellent article of food for the first few days. Toast, zwieback, and Holland rusk are permitted. After the acute symptoms have passed away, Irish potatoes, creamed asparagus tips, and string beans may be added to the list. Toward the end of the second week the patient may indulge in the softer meats, such as stewed chicken, sweetbreads, and scraped beef. Throughout the course of this disease he must absolutely avoid all alcoholic beverages, greasy or fried foods, acid drinks, and fruits. Friedenwald (12) has shown that catarrhal jaundice is accompanied by an increased secretion of HCl, the hyperchlorhydria keeping pace with the jaundice. This fact explains the necessity for the dietetic restrictions just mentioned. Carelessness in diet is almost sure to be followed by increased discomfort, and convalescence may be delayed for weeks, or the catarrhal condition may even become chronic. It is not wise to allow an unlimited diet too early. We should wait until the last trace of jaundice has entirely disappeared before permitting the patients to eat stewed fruits (preferably prunes or apples), or to indulge in the coarser vegetables, such as corn, beets, spinach, carrots, peas.

The itching of the skin rarely becomes very annoying in the acute

form of catarrhal jaundice. Lotions containing two or two and one-half per cent. carbolic acid are useful. Warm baths are moderately helpful. I have frequently seen good results from the following lotion recommended by Dr. Howard Morrow (20):

℞	Liquor carbonis detergens.....	12.0
	Liquor plumbi subacetatis.....	16.0
	Glycerin	16.0
	Aq. dest. qs. ad.....	240.0

Hypodermics of pilocarpin, gr. 1/4 to 1/6 (0.015 to 0.01 gm.), are said to be useful in obstinate cases. Osler recommends McCall Anderson's dusting powder. This is composed of starch, 30 parts, camphor, 6 parts, and zinc oxid, 15 parts.

After the subsidence of the acute symptoms dilute nitromuriatic acid in 15-drop doses after meals is frequently beneficial. The modus operandi is doubtful; the clinical fact is sure. During convalescence tr. of nux vomica, tr. of gentian, and other stomachics may be used. As a rule, the patients do as well without them as with them. Mild exercise, fresh air, and the avoidance of all nervous strain must be insisted upon until the health is completely restored. The convalescence is rarely interrupted if care in diet is exercised. No special after-treatment is required.

[A ten per cent. salve of menthol in lanolin frequently gives great relief. In some patients menthol dissolved in alcohol, ten per cent., seems more efficacious. At times less menthol should be used; in very nervous subjects the sensation of cold produced by menthol is followed by increased nervousness.—Editor.]

Chronic Catarrhal and Relapsing Jaundice

The clinician is sometimes confronted with cases of obstinate or recurring jaundice in which the diagnosis may for a long time be uncertain. An acute catarrh of the bile passages may become chronic through neglect, and in those addicted to alcohol one attack may follow another with only short intervals. Prolonged catarrhal jaundice may simulate an impacted common duct stone or may be a symptom of Hanot's disease (hypertrophic biliary cirrhosis). On the other hand, chronic jaundice may be dependent on organic lesions, such as stricture of the common duct, the pressure of tumors or portal glands, chronic pancreatitis, etc. Treatment must always be instituted before a diagnosis can be made, as the latter will often be based upon the results of the former. When medical treatment fails, operative interference will usually be called for. Hypertrophic biliary cirrhosis can occasionally be cured by continued

drainage of the gall bladder, though this operation is frequently without avail.

The medical treatment includes:

1. Gastric lavage.
2. Colon irrigations.
3. Restriction of the diet.
4. The use of proper saline and cholagog drugs.

Gastric lavage is indicated in every case complicated with gastric catarrh. The stomach should be washed out every morning before breakfast or one-half hour before the noon or evening meal. Lavage should be continued so long as mucus or food appears in the washwater. There is no advantage in adding soda, antiseptics, or any drugs to the water, which should be fairly hot to the touch. As the patient improves the lavage should take place every second, then every third, day, and finally it should be dispensed with altogether.

Many clinicians have noted the good effect of lavage in various inflammatory conditions of the bile passages and the gall bladder. It acts in various ways, principally by ridding the stomach of mucus and of germs adhering to the walls; and probably also by bringing about a healthier circulation in the walls of the stomach and bowel.

Colon irrigations are more useful than gastric lavage. Large quantities of warm 0.5 per cent. salt solution (2 or 3 liters) should be employed daily, either in the late afternoon or at bedtime. Part of the water thus used is absorbed and flushes out the portal circulation. It also removes much toxic material from the bowel, thus sparing the liver cells and rendering the bile itself less concentrated. The colon irrigations should be continued until the jaundice has completely disappeared, and until the constitutional symptoms (itching, mental depression, and irritability) have subsided.

The dietetic rules are, in the main, the same as are employed in other hepatic derangements. Greasy foods are absolutely forbidden, though fresh butter may be used in small quantities. Cream is not to be taken. The cruder and acid vegetables, such as cabbage, tomatoes, turnips, celery, cauliflower, rhubarb, radishes, navy beans, must all be omitted. All raw fruits are injurious, and even stewed fruits are better dispensed with in the great majority of cases. Condiments and all alcoholic beverages must be absolutely avoided. Buttermilk is usually not well borne. Many patients do better without eggs in any form. There is no objection to a moderate quantity of meat once daily. Sweet milk is well tolerated, also cereals, potatoes, and the simpler green vegetables. Light puddings and simple cakes, custards, and gelatin preparations are all suitable. The patient should take his three regular meals without extra lunches.

Drugs are useful in combating this disease. The most important is calomel, given after all the inflammatory symptoms have entirely disappeared. It should be given in minute doses ranging from gr. 1/10 to gr. 1/40 (0.006 to 0.0015 gm.) every hour, and its use may be extended over many days, or, if need be, weeks, with intermissions. A good routine plan is to order on alternate days gr. 1/20 (0.003 gm.) to be taken hourly for ten doses. The day following a saline is administered before breakfast, preferably a mixture of Epsom and Glauber salts with sodium bicarbonate. The calomel is to be begun immediately after breakfast and continued hourly until the ten doses are taken. Patients tolerate calomel well if given in this manner, and show no disturbance of the digestion or of their general well-being. The tongue becomes clearer, the sense of epigastric oppression rapidly diminishes, and the liver becomes markedly reduced in size after the first, second, or third day. If the bowels become too active under this treatment, or if there are signs of irritation, such as the appearance of mucus in the stools, the calomel should be stopped and the salines may be continued once or twice daily, or it may be advisable to rely altogether on the colon irrigations until the signs of irritability are gone. Other cholagog cathartics may also be used, but always in small doses. Large doses almost always do much more harm than good, and may increase the catarrhal swelling.

It is not wise to persist indefinitely with medical treatment. One must be guided by the condition of the patient. Most surgeons consider two or three months' duration of jaundice an indication for operation. Many internists have seen jaundice which has persisted for a longer period clear up eventually without operative interference. Steady deepening of the jaundice is an indication for immediate surgical relief. Before an operation is undertaken it is wise to administer calcium chlorid, 2.0 gm. (gr. xxx), three times daily for five or six days in order to avoid hemorrhages.

Syphilitic Disease of the Liver

Jaundice may accompany the secondary manifestations of syphilis. If not treated adequately it tends to become chronic. The treatment is that of syphilis, not that of catarrhal jaundice. Inunctions or the internal or hypodermic administration of mercury causes the jaundice to disappear in the large majority of cases. The treatment must be prolonged or relapses are apt to occur. The ordinary treatment of catarrhal jaundice is entirely without avail.

Tertiary syphilitic manifestations take the form of a diffuse interstitial hepatitis or of gummatous deposits. In both instances the liver is markedly enlarged. Later on bands of cicatricial tissue may form and the liver may contract or may present characteristic constrictions. The

latter forms are not amenable to treatment, but the earlier stages usually yield to active antisyphilitic measures. Billings (4) gives a good review of this subject. He concludes that mercury is the best specific medication. It may be given by mouth, by inunction, by deep intramuscular injection, or intravenously. Billings prefers the intramuscular injections, using salicylate of mercury in doses of one grain (0.06 gm.) daily or on alternate days. Fifteen to twenty-five injections are given. This course is followed by the iodid of potassium, which Billings thinks is especially valuable in gummatous disease. Small doses may give satisfactory results or the dose may have to be increased to 300-400 grains (20.0-30.0 gm.) daily. It is best to give the iodid after the mercurial injections.

A second course of these injections should be given in three or four months. Billings speaks highly of the value of salvarsan, but doubts that it will give better results than mercury and the iodids. Rolleston points to the necessity in many cases of using antisyphilitic measures persistently for many weeks before results are achieved. Gummata have occasionally been successfully resected; suppurating gummata have been scraped out with marked benefit to the patient. Medical treatment should follow these operations.

Congenital syphilis of the liver must be treated along the usual lines. Rolleston (22) gives the following directions: Mercury with chalk may be given in doses of ½ grain (0.03 gm.) twice daily to infants under two months, in doses of 1 grain (0.06 gm.) to older children. Mercurial inunction is a more satisfactory method. At the beginning 15 grains (1.0 gm.) of mercurial ointment should be used every day; it is rubbed on with flannel into the axilla, over the liver, over the spleen, a fresh location being chosen each day. This treatment should be carried out daily for three months, in the fourth month the treatment being intermitted for a week at a time, and in the fifth month for two weeks. In the second year of treatment mercurial inunction should be performed during one month out of three and a small dose of iodid of potassium given. In the third year the dose of the iodid may be increased, and in the fourth year the mercurial treatment may be dropped while the iodid is continued.

Cholecystitis and Cholelithiasis

To treat the diseases of the gall bladder intelligently it is necessary to have a clear idea of the relationship existing between cholecystitis and cholelithiasis. Catarrhal cholecystitis is a catarrhal inflammation of the lining membrane of the gall bladder due to infection. The commonest infecting agents are the colon bacillus and the typhoid bacillus. The continued presence of these bacilli in the gall bladder is very apt to

be followed by the formation of gallstones. This is especially true if catarrhal cholecystitis is present. The following facts must be clearly borne in mind:

1. The first attack of catarrhal cholecystitis is often overlooked, being mild in character and transient. It is apt to be followed by recurrences.
2. The severe attacks are quite characteristic. They are accompanied by slight fever, epigastric pain, tenderness in the region of the gall bladder, and gastric symptoms lasting several days.
3. Either the mild or the severer attacks may result in a chronic catarrh which leads to the formation of gallstones.
4. Catarrhal cholecystitis may probably be chronic from the beginning and insidious in its onset; in these cases gallstones may form without a preceding history of pain or digestive disturbances.
5. The symptoms from which the patient suffers are due in a large proportion of cases to the cholecystitis and may be entirely independent of the stones.
6. Only in a minority of cases is the clinical history dominated by the stones themselves.

The Treatment of Acute Catarrhal Cholecystitis

The simpler attacks of acute cholecystitis are treated like cases of acute gastritis or acute indigestion, with which conditions they are often confounded. If the stomach contains food at the onset of the attack vomiting should be induced by administering large quantities of lukewarm water. The addition of salt or mustard to the water has no advantage. If vomiting is delayed, the patient may hasten it by pushing his finger as far back on the tongue as possible. When vomiting is not readily induced in this way the patient should resolutely hold his finger in place until the vomiting ensues. The use of the stomach tube is rarely, if ever, indicated. One act of vomiting does not usually empty the stomach. It is best for the patient to repeat the process one or more times until the water returns clear. Complete rest is then necessary. If tenderness in the gall bladder region exists warm wet compresses should be applied. The patient should usually abstain from all food for at least eight to ten hours, though a cup of hot tea and dry toast can often be taken to advantage one-half to one hour after cessation of the vomiting. Continued retching can best be combated by an ice bag over the epigastrium, preferably applied directly to the skin for a few hours.

Nothing is more valuable than three to five drops of pure chloroform swallowed with a teaspoonful of shaved ice every half hour! This remedy is also valuable to combat a sense of epigastric pressure which is often felt for many hours.

When retching is violent, aromatic spirits of ammonia, compound spirits of ether, and similar drugs *often do more harm than good.* Equal parts of the spirits of chloroform and camphor in five to ten-drop doses on cracked ice is an efficient remedy. Morphin in small doses given hypodermically is not usually necessary, but it should be administered without hesitation if pain and vomiting are excessive.

Efforts at feeding should not be begun until the nausea and pain have entirely subsided. Hot tea is usually well tolerated. Simple gruels (barley, oatmeal) make an acceptable beginning; toast or bread and butter may soon be added.

After the second day the usual diet may gradually be resumed. If swelling of the gall bladder has been recognized during the attack, and if tenderness of the gall bladder region remains after the attack, the patient is confronted with the probability of relapses and with the possibility of the formation of gallstones.

Under these circumstances it is clear that the treatment of the patient should not cease with the passing of the attack. It is highly probable that careful and prolonged after-treatment will prevent a recurrence of the attacks, and may prevent the formation of gallstones.

Not nearly enough attention has been paid to this point. The initial attack of cholecystitis is a critical epoch in the patient's life. If the presence of cholecystitis is not recognized, or if the condition is neglected after the attack, there is every chance that the gall bladder infection may become chronic and that gallstones will eventually form. There is reason to believe that months are required for the actual formation of stones. It has been pretty well demonstrated that continued infection is required for this formation. Active and persistent treatment is, therefore, indicated for some weeks or months following every attack of cholecystitis. It is probable that urotropin is valuable in inhibiting the growth of bacteria in the bile. I have seen at least one striking case of typhoid infection of the gall bladder subside quickly after the administration of urotropin in doses of five grains every three hours. After even a mild attack of cholecystitis the patient should be subjected to the same regulations as if gallstones were definitely known to be present. These regulations will be described in detail further on.

The Treatment of an Attack of Gallstone Colic

The acute pain during the attack is to be combated by the hypodermic use of morphin. Many drugs are mentioned in this connection, and the list is copied from book to book. In actual practice morphin in doses of ¼ to ½ grain (0.015 to 0.03 gm.) is the one drug indicated. In robust individuals, when the pain is excruciating, an initial dose of ½ grain (0.03 gm.) is not too much, but the dose must be increased with caution.

It is easy to induce morphin poisoning if too large doses are used. In old patients, or when the pain is less intense, it is wiser to begin with ¼-grain doses (0.015 gm.) [or less—Editor], but this may be repeated in 15 or 20 minutes if required. Obstinate attacks may necessitate a third dose. The physician should never leave the patient until the pain is entirely overcome and the complete effect of the morphin can be estimated. This rule is the more imperative if large doses have been given. At the very onset of the pain the inhalation of chloroform is advised until the morphin has had time to act, but this will be rarely feasible or desirable.

When, for one reason or another, morphin cannot be administered hypodermically, some opium preparation may be taken by the mouth. Paregoric in teaspoonful doses, best given in a wineglass of hot water, repeated two or three times at short intervals, may be tried. Laudanum or the deodorized tincture of opium may be added to the dose, so that each teaspoonful of paregoric contains 10 minims (0.6 gm.) of the deodorized tincture. Administration of remedies by the mouth is exceedingly unreliable because absorption from the stomach probably does not take place, and gastric peristalsis is either inhibited or is reversed. Caution against poisoning the patient must be observed. Hot applications over the epigastrium and right hypochondrium are useful. Wet applications are better than dry. There is no value in excessive heat and the zeal of attendants to scald or burn the skin has nothing to recommend it. Thick flannel or a folded towel wrung out of very warm water answers every purpose. An oiled silk covering is useful.

When the patient awakes from the morphin sleep he may experience considerable pain in the epigastrium or in the gall bladder region. Recurrence of the severe paroxysm is always possible. It is often wise to continue the use of morphin by mouth for 24 to 36 hours after the initial paroxysm. The following formula given by Whitla I have used in scores of cases and have found it almost invariably well tolerated:

		Gm.
℞	Morphinæ sulphatis .....gr. i	(0.06)
	Bismuthi subcarbonatis .....gr. xlv	(3.0)
	Acidi hydrocyanici diluti..... .gtt. viii	(0.5 c. c.)
	Mucilaginis acaciæ .....℥vi	(24.0)
	Aquæ chloroformi q. s. ad.....℥ii	(60.0)

Sig.—Shake well. One teaspoonful every one to three hours if required. (As the sediment in this prescription tends to pack tightly on the bottom of the bottle, it is advisable to keep the bottle lying horizontally.)

During the first 24 hours after the attack it is usually advisable for the patient to abstain from all food and drink. If tenderness is present

in the gall bladder region large warm Priessnitz compresses are very useful in allaying inflammation. The compresses should be continued day and night until all tenderness and swelling have absolutely subsided.

All purgative medicines are strongly contraindicated during the first 24 hours. It is not unusual to see the administration of purgatives followed by marked exacerbations. As in all inflammatory processes, the chief indication is local rest, and this is best attained by starvation and functional inactivity. Even enemata should be avoided for at least 24 to 36 hours after the onset of the attack. At the end of this period a simple soapsuds enema may be given and the patient may begin to take food. Oatmeal and barley gruels are usually well tolerated; hot tea and unbuttered toast are easily taken; milk diluted with lime water may be given. Milk toast and broths free of fat can soon be added.

In a few days the patient may be taking fair quantities of food, though, as a rule, a light diet is to be preferred. All acids, fruits, and coarse vegetables must be forbidden the first few weeks. Even eggs act treacherously in some cases. It is advisable to avoid eggs in all cases in which bilious vomiting has been a feature.

The Treatment of Chronic Cholecystitis and Cholelithiasis

There is no medical treatment for gallstones as such. By medical means we cannot effect any important change in the gallstones themselves. As an important corollary to this statement, it must be added that gallstones as such do not usually produce symptoms. The history of patients who have gallstones is usually determined by the inflammatory changes which persist in the gall bladder or which recur or flare up from time to time.

Exceptions to these generalizations are found in those cases in which the gall bladder is packed with and overdistended by a large number of stones, and in those rare instances in which, in the absence of inflammatory attacks, the stones become lodged in the excretory ducts of the liver.

It should be clearly understood that the object of medical treatment is to reduce the gall bladder and its contents to a harmless condition. We no longer endeavor or expect to get rid of the stones by medical treatment, although this is sometimes incidentally accomplished. The aim of medical treatment is accomplished if active inflammatory processes subside, and if the gall bladder is made to functionate without distress. The object of treatment, in other words, is to render the gallstones latent and to transform the patient from a "gallstone sufferer" to a "gallstone carrier." In addition it is often necessary to treat those reflex functional disturbances and symptoms which an irritated or inflamed gall bladder sets up in other parts of the digestive system, particularly the stomach.

The treatment of chronic cholecystitis and cholelithiasis includes local measures, physical rest, dietetic régime, and the use of mineral waters and drugs.

Local Measures.—Local measures are indicated during the exacerbations of inflammation. They are of no obvious use in the absence of physical signs. When, however, there is a discoverable enlargement of the gall bladder, or any degree of sensitiveness in the gall bladder region, or when there is a tender Riedel's lobe, external applications are of undoubted value. As a general rule, it may be stated that the thoroughness and duration of external treatment depend entirely upon the local signs. Very warm Priessnitz compresses are to be preferred to all other forms of application, except in acute purulent exacerbations, when an ice bag should be given the preference.

During an acute inflammatory attack the Priessnitz compresses, covering the whole upper half of the abdomen, should be applied continuously during the twenty-four hours. As the local tenderness becomes less marked the compresses may be omitted during the night; in the later stages of the treatment the patient lies down with the compresses two hours in the forenoon and two hours in the afternoon, and this treatment is continued until the physical signs have completely disappeared. Persistence of the physical signs for several weeks under this treatment is an absolute indication for operative interference.

Among the local measures may be included colon irrigations with physiological salt solution. Nearly all pathological processes within the liver are alleviated more or less by this means, and irrigations should be performed daily during the subacute inflammatory stage. When the patient is able to take large quantities of hot salines the colon flushing may be discontinued.

Rest.—The value of physical rest in the treatment of cholelithiasis has not been sufficiently emphasized. There is no doubt that violent exertions tend to bring on attacks of colic and retard recovery. Horseback riding, automobile tours, and all athletic sports must be prohibited for months following any active symptoms. R. Kolisch (17) says that all Carlsbad physicians *without exception* value rest in the treatment of gallstones. Hence it comes that severe attacks in Carlsbad, where 10,000 patients are treated annually, are a great rarity. Even during an active Carlsbad course of treatment exercise is not a necessity. After patients leave Carlsbad they must have no abdominal massage, no gymnastic exercises, and no athletic sports for one year. Under these restrictions, says Kolisch, the vast majority of Carlsbad visitors remain well.

The Diet.—There is much divergence of opinion regarding the proper diet for cholelithiasis. During the acute inflammatory stage the diet should be limited to cereal soups, gruels, milk and lime water, bread, and toast. The simpler vegetables may soon be added, especially Irish potatoes (baked or boiled) and the tips of creamed asparagus. In general terms it may be stated that all greasy and acid foods must be prohibited. Cholelithiasis is so often complicated by secretory abnormalities in the

stomach, especially hyperchlorhydria, that the diet will often have to be determined by these outside factors. Personal idiosyncrasies must likewise be considered. This is especially true regarding eggs, which are well tolerated by many patients, but which are invariably followed by symptoms in others. Well-prepared meats are nearly always acceptable, except pork, bacon, goose, and sausage. Veal tongue or beef tongue, lobsters, and crabs must be avoided. Fatty soups should not be taken. All cereals are permissible, but macaroni and spaghetti should be prepared without cheese. Cheeses are usually well borne, but those which readily undergo acid fermentation, such as cottage cheese and New York creamery, are better omitted. Fresh butter is harmless. Hot breads are to be interdicted. Among the vegetables *well-prepared* peas, lima beans, spinach, corn, mushrooms, carrots, and asparagus are usually well tolerated. Tomatoes, cucumbers, beets, cabbage, cauliflower, radishes, sweet potatoes, and navy beans must be forbidden.

It is my experience that all patients who require treatment for gallstones are better off without fruits of any kind. All fruits pass out of the stomach slowly, increase gastric acidity, and are irritating. Vinegar, mustard, horseradish, and other spices must be forbidden on the same grounds. Custards, light puddings, light cakes, and gelatins may be taken freely. Ice cream, ices, and sweets of all kinds are apt to cause trouble. Individual observation is here necessary.

Hot tea is a safe beverage; alkaline waters may be used with safety. Coffee, cider, lemonade, ginger ale, all highly charged waters, cocoa, and chocolate must be omitted. Alcoholic beverages of all kinds are harmful.

It has been suggested that patients with gallstones should eat frequently in order to prevent the bile from stagnating in the gall bladder. In the fasting state the bile is stored up in the gall bladder and the frequent occurrence of biliary colic at night has been explained by the distention of the organ, which occurs at that time. It is doubtful if this advice has any value in the average case. Patients with reflex gastric hypersecretion or hyperchlorhydria would, it is true, be benefited by frequent meals.

Mineral Waters and Drugs.—The value of the saline mineral waters in the treatment of cholelithiasis is universally recognized. The alkaline waters neutralize or reduce gastric acidity; they flush out the bile passages, washing out the liver, as it were; they tend to reduce catarrhal processes in the stomach and in the upper intestines. They are also supposed to keep the bile thin and to stimulate its flow. The best time to administer the saline waters is from one-half to one hour before meals when the stomach is nearly or quite empty. Every experienced clinician has his own favorite formula. Some prefer the natural mineral waters of Carlsbad, Vichy, Neuenahr, Bedford, and consider treatment at the springs superior to home treatment. It is generally conceded that treat-

ment away from home offers many advantages. Patients when visiting resorts for treatment gain the tonic effect of travel; they submit more willingly to the dietetic and other regulations; they are relieved of all duties and cares; and in general can devote themselves with more regularity to the use of the chosen waters. It is not generally believed that treatment at the source possesses any specific superiority over the home treatment beyond the advantages just named. Carlsbad is the most famous resort for gallstone patients and most of the artificial formulæ are imitations of the Carlsbad waters.

In my opinion sulphate of sodium is the most valuable of all the salts usually employed, being far superior to the more generally used phosphate of sodium. A good formula is the following:

℞			
	Magnesiæ Sulphatis	60.0	℥ii
	Sodii Sulphatis	30.0	℥i
	Sodii Bicarbonatis	10.0	ʒiiss
	M.		

Sig.—One teaspoonful in a glassful of hot water one-half hour before breakfast and one hour before dinner and supper.

This formula is often too laxative in its effects and it may cause meteorism; it should be varied to meet various indications. In cases of marked hyperchlorhydria the amount of the bicarbonate can be increased as follows:

℞			
	Magnesiæ Sulphatis	60.0	℥ii
	Sodii Sulphatis	20.0	āāʒv
	Sodii Bicarbonatis	20.0	

Sig.—One teaspoonful in hot water as directed.

Equal parts of the three salts constitute an acceptable formula. After the first two or three weeks of treatment the remedy should be omitted at noon; later the evening dose may be stopped, but the patient should continue the medicine in the morning for months or even years.

Billings (3) recommends the following formula:

℞			
	Sodii salicylatis	10.0	ʒiiss
	Sodii phosphatis granulati	20.0	ʒv
	Sodii sulphatis exsiccati	60.0	℥ii

Sig.—One teaspoonful in hot water one-half hour before meals, three or four times a day.

Forchheimer prefers the simple sodium phosphate given one, two, or three times daily. Occasionally patients cannot tolerate saline drugs without nausea or at least anorexia. In these cases pure hot water can be used. I would warn against excessively hot water or excessively large

quantities of hot water, as I have seen many examples of gastric catarrh produced by indiscretions in this direction.

Before the pathology of cholelithiasis was so well understood the treatment was often directed to the solution or expulsion of the calculi. No one believes now that gallstones within the gall bladder can be dissolved by the administration of drugs. The use of strong purgatives and cholagog drugs for the purpose of expelling the stones is not to be recommended. Large stones will not pass; smaller stones are apt to lodge in the excretory ducts, and even if some stones were expelled others would be likely to remain behind. As a rule, strong purgatives succeed only in irritating the inflamed bile passages without removing the stones. Milder cholagogs given over a long period of time, such as pure ox-bile, bile salts, salicylate of sodium, and various combinations of the above, are advised by many clinicians, but in my opinion they are in every way less reliable and less effective than the salines. Tyson (23) says: "I have been in the habit of placing my patients between attacks on the succinate of sodium in doses of 5 grains (0.3 gm.) three times daily, and it has so happened that I have seldom met a recurrence in one of these cases, although many of them passed out of my observation and may have had attacks without my knowledge."

Pure olive oil has a preëminent reputation with the laity and has proved useful in allaying many symptoms. It is best administered in gradually increasing doses before meals and at bedtime. As much as a wineglassful may be taken at one time. Olive oil frequently removes the gastric symptoms of gallstones, especially when these are dependent on hyperchlorhydria or reflex pylorospasm. Rolleston suggests the possibility of olive oil dissolving stones which are lodged in the papilla of Vater. During the use of olive oil small fatty concretions are often expelled in the feces and may be mistaken for gallstones.

The Treatment of Gallstones in Transit

Gallstone colic may be followed by numerous complications. One or more stones may lodge in the neck of the cystic duct. In these cases the pains persist or recur with short intermissions, and accompanying the attacks of pain there is a gradual distention of the gall bladder. Opiates are required at frequent intervals, and hot applications are only moderately successful in relieving the distress. Suppuration within the gall bladder will be shown by a septic temperature and usually, though not always, by moderate or well-marked leukocytosis. Suppuration calls for surgical interference. It is proper to temporize if the symptoms are not life-threatening and if they show a tendency to recede. As in other intraabdominal conditions, it is often better to wait until the acute inflammatory symptoms have subsided. Even in non-suppurative cases the in-

dications become surgical as soon as more than a merely temporary obstruction in the cystic duct can be recognized.

When stones slip through the cystic duct and lodge in the common duct jaundice rapidly supervenes. During the first few days of the jaundice we are not able to tell if it is dependent on the presence of calculi or is due to catarrhal swelling of the mucosa. In fact, sometimes many weeks elapse before one can be sure on this point. It is therefore advisable to adopt a conservative course until the diagnosis is cleared up. The patient must stay in bed so long as there is evidence of inflammation of the gall bladder or tenderness of the liver. During the first few days no strong purgatives must be permitted. The effort to drive supposititious stones through an inflamed duct by means of strong cholagogs must be condemned. The attempt is usually followed by increased pain and jaundice, i. e., by increase of the local inflammation.

The diet must be carefully restricted, all greasy foods and acids being rigidly excluded. After the fourth or fifth day of jaundice colon irrigations with physiological salt solution should be practised systematically, at least once in 24 hours. The saline purgatives in hot water may now be used, preferably those which contain sodium sulphate. Calomel may be often used to advantage if administered in minute doses, 1/20 to 1/10 grain (0.003 to 0.006 gm.) every hour, until ten doses have been taken each day. In the absence of active inflammation no method is so good as this for reducing catarrhal swelling of the bile passages. Every morning a hot saline is given one-half hour before breakfast, and calomel is begun immediately after breakfast. This plan may be continued daily, or on alternate days, for a long period, often with the most striking benefit.

The more chronic the obstruction the more we are justified in resorting to strong purgatives without fear of making bad matters worse. Personally I have rarely seen efforts to dislodge obstructing stones crowned with success, but innumerable cases have been recorded.

The drugs most frequently employed over a long period of time are olive oil, salicylate of sodium, gr. x (0.6 gm.) three times daily after meals, ether and turpentine in various mixtures, and tincture of chelodonium.

Just how long we should persevere with medical treatment depends upon the conditions present in each case. No absolute rules can apply. So long as the patient is in good condition and free of fever and pain we can afford to temporize. Continuous loss of weight, regular though slight rise of temperature in the afternoons, or pronounced debility may be considered more imperative indications for operative interference. The waiting period may extend ordinarily from one to three months. To prolong medical treatment beyond this period is to subject the patient to the danger of permanent damage to the liver structures, and increases the risk of the operation itself.

Rolleston (22) advises persistent medical treatment even in the presence of recurrent attacks of fever and pain, but warns against allowing the patient to run down in health too far before resorting to an operation.

The Respective Indications for the Medical and Surgical Treatment of Cholecystitis and Cholelithiasis

With a few exceptions, every gall bladder disease begins as a medical case. In the great majority of instances the earliest symptoms are those of a catarrhal cholecystitis. These may be so mild that the true nature of the disease is overlooked, a diagnosis of simple "spoiled stomach" or "acute gastritis" being made. The severer cases are early recognized by the local signs and symptoms. Cholecystitis resembles appendicitis in this: that one attack predisposes to another, and also in the fact that a moderately severe attack may become latent or temporarily quiescent without, however, entirely clearing up. Cholecystitis differs from appendicitis in one very important particular, viz.: the exacerbations are not nearly so likely unexpectedly to assume serious or even dangerous aspects. The main argument for the immediate operation in all cases of appendicitis rests upon the fact that it is impossible for the clinician to estimate with certainty the condition of the appendix, and this uncertainty makes the retention of a diseased appendix more dangerous than an operation for its removal.

Such is not the case in diseases of the gall bladder. Unexpected surgical emergencies are here the exception, and the "tragic surprises" which accompany appendicitis are here so rare that they may be neglected in a practical discussion.

This radical difference in the clinical tendencies of the two diseases accounts for the fact that, whereas appendicitis has long been recognized as an essentially surgical disease in the great majority of cases, cholecystitis and cholelithiasis still occupy a fortified position in the "grenzgebiet" between medicine and surgery, with no lack of assailants and defenders in either camp.

There can be no question that a very large number of cases of mild catarrhal cholecystitis run a rapid course to complete and permanent recovery. That this is true of many moderately severe attacks I am led to believe by the careful observation of numerous cases over a long period of years. Even cases which are due to infection with the typhoid bacillus during or subsequent to an attack of typhoid fever usually end in complete recovery, and the numerous cases of so-called "typhoid carriers" who are in perfect health are a witness to this fact. Even so aggressive a surgeon as Deaver says (6):

"Typhoid cholecystitis rarely calls for operation. The majority progress favorably. I have followed too many cases to a sure convalescence

without operation to believe that all cases arising in typhoid fever should be operated on."

I believe we are justified in classing all the moderate attacks of acute catarrhal cholecystitis as medical cases, and we may look for a permanent recovery in most instances under appropriate treatment. We may draw a further conclusion that the mere presence of recognizable inflammation in the gall bladder is not *per se* an indication for surgical interference; we may go further and say that surgery of the gall bladder in acute catarrhal cases without definite surgical indications is meddlesome and unnecessary surgery. The successful issue of surgical interference in these cases simply shows, as Sahli has said in another connection, that "many medically curable cases likewise recover when treated surgically."

It sometimes happens that an acute attack of cholecystitis is so severe that it becomes life-threatening. These attacks are ushered in by chills and fever and marked prostration, and soon give rise to localized or, in the worst cases, to diffuse peritonitis. In the majority of these cases there has been a preceding history pointing to chronic gall bladder disease. When an ice bag applied locally and supportive measures do not seem to fortify the patient against the progress of the disease, immediate surgical interference may be necessary. One cannot be guided by a white blood count in this emergency because many cases of purulent cholecystitis are not accompanied by leukocytosis. If it is possible to tide the patient over the acuter symptoms before operating, this should be done, but the most experienced judgment is required to estimate the chances correctly. It should be borne in mind that the number of cases requiring immediate surgical interference compared to the total number of inflammatory attacks is exceedingly small.

In estimating the indications for treatment in the more chronic forms of gall bladder disease one meets with the greatest diversity of opinion. Some of the leading internists are radicals in advocating surgical interference in every case, while some of the most experienced surgeons refuse operation more frequently than they perform it.

Thus Frank Billings (3) is quite positive in declaring in favor of surgery. He says: "Gallstone disease must be recognized as a surgical disease. The danger of cholangitis, hepatic abscess, perigastric adhesions, pancreatitis, etc., occurring as a result of gallstones is so great that even the most conservative physician may well hesitate to take the responsibility of non-surgical treatment." Surely an extreme view. On the other hand, Hans Kehr operated only on 1,300 out of 4,000 cases referred to him, and in his latest report (16) he states that, "Kein Chirurg wird mehr die früzeitige Operation verlangen," i. e., "No surgeon will hereafter advocate an early operation," but should be satisfied if the cases are not sent to him altogether too late, i. e., with neglected choledochus obstruction or septic complications. In the hands of the most experienced

surgeons, says Kehr, almost the only cases which end fatally are cases of carcinoma or septic cholangitis. Kehr also believes that 80 per cent. of all cases will become latent in time. In face of these facts he rejects for operation all cases except in the presence of the following indications:

Absolute indications: chronic choledochus obstruction; acute and chronic empyema of the gall bladder; perforation; cancer. Relative indications: chronic symptoms, which cause inability to work or to enjoy life.

We thus have the curious spectacle of an internist of wide experience pleading for surgical interference in all cases, and a surgeon with still wider experience advocating conservative medical treatment in most cases in the absence of vital surgical indications. It is impossible to quote all the opinions of the leading authorities on this subject. We must content ourselves with presenting the various arguments on which these opinions are based.

The Arguments for Considering Chronic or Recurrent Gall Bladder Disease a Surgical Disease and Operating in All Cases.—1. Operation affords the only means of a permanent anatomical as well as clinical cure. Medical treatment may relieve the symptoms; it cannot bring about an anatomical cure in the sense of dissipating chronic cholecystitis or removing gallstones.

2. The early operation, i. e., before complications have arisen, is safe. The mortality rate in the hands of experienced surgeons is nearly nil. Thus Kehr lost only one in the last 73 uncomplicated cases. The Mayos' mortality in the same class of cases is only 0.5 per cent. The risk is increased by delay.

3. The early operation prevents complications, on the part of the gall bladder itself (perforations, adhesions); on the part of the common bile duct (obstruction leading to cholangitis and septic infection); and on the part of the pancreas (pancreatitis, abscess). Lastly, it prevents the development of cancer.

These arguments may be summed up very briefly, thus: Early operative interference is safe; it is sure; it prevents secondary and often pernicious complications.

The Arguments for Considering Chronic or Recurrent Gall Bladder Disease a Medical Disease in the Absence of Vital Indications.—1. In a very large proportion of cases chronic gall bladder disease tends to a gradual clinical cure. In other words, gallstones become latent, inflammation of the gall bladder subsides or disappears, and the "gallstone sufferer" becomes merely a "gallstone carrier." Kehr estimates this proportion at 80 per cent. Goldammer makes the same estimate. Franz Frick (11) has shown that, whereas autopsy records show a larger and larger prevalence of gallstones at increasing ages, clinical records show

the greatest prevalence of gall bladder diseases between the ages of 25 and 50. In other words, as patients grow older their gall bladders give them less and less trouble.

Every experienced clinician has observed many cases in which active gall bladder symptoms have disappeared never to return.

2. The more serious complications of cholelithiasis are the result of neglect. It is undoubtedly true that careful living on the part of the patient and careful observation on the part of the physician will prevent most, if not nearly all, of the life-threatening accidents connected with cholelithiasis.

3. The truly surgical complications do not, as a rule, arise suddenly, but, on the contrary, they usually give ample warning, so that there is plenty of time to operate when the indications call for an operation. For example, the severe forms of chronic cholecystitis are preceded by months or even years of local symptoms; only the neglect of obvious surgical indications permits the development of dangerous or fatal conditions. Cases which obstinately resist medical treatment and which, despite proper treatment, present persistent dyspeptic disturbances or attacks of recurrent jaundice may well be considered surgical cases.

When life-threatening or fatal symptoms arise in this class of cases we may well attribute the mortality to the inattention or indecision of the attending physician, but the theory of the propriety of medical treatment is in no way affected.

This is especially well illustrated in cases of cancer of the gall bladder. The occurrence of cancer of the gall bladder as a well known sequel of cholelithiasis is mentioned by nearly all surgeons as one of the prominent reasons for early operation. But it must be borne in mind that cancer occurs only in a very small proportion of all cases, and *that it scarcely ever occurs without a long history of local signs and obstinate symptoms. Cancer of the gall bladder rarely has an insidious onset, and its occurrence need not be feared in the uncomplicated or latent cases.* As Neusser has well said: "The specter fear of the serious consequences of cholelithiasis, which the surgeons love to oppose to a conservative treatment, is much weakened by contrary considerations."

4. The results of surgical interference are not so uniformly good as the face returns of surgical statistics would indicate.

In the first place, the surgical mortality even in the uncomplicated cases is something. The most experienced surgeons lose from one-half to one and a half per cent. in the simplest cases, and the mortality is undoubtedly greater in the average run of cases. We are in no position to judge of the post-operative morbidity, i. e., of the per cent. of patients in whom symptoms recur after even a successful operation. No available statistics are to be found, valuable as such a collection would be. Every clinician is familiar enough with the persistent dyspepsia, the

recurrent pains, and the localized discomforts which many patients present after having had gallstones removed. Add to these cases the small number of those who are harassed by adhesions, hernias, or fistulæ, and we readily see that operative interference is not always synonymous with clinical cure, and the clinical history does not always end with the departure of the patient from the hospital.

The arguments for the medical treatment of cholelithiasis may be briefly summed up thus: Medical treatment results in a clinical cure in a large percentage of cases, possibly 80 per cent.; the occurrence of serious complications may be foreseen, and may be forestalled by operative interference when called for.

After a thorough review of the whole subject the various indications for treatment may be summed up as follows:

Indications for Operative Interference.

1. Acute purulent cholecystitis threatening life.
2. Perforation of the gall bladder.
3. Gangrene of the gall bladder.
4. Chronic distention or thickening of the gall bladder. In the words of Quenu: "Hydrops calls for an operation, empyema demands it."
5. Persistent dyspeptic symptoms, especially when accompanied by physical signs of a diseased gall bladder.
6. Chronic obstruction of the common duct extending over a period of three months.
7. Chills and fever in the course of the disease with signs of enlargement of the liver, local tenderness, or jaundice.
8. The presence of symptoms which seriously interfere with the work of the individual or his ability to enjoy life. The occupation of the patient, his means, and his environment play a rôle in this decision.

Indications for Medical Treatment.

1. Simple catarrhal cholecystitis.
2. The early attacks of biliary colic, before the ability of medical treatment to render the stones latent has been thoroughly tested.
3. Cases of cholelithiasis in which the attacks are infrequent and not accompanied by obvious complications.
4. Cases of cholelithiasis with predominating gastric symptoms due to hyperchlorhydria and without marked local signs.
5. Cases with serious complications on the part of the kidneys, heart, or blood vessels which would render surgical interference dangerous.

DISEASES OF THE LIVER

Cirrhosis of the Liver

(*Portal or Laennec's Cirrhosis*)

For practical purposes we may divide the clinical history of cirrhosis of the liver into three stages:

1. The stage of development, during which the presence of the disease may be suspected but cannot be proved. Enlargement of the liver may or may not be demonstrable.
2. The active stage, during which ascites is the predominating symptom.
3. The terminal stage, presenting various phases of toxemia.

The Treatment of the Developmental Stage.—We are justified in suspecting the oncoming of cirrhosis in patients who have been addicted to the stronger alcoholic beverages and who, with little or no warning, have copious hemorrhages from the stomach or bowels, or who, in the absence of hemorrhage, present a more or less constant enlargement of the liver, combined with the symptoms of gastrointestinal catarrh and marked nervousness, and who void a scanty quantity of highly colored urine, which has a high specific gravity, but which contains a moderate or subnormal quantity of urea. These patients usually have a muddy complexion, which is sometimes even subicteric in character; they also become reduced in weight and strength. The presence of alimentary levulosuria increases the probability of the presence of cirrhosis.

The treatment during this stage may succeed in delaying or preventing the progress of the disease. The objects of the treatment are:

1. To remove all the etiological factors.
2. To remedy the gastrointestinal symptoms.
3. To inaugurate a system of diet and medication which has been clinically shown to be favorable in diseases of the liver.

The use of alcoholic beverages must be absolutely and permanently prohibited. Drugs must be avoided which contain a large percentage of alcohol. During the advanced stages of cirrhosis absolute abstinence from alcoholics may be attended with more harm than good, but in the early stages total abstinence must be insisted upon. The patient must omit all highly spiced foods containing mustard, pepper, horseradish, or other condiments.

The gastrointestinal symptoms usually require special treatment. Alcoholic gastritis is frequently present. Gastric lavage is of marked advantage in this condition. The stomach may be washed out every morn-

ing before breakfast, several quarts of warm water being used. The addition of drugs to the washwater has no advantage. Instead of the lavage, the patient may drink large quantities of hot water, from one-half pint to a pint, one-half to one hour before breakfast. When constipation is present a teaspoonful of the natural or artificial Carlsbad salts may be dissolved in the water. Many patients are benefited by taking a teaspoonful of Carlsbad salt or similar preparation one-half hour before breakfast and one hour before dinner and supper. A good formula is equal parts of magnesium sulphate, sodium sulphate, and sodium bicarbonate. If purging is too active the dose may be reduced one-half, or the salts may be administered in the morning, the hot water alone being taken in the forenoon and afternoon. Hot water is not always well tolerated, but may increase an existing gastritis. When well borne it is often markedly beneficial, carrying off the gastric mucus, "flushing out" the liver, and stimulating the circulation in the stomach. In cases of hypoacidity dilute hydrochloric acid or the nitrohydrochloric acid may be given with advantage. Fifteen or twenty drops well diluted and taken after meals sometimes relieve the sense of fullness in the stomach and reduce the belching. Vomiting, if present, is usually relieved by the measures just mentioned. Gastric sedatives, such as subnitrate of bismuth, dilute hydrocyanic acid, are often useful. The bitter tonics, gentian, nux vomica, condurango, are relatively ineffectual. The digestive ferments never yield more than merely temporary results.

Diet.—The diet of patients in the early stages of cirrhosis of the liver should be carefully controlled. Unfortunately the science of chemical physiology has not advanced sufficiently to give us rational guidance. Empirically we have learned that all greasy foods and most acid foods are not well tolerated. All stimulants, including coffee, must be avoided. A pure milk diet is theoretically advisable, but is rarely practical. Few patients remain well nourished on a milk diet, and few can continue it without disgust or marked dyspeptic disturbances for any length of time. Milk makes few demands on the digestive organs, is a good diuretic, does not lend itself to harmful putrefactive changes in the colon, and is, therefore, invaluable where it can be well tolerated. It should form the chief article of nourishment so long as it is easily and pleasantly taken and so long as it is digested. Very often the milk can be modified to advantage.

The addition of bicarbonate of sodium or lime water reduces the tendency to flatulence and dyspepsia. The addition of barley gruel or other cereal diluents is rarely palatable to adults for any length of time. The various preparations of fermented milk are all valuable, but usually they do not possess any advantage over the ordinary milk. Skimming the milk renders it more digestible.

Practically a pure milk diet is rarely successful for any length of

time. It is of the utmost importance that the strength of the patient be not sacrificed to any theoretic considerations whatsoever. Therefore, a mixed diet is preferable in nearly all cases. All the cereals are appropriate. Well-prepared bread is a desirable addition. Good butter may be taken freely. The use of vegetables and fruits must be governed by the condition of the stomach and bowels. The more acid fruits, such as oranges, grapefruit, peaches, plums, must be avoided. The coarser vegetables, such as cabbage, kale, tomatoes, and radishes, must be forbidden.

Much diversity of opinion exists regarding the desirability of meat. My own experience leads me to believe that well-prepared meats, beef, chicken, sweetbreads, lamb, roast veal, are valuable and harmless additions to the dietary and may be taken once daily without harm. The more easily digested fishes are also acceptable. The very fatty fishes, as well as pork, bacon, tongue, goose, lobster, and shrimps, should not be taken. Eggs are well digested by some patients and upset others. It is necessary to individualize. Critical observation and a not too close adherence to theoretic considerations are recommended.

Drugs.—The use of drugs has a distinct place in the treatment of the early stages. Formerly it was believed that malaria played a rôle in the development of cirrhosis and quinin was often given, but without benefit. It is now known that true hepatic cirrhosis is not due to malaria. The value of iodid of potassium is problematic. In cases occurring in syphilitic patients the iodid should be pushed to the point of tolerance.

In non-syphilitic cases I have never seen any good results from the use of the iodids. On the contrary, patients are often made much worse by pushing the remedy at the expense of the digestion and the appetite. I am convinced that the drug is useless or even harmful in the ordinary cases, and it is not indicated unless there is a suspicion of syphilis. In the absence of a positive Wassermann or Noguchi test the iodids should not be given. Rolleston, Stadelmann, and others think that iodid of potassium should be given a trial, even if syphilis is not known to be present. A few authors (Forchheimer, Eichhorst) believe that good results have been obtained in the early stages of non-syphilitic cirrhosis by the long-continued use of moderate doses of the iodid of potassium, but the large majority of observers are of a different opinion.

Calomel is a more useful drug. Its systematic use was formerly much lauded by many German clinicians. It is undoubtedly of great value in the hypertrophic form of cirrhosis (Hanot's disease), and in all cases of alcoholic cirrhosis in which there is an associated catarrh of the bile passages.

There is a wide variation in the dosage. Large doses sometimes exert a markedly beneficial influence. 0.2 gm. (3 grains) may be given three times daily for a period of three days, these doses to be repeated after an interval of several days. Calomel can advantageously be given in

minute doses for its effect both upon the liver and the intestinal contents. Rolleston recommends 0.006 to 0.003 gm. (gr. 1/10 to 1/20) given three times daily. I have frequently given calomel 0.003 gm. (gr. 1/20) hourly for days at a time with markedly beneficial effects. An occasional dose of a saline purgative before breakfast is of advantage during the calomel treatment. We must avoid reducing the strength of our patients by strong purgatives, and any treatment which deranges the digestion or lowers the vitality of the patient does more harm than good.

Treatment at a foreign or native watering resort is desirable in the early stages if the patient has the necessary leisure and money. The spa treatment has well-recognized advantages. Travel has a tonic effect. Patients are relieved of their daily cares and duties. They have nothing to distract their mind from the systematic habits required at the various resorts. They are more obedient to dietetic rules. The gastric and intestinal functions are stimulated to heightened activity by the hot mineral waters. The flushing of the stomach and intestines reduces the possibility of autointoxication, and catarrhal processes in the bile ducts, stomach, and small intestines are relieved. Especially useful are Carlsbad, Vichy, Homburg, Kissingen, Harrogate, French Lick, and Bedford Springs.

Treatment After the Appearance of Ascites.—Hale White takes a most gloomy view concerning the outlook for patients in whom ascites has supervened. "There appears no doubt," he says, "that, when ascites is not due to simple chronic peritonitis or tubercular peritonitis, its supervention in cirrhosis means that the patient will die within two or three months." This conclusion has so many exceptions that we are justified in rejecting so pessimistic an attitude toward our patients, and there is no doubt that scrupulous attention to details will often be followed by more favorable results, especially in private practice. Certain it is that well-established cirrhosis cannot be cured anatomically; nevertheless, cases are recorded in which apparent cirrhosis with ascites has been followed by a clinical recovery for many years. Subsequent autopsies in some of these cases have shown that the patients had cirrhosis which had become latent. It is likewise true that many patients dying of other diseases are found post mortem to have had cirrhosis of the liver.

The treatment of ascites has two aims:

1. The removal of the fluid.
2. The prevention of its reaccumulation.

Hale White sees no advantage in the removal of the fluid unless the breathing and the action of the heart are impaired. The modern tendency, however, is to withdraw the fluid as soon as the patient is seriously embarrassed by its presence. It is surely preferable to perform early paracentesis than to exhaust the strength of the patient by vigorous purgation, which is almost invariably futile.

Diuretics do little toward removing accumulated fluid, though they are of some advantage in preventing its reaccumulation. The dangers of paracentesis when properly performed are few. Debove and Castaigne (7), in a brief but brilliant monograph, call attention to the precautions which should be thrown about this apparently trivial operation. They, in common with most French authorities, consider the point of election to be the junction of the outer with the middle third of a line drawn from the umbilicus to the anterior superior spine of the ilium. The median line a few inches above the symphysis pubis is also a suitable place. The patient should empty his bladder before the puncture. A small trocar should be used so that the escape of fluid is not too rapid. Strict antiseptic precautions should be taken. The best method of procedure is the following: If the lateral point is chosen the patient lies in bed; for the median puncture the patient may be seated in a rocking-chair, which is tilted backward. The abdomen is thoroughly scrubbed with soap and water. The skin at the site of puncture is painted with tincture of iodin. It is then sprayed with ethyl chlorid. A small incision is made through the skin with a small knife and the trocar is then plunged directly into the peritoneal cavity. The fluid should be permitted to escape slowly. If the patient is in fair condition all the fluid should be removed. It is convenient to attach a rubber tube to the cannula in order to conduct the fluid to a basin on the floor. After the fluid has all escaped the cannula is removed and a silk suture closes the wound. This is then covered with a piece of aseptic gauze. Instead of closing the wound with a stitch it may be painted over with collodion; the suture is preferable. A cannula may be left in place for a few days in order to retard the accumulation of fluid. It soon ceases to drain and its retention in place has few advantages.

After the fluid has been removed or even during its removal it is generally recommended to fasten a bandage about the abdomen and to draw it as tight as the patient can endure with comfort. A cat-o'-nine-tails bandage is best for this purpose. The bandage is supposed to prevent faintness on the part of the patient from overfilling of the abdominal vessels, and even to forestall hemorrhages from the same cause. During the past few years I have usually dispensed with this precaution altogether and without regret.

After removal of the fluid one should not overlook the opportunity of immediately palpating accurately the liver and spleen. Many details connected with these organs can then be made out which are obscured by the presence of fluid. Debove and Castaigne discuss in detail the dangers connected with tapping. They classify them into two groups, called the immediate and the remote complications. The immediate complications include hemorrhages from the wall of the abdomen; hemorrhages from the gastrointestinal canal, and cardiopulmonary disturbances. Hemor-

rhage from the wall of the abdomen is due to wounding of the epigastric artery. The blood may escape externally, may infiltrate the abdominal wall, or finally may be poured into the abdominal cavity, with fatal results. Rapid collapse after paracentesis should suggest this possibility and lead to a search for the hemorrhage.

Hemorrhages from the digestive tube are due to rapid decompression. They usually cease spontaneously, but may prove fatal. Hence the necessity of the compressing bandage after the puncture.

The cardiovascular disturbances may occur during the paracentesis or shortly thereafter. Intense dyspnea and rapid dilatation of the heart may occur, leading to a fatal collapse. This complication must be guarded against by using proper cardiac stimulants before the operation in all weak patients. Digitalis is especially valuable. Hypodermoclysis of 250 c. c. physiological salt solution may be given one hour before the operation, and may be repeated after 12 hours. In very debilitated subjects it is advisable to remove only a few liters of the ascitic fluid, enough to prevent the mechanical embarrassment caused by the fluid. The remote complications are two in number and only gradually follow the removal of the fluid. The first is called by the French writers l'anémie séreuse, i. e., exhaustion of the blood serum; the second is a deep jaundice, the so-called icterus gravis, which supervenes a few days after paracentesis. Both of these complications are prevented by observing the precautions already mentioned.

How Can Reaccumulation of the Fluid Be Delayed or Prevented?—*A milk diet* is strongly advocated by many French clinicians. Lancereau in particular considers it an absolute condition of success. The milk diet acts in two ways, first, by sparing the liver cells, and, second, by stimulating copious diuresis. Many cases are on record in which the rigid milk diet prolonged over many weeks was followed by a disappearance of the ascites and a complete clinical cure. Approximately three liters should be administered daily, but the quantity will vary with each individual. *The salt-free diet* was first used in the treatment of the ascites of cirrhosis in 1903 by Achard et Paisseau (1). It has been tried with varying success in hundreds of cases since that date. All observers agree that the absorption of fluid from the peritoneal cavity under the influence of the salt-free diet is not nearly so rapid as the disappearance of edema of the legs in cases of nephritis or heart disease. There is no doubt, however, that ascites has been made to disappear by withholding all salt from the dietary.

An interesting summary of observations was published by Henri Guilhaume (13). Among his conclusions are the following:

1. Under the influence of a salt-free diet ascitic fluid is absorbed less readily in cases of cirrhosis of the liver than in cases of Bright's disease or cardiac insufficiency.

2. The therapeutic results are superior to those obtained by a milk diet.

3. The salt-free diet should be tried in cases of cirrhosis as rigidly as the endurance and taste of the patient will permit.

Sir Clifford Allbutt (2) describes a sensible method of using the salt-free diet. "At first only the salt on the table is forbidden. The next step is to reduce the salt in the dishes, the bread and butter, etc., so that in four or five days more all salt is rigorously excluded. The total exclusion is tolerable for another four or five days, when a little salt may be added to the cooked food or to the bread, and so gradually a return made not to ordinary quantities of salt, but to so much as may be really necessary."

Organotherapy has been tried in cases of cirrhosis. Usually the uncooked liver of hogs is taken in daily doses of about 150.0 grams (5 oz.). Successful cases were reported in 1896 by Vidal and by Gilbert et Carnot (14). Mouras reported seven cases in which the ascites was cured by organotherapy and collected other cases. Debove et Castaigne have not seen glowing results from this treatment, and call attention to the danger of infecting the patient with tubercle if the raw liver is employed. Various drugs have been recommended to delay the accumulation of fluid. Diuretics are preferable to cathartics because they are less exhausting to the patient. Hale White thinks highly of copaiba resin in doses of 15 grains (1.0 gm.). The pill known as Baillie's or Addison's pill, composed of one grain each (0.06 gm.) of powdered digitalis leaves, squill, and blue mass, is very popular and often efficient. Musser recommends apocynum, of which the tincture can be given in doses of 15 to 30 minims (1.0 to 2.0 c. c.) three times daily, or the fluid extract in doses of 10 minims (0.6 c. c.) three times daily. Calomel in minute doses is often useful. Diuretin is not beneficial. Iodid of potassium is without avail.

Purgatives if pushed to extremes do more harm than good. In moderate doses they do not seem to prevent the accumulation of fluid. Jalap is probably the most beneficial.

In 1909 Eichhorst (9) spoke in the highest terms of the value of cream of tartar, not only to prevent the accumulation of fluid, but also to cause its rapid absorption. Eichhorst's formula is as follows:

℞	Decocti althaeæ	180.0	℥vi
	Potassii bitartratis	15.0	ʒiiiss
	Syrupi simplicis	20.0	ʒv

Sig.—Shake well. One tablespoonful every two hours.

Jüsgen reports the results of using Eichhorst's remedy in the St. George Hospital in Hamburg. His conclusions are very favorable. The

mild cases showed rapid improvement; even in severe cases with marked ascites and edema the ascites quickly disappeared. Nephritis delays, but does not prevent, favorable results so long as the heart is not seriously damaged. Dock (8) reports a case which showed marked improvement under the use of compound jalap powder which contains cream of tartar.

Reducing the quantity of fluid ingested may temporarily limit the accumulation of fluid, but has so many objectionable features that it cannot be recommended.

The surgical treatment of the ascites of cirrhosis was originated independently by Talma and Morison. It was based on an effort to aid nature in establishing a collateral circulation between the portal and the systemic venous system. F. P. Weber (24) thus describes the theory of the operation: "Cases of hepatic cirrhosis might perhaps be roughly divided into the two following groups:

"a. Patients who for some reason (for instance, the presence of old perihepatitis and perisplenitis and extensive spontaneous omental adhesions) have the collateral venous circulation well established, and do not readily develop ascites, but are especially liable to hematemesis from dilated esophageal or gastric veins. The liver is generally decidedly enlarged in this group of cases.

"b. Patients with a poor collateral venous circulation who develop ascites early. The main object of omentopexy and peritoneal drainage should be to convert patients of class b into patients of class a."

The technique of the original Talma operation or the Talma-Morison operation must be sought for in textbooks on surgery. Numerous modifications have been devised by other surgeons.

It is difficult to estimate the value of surgical interference. The publication of many successful cases resulting in good health for many years encourages operative treatment. Nevertheless, a large majority of the patients operated on either received no benefit at all or had their lives shortened by the operation. Undoubtedly hundreds if not thousands of unfavorable cases have never been reported. Dock suggests that the facts be laid before the patient himself. Many a patient would brave the danger of the operation in the hope of a possible cure. Rolleston says (page 260): "When medical treatment and a course of iodid have not benefited a case of ascites, which is thought to be due to either syphilis or cirrhosis, the question of operative interference should be considered."

The earlier the operation is performed the better the chances of permanent relief. To operate in a late stage means almost inevitably to meet with failure.

Treatment of the Terminal Stage.—Of 34 fatal cases in the clinic of Professor Spillman and Bernheim in Nancy (5) seven died of spontaneous hemorrhage, one of hemorrhage after paracentesis; five died of icterus

gravis; three of uremia, six of tuberculosis, five of bronchopneumonia, one each of heart failure and infection, and two of simple peritonitis.

When the disease runs its course the final stages are often marked by delirium and coma. These symptoms may be of renal, intestinal, or hepatic origin. Hemorrhages may occur at any stage in the disease; in fact, hematemesis is frequently one of the earliest symptoms. The treatment of the hematemesis is the same as in cases of gastric ulcer. Absolute rest, absolute abstinence from food or drink, the external application of ice, and the use of morphin hypodermatically comprise the routine treatment. The patient must lie flat on his back at least for three or four days; an ice bag should be placed on the epigastrium. If the patient is shocked or restless nothing is so useful as morphin given hypodermatically in doses of gr. ¼ to gr. ⅛ (0.015 to 0.008 gm.) repeated every 3 to 6 hours if required. Hypodermoclysis may be needed in severe cases. The patient should not be permitted to suck ice or sip water. Hemostatic agents by mouth or hypodermically are of little or no avail. Calcium chlorid in dram (4.0 gm.) doses may be given by the rectum. After the hemorrhage has ceased at least twenty-four hours should elapse before feeding either by mouth or by rectum is begun. Rectal injections of 8 ounces (250 c. c.) of salt solution every six hours answer every requirement and are preferable to nutrient enemata. After forty-eight hours iced milk mixed with equal portions of lime water should be given per os, beginning with two ounces every two hours. No absolute rules can be given; larger or smaller quantities seem to be tolerated equally well. One must be guided by the symptoms. Patients often live many years after the initial hemorrhage. The after-treatment is given in detail above. When hemorrhage from the stomach or bowels occurs in the terminal stage of cirrhosis, the end of the patient is not far off. Turpentine enemata are recommended by Rolleston for severe attacks of melena without hematemesis. Hemorrhage from other mucous membranes should be treated locally when possible (epistaxis, hemorrhoids, etc.); multiple hemorrhages usually indicate advanced hepatic insufficiency and signify an early end.

The delirium and coma must be treated in a palliative manner. Strenuous efforts to prolong life to the utmost by means of packs, transfusions, etc., are not in place. When the outlook is hopeless it becomes the duty of the physician to prevent suffering, rather than to prolong life.

Prolapse of the Liver or Hepatoptosis

Mild grades of liver displacement are not infrequent. Total prolapse is much rarer. It occurs principally in women over forty who have borne several children and who present various symptoms of neuras-

thenia. It is commonly associated with general visceroptosis (q. v.) and almost always results from a weakening of the intraabdominal ligaments and the abdominal wall. It must be understood that complete ptosis of the liver usually involves a double rotation of the liver, in addition to the dropping of the organ. The liver rotates on a transverse axis, so that the diaphragmatic portion moves anteriorly, bringing the anterior surface into greater contact with the anterior abdominal wall. The under surface of the liver turns also to the left, the convexity to the right. The liver thus becomes easily palpable, moves easily under the hands, drops when the patient stands, and can be pushed back into place when the patient lies down.

The treatment must fulfill three indications:

To Support the Prolapsed Organ.—In the milder grades this can be accomplished by any well-fitting abdominal supporter which, like all proper abdominal bandages, must bring most pressure to bear on the lower half of the abdomen. In the severer cases we must resort to strapping with adhesive plaster or to the use of specially designed corsets. Strapping with adhesive plaster has the obvious disadvantage of being only a temporary appliance; the strapping must be frequently renewed; it tends to irritate the skin and cannot be compared in permanent comfort with a proper corset. The requisites for a good corset are thus excellently summarized by W. Hale White (25):

"It should have a firm grip on the ilia, be loose at the upper part, and be so made that by lacing it from below upward considerable pressure is brought to bear on the lower part of the abdomen; it should be laced up when the patient, in the erect posture, drawing a deep inspiration, thus raises the ribs and at the same time contracts the abdominal muscles as much as possible."

To Increase the Tone of the Abdominal Walls.—This can be accomplished by abdominal massage, by electricity, and by gymnastic exercises. The usual exercises for increasing the power of the abdominal muscles are these:

The patient lies on his back, and keeping the legs stiff raises and lowers the upper half of the body six to ten times. Or, lying flat, he alternately bends and straightens out the legs with the body held rigid. Deep breathing exercises are also of value.

To Increase the State of Nutrition of the Patient.—This relieves hepatic congestion, and tones up the muscular system. Detailed instructions are not necessary. The principles of dieting will be discussed under enteroptosis (q. v.). The use of cholagog cathartics is invaluable and general tonics are usually indicated. When palliative measures fail to relieve the symptoms sufficiently resort may be had to surgical procedures. This is only exceptionally necessary. Gerard Marchant was the first to fix the liver by suturing it to the costal margin in 1891. Since that date

various other methods of suturing and attaching the liver have been successfully employed.

Abscess of the Liver

Multiple abscesses of the liver of pyemic origin and suppurative pylephlebitis are practically always fatal and are not amenable to medical or surgical treatment. The only hope of successful treatment in the future is along the lines of serum treatment. All we can do at present is to combat the general pyemia.

The solitary abscess of dysentery, the traumatic abscess, and the suppuration by extension from a purulent gall bladder can all be successfully treated by the surgeon. It is probable that the more general adoption of the ipecac treatment in cases of dysentery will somewhat limit the incidence of hepatic abscess, which complicates dysentery in from 15 per cent. to 30 per cent. of all but the acute cases. The chances of recovery are increased by an early diagnosis. Diagnostic puncture of the liver should, therefore, be practiced "on suspicion" and is a harmless procedure when properly carried out. A few years ago a young man from Florida was under my care for intermittent fever and liver pains. He had had dysentery, but had no discoverable amebæ in the stools and no local signs. Owing to the persistence of symptoms and the exclusion of other possible foci, liver puncture was freely performed, and revealed a deep-seated abscess, which was opened and drained by Dr. H. T. Whitacre with perfect results.

Geo. F. Johnson (15) says that "surgical treatment must be prompt and bold and radical. No measure will succeed which does not completely evacuate the abscess cavity and allow free drainage. This can be done with precision and safety only by incision. Aspiration, puncture with trocar, direct puncture with scalpel, opening by caustics, or the thermocautery are uncertain, insufficient, dangerous, and unsurgical, and are mentioned only to be condemned."

When an abscess points or when its location can easily be determined on exposure of the liver it is often best to perform the operation in two stages. There is considerable room for difference of opinion as to the advisability of operating after rupture of the abscess into the lung. The best practice seems to be to postpone operation until the patient's health can be built up by tonics, good feeding, and sea air. Rupture of the abscess into the colon or externally is usually followed by spontaneous recovery. Rupture into the peritoneal cavity, the pleura, the pericardium, or elsewhere calls for immediate surgical interference.

Tumors and Cysts of the Liver

The simple cysts and benign tumors of the liver are usually pathological curiosities and have comparatively little clinical interest. A growing tumor should always arouse suspicion of syphilis and should be treated accordingly with large doses of iodids or mercury (see Syphilis of the Liver). Early surgical interference will probably result in the saving of some lives in cases of primary carcinoma, especially of the gall bladder. Resection of the diseased areas is carried out successfully by modern methods. Actinomycosis of the liver should be treated by large doses of the iodids. Hydatid disease is curable surgically in the large majority of cases. C. MacLaurin (19) gives a record of 420 cases of hydatid disease treated in the Royal Prince Albert Hospital in Sydney. During the past five years the operative mortality was only 1 to 2 per cent. "The only cases which now die," says MacLaurin, "are some of those which were ruptured and a few which have suppurated." The ultimate outcome in this disease, however, is always doubtful. Recurrence is common and the peritoneum frequently becomes involved. This complication is usually fatal. The operation of choice is the excision of the mother cyst. By preference the posterior transcostal route is selected when possible.

Cancer of the liver, when primary, nearly always runs a very rapid course, so that only a few months elapse between the onset and the fatal termination. Not all cases require opiates, but morphin should be given without stint when pain is a prominent symptom. The treatment of secondary carcinoma is purely symptomatic. I am of the opinion that much suffering can be spared the victims of gastrointestinal cancers by reducing the diet to the simplest possible rations, excluding, so far as is possible, all albuminous foods. Barley and oatmeal soups, and gruels should be the basis of the diet. Opiates, when required, should be given. Many a patient, however, has his total suffering increased by the too early and careless use of morphin. In general terms, we may say that, when patients have an incurable malignant disease, our efforts should be directed not to prolonging life, but to making it tolerable.

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CHAPTER VIII

DISEASES OF THE PANCREAS

WILDER TILESTON

General Considerations.—In 1898 Oser (29) wrote: "We are rarely in a position to make a correct diagnosis of pancreatic disease, and therefore can seldom employ a rational mode of treatment." The work of the last ten years, however, has greatly enriched our knowledge of the pancreas and its diseases in all directions, so that to-day we are often able to diagnosticate correctly and cure or alleviate diseases of this interesting gland. This great advance is due largely to the labors of Robson (33) and Körte (19) in the domain of surgery, and to v. Noorden and his pupils and Wohlgemuth in medicine.

As is well known, the pancreas is a gland possessing both an internal and an external secretion. It is with the latter that we are concerned here, as the internal secretion is dealt with in the chapter on diabetes. Recent work by Wohlgemuth (45) and by Bickel (2) has shown that the amount of the pancreatic secretion can be influenced to a considerable extent by diet and drugs. Thus bouillon, alcohol, sodium chlorid, hydrochloric acid, and pilocarpin all increase the secretion, while alkalies, atropin, and opium diminish it. The amount secreted is least on a fat diet, somewhat greater on one of protein, and largest on a carbohydrate diet. The concentration of the ferments, however, varies widely under different conditions, and no definite laws for man have been established yet. The pancreas secretes very little except under the administration of food by the mouth, so that in rectal feeding and starvation we possess ways of temporarily setting the gland at rest.

Secretin injected subcutaneously causes an active secretion of pancreatic juice in animals, and this secretion can be inhibited by the injection of adrenalin, as shown by Pemberton and Sweet (30). These facts, however, have not yet proved of value in practical therapeutics.

Opotherapy.—Where the pancreatic juice is deficient, it has been shown (Tileston, 40) that the administration of raw pancreas or of pancreatic extract increases very materially the absorption of both fat and protein. This is in marked contrast to the inefficiency of these prepara-

tions in supplanting the *internal* secretion of the pancreas in diabetes. Raw pancreas is somewhat more effective than the extracts, but is harder to procure, and usually soon becomes distasteful to the patient. Any good preparation will do; pankreon does not seem to be superior to other active extracts. It is best given after meals with an equal amount of calcium carbonate, in rather large doses, one to three grams (15 to 45 grains). The addition of the alkali tends to insure an alkaline medium for the action of the ferments, and to prevent their destruction by the hydrochloric acid of the gastric juice.

Surgical Treatment of the Pancreas.—The experience of recent years has demonstrated that the pancreas may be attacked quite freely, extensive resections may be performed, free incisions may be made, or small pieces may be removed for examination without danger, provided that injury to important adjacent structures (splenic artery and vein, pancreatico-duodenal and middle colic arteries, inferior vena cava, etc.) is avoided, adequate drainage is supplied, and the peritoneum is protected from the corrosive action of the pancreatic juice.

Routes of Approach to the Pancreas.—Various methods of exposing the pancreas for the purposes of operation have been devised. They may be divided into transperitoneal and extraperitoneal routes. Of the former there are three: (1) Through the gastrohepatic omentum, useful only in cysts presenting above the stomach, and in marked ptosis of the stomach; (2) through the gastrocolic omentum, the usual route where exposure of the whole gland is desired; and (3) through the transverse mesocolon, for cysts presenting below the colon, and for exposure of the tail of the pancreas. The extraperitoneal routes are the lateral abdominal one of Bardenheuer and the lumbar. The former is said to give a good exposure of the body and tail of the pancreas, while the latter is useful only in the drainage of cysts and abscesses of the organ.

The best works to consult on diseases of the pancreas are those of Opie (28) for the pathology, and of Robson and Cammidge and Körte for the surgical and clinical aspects; Oser's monograph in Nothnagel's encyclopedia, though now out of date, contains much valuable information.

ACUTE PANCREATITIS

This condition is characterized by the sudden onset of excruciating pain in the epigastrium, soon followed by vomiting, which becomes incessant, by collapse, and the appearance of a diffuse swelling in the epigastrium, which is tender. Constipation is marked, but usually not absolute. The disease is usually mistaken for acute peritonitis or intestinal obstruction, but the diagnosis may be made at the time of the laparotomy, if not

before, by the presence of fat necroses in the mesentery and omentum and of blood-stained fluid free in the peritoneal cavity.

For the purpose of treatment the hemorrhagic, suppurative, and gangrenous forms may be considered together. It will be advisable, however, to discuss separately the early stage, in which the symptoms of pain, collapse, and vomiting predominate, and the later stage of abscess formation, when there are chills and hectic fever and a tumor in the epigastrium.

The Early Stage.—In the severe cases operation offers the only hope for the patient, for recovery under medical treatment almost never occurs. It has been recommended by some surgeons to wait until the period of collapse is over before operating, on the ground that the mortality of operation during the stage of abscess formation is much less than that of early operation. But this reasoning is fallacious, because the majority of patients die in the early stage, and only the more favorable cases survive till an abscess appears. The collapse being due to the absorption of toxic products from the diseased pancreas, it is logical to operate at once and remove the source of intoxication.

With regard to the method of operation, there can be no question that drainage of the pancreas, preferably with incision of the gland, is the best procedure. The statistics of v. Mikulicz (44) show this very clearly, for the mortality in the cases without drainage of the pancreas was 80 per cent., while in those with drainage it was only 38 per cent. The incision is made in the middle line, the general peritoneal cavity is walled off with gauze, the pancreas exposed, usually by the gastrocolic route; the swollen gland is incised in several places, the fluid is mopped up with gauze, and drainage is provided, either through the original wound, or through a stab wound in the left loin. Hemorrhage may be controlled by packing with gauze. If jaundice is present, it is important to drain the gall-bladder; gall-stones, if present, should be removed if the condition of the patient permits; otherwise they may be left for a later operation. It is essential that the operation should be rapid and that shock from unnecessary handling of the intestines and exploration of the abdominal cavity should be avoided. The operative mortality in the early stage is high, being 61 per cent. in the 59 cases collected by Robson and Cammidge (33); but it must be remembered that the disease is practically always fatal without operation.

A recent publication by Körte (21) is of great interest in this connection, embodying, as it does, the experience gained by him and Brentano in a series of 44 personal cases of acute pancreatitis, 38 of which were operated upon. In four of the latter the operation was undertaken for disease of the bile-passages, and the lesion of the pancreas was not directly treated; all died. Of the remaining 34 cases 18 got well, giving a mortality of 47 per cent. Contrary to the statements of previous writers,

his statistics showed that recoveries were much more frequent in the early stage than later. Thus the mortality in 16 cases operated on in the first two weeks was 31 per cent., in 14 cases in the third and fourth weeks 50 per cent., and in four cases in the fifth to seventh weeks 100 per cent. Körte believes that early operations may prevent necrosis and gangrene, especially if pressure is relieved and drainage facilitated by puncturing the gland in several places with a blunt instrument. The mortality was greatly increased by the presence of necrosis and gangrene, being only 24 per cent. in 21 cases without much necrosis, and 85 per cent. in 13 cases where extensive destruction of the gland had taken place.

In a certain number of cases the disease runs a milder course (the subacute form of Robson and Cammidge), the onset being less severe and collapse absent. Here it is allowable to wait until an abscess has formed; indeed, the patients usually do not come to the hands of the surgeon until suppuration has occurred. Occasionally the inflammation subsides without abscess formation, and in such cases the question of purely medical treatment may be considered. Since, however, relapses are common and may prove fatal, it is probably better to operate even in the absence of abscess formation.

The Late Stage.—Treatment here consists simply of opening the abscess and providing drainage. The incision is made over the most prominent part of the abscess, which will usually be in the middle line, but not infrequently in one or the other loin. The operative results in this stage are decidedly better than in the early stage, Villar's (42) statistics showing a mortality of 38 per cent. in 53 operations. This does not take into account the cases which died later of diabetes or inanition, the result of destructive changes in the pancreas. The chances for recovery are best where there is a single abscess, while cases with multiple abscesses or diffuse suppuration almost always die.

Dietetic and Symptomatic Treatment.—Most cases will require morphia for the pain. Cathartics are not indicated, but the lower bowel should be emptied by enemata. Lavage of the stomach may be employed against the vomiting. The collapse is to be combated by the usual measures. During the early stage it is better not to attempt feeding by mouth, but to resort to rectal feeding. There are two reasons for this: firstly, because the vomiting is often uncontrollable; secondly, because it is desirable to place the pancreas at rest, and this is best done by avoiding the chief stimulant to pancreatic secretion, the presence of food in the duodenum. Later on skimmed milk or buttermilk would be an appropriate form of nourishment. After recovery from the immediate effects of the acute disease, chronic lesions of the pancreas often remain, especially diabetes or insufficiency of the pancreatic secretion; directions for the treatment of these conditions will be found in the chapter on diabetes and in the section on the diet in chronic pancreatitis.

CHRONIC PANCREATITIS

Chronic pancreatitis occurs in the form of a chronic inflammatory process involving chiefly the interstitial tissue. Opie (28) distinguishes two types, the *interlobular,* in which the process involves the bands of connective tissue which run between the lobules of the gland, and the *interacinar,* in which the connective tissue proliferation takes place between the acini. In the interlobular type the islands of Langerhans are not involved until late in the disease, if at all, while in the interacinar form involvement of the islands is apt to occur early, with diabetes as the consequence. The main causes of chronic pancreatitis are infections from the intestine or from the biliary tract by way of the duct of Wirsung; obstruction of the ducts, as by tumors of the head of the pancreas, gall-stones in the duodenal papilla, or pancreatic calculi; alcoholism, syphilis, and arteriosclerosis. Localized pancreatitis may occur by extension from a gastric or duodenal ulcer. The Laennec type of cirrhosis is very frequently accompanied by chronic pancreatitis, both being probably due to a common cause, alcohol. Hemochromatosis is usually associated sooner or later with chronic pancreatitis and diabetes.

The symptoms of chronic pancreatitis vary considerably according to the part of the gland affected. Perhaps the majority of cases show no definite symptoms of pancreatic disease during life, and are first discovered by the pathologist. Clinically the condition is met with most frequently as a complication of infections of the bile-passages, and here the symptoms of pancreatitis will be masked by those of the biliary infection, and the head of the pancreas will be found enlarged and hard at the operation undertaken for gall-stones. In another type which is fairly common there is chronic jaundice due to pressure of the inflamed head of the pancreas on the common bile duct, and here there are attacks of pain in the epigastrium, and sometimes the enlarged gland may be felt as a hard, tender tumor. In such cases the diagnosis from cancer of the pancreas is often difficult, even after the abdomen has been opened. Or, again, the pressure may be exerted on the ducts of Wirsung and Santorini, and exclusion of the pancreatic juice from the intestine take place, resulting in characteristic disturbances of digestion, with the passage of very bulky stools, showing on microscopic examination large numbers of droplets of neutral fat (steatorrhea) and many undigested muscle fibers (creatorrhea). In such cases, if a considerable amount of fat is given in the diet (about 100 grams), there will usually appear in the stools masses of fat visible to the naked eye, a phenomenon which is practically pathognomonic of absence of the pancreatic juice from the intestine.

In many cases, however, there is neither jaundice nor complete obstruction of the pancreatic ducts, and then the clinical diagnosis becomes

very difficult. It is possible in those cases with glycosuria and attacks of colicky pain situated in the epigastrium, and may be made with some reserve in cases of pain, emaciation, and *alimentary* glycosuria. Pancreatitis may be suspected in those cases of alcoholic cirrhosis showing marked glycosuria after the administration of glucose, even in the absence of abdominal pain. Alimentary *levulosuria,* on the other hand, points rather to disease of the liver than of the pancreas. The well known Cammidge reaction is of little or no value in the diagnosis of pancreatic disease.

Treatment of Chronic Pancreatitis.—The first indication in this, as in all disease, is to find the cause, and remove it if possible. Catarrh of the stomach and duodenum should receive careful attention, and the underlying causes, of which alcohol is perhaps the chief, should be eliminated. In all cases of cholelithiasis in which there is reason to suspect involvement of the pancreas the gall-stones should be removed and the gall-bladder drained. This in itself is usually sufficient to bring about a cure of the pancreatitis. Thus, in a case of cholelithiasis seen by the writer, with slight jaundice and small amounts of sugar in the urine, the glycosuria disappeared after the removal of a gall-stone from the cystic duct. Syphilis, although a rare cause of pancreatic disease, should be borne in mind, for specific treatment may prove curative.

Medical Treatment.—In those cases which have not reached the later stage, in which cure by any means is impossible, an attempt should be made to bring the inflammatory process to a standstill by means of rest in bed, heat applied to the epigastrium (either in the shape of poultices or the thermophor), and appropriate diet.

The diet in chronic pancreatitis should be adapted to the circumstances of the individual case, depending on the presence or absence of obstruction of the common bile duct and the pancreatic ducts, and of glycosuria. If all the ducts are open the diet should be simple and easily digested; that is about as much as can be said at present. It remains for future investigations to show which form of diet puts least work upon the pancreas. It is known to be sure that, as a rule, in human beings a diet of fat and protein calls forth the smallest amount of pancreatic juice, and a diet of carbohydrates the largest; but, as the concentration of the pancreatic juice varies considerably under different conditions, it probably would be a mistake to prescribe an anti-diabetic diet.

If the bile duct is obstructed, but the pancreatic ducts are open, as shown by the presence of jaundice with an excess of fatty acid crystals, but no gross fat and few neutral fat droplets in the stools, the diet should be that of simple jaundice, i. e., with fats restricted.

When the stools are bulky and show fat visible to the naked eye, and under the microscope large numbers of neutral fat droplets and undigested muscle fibers, in other words, when the pancreatic juice is absent from

the intestine, the diet should consist largely of milk, eggs, bread, cereals, and carbohydrates, for in such cases casein, egg albumin, and vegetable protein are better digested than is meat, and emulsified fats are probably better digested than are the non-emulsified. Carbohydrates are well digested in the absence of pancreatic juice, and may be given freely unless glycosuria is present.

Opotherapy.—As was stated at the beginning of this chapter, the administration of raw pancreas or of active pancreatic extracts often increases very materially the absorption of fat and of protein in cases where the pancreatic juice is deficient. Quite large doses should be given, from one to three grams (15 to 45 grains) three times a day after meals, with an equal amount of calcium carbonate. If the extract is without effect raw pancreas should be tried, using the whole gland of a pig or sheep, procured fresh each day. Sailer (36) has reported the recovery of two cases of chronic pancreatitis following the use of small doses of pancreatic extract (10 grains, 0.60, three times a day, given in gelatin capsules hardened in formalin to protect them from digestion in the stomach). It is hard to understand how such small doses could be curative. Where jaundice is present the use of desiccated bile or of bile salts is indicated, as the fat-splitting action of the pancreatic juice is greatly enhanced by the presence of bile.

Surgical Treatment of Chronic Pancreatitis.—Surgical treatment is indicated, (1) in all cases which are due to gall-stone disease; (2) in the absence of gall-stones in those cases where jaundice exists and medical treatment is without avail, and (3) where there are repeated attacks of violent pain in the epigastrium.

In the cases associated with cholelithiasis removal of the gall-stones with drainage of the biliary passages for a few weeks usually results in a cure. In advanced cases cholecystenterostomy as advocated by Robson (33), or cholecystgastrostomy (Kehr, 16), is preferable, as it affords permanent drainage of the bile passages. These latter operations are also indicated in cases of pancreatitis with jaundice due to compression of the common bile duct by the head of the pancreas. The anastomosis should be made, if possible, between the gall-bladder and the duodenum, or the upper part of the jejunum. Anastomosis with the transverse colon is undesirable for two reasons: firstly, because the bile is not available in the small intestine for digestive purposes; secondly, on account of the danger of infection of the bile passages from the colon.

Drainage of the bile passages acts favorably on the inflamed pancreas in two ways: (1) it removes the source of bacterial infection, and (2) it relieves tension on the head of the pancreas by the dilated common bile duct. Mechanical obstruction to the outflow of the pancreatic juice, a potent cause of pancreatitis, may be removed where there is a stone impacted in the duodenal papilla or in the pancreatic portion of the common

duct, or in the duct of Wirsung. Medical treatment should not be persisted in longer than six weeks after the appearance of jaundice, on account of the likelihood of the development of the hemorrhagic diathesis.

Where jaundice is intense and of long duration the danger of hemorrhage at the operation, or afterward, may be best averted by the transfusion of blood shortly before the laparotomy. The blood of the donor and of the patient should be tested previously, to make sure that hemolysis does not occur. In case transfusion is not available, the next best measure is the subcutaneous injection of 30 to 50 c. c. of human serum, or, failing this, of rabbit serum.

The administration of calcium salts, which has been so warmly advocated by Robson and others, has probably little effect as a prophylactic against hemorrhage. They may be used if nothing better is at hand, in the form of calcium lactate, 60 grains (4.0), in divided doses, given the day before operation, and by enema afterwards. Hemorrhage from the wound after operation may be controlled by packing combined with the local use of adrenalin.

In a few instances operation has been undertaken in the absence of jaundice for the relief of attacks of severe epigastric pain; in the case of Martina (24) partial decapsulation of the pancreas, which was encased in a mass of dense fibrous tissue, restored the patient to health.

The presence of a moderate amount of glycosuria is not a contraindication to operation, but rather the contrary, for in cases not too far advanced a cure of the pancreatitis may be expected, and with it a disappearance of the sugar from the urine. In other cases the patient is apparently restored to health, but the pancreas has been too much damaged for restitution to the normal, and the diabetic condition persists. It goes without saying that cases of grave diabetes should not be operated upon, except as a last resort.

The results of surgery in the hands of skilled operators have been most encouraging. Thus Robson (33) states that his operative mortality in 1904 was 3.9 per cent. Of 55 patients operated on for chronic pancreatitis with gall-stones, 3 died soon after operation; all were in very poor condition at the time of operation; of the 52 who recovered, 48 were living and well when last heard from, one 9½ years after operation has diabetes, one died of cirrhosis of the liver, and two others of diseases not related to the pancreas. Out of 46 cases of pancreatitis without gall-stones, one died after operation, six did not reply to letters, the others were all well, with the exception of one patient, who developed glycosuria, one who "shows signs of permanent damage to the pancreas by the urinary (i. e., Cammidge) test, and one who has anemia suggestive of the pernicious type." Since then Robson's mortality has sunk to 2 per cent., a truly brilliant record. Kehr's (16) results are not so striking, perhaps because his material is different. Of five cases of pancreatitis without gall-stones, all were cured, while in 54 cases associated with gall-stones

the mortality was 17 per cent. He prefers anastomosis of the gall-bladder with the stomach to that with the duodenum, for technical reasons; apparently the entrance of the bile into the stomach has not proved injurious to the digestion in his patients. Where the stone is in the common duct he prefers to excise the gall-bladder and drain the hepatic duct, while Robson retains the gall-bladder if possible, on the chance that cholecystenterostomy may be required later.

HEMOCHROMATOSIS

This remarkable condition is characterized by the deposition of pigment in the skin, liver, pancreas, and lymph nodes, and by the occurrence of cirrhotic changes in the liver and pancreas. The latter frequently lead to diabetes. Since the cause is unknown, the treatment must be purely empirical. In the later stages, when glycosuria is present, the treatment is that of diabetes. The disease is apparently always fatal sooner or later.

PANCREATIC INFANTILISM

Byrom Bramwell (5) has described a case of stunted growth with diarrhea and fatty stools, in which the administration of pancreatic extract over a long period was accompanied by a very rapid increase in weight and height, and the development of the sexual organs, which were previously in an infantile state. He therefore ascribed the infantile condition to defective pancreatic secretion. The condition must be quite rare, for no more cases have been reported. Herter's (15) cases of stunted growth with diarrhea do not appear to come under this category.

TUBERCULOSIS OF THE PANCREAS

Tuberculosis of the pancreas is a rare condition. It is always secondary to tuberculous disease elsewhere in the body. It occurs in two forms: as miliary tubercles and as large caseating masses. The latter probably originate in the lymphoid tissue of the gland. Very rarely the tuberculous mass may be large enough to palpate, as in the case of Sendler (37), who successfully removed a tuberculous lymph node the size of a walnut from the head of the pancreas.

SYPHILIS OF THE PANCREAS

Syphilis of the pancreas is frequently found at autopsy in cases of congenital syphilis, either in the form of diffuse infiltration or of gummata, but does not give rise to special symptoms. In the adult pancreatic syphilis is rare, and occurs in the form of gummata, and of syphilitic in-

duration similar to the syphilitic cirrhosis of the liver, with which it is almost always associated. It may cause a palpable tumor in the epigastrium, and by compression of the pancreatic ducts and common bile duct give rise to characteristic changes in the stools and jaundice, as in Trinkler's case (41); or the islands of Langerhans may be involved, with diabetes as the result. According to Opie (28) syphilis rarely causes the ordinary types of chronic interstitial pancreatitis.

Cure or improvement after antisyphilitic treatment may be expected in the early stages. Moffitt (26) has seen two cases of diabetes in syphilitics cured by specific treatment, so that it will be well to give diabetics in whom a clear syphilitic history or a positive Wassermann reaction is obtained the benefit of a course of mercury and potassium iodid, or of salvarsan.

PANCREATIC CALCULI

Stones of the pancreas are exceedingly rare. They are situated in the ducts, and are apt to give rise to attacks of epigastric colic, and to chronic pancreatitis, frequently accompanied by diabetes. Medical treatment can be only palliative. In recent years a number of operations for the removal of pancreatic calculi have been recorded by Gould (12), Allen (1), Dalziel (7), Moynihan (27), Robson (32), Link (23), Staehlin and Roeber (38), Ruth (35), and v. Friedländer (43). The operative mortality was 22 per cent. For the operative methods the reader is referred to Robson and Cammidge, page 485. Link found the ducts filled with minute calculi, too numerous for complete removal, and performed the novel operation of pancreostomy, with the formation of a permanent pancreatic fistula. The patient obtained relief from the attacks of pain and gained 20 pounds in weight.

PANCREATIC CYSTS

True cysts of the pancreas have an epithelial lining, and are either retention cysts, due to obstruction to the outflow of pancreatic secretion, or cystic tumors, proliferating cystadenomata. The true cysts are of rare occurrence, compared with the frequency of pseudocysts, which have no epithelial lining and are probably due to the corrosive action of the pancreatic juice.

Pseudocysts constitute the great majority of pancreatic cysts, and are due in about one-third of the cases to trauma, and in the other two-thirds to inflammatory conditions in the pancreas. They are situated usually either between the anterior surface of the gland and the peritoneum, or in the omental bursa. One or more of the ferments of the pancreas is usually, but not always, present in the contents.

Echinococcus cysts of the pancreas have been met with in a few instances, and have been cured by incision and drainage.

Treatment.—The tapping of pancreatic cysts has fallen into deserved disuse on account of its failure to cure and its dangers. The two methods in vogue now are: (1) extirpation, and (2) incision and drainage.

Extirpation.—Complete extirpation is seldom possible, owing to the frequency of adhesions. It is necessary for cure only in the cases of true cysts, where the epithelial lining continues to secrete after incision and thus prevents the obliteration of the cyst by granulation tissue. According to Goebel (11), extirpation should not be attempted except under favorable circumstances, as where the cyst has a pedicle or is situated in the tail of a movable pancreas, for the mortality is high, 10.7 per cent. for complete extirpation, 55.5 per cent. for partial extirpation, i. e., where the operation had to be left uncompleted on account of technical difficulties.

Incision and Drainage.—This operation is usually done in one stage. The incision is made over the most prominent part of the cyst, usually in front, rarely in the loin. The cyst is exposed by incision of its peritoneal coverings, and the contents evacuated through a large trocar, after protection of the abdominal cavity by packing. The opening is then enlarged and the edges of the cyst are sutured to the parietal peritoneum. The insertion of a large drainage tube concludes the operation. The skin may be protected from the corrosive action of the pancreatic secretion by the application of stearate of zinc, or antiseptic ointments.

The results after incision and drainage are good, as a rule. Goebel (11) states that a cure resulted in 96.4 per cent. of 190 cases collected from the literature, but this figure is probably far too high, as the later history of many of the cases is unknown. Robson and Cammidge give the operative mortality as 11.6 per cent. The cyst cavity gradually closes up by the collapse of the walls and the formation of granulation tissue, and after about a month only a small fistula remains, which usually closes entirely later. Recurrence of the cyst is rare, except in the case of true cysts. The injection of irritating fluids into fistulæ to promote closure may be dangerous, as in a case of Lazarus (22), in which death resulted from the injection of a silver nitrate solution. Persistent fistulæ are often to be healed by the use of anti-diabetic diet (see section on Pancreatic Fistula), or by extirpation.

TUMORS OF THE PANCREAS

The most common new growth of the pancreas is carcinoma, which occurs in three forms: as a primary tumor, by extension from neighboring organs, particularly the stomach, and as metastases from carcinoma elsewhere in the body. The metastases rarely give rise to symptoms.

Other tumors of the pancreas, such as sarcoma, fibroma, and adenoma, are great rarities.

In carcinoma it is almost always the head of the gland which is affected; the tumor is seldom palpable, owing to its small size and deep-seated position. Almost invariably in cancer of the head of the gland there is compression of the pancreatic ducts, which gives rise to the characteristic symptom of bulky stools containing an excess of neutral fat droplets and undigested muscle fibers; often there are masses of fat visible to the naked eye. Jaundice is almost always present, and is accompanied by a dilated gall-bladder, which usually can be palpated, in contradistinction to obstruction of the common duct by stone. The biliary obstruction in cancer is usually complete, so that no bile-pigment can be demonstrated in the stools. The combination of "pancreatic" stools with jaundice and a palpable gall-bladder is almost pathognomonic of cancer, but a few cases of chronic pancreatitis with these signs have been reported. Cachexia is usually very rapid, more so than in chronic pancreatitis, but this rule also has its exceptions; in fact, there are cases where only an exploratory laparotomy will decide the diagnosis. Carcinoma of the body and tail of the pancreas cannot be diagnosticated unless a palpable tumor is present.

Surgical Treatment of Tumors of the Pancreas.—Cancers are very seldom suitable for extirpation, on account of the technical difficulties of removing the head of the pancreas, which difficulties are often enhanced by the presence of adhesions and the involvement of lymph nodes and other adjacent structures. Thus Kehr (16), in an experience of 71 cases, did not meet with a single one in which removal was possible. In a few instances carcinomata have been successfully removed, but death has taken place within a few months from recurrence of the growth.

Exploratory laparotomy is usually justifiable because of the impossibility of distinguishing with absolute certainty by other means between chronic pancreatitis and cancer. If on exploration there are metastases or the diagnosis seems certain, it is probably best to close the abdomen without attempting more. The operation of cholecystenterostomy or cholecystgastrostomy has been often performed, for the sake of relieving the jaundice. On account of the very high mortality it has been given up by most surgeons; Kehr, however, advocates it, having operated on ten such patients, who lived 2 years in comparative comfort after the formation of an anastomosis between the gall-bladder and the stomach. He does not state, however, how many of his patients died as the immediate result of the operation.

Benign tumors situated in the body or tail of the pancreas have been removed successfully in a few instances, such as the case reported by Finney (9), who has collected the literature on the subject. These cases are important as showing that operations on the pancreas can be performed without much danger, providing that the peritoneum is protected by pack-

ing from the action of the pancreatic juice, and adequate drainage is established. Thus Finney was able to resect most of the pancreas along with the tumor, and suture the head and the tail of the gland together.

Medical Treatment of Carcinoma of the Pancreas.—The diet should be the same as that outlined under chronic pancreatitis (q. v.). Pancreatic preparations are indicated if there is deficiency of the pancreatic juice, and fel bovis or bile salts if jaundice is present. Morphia may be required for the pain, and warm bran baths with the addition of bicarbonate of soda (6 ounces to 30 gallons of water) for the itching.

INJURIES TO THE PANCREAS

Injuries to the pancreas may be considered under three headings, viz.: (1) Lacerated wounds due to contusions of the abdomen, the so-called subcutaneous rupture of the pancreas; (2) bullet wounds, and (3) penetrating wounds.

Rupture of the Pancreas.—The pancreas is deeply situated and admirably protected from external violence. It is sometimes ruptured, however, as a result of direct force applied to the epigastrium or adjacent parts; such cases have been reported after the following accidents: being caught between two cars, being run over, kicked by a horse, or struck in the epigastrium by a blunt object. Most often other abdominal organs are injured as well, especially the liver, spleen, or kidneys. In a few cases isolated rupture of the pancreas occurs, and is the cause of the fatal outcome, either by hemorrhage or from the effects of the extravasated pancreatic secretion. More often trauma is the cause of a slight bruising of the pancreas, with leakage of blood and pancreatic juice into the omental bursa, and the subsequent formation of a pseudocyst.

The diagnosis of pancreatic rupture is extremely difficult. Usually the symptoms point merely to some grave intraabdominal injury. Epigastric muscular spasm and tenderness is a very early symptom, followed within a few hours by pain, vomiting, increasing pallor, and collapse. The temperature is normal at first, but may be elevated later. The presence of a tumor in the epigastrium may lead to the right diagnosis, as in the case of Blecher (4). Sugar has been observed in the urine in three cases only, after the operation. After the abdomen is opened the oozing of blood from the omental bursa, the presence of a tumor in the region of the pancreas or of fat necrosis should lead to the correct diagnosis, which is very important, as the life of the patient depends upon it.

Treatment.—Rupture of the pancreas, if extensive, is probably always fatal unless treated surgically. Garre (10) in 1905 published the first case cured by operation; Heineke (13), two years later, was able to collect 19 cases of isolated rupture of the pancreas, and since then cases

have been reported by Hermann (14), Brewer (6), Picqué (31), Dreifuss (8), and Rosenbach (34), making a total of 24 cases. Five cases were not operated upon; all died. Of the 19 cases undergoing operation 13 recovered. Six died, but in three of these the rupture of the pancreas was not discovered at the operation, two came late to operation in a desperate condition, and one, the case of Miculicz, reported by Stern (39), recovered from the pancreatic condition, to die of pneumonia five months later. *Thus every case with early operation and proper treatment of the pancreas recovered.*

Method of Operation.—After the removal of the extravasated blood and the control of hemorrhage, by packing if necessary, the condition of the gland is examined. If the edges of the tear are clean-cut, suture is indicated; otherwise packing. In suturing the duct should be avoided. Drainage must be provided in any case, as even after the most careful suture there is always leakage of pancreatic secretion, the escape of which must be provided for. A pancreatic fistula always forms after the operation.

Bullet Wounds of the Pancreas.—The pancreas is sometimes involved in bullet wounds of the abdomen, almost never alone. Such wounds are to be treated in the same way as rupture of the pancreas. The results have been encouraging, nine patients recovering out of a total of 15 operated upon, according to Robson and Cammidge (33), and, in three of those dying, the wound of the pancreas was not discovered at the operation.

Penetrating Wounds of the Pancreas.—The pancreas is occasionally wounded by thrusts with a knife or bayonet. Almost invariably a portion of the pancreas has protruded from the abdominal wound, and the general peritoneal cavity has not been exposed to the action of the pancreatic juice. This is probably the reason that almost all the reported cases recovered. In some the exposed portion of the pancreas has been resected, in others it has been cleansed and returned to the abdominal cavity. Drainage is necessary in all cases.

PANCREATIC FISTULA

Fistula is a not infrequent sequel of operations on the pancreas of all sorts, particularly after those for cyst or injury. The secretion from the sinus usually contains the pancreatic ferments, and is extremely irritating to the skin. Sometimes the fistula becomes temporarily obstructed, and then there is abdominal colic from the retention of the pancreatic fluid.

Treatment.—Until recently fistula of the pancreas was treated only on general surgical principles, often without success. The injection of

irritating substances, such as tincture of iodin and silver nitrate, may promote closure, but has not proved without danger. Sometimes a secondary operation has been performed and the fistulous tract dissected out, and in a few instances the fistula has been transplanted into the stomach (Michon, 25), or into the gall-bladder, and the gall-bladder connected with the stomach (Kehr, 17).

Such measures, however, have become unnecessary for most cases since the valuable discovery by Wohlgemuth (45) that the pancreatic secretion in man can be influenced to a large extent by diet and by drugs. This observer, experimenting on a case of pancreatic fistula, got very similar results to those obtained by Pawlow in dogs: the secretion was greatest on a diet of carbohydrates, less on a protein diet, and ceased altogether when fats alone were given. Hydrochloric acid increased and sodium bicarbonate diminished the secretion. The use of a strict antidiabetic diet, with sodium bicarbonate in drachm doses both before and after each meal, resulted in the prompt and permanent closure of a fistula of long duration. Since then this treatment has been employed with striking success in a number of cases; fistulæ that had persisted for years were closed in a few days or weeks. In a few instances, however, the treatment has failed, viz., in those of Körte (20) (4 cases), Kempf (18), Bickel (3), and Michon (25). The diet should be kept up for a while after the fistula has closed, or else it may break out again. If no result is obtained in six weeks it is useless to continue the treatment longer, and surgical measures must be resorted to.

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CHAPTER IX

DISEASES OF THE PERITONEUM

J. T. Halsey

ACUTE LOCALIZED PERITONITIS

Inasmuch as a localized peritonitis is almost always a secondary condition dependent on a primary diseased condition in a neighboring organ, the treatment of localized peritonitis is necessarily influenced by a consideration of the underlying cause. Therefore, a discussion of the treatment must be preceded by a brief consideration of the etiology.

Appendicitis and disease of the uterus and its adnexa are, by all means, the most frequent and most important causes of localized peritonitis. Ulcers of the stomach and in the large or small intestine, gall bladder disease, inflammatory processes in or about the kidney, bladder, or prostate, abscess of the liver, pancreatitis, and intestinal obstruction are other common intra-abdominal causes, while disease of the vertebra or of the bones of the pelvic girdle and pleurisy may, at times, be the starting points of peritonitis. External violence, with or without rupture of an abdominal organ, may set up localized peritonitis. As a rule, peritonitis complicating acute infectious diseases is not localized, although at the start it may be so.

Prophylaxis

The prophylaxis of localized peritonitis is of extreme importance and consists in the early recognition of the presence of any of the above-mentioned underlying conditions and the prompt institution of the correct treatment (often surgical), which has been discussed in the appropriate sections of this work. Often, however, the underlying condition gives no sufficient sign of its existence until after it has given rise to a localized peritonitis and, therefore, in such cases prophylactic measures cannot be observed.

Treatment

The chief aim of the medical attendant in a case of localized peritonitis should be the prevention of the spread of the inflammation into the general abdominal cavity. Much less important, though often not so regarded by the patient or the physician, is the relief of the pain and other symptoms. It cannot be too strongly emphasized that a purely symptomatic treatment, carried out before any thorough attempt has been made to discover the underlying cause, is likely to be responsible for the evolution of a localized into a diffuse septic peritonitis, with its attendant grave prognosis. It is a rule to which there are few exceptions that morphin should be used not at all or very cautiously in the presence of localized peritonitis before the underlying cause has been carefully sought for and a diagnosis of reasonable probability reached.

Surgical Treatment.—The question of treatment, then, may be considered in the light of such diagnosis, and especially the question as to whether immediate surgical intervention is indicated or not. This will depend chiefly on the primary condition and cannot be considered here, as these conditions are so numerous, and as full discussions of the various indications are to be found elsewhere in this work. If there is evidence that the peritonitis is progressive, operative interference is usually indicated. A localization of the peritonitis is, however, not a contraindication to operation, but this decision must depend on the underlying cause.

Medical Treatment.—If a decision against operation be reached, the so-called medical treatment should be instituted.

Rest.—An acute localized peritonitis demands that the patient remain absolutely at rest and in bed. All shifting and turning should be avoided except that indispensable to the proper examination and care of the patient. Bed pan and urine bottle should be used, and the patient should not be allowed to raise himself to take food or drink, should such be allowed.

Relief of Pain.—The rest alone, with avoidance of any pressure on the painful areas, is at times sufficient to give marked relief, but usually we find it necessary to supplement this by other measures. The best of these is the continuous application of cold over the inflamed area by the use of ice bladders. In order to secure the best results from this procedure the application must be continuous. Attention must be paid here to three points. The ice bags must not be so heavy as to cause pain or to oppress the patient, must be promptly refilled as soon as the ice is melted, and so applied and secured that they remain in the right place. This last appears so self-evident that it may appear superfluous to mention it, but frequent experience has shown that nurses, physicians, and patients are too often neglectful of this precaution. We cannot maintain with cer-

tainty that the external application of cold does more than relieve pain, but clinical experience gives some ground for belief that cold, if continuously applied, checks peristalsis and, in this or some other manner, favors a limitation of inflammation.[1]

Penzoldt suggests that, though the ice bag may have no direct influence on the inflammatory process, it renders valuable service by helping to keep the patient quiet. It cannot be denied that there are patients who, even after a fair trial of sufficient duration, complain bitterly of the ice bags, claiming that they not only do not diminish the pain, but that they increase it, or add to the general discomfort. In view of our uncertainty as to the real value of cold in these conditions, it is not advisable to persist in its use in such cases. Hot applications may then be substituted.

In cases where the peritonitis is due to a lesion in the appendix or elsewhere in the alimentary canal, the author is averse to the use of heat externally, for there is good ground to believe that it stimulates peristalsis, which is not desirable in such cases.

It is often necessary to supplement the action of the local applications by pain-relieving drugs. Acetylsalicylic acid (aspirin) in doses of gm. 0.5 to 0.7 (gr. vii-x), or similar analgesic drugs, often act here most satisfactorily. Opium or morphin, however, will often be indicated in spite of various disadvantages attendant on their use. From them we get most prompt and grateful relief of pain, and often, too, their power of checking peristalsis is of distinct benefit. On the other hand, the relief of pain may give a false sense of security to patient and physician, and lead to a failure to recognize unfavorable developments in the case, until valuable time may have been lost. Morphin should, therefore, be used cautiously, in as small amounts as will secure the desired relief, and the medical attendant should be on his guard against being misled by its masking of the symptoms. The decision for or against its use and as to the dosage must be made in the individual case only after a careful weighing of these considerations, and it never should be given in amounts sufficient to stupefy the patient or to cause paresis of the bowel.

Diet.—In local peritonitis, due to appendicitis or other conditions in the alimentary canal, there is a general acceptance of Ochsner's view that neither food nor drink should be given by mouth, and that the stomach should be emptied by lavage. Any food or drink sets up peristalsis, and in these conditions we endeavor to avoid this. Thirst may be

[1] Bass recently has put forth some evidence that local reduction of temperature may have most important and favorable action on the processes of immunity and resistance to infections. From Schultze's observations we know that cold externally will cause a local diminution of temperature in the abdominal cavity. It may be that in this way external cold produces in these cases some of its apparent results.

controlled by sucking of ice and by rectal administration of small amounts of saline, best given in the form of the Murphy drip.

In cases secondary to other primary causes such complete abstinence is not so urgently indicated, but the author believes that these cases will not be harmed and may be much benefited by following out Ochsner's plan. These patients are in no danger of starvation and will, at most, suffer only inconvenience by abstinence of several hours', or days', duration.

When the acute symptoms subside, easily digestible liquids and soft solids may be given in moderate amounts and, if well borne, a gradual return be made to the ordinary diet. It is best, as a rule, not to commence with oral administration of food or drink until the bowels have moved. If the need for food be pressing, a certain amount of food can be absorbed from the bowel. Grape sugar in 5 per cent. solution is usually readily absorbed; 1,000 c. c. of such a solution contains about as much caloric energy as a glass of milk.

Bowels.—There is much diversity of opinion among physicians and surgeons as to the use of cathartics. Apparently modern opinion is chiefly in accord with Ochsner in his strong condemnation of catharsis in any case of peritonitis where the appendix or other portion of the alimentary canal is involved. Until the condition has run its acute course, or has been relieved by operation, most authorities believe that catharsis is likely to have disastrous results, and they unite in recommending that the bowels be left undisturbed, or that, as occasion arises, they be cautiously moved by small enemata.

Even in peritonitis dependent on other causes the author believes this the preferable course, although many believe, with the late Lawson Tait, that free catharsis by means of the purgative salts exerts a markedly beneficial effect on the course of the peritonitis resulting from disease of the female genitalia. It may well be that in such cases the emptying of the bowel of its stagnating and presumably poisonous contents more than counterbalances any harm which may be done in the way of spreading the infection as a result of the active peristalsis.

Vomiting.—Vomiting, which not infrequently is a symptom in localized peritonitis, deserves our especial consideration as being often of grave significance, as well as being very distressing and harmful. Abstention from food and drink and lavage, repeated, if necessary, at intervals, are the best methods of treatment. Ice to the epigastrium and throat often aids, and morphin also will usually control it, at least temporarily. Persistent vomiting is a grave sign and, as a rule, is an indication for prompt surgical intervention.

General Measures.—Abundance of fresh air and a cheerful but quiet environment should, of course, be provided. The temperature and circulation rarely call for any treatment. When they do so, the indications

are similar to those in general peritonitis, to the section on which the reader is referred.

Summary.—The cause of the local peritonitis should be determined and if this calls for surgical treatment this should promptly be instituted. Non-surgical treatment should always be conducted with the probable underlying cause in mind, with a careful avoidance of any procedures which could aggravate the primary condition. It consists, briefly, in absolute rest in bed, the continuous application of ice bags over the inflamed area, and the cautious use of such drugs as acetylsalicylic acid or morphin in doses just sufficient to ease the pain. In most cases no food or drink should be given by mouth, but fluid may, with advantage, be given by rectum. As a rule, catharsis is to be avoided, the bowels being moved by enemata. Vomiting is to be controlled by lavage, complete withholding of everything by mouth, and by the use of morphin.

ACUTE DIFFUSE PERITONITIS

(*Progressive Septic Peritonitis. Acute General Peritonitis.*)

Twenty years ago over 90 per cent. of these cases died, whether treated conservatively or surgically. To-day over 90 per cent. should and do recover when the condition is recognized with reasonable promptness and immediately operated upon. (Bevan, Deaver,[1] Murphy,[2] et al.) Such results as these compel the conclusion that acute diffuse peritonitis is a surgical disease to be treated surgically. Only when consent for operation is refused, or where the underlying cause or the present condition of the patient is such as to indicate the uselessness of operative procedures, should the medical attendant content himself with non-surgical treatment. Absolute lack of the most rudimentary surgical facilities may, under exceptional conditions, also at times compel the physician to abstain from operation.

In addition to the etiological factors which have been enumerated in the preceding section, a general peritonitis may arise in the course of various diseases. Among these may be mentioned nephritis in its terminal stages, scarlatina, erysipelas, septicemia, and pneumonia. The pneumococcus may at times, especially in children, cause a primary infection of the peritoneum.

[1] Deaver reports a series of 105 cases of diffuse peritonitis following appendicitis with 2 deaths, and another series of 74 cases with 6 deaths.

[2] Murphy reports 49 consecutive cases of diffuse septic peritonitis of various origin with only 2 deaths.

Prophylaxis

From a consideration of the etiology one must conclude that diffuse peritonitis is usually a preventable condition. Its prophylaxis consists in the prompt recognition of the conditions which may cause a peritonitis, and the institution of the correct treatment, which most often means prompt operation.

The author believes that most physicians and surgeons would concur in the estimate that, in an overwhelmingly large proportion of the cases of diffuse or general peritonitis which they see, early diagnosis and prompt and correct treatment would have prevented its development. The routine practice of treating cases of acute abdominal pain by a hypodermic of morphin and the administration of a purge is unfortunately apparently deeply rooted not only in the minds of the public at large, but also in those of a too large proportion of the medical profession. This procedure is undoubtedly chiefly responsible for a very large percentage of cases of general peritonitis and cannot be too strongly condemned. Fortunately the views of Ochsner and others as to the harmfulness of such treatment are now accepted by most surgeons and many physicians.

For further discussion of the prophylaxis of this condition the reader is referred to the article on the treatment of localized peritonitis and to Ochsner's publications.

Treatment

Surgical Indications.—Once the diffuse peritonitis has developed, laparotomy should be promptly performed, and the necessary surgical work done as quickly as possible. The prognosis is so dependent on the time when the case is operated upon that the medical attendant should not hesitate to insist on laparotomy as soon as there is reasonable ground for suspecting the development of a diffuse peritonitis. Operation is contraindicated in cases where the condition responsible for the peritonitis is of a character to make intervention hopeless. Such are, for example, cases in the terminal stage of nephritis, cases with severe diabetes, or cases of peritonitis caused by the rupture of an undoubtedly carcinomatous ulcer.

There is also a difference of opinion among the best authorities as to the advisability of operation in certain cases where the general peritonitis is of several days' duration and the patient's general condition extremely bad. It is most difficult to dogmatize here as to whether to operate or not. Undoubtedly there are certain of these patients in whom a laparotomy is likely to hasten death, or to destroy any chance of recovery which may remain. Further, we have all probably seen cases of general peritonitis go on to recovery after the surgeon had refused to operate on

account of his conviction that the general condition was so bad that the patient could not rally after the laparotomy. Among those who advise waiting under such conditions are such leaders in surgery as Ochsner and Deaver, especially the former. Murphy and others of equal ability would appear to often favor operation in a certain proportion of those cases which others would consider unsuitable. In these apparently desperate cases the question for or against operation must be carefully weighed from all points of view.

The author must confess to an inability to recognize which of these cases will be given a better chance by failure to operate. His own position is that surgical measures give the majority of these cases their best chance to recover, and he, therefore, would advise operation in all such cases in whom the condition holds out a reasonable probability that they can survive a simple incision and drainage, which may be done under local or nitrous oxid anesthesia. The relief of tension thus obtained will, he believes, more than counterbalance the harm done by the very small amount of surgical shock produced.

At times benefit is derived in such cases from the opening of a loop of gut and the insertion and retention of an umbrella catheter in this opening, which affords a channel through which flatus and stagnating feces may be passed and fluid or food be given (Parham).

Medical Treatment.—In those cases where, for one reason or another, a decision against operation is reached the so-called medical treatment must be carried out. Our indications here are mainly three: First, the relief of pain and distress; second, supporting the patient until such time as the disease may have run its course; and, third, an endeavor to diminish the toxemia which threatens to overwhelm the patient. It is, however, far easier to state these indications than it is to successfully fulfill them.

Rest.—Absolute rest as favoring the conservation of strength and the relief of pain is a generally accepted measure. The Fowler position has been of such value in the treatment of these cases after operation that it should be the one adopted. Whether it is of equal value in cases treated medically is questionable. However, in this position these patients are more comfortable. It mechanically facilitates the respiration, the passage of flatus or feces, and the oral administration of food, drink, or medicine. In addition, it is probable that, as a result of allowing the greater portion of the exudate to gravitate into the pelvis and away from the diaphragm, the absorption of poisons from the peritoneal cavity is retarded. All unnecessary turning or moving of the patient is most rigorously to be avoided.

Opium and Morphin.—Opium or morphin has always been our main reliance in these cases, and should be given regularly in amounts sufficient to relieve the patient's pain and distress, if this can be done without producing too great stupefaction and depression. By relief of pain and

vomiting and securing quiet and rest this drug, more than any other measure, conserves the patient's strength. Its quieting of peristalsis is also, within certain limits, probably a valuable action. Lastly, in a disease of so nearly hopeless a nature, the relief of useless distress and suffering is by no means to be despised. On the other hand, their tendency to cause or aggravate paresis of the intestine is a most undesirable action of these drugs, as is also their power of later causing nausea and vomiting, an action too often forgotten.

Austin Flint advocated the use of opium regularly, persistently, and in large dosage (gm. 0.03, gr. ss, every three or four hours or more if necessary). He cites one patient who recovered after taking over 900 grains of opium in one week. These large doses have fallen into disrepute of late years, but recently Stockton has urged the value of this method of treatment in cases not treated surgically.

The administration of opium in peritonitis was recommended by a number of observers: Watson, Graves, Stokes, and others. It remained for Alonzo Clark to formulate a method for the application of opium or morphin, which has since been called Clark's method or treatment. In 1851 and 1852 this great clinical master treated the cases of puerperal fever in the lying-in wards of the old Bellevue Hospital of New York. As Alonzo Clark was in the habit of saying: a number of cases treated by him recovered, while without it practically all died. The method was originally employed in all kinds of peritonitis, notably by those who had come under the direct or indirect influence of Alonzo Clark's teachings. The puerperal cases were published, especially considered and referred to, because of Alonzo Clark's pathological views in connection with puerperal fever.

Opium or morphin was given in the following way. The first thing to be accomplished is to relieve the pain; for an adult from one-half to one grain of morphin, or its equivalent of opium, is given for this purpose. If the patient is not relieved in two or three hours another dose may be given, smaller than the original one, provided the pain has been relieved. The pulse and relief of pain is the index of the dosage; the drug is ordinarily repeated every two to three hours. The production of undue narcotism is prevented by observing the pupils, the degree of somnolence, and the number of respirations. Alonzo Clark considered ten respirations per minute as much reduction as was safe, although he always told us of one case in which the number of respirations was reduced to six and the patient recovered. As soon as respiration becomes too slow the remedy must be reduced in dose and it must be administered at longer intervals. One of Clark's cases took 1,018 grains of opium in seven days—in the second twenty-four hours 472 grains were administered, the patient recovering. The bowels are not interfered with; they are allowed to empty themselves spontaneously, which may not occur for a

week or more, the utmost which should be done is the administration of a simple enema.

[In the early days of my experience I gave this treatment in every case of peritonitis. As the etiology of the disease was worked out it became less and less necessary to employ it. While the employment of opium in peritonitis was dropped without rhyme or reason, very large doses (Clark's method) do not seem to be necessary.—Editor.]

Diet.—These patients do not die of starvation. Vomiting is a very constant and distressing symptom and is only aggravated by attempts to give food or drink. Further, food is an exciter of peristalsis, which is one thing which, in the acute stages, we wish to avoid. Early in the case, therefore, nothing should be given by mouth. Later, after the more acute symptoms have subsided, liquid and semi-solid food may be given and, if well borne, may be continued. If, however, vomiting persists or is caused by feeding, all oral administration should be at once discontinued. The most pressing need is that for fluid, which can be best given in the form of a Murphy drip of hot saline to which dextrose in 5 per cent. strength may be added if there be an urgent indication for nourishment. This has a certain food value, is usually well absorbed, and is much better borne than most of the nutrient enemata.

Bowels.—Almost invariably a patient with general peritonitis becomes most absolutely constipated and paresis of bowel and meteorism develop. This is a grave complication and one we find most difficult to combat. If, by the cautious use of enemata and the passage of the rectal tube, we are able to mitigate this condition, we are indeed fortunate, but too often these measures are ineffectual. Should purgatives be used to overcome this condition or not? There is to be found one of the most difficult of all points for us to decide. In the unoperated cases we are often in doubt as to what was the primary condition. If the case be one arising from appendicitis, obstruction, or perforation, and one which has not been operated upon, purgation can only aggravate the condition. If, however, the general peritonitis be of other causation, the objections to catharsis are not so strong. In these latter cases the advantages of free purgation overbalance the probable disadvantages. The ordinary cathartics frequently are ineffectual. Salines and calomel are, as a rule, the ones to be employed. In this connection it seems well to warn against the use of magnesium sulphate. Experience has taught us that in general peritonitis any cathartic may fail to produce an emptying of the bowel, and Boos has shown the real danger of severe or fatal poisoning which may result from its absorption under these conditions. Sodium sulphate is equally efficacious and if absorbed is not poisonous. Eserin sulphate in doses of 1 to 1.5 mg. (gr. 1-60-1-40) hypodermically is frequently efficacious where other cathartics have failed. Turpentine stupes and other

hot applications may be tried to relieve the meteorism, but little is to be hoped from their use.

Vomiting.—See article on Localized Peritonitis.

Temperature.—The temperature rarely calls for treatment. When it is high and continuous we must content ourselves with such simple measures as sponging with cool water or alcohol. This will rarely have a marked effect on the temperature but will often add markedly to the patient's comfort. The antipyretic drugs should not be used for this indication.

Toxemia.—Toxemia, with its resulting depression of the circulation and respiration and of the central nervous system, is the cause of death in peritonitis, and most urgently demands treatment. Evacuation of the bowels, if this can be accomplished, removes one of the sources of the toxic materials. The Murphy drip is probably the most efficacious means we have of lessening the harmful results of the various poisons with which we have to deal. It should be started early in these cases and be almost constantly used up to the termination of the case. A discussion as to the manner in which it produces its favorable effects would lead us too far, but experience has demonstrated its great value. At times intravenous administration of saline or hypodermoclysis will supplement or take the place of the Murphy drip. Caffein, strychnin, digitalis, alcohol, camphor, and epinephrin are all recommended as the drugs to be used in combating the general depression and especially that of the circulation. Of the digitalis group little can be expected. Strophanthin, mg. 0.5 to 1.0 (gr. 1-120 to 1-60), given intravenously once in 24 hours, should be the one used, but its value here is more than doubtful. There is much diversity of opinion as to the value of strychnin. It should, however, be tried, in dosage of mg. 1.5 to 2.0 (gr. 1-40 to 1-30) every 2 to 4 hours, until three or four doses have been given. If, then, no benefit is apparent it should be stopped, as in this dosage it is too poisonous a drug to continue. Whiskey, 15 c. c. (℥ss) every 3 or 4 hours, may also be tried. Its continuance or discontinuance should depend on the opinion formed as to its effect. The German school believes in camphor, 1.0 c. c. (℥ xv) of a 5 per cent. solution in sterile oil given hypodermically, but with us it is less favorably regarded.

The author believes that caffein and epinephrin do good under these conditions. Caffein in the form of a strong infusion of coffee may be added to the Murphy drip or caffein and sodium benzoate may be given hypodermatically, 0.12 to 0.18 gm. (gr. ii-iii) every 2 to 4 hours. Epinephrin may be given intravenously, 1.0 c. c. ℥. xv) of 1-1,000 solution to 500 c. c. of saline, introduced very slowly or intermittently, or it may be given intramuscularly, 1.0 c. c. (℥. xv) of 1-1,000 solution. As its effects are not lasting this must be repeated every hour. Its favorable temporary effects are at times unmistakable and it should be given a trial. Heat externally is one of our best stimulants. The author is convinced that he has seen

striking benefit result from the use of an electric heating apparatus in cases with general peritonitis.

TUBERCULOUS PERITONITIS

Surgical Versus Medical Results.—In the course of the last three decades our views of the prognosis of tuberculous peritonitis have undergone many changes. At one time regarded as a necessarily fatal disease and, therefore, as one in which treatment was only palliative, after König's communication in 1884, it was generally looked upon as a surgical disease with a relatively good prognosis if treated surgically. Surgeons reported numerous cases treated by laparotomy, claiming cures in a large majority of cases. Succeeding this wave of optimism, however, a change of opinion has occurred in the last decade, partly as a result of numerous reports of cures in cases treated non-surgically, but especially from investigation of the later history of the cases reported as cures following laparotomy. Among the first to call in question the value of the surgical treatment of this condition Borchgrevink, Wunderlich, and Rose should be especially mentioned. Especially important was the communication of Wunderlich, who, in 1900, analyzed the results of 344 cases treated surgically by various surgeons. Of these 344 patients, only 176 could be traced after three years, and of these only 46, or 26 per cent., were in good health. Of the 168 untraced cases, probably a still smaller percentage would have been found alive and well. Of more recent articles on the subject those of Stone and Hammand show that the permanency of the operative cures is far less than had been hoped. Cornet, in a review of nearly 1,000 cases, concludes that after laparotomy the percentage of cures is under 25 per cent., while Bircher gives the following figures for 1,295 operative cases collected from the literature: Immediate cures, 69 per cent. Of these, 888 cases followed for one year or more, 31 per cent. cures, while 634 cases which could be traced after two years or longer had elapsed showed but 28 per cent. still in good health. The same author collected 600 cases treated conservatively with between 40 and 50 per cent. of immediate cures and between 20 and 30 per cent. of permanent cures.

In considering these results, one must remember that, generally speaking the cases treated surgically were of a more favorable class than those treated conservatively, for, especially of late years, surgeons have refused to operate on cases of tuberculous peritonitis with advanced tuberculosis in other parts of the body, and, as a rule, have operated only on the cases with serous exudate, i. e., on those cases which have the better prognosis. As a result, the cases treated conservatively have often been those with relatively bad prognosis. This difference in the character of the cases treated surgically and conservatively will perhaps account in part for the somewhat poorer results in the non-surgical series. On the other hand,

in reviewing the literature one must be struck with the frequency with which cases treated unsuccessfully by internal measures have shortly after operation been strikingly improved. It is also probable that the percentage of permanent cures following laparotomy would have been larger had the laparotomy been followed by a sufficiently long treatment according to approved so-called internal methods.

Surgical Indications and Contraindications.—It is probable that most modern authorities are in accord with the view that, as a rule, cases of peritoneal tuberculosis should at first be treated conservatively along the same lines as are followed in the treatment of tuberculosis of the other organs and that surgical treatment is to be instituted in ordinary cases only after the conservative treatment has failed, or in the presence of definite indications. Among these latter are the presence of definite, marked, and probably primary lesions, such as a tuberculous tube, appendix, or ulcer of the bowel, or the presence of an excessive amount of peritoneal effusion which does not yield to internal treatment, or some condition causing more or less complete obstruction of the bowel. Ulcerative cases and the dry forms of peritoneal peritonitis, as a rule, should not be treated surgically. The prognosis in these cases is especially bad, and in them surgical intervention appears, as a rule, to do more harm than good. Advanced tuberculous disease in other organs is usually an absolute contraindication to laparotomy except in the presence of some urgent surgical indication.

The author believes that nitrous oxid anesthesia should be used whenever possible in all tuberculous cases as a precaution against lighting up or aggravating pulmonary lesions, which is a real danger if ether be used.

Medical Treatment.—As mentioned above, the non-surgical treatment of tuberculosis of the peritoneum is essentially that of any tuberculosis. Proper food, fresh air, rest, and general hygienic measures are the essentials.

Tuberculin.—Tuberculin has the same indications here as in other types of tuberculosis and good results have been reported from its use (v. Rook, Riegel, Kümmel, Gray, McCall, and many others). The initial dose should be small, in doses from 1-1000 to 1-500 mg. of old tuberculin, which should be gradually increased.

Autoserotherapy.—In view of the favorable results which have been reported from autoserotherapy in tuberculous pleurisy it would seem probable that this method of treatment might be of value in tuberculous peritonitis and reports of such results are to be found in the literature (Euler, Andibert et Nonges, Cariani, Costa). The value of this procedure has not yet been established, but it may be tried without hesitation.

Other Measures.—In addition to the general measures, as indicated, numerous suggestions as to special measures have been made by various

authors. In Germany for many years it has been customary to treat these cases by inunctions of mercury over the abdomen, but this is a procedure of doubtful efficiency. Of recent years a number of Italians have reported favorable results from the hypodermic injection of an iodate of guaiacol, according to the method of Durante. X-rays have been used with apparent benefit in combination with operative or conservative treatment (Urbino, Bircher, McGlinn), but this method has not yet been sufficiently tried to permit of any definite conclusion as to its real value. In the treatment of tuberculous peritonitis two conditions, the exudate and the frequently obstinate constipation, call for especial treatment.

Treatment of the Effusion.—Very often the effusion commences to subside promptly after the institution of the general treatment, but if it does not do so special measures must be adopted. While free purgation and strict limitation of the intake of fluids might act favorably in causing the disappearance of the exudate here, as in other cases of ascites, these are both measures which may well work irreparable injury in a tuberculous patient by interfering with nutrition and exhausting the patient. They should, therefore, if tried be used cautiously and judiciously. Alwens reports good results here from a salt-free diet. Not much is to be hoped from the use of diuretics, but they may be tried. It is possible that mercury inunctions owe some of their repute to their diuretic effects. Tapping is generally discountenanced as liable to do more harm than good (Graser). A persistence of any large effusion after fair trial of internal treatment is one of the indications for laparotomy.

Constipation.—The constipation is to be treated by proper diet, enemata, and cathartics, according to general rules. It should be remembered, however, that the constipation may be caused by a partially obstructive condition due to adhesions or to an appendicitis and that here again we may have the indication for operative interference.

Summary.—Tuberculous peritonitis is always a disease demanding internal treatment and only under special conditions requiring surgical treatment. The internal or non-operative treatment is, in general, the same as that for tuberculosis in other parts of the body and consists mainly in rest, proper food, fresh air, and general hygienic measures. Tuberculin is to be used in selected cases. The disappearance of the effusion, when this is present, may be hastened by moderate purgation, by restriction of the diet, and by the use of the ordinary diuretics. Laparotomy is indicated in the cases with serous effusion if, after several weeks of conservative treatment, satisfactory progress has not been made. Other indications for laparotomy are the presence of well-defined and probably primary foci in the tubes, or appendix, a localized ulcerative process, or the presence of some condition causing complete or partial obstruction of the bowel. Excessive ascites or the persistence of a considerable effusion are also frequently indications for laparotomy. The

ulcerative forms and those without effusions are especially unsuitable for operation and should not be operated upon except in the presence of definite and well-defined indications.

PERITONEAL ADHESIONS

Peritoneal adhesions are the result of former acute peritonitis or of trauma at the time of a laparotomy. Their development may to some extent be hindered or prevented by prompt diagnosis and treatment of peritonitis or its underlying causes. At the time of the performance of operation, the surgeon, by attention to this matter, can do much by various procedures to lessen the liability to the formation of adhesions, but we are not yet in a position to entirely prevent their occurrence.

As a rule, peritoneal adhesions cause no symptoms and, therefore, call for no treatment. Not infrequently, however, they do cause disagreeable and serious symptoms which urgently demand relief. When, by causing obstruction, adhesions threaten the life of the patient prompt laparotomy is indicated, but, fortunately, the indication is rarely so urgent, as they usually simply cause pain or distress to a greater or less degree. Whether such cases should be treated surgically or not depends largely on the degree of distress or disability caused by them. Frequently purely symptomatic treatment suffices to carry the patient along for a period during which the adhesion is absorbed or stretched sufficiently to inhibit its harmful action, or for the organ or organs affected to accommodate themselves to the condition so that the annoying symptoms disappear. This possibility should lead one to adopt a waiting policy when confronted by a case with distressing but not dangerous symptoms, attributed to the presence of adhesions. During this time massage or local counterirritations may be prescribed and the case treated purely symptomatically.

The results reported indicating that fibrolysin at times causes the absorption of pathological connective tissue would encourage the belief that it might with benefit be used in these cases. The author has found but one such case reported in the literature, that of Koppang, who reports an entirely successful result after a course of 60 injections extending over a period of 6 months.

A further ground for postponing operative interference in these cases is found in the experience that, after being broken up, these adhesions frequently recur. Kelly reports a case laparotomized fourteen times for recurring adhesions but finally and permanently relieved. In spite of the uncertainty of the relief the distress caused by such adhesions is not infrequently so great as to justify operation. Especially is this so in cases with adhesions in the neighborhood of the gall bladder and the pylorus. Here, too, the results of operative treatment are especially good. Again,

in some cases where the adhesions are responsible for obstinate and grave constipation, relief can be obtained only by operation, at times with short-circuiting of the bowel.

CHRONIC PERITONITIS

Chronic peritonitis presents itself under two forms, for which the indications are different.

Localized Form.—The localized form with a localized progressive inflammation, with the production of new tissue, is almost invariably caused by disease in some abdominal organ. Its symptomatology is often practically the same as that of peritoneal adhesions with the important difference that there is much less probability that the symptoms caused will spontaneously subside. The treatment should be based on that of the underlying disease. Otherwise the indications are similar to those of peritoneal adhesions, to the section on which the reader is referred.

Generalized Form.—The clinical picture here resembles very closely that of a tuberculous peritonitis. In fact, many cases first diagnosed as chronic peritonitis ultimately prove to be tuberculous. Simple laparotomy and other surgical measures, including the Talma operation (Moynihan), prove here of no value. As this condition is often associated with syphilis, cardiac or arterial disease, these, if present, should be treated. The usual methods of relieving ascites by reduction of fluid intake, catharsis, and the use of diuretics, are indicated. Tapping often very frequently repeated is, as a rule, necessary. Moynihan recommends the intraperitoneal injection of epinephrin, 1.0 c. c. of 1-1,000 solution. At times, obstruction of the bowel occurs in these cases and must be relieved surgically.

MALIGNANT DISEASE OF THE PERITONEUM

The only treatment which holds out any hope of cure is surgical. Almost invariably, however, the extent and distribution of the lesions are such as to defeat any attempts at radical extirpation. Our treatment must be purely symptomatic. Tapping to relieve the effusion, which is often present, is indicated.

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II. DISEASES OF THE RESPIRATORY TRACT

CHAPTER I

DISEASES OF THE NOSE

B. R. Shurly

RELATION OF GENERAL THERAPEUTICS TO SPECIAL TREATMENT OF THE UPPER RESPIRATORY TRACT

The natural modern trend of our highly developed specialties is rapidly producing a sharp line of demarcation between the treatment of general and special pathological phenomena. There is danger in this development that rhinology and laryngology may become departments of therapy only, while the state of the general human machine is frequently ignored. Many disastrous failures of treatment by laryngologists are examples of this fact. Many conditions of the upper respiratory tract are wholly systemic in origin and must be treated on a broad and liberal basis. For example, this department of medicine must be ever alert to offer therapeutic care to the various special and frequently general manifestations that occur in syphilis, tuberculosis, diphtheria, thyroid disease, gout, rheumatism, and various general infections of the staphylococcus, streptococcus, influenza bacilli, and other pathogenic bacteria. Therapeutics has developed a series of specifics and other remedies of great value. Their usefulness is placed upon a definite and exact basis of value. These therapeutic indications must be met as promptly by the specialist as by the internist. Text-books are laden with innumerable drugs and general therapeutic measures that are recognized by practitioners as worthless and harmful from the fact that frequently valuable time is lost in the treatment of disease by therapeutic methods that deserve a place only in the history of medicine. It has been our endeavor to eliminate and discard remedies that serve to fill the pages of the text-book and mention those only which clinical experience has proven of real curative merit, or at least as additions to the comfort, and not the discomfort, of the patient. There is a place in laryngology for the physician as well as the surgeon. Re-

cently the radical surgeon laryngologist is receding to the more logical fields of conservatism, and slowly he will appreciate more and more the true usefulness of his friend and consultant the physician laryngologist.

ACUTE RHINITIS

(*Acute Coryza*)

The treatment of acute rhinitis involves primarily a study of the habits, dress, occupation, temperament, and local and general physical defects of the individual. This study will develop principles of prophylaxis that require enforcement by careful attention to details.

Neglect or carelessness in regard to clothing, house ventilation or heating, and exposure must be studied and the remedy suggested. A definite plan of cold sponge bathing may be of prophylactic benefit. The neck and chest may be quickly sponged with cool and later very cold water, or the body may be gone over with a stiff flesh brush. When this latter procedure is adopted the smallest amount of water which will form a lather with pure white castile or common laundry soap should be used. A sharp reaction of the skin should be obtained afterward by brisk friction with a turkish towel, which will remove the lather without rinsing. This morning bath should be taken in a room which is thoroughly warmed. In debilitated subjects the change to a cold bath should be made gradually.

Many individuals are particularly susceptible to drafts of air, and some to drafts when applied to definite areas of the body, such as the back of the neck, the interscapular region, or about the feet. Advice in regard to wearing apparel may be advantageously given. The use of high shoes, warm stockings, and proper underwear of wool, silk, or flannel will prove a necessary prophylaxis in some cases. Chest protectors, neck furs, and mufflers should be dispensed with. Many colds may be prevented by the prompt removal of damp clothing so as to quickly restore the body heat.

In cases of recurrent coryza the condition of the nasal and nasopharyngeal chambers must be thoroughly investigated. Septal deformities, hypertrophies, adenoids, and all other important conditions that interfere with nasal drainage and respiration must receive proper surgical attention. When acute coryza is present in the household delicate subjects may receive a prophylactic inoculation of a vaccine. This may be prepared from a nasal culture obtained from the member of the family who was the original source of infection.

A careful regulation of the temperature of living rooms to about 65° F. is important, while a cold, well-ventilated sleeping room, warm bed covering, and night garments are advantageous to many people dur-

ing the winter months. Susceptible infants and young children may be provided with an improvised sleeping bag, or pinning blankets to avoid the dangers of exposure at night. Sleeping out of doors or in a window tent has given excellent prophylactic results in selected cases.

Against an acute attack radical abortive measures must be adopted early. The time-honored administration at bedtime of five to ten grains (0.3 to 0.6 gm.) of Dovers' powder alone, or with five grains (0.3 gm.) each of aspirin and quinin, is frequently successful. A mustard foot bath will encourage leukocytosis; and a hot lemonade with spiritus frumenti will establish diaphoresis. The patient should immediately retire and remain covered with several warmed blankets until profuse perspiration ensues. On rising in the morning a saline laxative such as a Seidlitz powder may be necessary. During the day the Lincoln formula of quinin sulphate, gr. ½ (0.03 gm.); fluid ext. of belladonna, gr. ⅛ (0.007 gm.); gum camphor, gr. ¼ (0.012 gm.), every three hours; or three drops each of tr. belladonna and tr. opium in a half ounce (15 c. c.) of camphor water may be given.

The nose should be examined under good illumination and a culture taken from the secretion if the vaccine treatment is to be adopted. If Bosworth's method be selected—then a 20 per cent. solution of cocain is applied to the inferior turbinates, after which a bead of chromic acid is fused upon a probe, and with this a fine linear cauterization is made along the median surface of each inferior turbinate.

Trouble may be avoided by inquiring for any idiosyncrasy against quinin or belladonna before continuous doses of these remedies are prescribed. If the abortive treatment is not successful much may be done for the comfort of the patient by the use of sprays, irrigations, and pigments. The various preparations of the suprarenal gland are useful. Adrenalin chlorid diluted with normal salt solution (1-10,000) with or without cocain or eucain (1 per cent.-2 per cent.) affords relief. The nose may be irrigated with a mild solution of Pul. Antisepticus Co. U. S. P. The anterior douche must be used with caution. The patient's head is tipped well to the left, and he is requested to take and hold a long breath while the right nostril is slowly irrigated. The head is then tipped to the right and the left nostril irrigated in the same manner. Viscid tenacious secretion is dislodged by this method to the great relief of the sufferer. This procedure is free from danger if performed with gentleness and correct technique in properly selected cases. A spray or application should follow of:

Pulv. Mentholis.
Pulv. Camphoræ, āā gr. v (0.3 gm.).
Petrolati Liquidi, ℥i (32.0 gm.).

Every prescription containing cocain should be written with precautionary signs—non repetus. A good office application that will reduce and hold the annoying intumescence is cocain 2½ per cent., antipyrin 2½ per cent. If suprarenal ext. or adrenalin are used care must be exercised not to introduce these solutions without considerable dilution. Harm is often done by the use of astringent and irritating sprays.

In the subsiding stage a capsule of cinchonidia sulph., grs. 2 (0.12 gm.), and hydrastin (white alkaloid), gr. ¼ (0.015 gm.), is efficacious. In children the tr. of chlorid of iron with glycerin and water is valuable. If subacute intumescence prevails the application of the galvanocautery affords relief during the winter season. In infants or young children relief may be secured by the instillation of a solution of adrenalin (1-10,000)—put five to ten drops into the nostril with a medicine dropper. Inhalations of one part menthol to 10-20 parts of chloroform may be used on a handkerchief, or with a convenient nose and mouth inhaler.

As acute rhinitis is usually caused by microbic infection, an investigation of the bacteriology will reveal most frequently which are the microorganisms concerned: catarrhalis, staphylococcus, streptococcus, pneumococcus, or influenza bacillus. Great curative value is claimed for the autogenous vaccine made from the culture. When the laboratory equipment is not available a stock vaccine with urotropin internally may be given. The true worth of this treatment must be demonstrated by future clinical reports.

CHRONIC RHINITIS

Anatomic or pathologic conditions that are sufficient to interfere with nasal drainage or proper respiration must receive surgical attention. The etiology should be carefully investigated, and systemic dyscrasiæ, such as gout, rheumatism, tuberculosis, syphilis, or neurasthenia, cardiac and renal insufficiency, must be given appropriate treatment. The excessive use of alcohol, tobacco, or drugs will prevent successful treatment, and they must be discontinued or modified. Habits of personal hygiene should be considered, and details relating to proper clothing, exercise, bathing, and ventilation of the working and sleeping apartments should be subjects for instruction to each individual sufferer. The warm and dry climates of Egypt, Mexico, Arizona, New Mexico, and the Northwest are often advisable when the leisure, the financial condition, and inclination of patients will permit travel and absence from home. Among children with a tendency to over-activity of the lymphatic system the syrup of the iodid of iron would be an important aid to local treatment. The early removal of adenoids of the nasopharynx, and offending tonsils, offers a valuable prophylactic measure in limiting acute inflammations in the upper respiratory tract, and also of the chronic rhinitis of adult life.

Every case of chronic rhinitis presents two chief therapeutic indications: the establishment of thorough cleanliness by the restoration of free nasal drainage and free nasal respiration. These must be accomplished by the destruction of the least possible amount of mucous membrane. If mild pathologic changes have occurred medicinal methods may be sufficient. Cleansing sprays or douches of Dobell's or Seiler's or of the normal salt solutions; or a solution of potassium permanganate, gr. ⅛-℥i, or a solution of Pulv. Antiseptic Comp. One-half teaspoonful to the pint will be sufficient. Many escharotics have been advocated. Those of real power, however, are chromic and trichloracetic acid. In the intumescent varieties these measures, especially with children, afford prompt relief—in properly selected cases. The fused bead of chromic acid is preferable to many plans, but the danger of excessive cauterization is imminent if the acid runs on to the floor of the nose or extends over an uncontrollable area. The tissue should be dried before the acid is applied. Mild intumescent and hyperplastic conditions may be improved by applications every third day of argyrol, 20-50 per cent., or nitrate of silver, 5 per cent., or iodin, grains x, to glycerin ℥ss, aqua ℥ss.

Many favorable results are reported from electrolysis. Five to ten milliampères are passed through a double needle by the bipolar method for three to five minutes. The galvanocautery affords the best and most definite method (except those strictly surgical) of reducing intumescence and hyperplasia. Free nasal drainage and respiration may be quickly and simply restored in moderately severe and otherwise suitable subjects by this procedure. The inferior turbinates should be cocainized with a two to four per cent. solution, or alypin, 10 per cent., before operation. A deep line should be drawn from the posterior portion of the turbinate body anteriorly, and extending down to the periosteal layer. The wound should be covered with a bland oily spray followed by an insufflation of aristol. The middle turbinate should not be cauterized. When these measures appear to be ineffective (or, in fact, in all cases of marked nasal obstruction) prompt surgical methods should be adopted. The submucous resection or anterior and posterior turbinectomy of the inferior and middle bodies are operations which afford splendid results when indicated.

MEMBRANOUS RHINITIS

The plan of therapy adopted in pseudo-membranous rhinitis is dependent in part upon the bacteriologic findings. The presence of Klebs-Loeffler bacilli, particularly with a secondary infection elsewhere, demands an early dose of antidiphtheritic serum, the initial strength of which should be 5,000 units. In mild primary infections among adults under continuous observation antitoxin may be held in reserve. As the in-

volvement of the nasal mucous membrane may be transmitted in like form to those under immediate exposure, the prophylactic use of antitoxin may be necessary. The usual dose of calomel, followed by an appropriate saline, as Rochelle salts, will be indicated. Locally a thorough cleansing treatment should be prescribed. For this purpose the posterior, or carefully directed anterior, douche of warm normal salt solution, boric acid, soda bicarbonate, or liquor calcis, U. S. P., will lessen the absorption and aid the exfoliation of pseudo-membrane. Peroxid of hydrogen may be applied directly to the parts with a cotton pledget. It inhibits the bacterial growth. It must be remembered that the separation of the pseudo-membrane from the nasal mucosa leaves a raw and frequently bleeding surface; therefore, it should be neither forcibly detached nor treated with powerful antiseptics or astringents. The excoriation may be treated with advantage by applications of silver nitrate [10 grains] (0.6 gm.) to the ounce (30 c. c.)] or a copper sulphate solution. Aristol insufflated freely is particularly beneficial. When the acute symptoms have subsided tonic treatment such as the elixir of calisaya, iron, and strychnin should be administered.

ATROPHIC RHINITIS

A glance at the various text-books reveals the fact that the number of remedies advocated for the treatment of "atrophic rhinitis" is quite as great as the inefficiency and uselessness of the majority of them. A definite plan must be selected and continued for some months if good results are to be expected. The treatment should be general and local. Attention must be given to hygienic details, and all exposure avoided when possible. An even, warm, moist climate favors recovery, and many patients improve rapidly in a sub-tropical climate. The use of the iodids of iron, arsenic, or potassium are indicated, and their tonic and alterative action on the glandular apparatus is beneficial. Hypodermic injections of the citrate of iron and strychnin are very effectual in anemic cases. The hemoglobin may be raised five per cent. a month by this method. A comparatively painless hypodermatic injection of iodin, 10 per cent. (iodolena), in almond oil may be injected, intramuscularly when the stomach is irritable or easily disturbed by the iodin salts.

If the atrophic process is attended by thyroid deficiency, iodin (gr. 1/12) prepared in cubes of gelatin (gr. 1/12 to each) (1 x 1/8 inch) may be given three times a day with milk, before eating, in addition to applications of iodin by electrophoresis. A general tonic effect to the glandular system may be produced by the soap bath, as follows: The patient strips in a warm room and thoroughly covers the body with a thick lather of white castile soap, the smallest quantity of water being used. A flesh

brush is now quickly applied over the whole surface of the skin for a period of five minutes, when the redundant lather is removed with a Turkish towel and sharp friction. The patient then returns to bed. Tonics of strychnin, iron, or phosphorus should be continued throughout the treatment.

Thorough local cleansing measures are essential. A plan of office and of home treatment should be chosen which shall involve simplicity, economy of time, expense, and effort. The methods adopted must be carried out through a long period of weeks or months. Results are obtained only by the exercise of patience and persistence. Especially with children it is necessary to use alkaline solutions that are pleasant in taste and odor for cleansing purposes. Of the official preparations the solutions made from Seiler's tablets, sodium chlorid, borax, or boric acid are convenient, cheap, and efficient. Innumerable preparations have been marketed that contain these essential ingredients, whose color and odor are made attractive. The efficiency and value of them, however, depend upon their alkalinity and mild antiseptic properties. In severe cases, where the crusts are dry and tenacious and show marked decomposition, potassium permanganate, 1/12 grain to the ounce, peroxid of hydrogen, or sol. mercuric chlorid (diluted one to seven), 1-3,000, may prove of greater usefulness than the above-mentioned preparations. These solutions should be warmed and either sprayed or syringed through the nasal passages both anteriorly and posteriorly.

If these measures are insufficient to remove crusts and infected secretions from the nasal channels, cotton swabs saturated with peroxid of hydrogen should be used. Treatment often fails because thorough cleansing methods have not been adopted. The nasal passages should be carefully examined after the douche or sprays are made, in order to determine satisfactorily the condition of the nasal cavities before a routine treatment is instituted.

Of the various oleaginous preparations for applications or sprays that have been recommended in great number, oleum picis and balsam of Peru may be considered among the best and safest. Thymol, menthol, and camphor may be used from time to time as adjuvants and as convenient preparations for home treatment, however. G. L. Richards favors a douche containing five to ten drops of formaldehyd in eight ounces of warm water, preceded by an application of cocain. In the more advanced stages of atrophy the milder methods are inefficient and additional stimulating treatment must be chosen. No cases that afflict these unfortunates call for greater mutual courage and persistence on the part of the patient and physician than the chronic atrophic forms that have developed ozena with all its depressing conditions. Galvanism and faradism applied over a period of months may give well-earned results. The current should be passed through a naked electrode with a ball-shaped distal extremity.

The electrode should be long and slender and all atrophic regions should be reached if possible. The treatment is commenced with one to five milliampères and gradually increased at each successive sitting. The cathode is placed against the auricular fossæ while the anode is passed rapidly over the atrophic areas. Later the faradic may be substituted for the galvanic current. The application is usually followed by a reactionary hyperemia, and if any excessive irritation follows it may be allayed with a spray or application of menthol in petrolina oil. The application may be repeated daily at first and gradually reduced to twice a week. Massage is a favorite method with many laryngologists. Instruments for this may be applied by hand, the electric motor, or a special vibratory apparatus. Kelligrew claims to have treated over a thousand cases with marked improvement by vibratory and light stroking movements applied by means of a sound twenty centimeters in length. The instrument is covered with a rubber head over some cotton. The floor of the nose, meati, inferior and middle turbinate bodies, and septum are treated in order. W. Freudenthal has designed a good instrument for employing electrical vibratory massage.

The tampon suggested by Gottstein has been recommended extensively. This may be placed by means of a screw applicator into one passage and allowed to remain four or five hours, when the other passage is treated in a like manner. Various modifications have been devised by Percher, Hubbard, and Leland, whereby pigments of ichthyol, iodin, or an alcoholic solution of acetanilid are applied by this method. This plan is frequently annoying and obnoxious to the patient, and may fail for this reason.

The most efficient topical application is iodin, gr. vii-xii, glycerin, ℥ss, aquæ, ℥ss.

Ichthyol, 20 per cent., argyrol, 20 per cent., or resorcin, followed by a spray of menthol and camphor, five grains each to the ounce of petrolina oil are valuable.

RHINOSCLEROMA

Rhinoscleroma is exceedingly rare in this country. Only three cases were reported in the United States before 1893. The pathology and treatment of this disease have been most carefully studied by Emil Mayer and Gertser of New York, and by Chiari, Ganghofner, and Paultauf of the old world. Freudenthal has suggested the value of Coley's fluid or rhinosclerene proposed by Pawlowsky. The use of autogenous vaccine has apparently offered something of inhibitory value in a few cases. Five cases have come under the writer's observation with laryngeal involvement that were relieved for a time by dilatation with Schroetter's tubes. In Lubliner's case the lesions disappeared after an attack of typhoid fever. Mercury and iodids have been used extensively without success. Temporary

relief has been accomplished with the various chemical caustics. Palliative surgical methods are recommended in selected cases to relieve stenosis.

ACUTE SUPPURATIVE INFLAMMATION OF THE SINUSES

The tendency of acute inflammatory processes in the nose to extend to the accessory cavities is well marked in certain individuals, especially when living in the changeable climate of the north temperate zone. Hence the importance of thorough treatment of cases of acute rhinitis is to be emphasized on account of the danger of this annoying and occasionally dangerous complication ensuing. The microbic epidemics of winter, especially that of influenza, may invade these cavities in a large number of individuals. Those patients having a lowered resistance to pus infection must be protected, if possible, from exposure. This is especially necessary with those who are enfeebled by disease of the upper respiratory tract. In such cases a constitutional supporting treatment is advisable. A sojourn in the warmer climates of Florida, the Bermudas, or Bahamas during February, March, and April, is usually of great protective value.

It must be remembered that "acute sinus infection" is frequently the cause of serious complications affecting the pleura, lungs, heart, or kidney, so that energetic therapy may give valuable prophylactic results toward preventing arthritis, pneumonia, pleuritis, brain abscess, or suppurative otitis media. The ordinary difficulties of drainage are such that an acute suppurative sinusitis becomes a dangerous focus of infection and one which is frequently overlooked by the general practitioner. It often passes in the majority of cases for an ordinary acute coryza. Suppurative acute inflammation of this type may involve any one or more of the ten classified accessory sinuses. The varieties of infecting microorganisms, and their virulence, the quality and quantity of the drainage of the part, the resistance of the patient, and the proper choice of treatment will determine in a great measure the rapidity and thoroughness of recovery. These points of the condition of the case will establish the guide to the principles of management. The remedies at our disposal are exceedingly efficient for reducing turgescence of the nasal mucosa, and prompt and continuous drainage must be restored and maintained by the frequent use of them.

The use of the various coryza formulæ in these acute suppurative processes is to be condemned as harmful interference with nature's plan of drainage, especially in the region of the middle turbinate body. Hyperemia should be relieved by the free use of adrenalin chlorid, 1:10,000. In one's office the orifices of the accessory sinuses can be especially treated by applying a pledget of cotton saturated with a solution of

cocain (2 per cent.) or a solution of adrenalin, or both. The nasal passages may be gently irrigated with hot normal salt or other mild alkaline solutions previously. The crust that may occlude the orifices of these sinuses may be thoroughly washed away by this means. When the secretions are particularly tenacious a bland, oily spray of menthol and camphor in albolene will hasten their removal. The patient should be given a prescription for an adrenalin spray (1:10,000) with eucain hydrochlorate (1 per cent.), and also some bland oil to be used at home. A post-nasal douche may become necessary if the sphenoid and posterior ethmoidal cells are involved. In cases of antral, frontal, or anterior ethmoidal cell suppuration the irrigation and spray should be directed toward the middle turbinate body through the anterior naris. Obstruction of the sinuses and extension of suppuration are more liable to occur at night than in daytime. Instruction should therefore be given the patient to thoroughly open the drainage canals by these methods of douching or spraying night and morning and, if necessary, during the night, especially if pain or feeling of obstruction interferes with sleep. Patients treated thoroughly in this manner will avoid chronic suppuration, as well as obtain relief of distressing symptoms. When it is possible to probe the sinus, the skilled laryngologist may readily irrigate the sinus through the application of a special cannula. The solution to be used should be a hot normal salt or the mildest of antiseptics. The use of strong solutions is attended by pain and reactionary swelling that will prove harmful. Aspirin in moderate doses affords relief to pain and nervous irritability. Quinin in large doses adds to the congestion of the nose and ears and is contraindicated in the later stages of the attack.

A culture should be taken of the secretion, and the varieties of microorganisms present ascertained. A vaccine may be prepared of this, or the stock vaccine may be given. In some cases it proves of great value. If the acute suppuration does not subside readily the infected sinuses should be more thoroughly investigated. The antrum of Highmore drains with greater difficulty on account of its size and position. An attempt should be made to wash the cavity (the antrum) with normal salt solution through the natural opening. When this is not successful the antral wall should be punctured in its thinnest portion. The site of selection is usually in the inferior meatus, about 1-1¼ inches within the nostril. The ordinary needle of a large antitoxin syringe or that of Myles, Coakley, or Halle may be used for the purpose. The needle is to be directed outward and upward, and with a firm and steady pressure, until it passes through the plate of the bone. No fluid should be forced through the needle until the operator is satisfied that the antrum has been entered. Air may be forced through gently, and will be accompanied by a characteristic sound as it passes out of the natural orifice into the nasal passage. Acute suppuration will usually subside after flushing the antrum at one or two

sittings. This method is also of diagnostic importance. The frontal sinus is irrigated with greater difficulty. To do this a fine cannula, especially adapted for a narrow canal and bent at the proper curve, should be passed into the sinus, which is then irrigated.

EPISTAXIS

In the treatment of epistaxis, or "nose bleed," it is of the utmost importance to determine the causal factors. A careful examination with a good light and nasal speculum should be made. The traumatic varieties will call for topical applications. The simple domestic methods of relief, such as holding the hands above the head, the application of ice to the alæ and root of the nose, may be sufficient. As the majority of simple cases come from a rupture of the septal artery at Kesselbach's spot, a short distance within the vestibule, a cotton tampon inserted and resting over this area, with pressure from the outside, will promptly arrest an ordinary hemorrhage. The tampon may be saturated with adrenalin chlorid (1:1,000), or cocain and antipyrin (each 2½-5 per cent.) or by peroxid of hydrogen. In every case that is not relieved by these simple methods the bleeding point should be found and treated. The habits and constitutional dyscrasia of the patient must be carefully studied.

In atheromatous subjects, or those with high blood-pressure, epistaxis is often a safety valve of nature that may prevent impending disaster in a more remote region of the body. When the bleeding from the septal artery or from granulations on the turbinate bodies is excessive or recurrent the application of trichloracetic acid, the nitrate of silver stick, or the galvanocautery point (applied and removed at red heat) will give prompt results. When the ethmoidal arteries are bleeding, a bismuth or iodoform gauze tampon to the roof of the nose will prove successful.

If the anterior method of nasal tampon is chosen it is essential that either dressing or nasal forceps with fine blades should be used, and strips of gauze, one-half inch in width, passed well back into the posterior portion of the nasal canal, followed by others until firm and uniform pressure is effected. The gauze may be saturated with suprarenal extract, or dusted, if necessary, with tannogallic acid powder. The use of Monsel's solution, chlorid of iron, or other powerful astringents is a method of last resort, but objectionable on account of forming hard clots.

In severe post-operative epistaxis, or in persistent hemorrhage after the simple methods have failed, it may be necessary to use a posterior tampon. This is prepared from cotton or gauze, by trimming and rolling a suitable piece to a size that will enter the posterior opening and not easily pass forward into the nasal passage. It should measure for an adult about 1¼ x ⅞ inches. A string should be passed around the middle of the

tampon, leaving two long ends. A small soft catheter should be passed through the bleeding side into the pharynx, where it is seized with a long forceps, and the cord drawn out of the mouth cavity. One of the free ends of the string is tied firmly to the catheter and the latter withdrawn through the nasal passage, while the tampon is forced gently into the posterior opening by the index finger of the free hand. The ends of the strings from the nose and mouth are then fixed with adhesive plaster.

Internal medication is especially indicated in cases of renal or cardiac (vascular) disease attended by high blood-pressure. This may be accomplished by the use of tincture of aconite in drop doses of three to five drops at once. Nitroglycerin (gr. 1/100) hypodermically will act promptly, or this preparation may be given every half hour for three or four doses. If the blood-pressure is low, tincture of digitalis (min. 5) every hour for three doses, or camphor, or ammonia, will be more beneficial. When the hemorrhage is continuous or profuse, hydrastinin hydrochlorid (gr. ¼) or stypticin (gr. 1/3) hypodermically will be efficacious. In persistent cases due to hemophilia, anemias, or allied disorders the hypodermic use of antitoxin or a freshly prepared horse serum is of value. Calcium lactate in fifteen-grain doses hourly, by raising the coagulation point, may be necessary. Gelatin in large quantity has a similar influence. The use of ergot is unscientific and harmful from the fact that valuable time is lost. Therefore a more suitable remedy must be chosen. In recurrent and persistent epistaxis the presence of post-nasal ulceration or a tumor, or the possibility of pulmonary hemorrhage, must be eliminated.

OZENA

While comparatively few cases of recovery from ozena are reported, yet in the majority of cases it is possible to outline a plan of treatment that will afford great comfort and temporary relief. This plan should always begin with thorough cleansing of the parts. It is important to improve the general physical condition and to prevent the chemical changes which unhealthy secretions undergo. It is only by the utmost diligence that satisfactory results may be obtained.

The patient should be instructed in the use of the antiseptic alkaline solutions such as Seiler's and Dobell's solutions, or compound antiseptic powder (U. S. P.). It is often necessary to soften the crusts with vaselin or liquid petroleum before the cleansing wash is used. This routine on the part of the patient should be followed by efforts to prevent effective crust formation and its decomposition. Internal administration of the iodid of iron, cod-liver oil, phosphorus, strychnin, or arsenic will be frequently indicated. Plenty of out-door life and exercise with good nourishing food should be ordered. (See Atrophic Rhinitis.)

The special treatment of this disease offers many different plans and agents under the theory of the infective character of ozena. The hypodermic use of antidiphtheritic serum has been proposed and highly recommended by Gradenigo. The duration of treatment varies from thirty to sixty-eight days, during which time 5,000 to 48,000 units of serum were employed. Perhaps the most efficacious local application is a 2 per cent. solution of creolin followed by ichthyol, 20 to 50 per cent., and a mixture of iodin and oil of cloves. Massage and electricity are beneficial methods of treatment. In some cases the stimulating effect of iodin, grs. 48; potassium iodid, 16 grains; water, 1 ounce; glycerin, 1 ounce; is followed by improvement.

The hypodermic injection of iodin is highly recommended. This may be given in the 5-10-20 per cent. preparations in almond oil (iodelaine). The stronger preparations are more or less painful. A spray of bichlorid of mercury, 1 to 3,000, is an excellent medicament in cases that are possibly luetic in origin.

Our knowledge upon this subject will be greatly increased by the collective investigations under the direction of the International Laryngological Congress which meets in Copenhagen in 1914.

CHAPTER II

DISEASES OF THE LARYNX

B. R. Shurly

ACUTE LARYNGITIS

Prophylactic and Internal Treatment.—The prophylactic and internal treatment of acute laryngitis, or acute laryngeal catarrh, has much in common with acute inflammation in the nasal passages, nasopharynx, and pharynx. The use of aspirin and Dover's powder (in three to five-grain dosage) is beneficial and comforting. The use of the voice should be forbidden, as rest is an essential measure, especially at the outset or early stage. Advice in this regard must be firm, as rest will decidedly favor other abortive measures. The upper respiratory cavities should be examined, as acute laryngitis is rarely the primary affection, nevertheless the attending acute inflammation should receive equal attention. Small and frequent doses of tincture of aconite root, one to two minims every hour until the constitutional effect is noted, will often relieve local congestion and the pyrexia. If pain be prominent aspirin often gives prompt relief. It may be administered in rheumatic subjects together with salicin. In malarial districts the addition of quinin is advantageous. The early use of calomel in 1/10-grain doses until ten are taken should not be forgotten. This should be followed by the usual saline in the morning. The cold compress over the larynx, covered with an oiled silk pad, is grateful to many patients. The ice collar or Leiter coil may be adopted if convenient. However, the danger of additional congestion of the parts after continued hot applications makes them of doubtful utility. A room saturated with a steam moisture is grateful and comforting. A croup tent may be improvised and supplied with alkaline steam (soda bicarbonate, one ounce to a quart of water) from a kettle to which a piece of garden hose has been attached to the spout. Various steam inhalers are in the market. A pitcher of boiling water with a cornucopia of paper placed over it as an inhaler affords a satisfactory method of supplying a medicated vapor. A favorite and useful formula is: Menthol, grs. ii; tinc. benzoin comp., ℥ss; tinct. opii comp., ℥ss. A teaspoonful of the

mixture is added to a pint of boiling water and placed in the inhaler or pitcher. The medicated steam is inhaled as hot as possible for five to ten minutes. This may be repeated at hourly intervals. Oil of eucalyptus in the proportion of one ounce to the quart of water may be used in the same manner or boiled over a spirit lamp.

Oleum terebinthinæ, oleum pini, and oleum juniperi are also to be recommended, to be used in the same way. When the larynx is dry and a tickling sensation with a short frequent cough is present, then tartar emetic in careful dosage is indicated. This may be administered pleasantly to adults in the following prescription:

Antimonii et potassii tartratis.....gr. ss
Tincturæ ipecacuanhæ et opii.....ʒss
Liquoris potassii citratis .....ʒii

Sig. ʒi every two hours.

Some of the various lozenges that contain ammonium chlorid or menthol and camphor are very acceptable. In very young children a powder containing a half to one grain of cinchonin with 1/12 grain of ipecac will often give great relief. Vaccine therapy may be resorted to with advantage if the infective origin is known.

Local Treatment.—The upper passages should be cleansed with a spray or irrigation of warm normal salt solution. Dobell's or the Seiler solution may be preferred. An attempt should be made by every practitioner to eliminate from use a vast list of proprietary preparations which are to be found on the shelves of the laity, and which are used to the detriment, many times, of the delicate nasal mucous membrane of the patient. The therapeutic properties of these solutions are generally based upon the ingredients of the original solutions of either Seiler or Dobell. Many of these proprietary solutions are compounded of inferior materials and of a strength (of solution) that is not only harmful but frequently permanently injurious. The choice in the U. S. P. of salt, Dobell's or Seiler's solution, Pulv. Antiseptic Comp., etc., is amply sufficient to fulfill all indications.

An inhalation spray of menthol and camphor in albolene is valuable and soothing, especially in the dry stage of the attack. To use the spray effectually the anterior portion of the tongue is to be wrapped with a piece of gauze, then extended and held by the patient, while the alæ of the nose are compressed by the operator to prevent nasal respiration. The patient now inhales and exhales while the spray is continued. By this method the mucous membrane of the larynx is more quickly and thoroughly treated. A down spray, consisting of alum (gr. x), acid carbolic (gr. ii), glycerin (½ ounce), to ½ ounce of water, may be applied

directly to the larynx with benefit. Strong astringents should be used only exceptionally.

In children, in whom edema develops frequently, a dose of turpeth mineral or syr. ipecac, used as an emetic, together with a prompt steam inhalation, will afford suitable means of relief. [In most cases in children the administration of bromid of potassium is promptly followed by relief in spasmodic croup, whether due to laryngitis or a purely nervous mechanism.—Editor.]

Intralaryngeal applications are of benefit in the subacute stage, such as argyrol, 20 per cent., or alumnol, 20 per cent. Spasms of the glottis may prove annoying, and dangerous in some cases. Anodynes such as heroin, codein, or opium, by mouth or hypodermatically, will promptly allay the nervous phenomena in such cases. Intubation, or even tracheotomy, may be necessary in rare occasions.

It is important to adopt every therapeutic measure to maintain and preserve the general good condition of the patient. Reconstructive or nerve tonics, such as nux vomica and strychnin, with quinin and iron, are frequently indicated. The use of alcohol and tobacco should be prohibited during an attack.

CHRONIC LARYNGITIS

This condition may appear as a hypertrophic, a subglottic, or a pachydermatous variety. The hypertrophic form may exist with chorditis nodosa, familiarly known as "singer's nodes." The various forms of systemic disease must be investigated and treated accordingly. The value of a warm, dry climate must be considered, but recommendations must be based upon the financial and general condition of the patient, the age, and possibilities of travel, etc. Conditions causing nasal stenosis and pathologic areas of hyperplastic gland tissue must be surgically removed. Attacks of indigestion, gout, and rheumatism should be modified by proper systemic treatment. In cases that develop nodes a six months' rest is necessary. The use of alcohol and tobacco should be forbidden. Internally, potassium iodid, ten to fifteen grains (0.6 to 1.0 gm.) t. i. d. may be given to assist in the absorption of hyperplasia. Locally, the use of caustics or astringents is frequently indicated. The former should be applied by the skilled specialist of experience only. The fused nitrate of silver or the galvanocautery are the methods of greatest usefulness. Locally, laryngeal sprays of alumnol, alum, or zinc, preceded by a spray of Seiler's solution, aid in giving comfort to the patient. They are of no curative value, however. The same may be said for oil sprays, such as menthol and camphor in albolene. Laryngeal applications should be made with great care and only with a reliable instrument that will grasp and hold firmly the proper sized cotton

pledget. The excess of solution must be carefully removed. Increasing strength of zinc chlorid, gr. x to 1 (0.6 to 3.0 gm.); nitrate of silver, gr. 5 to 30 (0.3 to 2.0 gm.); argyrol, 10 to 50 per cent., may be introduced into the larynx with benefit.

EDEMATOUS LARYNGITIS

Edema of the larynx requires active treatment by a brisk cathartic of calomel followed by magnesium sulphate or elaterium, gr. 1/6. Alkaline steam inhalations, hot astringent gargles, a mustard counterirritation over the larynx, followed by ice bags to the neck, should be ordered at once. If the patient is syphilitic and potassium iodid has been administered it should be discontinued immediately, as this drug greatly aggravates the condition of some patients. A spray of adrenalin (1:10,000) through the nose and into the larynx may temporarily relieve. Its use is attended, however, with the danger of reactionary swelling.

When edema follows the entrance of a foreign body, or after bronchoscopy or the removal of an intubation tube, the use of codein or Dover's powder to allay the restlessness may be valuable. The use of pilocarpin early is favored by some authors, but the danger of its depressant effects should be considered.

This condition is usually associated with systemic disease, such as syphilis, tuberculosis, myxedema, carcinoma, bulbar paralysis, or cardiac, renal, and hepatic disorder, and appropriate diagnosis and general therapy are required. If the edema does not respond to the simpler measures and cyanosis intervenes, scarification of the affected region of the larynx should be undertaken. A 20 per cent. solution of cocain should be sprayed or applied over and into the larynx and the excess swallowed. Scarification should be performed under the direction of a laryngeal mirror and reflected light. A laryngeal knife is chosen preferably for the purpose. Ichthyol (30 per cent.) may then be applied. The resulting hemorrhage and transudation are usually beneficial. If the dyspnea continues and urgent symptoms develop scarification could be repeated with a guarded bistoury under direction of the index finger.

In great emergency intubation or tracheotomy must be performed. The former operation is often difficult. If one or two trials are not successful tracheotomy should be performed without delay.

SPASMODIC LARYNGITIS

False croup, laryngismus stridulus, or spasmodic croup requires prompt differential diagnosis. In children subject to attacks adenoids, hyper-

trophied tonsils and elongated uvula may require operation. A cold sponge over the chest, neck, and region of the larynx may be valuable. Gastrointestinal disturbances should be avoided by carefully selected diet. During an attack treatment directed toward relaxation of muscular spasm must be administered. A hot bath and a teaspoonful dose of syrup of ipecac are favorite and efficient household remedies. Wine of antimony (fifteen drops) or antimony and ipecac (āā gr. 1/100) every fifteen minutes until emesis results may be given a two-year-old child. Turpeth mineral (gr. ii) was formerly used by many practitioners, but two fatal cases reported by McPhedran proved the danger possible from its use. Antimony may produce depression, and not more than three doses should be given.

Alkaline steam inhalation is useful from a croup kettle or improvised apparatus. Tr. benzoin comp. with paregoric (equal parts), a teaspoonful to a pint of hot water, offers a soothing inhalation. Poultices, stupes, or antiphlogistic preparations are beneficial, but the child must remain indoors for several days if they are used.

The attack is liable to recur on succeeding nights unless an antispasmodic or sedative, such as Dover's powder or antipyrin, is given. [In my experience the administration of the bromid of sodium or of potassium renders all other medication unnecessary, except local applications.—Editor.] Plenty of fresh air should be allowed, unless the atmosphere is damp and cold. Calomel and milk of magnesia may be prescribed with advantage the day following an attack, or an enema of soapsuds and water may be ordered at the first visit. If nutrition and vitality are lowered, careful regulation of the diet and tonic treatment are recommended. In adults when the spasmodic attack is chiefly nervous a hypodermic of morphin (gr. 1/6) will afford prompt relief. This medication should not be repeated, and it is unwise to inform the patient in regard to the drug or dosage used.

MEMBRANOUS LARYNGITIS

It has been established after much discussion and experience that membranous croup must be considered (and treated) as a Klebs-Loeffler infection. Therefore antitoxin in full dosage (5,000 units) must be given at the earliest possible moment. This axiomatic practice is so important that no time should be lost in administering this specific, even if a doubt of the diagnosis exists in the mind of the practitioner. We know that death occurs rapidly from mechanical obstruction of the larynx and not from absorption, and the greatest haste is imperative, especially in children of the so-called croupy age. Treatment should be initiated with a brisk calomel purge followed by milk of magnesia. A culture will give valuable information in regard to the variety of microorganisms present.

This culture may be taken quickly from the epiglottis and arytenoid region by bending the platinum loop or cotton carrier to a proper angle. It is unwise to use strong emetics in this form of croup, as the depressant effect is often marked, and the stomach becomes quickly deranged. Cold compresses, or better, the ice collar, will be found agreeable and serviceable throughout the attack. The inhalation, almost continuously, of steam from alkaline water is indicated from the onset. An albolene spray containing menthol is soothing to the larynx and allays the painful and dry condition of the membrane. Calomel sublimation may be advantageously used. Ten to fifteen grains (0.6 to 1.0 gm.) of the pure powder may be incinerated slowly on a hot shovel or on a piece of metal held over an alcohol lamp. Inhalation is facilitated by constructing a croup tent with an open umbrella and a sheet. The vapor of slaked lime may be substituted for steam of alkaline water or alternated with it. When these methods of treatment are insufficient to relieve an increasing dyspnea the indication for intubation or tracheotomy must be considered and promptly adopted. The former operation should be chosen, if possible, because it is quick, painless, and efficient. Antitoxin and intubation will save four out of every five cases in the later stages of asphyxia. Convalescence will be favored by full doses of tr. ferri chlor., well diluted with glycerin and water.

CHRONIC ATROPHIC LARYNGITIS

Laryngitis sicca, or chronic atrophic laryngitis, usually attends similar manifestations in the upper air passages. Pilocarpin in 1/10-grain dosage, three times a day, by aiding general glandular activity, may prove of service. Phosphorus (gr. 1/100) in oil, in capsule, or iodid of potassium, are also indicated. When a laryngeal spray is used the patient should hold the tongue with a piece of gauze between the thumb and index finger. The operator then holds the nose, and deep inhalations are taken. The use of a menthol (0.30 gm.), albolene (30.00 c. c.), Dobell's solution as a down spray can thus be used to the larynx and are grateful. Of the local applications 5 to 10 per cent. oleum picis or argyrol (50 per cent.) are most efficient. Numerous remedies have been advocated, such as inhalations of benzoinated steam, applications of (2 to 5 per cent.) thymol in petroleum oil, camphor (5 per cent.) in oil, zinc sulphate (1 to 3 per cent.). When the trachea is involved intratracheal injections of menthol, guaiacol, and camphor in olive oil will prove beneficial. Good results cannot be obtained, however, without careful treatment of the upper passages at the same time. (See Atrophic Rhinitis.)

TUBERCULOSIS OF THE LARYNX

Treatment may be classified as prophylactic, hygienic, climatic, specific, symptomatic, local, surgical, and general. There is a popular belief among the laity that so-called catarrhal affections of the nose, throat, and larynx lead to tuberculosis. It is exceedingly difficult to prove the scientific truth or falsity of this assertion.

The prophylactic treatment of this affection is grouped around our conception of that which will best promote immunity. This involves the problem of the fight against infection and the predisposing factors of heredity.

Prophylactic treatment is particularly the field of the family physician, who becomes necessarily a student of a predisposed individual. If the treatment by fresh air, sunlight, forced feeding, and carefully directed exercise has any curative value during the progress of the disease it must in all certainty have untold value along prophylactic lines.

Children who bear the earmarks of tubercular heredity, who are exposed at home to infection, and who show well-defined signs of latent danger, should receive the timely advice of the family physician as to occupation, habits of life, diet, and general hygiene. It is recognized that the difficulties of good results are extremely numerous among a class of individuals who take unkindly to discipline; but the problems of prevention cannot be solved without early diagnosis by the medical profession and painstaking care of the subjects under exposure.

The hygienic treatment requires proper clothing, sufficient but not too frequent bathing, digestible and nourishing food, out-of-door life with properly ventilated or open-air sleeping apartments. Coal gas, air laden with organic matter as found in our cheap theaters and public halls, the use of tobacco, ice, and alcoholic drinks are irritating to these lesions. The use of the voice in laryngeal phthisis should be prohibited or moderated. This rule of rest or exercise is as important in laryngeal involvement as in the pulmonary varieties.

The influence of climate is well recognized by the profession and laity. In laryngeal infections that complicate a far advanced pulmonary involvement advice to remain at home is much more valuable than a recommendation to seek some indefinite place in the western country. Far advanced tuberculosis should be fought at home, and no patient should be allowed to seek new environment without sufficient financial resources. Usually a warm moist climate improves the inflammatory and catarrhal condition of the larynx, but as the pulmonary lesions do better in a dry, warm climate with altitude it is advisable to study the condition and, when possible, recommend sanatorium treatment in New Mexico, Arizona, or selected parts of Southern California. It is essential that medical supervision should be obtained for each patient, and the family physician or specialist

who firmly believes that climatic treatment offers for his special patient something of genuine benefit should direct him with great care to some competent practitioner or chief of a sanatorium in the region especially indicated. When the local lesion is in the early stage, these patients do well at a considerable altitude (6,000 feet).

Many cases under careful supervision improve satisfactorily in the lower altitudes—below three thousand feet—at which place they receive the full benefit of all therapy other than climate. Discomfort and distress are increased during the wind and dust storms of some of our favorite Colorado and New Mexico resorts.

Some remarkable arrests and cures have been obtained among laryngeal and pulmonary patients sent to an altitude such as Silver City, New Mexico, about six thousand feet. In this region the altitude is played against the latitude, resulting in cool or cold nights with warm or hot days.

Patients with tuberculosis of the upper air tract without much pulmonary involvement will improve and obtain great comfort from an ocean voyage to the Riviera or Egypt.

The numerous specifics that have been brought forward from time to time for the cure of the various forms of tuberculosis have failed to establish the claims made for them. Skepticism and therapeutic nihilism are unjustifiable, however, as usefulness may be found for many of the remedies, in selected cases. Unfavorable results in therapeutic procedure in tuberculosis of the upper tract are largely due to the fact that many of these manifestations, and the laryngeal forms in particular, are almost invariably attended by pulmonary infection of more or less virulence. In a large experience during twenty years the writer has not seen a case of primary laryngeal tuberculosis in private practice.

Among the modern so-called specifics may be mentioned tuberculin in various forms, with or without vaccines, sera and antitoxins, iodin, chlorid of gold and sodium, creosote, formalin, oil of cloves, and nuclein. In addition may be mentioned the X-ray and radium.

While brilliant results have been obtained when these sera or drugs were used the test of time has proved their failure. It is very important to differentiate between tubercular, chronic, and syphilitic laryngitis before a definite plan of treatment is adopted.

Tuberculin, the double-edged sword, stands out preëminently as the most useful remedy discovered up to the present time. The selection of the dose, a study of the individual, a most watchful care of the patient, and careful attention to the rules of administration are essential to successful treatment. Pottenger shows that we have manifest evidence of its value in tuberculous laryngitis, where in small infiltration and even ulceration great improvement and cure may be looked for in a large percentage of cases. Trudeau advances important rules for consideration. He ad-

vises a minute dose of 1/10,000 or 1/20,000 of a milligram of the solid substance of Koch's bacillen emulsion or 1/1,000 of a milligram of old tuberculin, increased very gradually, and at intervals that will produce as little disturbance as possible. At the slightest evidence of intolerance, such as irritation at the site of injection or slight temperature reaction, the interval should be lengthened and the dose diminished. No injection should be given for some days following a reaction. It is necessary to have the patient under observation for at least six months if this treatment is commenced.

In the writer's experience many cases have been favorably influenced by the use of Deny's filtrate (B. F.), beginning with 1/50,000 or 1/100,000 of a milligram and increasing with extreme care at weekly or bi-weekly intervals to avoid every possibility of a reaction. Failure comes from "beginning treatment with too large amounts; raising the dose too rapidly or at too short intervals; repeating the dose before all effects of a reaction have passed; increasing a dose after a reaction; neglecting malaise, headache, anorexia, increased temperature, cough, and expectoration as indications of a limit of tolerance." When a reaction occurs or when anemia is associated with the tuberculous lesions valuable assistance during the interval may be obtained by the hypodermic use of the green citrate of iron (gm. 0.05) and sodium arseniate (gm. 0.001). This method of medication saves a delicate digestive apparatus for other usefulness, and affords a stimulating and reconstructive treatment of great and as yet unrecognized value.

In cases mixed with syphilitic infection mercury and iodin will furnish the best results. The biniodid of mercury (gr. i), potassium iodid (℥ss), cinnamon water, and distilled water (℥ii) each in teaspoonful doses three times a day, will promote a startling effect in properly selected cases. Its administration in lesions of strictly tuberculous type is often detrimental and contraindicated. The use of phosphorus (gr. 1/100) in ten to fifteen minims of olive oil in capsule is beneficial in the more chronic cases. It should be given after a full meal and promptly discontinued if irritation of the stomach, urticarious eruption, or aphrodisiac effects follow its use. Symptomatic remedies are necessary to allay cough, temperature, pain, diarrhea, and mental distress from time to time. Heroin (gr. 1/12) or codein (gr. ⅛-1/6) are efficient drugs to relieve the irritation of the larynx. They should be administered with caution and not until decidedly indicated. Aspirin, guaiacol, and quinin will control temperature when necessary. If alcohol is demanded the malt beverages and preparations other than spirituous are preferable. Rectified spirits in milk is better than whiskey, brandy, or rum. While in diarrhea and pain opium or morphin may be necessary, although their use should be postponed as long as possible. Sleep may be secured by veronal or trional if absolutely indicated.

The prescribing of depressing drugs should be withheld from patients that offer a hope of cure, as the resistance may be undermined by the prostration, interference with elimination and normal digestion that attend their constant use.

The local treatment consists of the inhalation of gases or medicated air in sprays or powders and the application of drugs to the affected region. Among the many ingenious methods of local therapy that have been advocated from time to time, a few useful palliatives may be mentioned. Reference may be made to some special text-book if the complete list is desired.

Before treatment is administered, a spray of Dobell's solution should be used to remove secretion from the larynx. The application of formalin in gradually increasing strength is preëminently the most beneficial remedy. It should be prepared daily from a 40 per cent. solution. Until the tolerance of the larynx is obtained the pigment may be used in one-half per cent. strength, increasing to one and gradually to 10 per cent. Two per cent. cocain may be used if much pain is encountered. The preparation of Lake combines formalin (7 per cent.), lactic acid (50 per cent.), glycerin (20 per cent.), water (to 100 per cent.). The application of lactic acid (20 per cent.) is a favorite with many laryngologists. Iodoform insufflation is recommended highly by the older laryngologists. Orthoform and anesthesin are used for the relief of pain.

Freudenthal highly recommends fulguration for the cure of ulcerated areas. Argyrol (20 per cent.) is an acceptable substitute when irritation follows the use of formalin, lactic, nitric, or hydrochloric acid. Intralaryngeal injections of guaiacol (2⅛ per cent.), menthol and camphor (āā gr. ii) in olive oil are often beneficial in the relief of pain and cough. Deep injections of alcohol into the region of the nerves may be used to allay pain. The use of the X-ray is followed by dangerous reactions.

When these measures are not sufficient to modify or allay the ravages of disease, surgical intervention may be required. The lesions affecting the epiglottis may be removed by epiglottectomy as practiced by Lochard of Denver.

Curettage has been employed to remove the tubercular deposits. It is possible, however, to remove only a small portion of pathologic tissue by this method. It is advisable only in selected cases where other methods have failed.

When deglutition becomes very painful a spray of cocain (10 per cent.) before meals is justifiable. The Wolfenden position may be assumed with additional comfort in swallowing. The head is hung over the bed and the liquid drawn through a tube from the glass upon the floor. In this manner the patient drinks like a horse.

Laryngectomy, thyrotomy, or tracheotomy are rarely indicated in this disease. In the late ulcerative stage it may be necessary to administer an

occasional small dose of morphin hypodermically. Constitutional treatment may be of advantage in the earlier stages, in the form of cod-liver oil, malt, hypophosphites, or creosote.

SYPHILIS OF THE UPPER RESPIRATORY TRACT

Modern diagnostic methods of recent years, which include the recognition of the spirochætæ pallida and the deductions from the Wassermann reaction, have materially aided early specific therapy in luetic disease. The treatment consists of both local and general measures.

The general treatment may be commenced with the definitely recognized chancre. It consists essentially in the administration of well-selected preparations of mercurials and iodin or the use of salvarsan. The choice of preparation may be determined by the character and stage of the lesion. A definite plan of procedure should be laid out for each patient. For the primary and secondary forms mercurials predominate. We must decide upon a choice of hypodermic medication by salvarsan, intramuscular or intravenous, the hypodermic method of administration of mercury bicyanid, bichlorid, biniodid, salicylate, or calomel; the method by inunction, which consists of blue ointment, mercury vasogen, mercurettes, or the administration by mouth of blue mass, calomel, mercury protoiodid, bichlorid, etc. It is important to adopt one of these definite plans and adhere to it until the indications for a change of method or preparation are demonstrated.

In the later stages of the secondary form the mixed treatment is more efficient. This consists of a prescription containing the bichlorid or biniodid of mercury with potassium iodid.

When the disease is very active or the individuals under observation are particularly irresponsible or careless with the directions imposed it is necessary to use salvarsan or other hypodermic medication at once.

Before the use of salvarsan is undertaken a careful study of the patient with special reference to the condition of the heart, lungs, kidneys, and acoustic nerve should be made. It may be wise to explain possible dangers in its use and, if the intramuscular method is chosen, the fact that the injection is often quite painful should be mentioned. The amount of pain will depend upon the care with which the salvarsan is prepared and the site and method chosen for the injection. The average dose for intramuscular injection is 0.6 gram (9 gr.). When the intravenous method is selected the average dose for women is 0.3 gram (4½ gr.) and for men 0.4 gram (6 gr.). It is often necessary to repeat this dosage a second or third time, at intervals of three or four weeks. In feeble patients caution should be observed, and a small dose of 0.2-0.3 gram (3-4½ gr.) administered. This may be repeated in a couple of days.

For children 0.2 gram and for infants 0.02-0.05 gram are advised.

It is exceedingly important that the chemist or pharmacist should prepare salvarsan for use with the greatest care and detail. Instructions prepared by Elsner and others are readily obtained.

The marvelous and astonishing results in lesions of the upper respiratory tract are second only to those from the use of diphtheria antitoxin.

The local auxiliary treatment for primary infection should consist of mild, cleansing topical applications with a view to removing adherent secretion and modifying the character of the local disturbance. Sprays of peroxid of hydrogen, Dobell's solution, or 1:4,000 bichlorid are useful.

In the ulcerative forms permanganate of potassium, two grains to the ounce, may be chosen with advantage. Nitrate of silver (10 to 30 grains to the ounce) or the insufflation of iodoform, aristol, or calomel may be used with advantage. In sluggish ulceration lactic acid (20 per cent.) or trichloracetic acid may be used to sear over the diseased area. The general hygiene, and especially the toilet of the mouth, should be strictly enforced. Frequent simple or hot saline baths aid materially the action of mercury and the iodids.

If the hypodermic use of mercury is desired a painless preparation of 1/20 to 1/40 of a grain of cyanid of mercury may be obtained. Hypodermic iodin (5-10-20 per cent.) in almond oil (iodoleina) may be used also when patients fail to take these remedies well by mouth.

In the treatment of congenital syphilis no preparation is more satisfactory than mercury with chalk. In infants the body band may be smeared with mercurial ointment daily.

The sequences of syphilis demand special treatment to suit the individual case. Impending stenosis must receive daily dilatation by properly selected methods and instruments. Laryngeal stenosis may require intubation, tracheotomy, or the passage of Schroetter's tubes. A few experts in the rhinolaryngological field obtain good results in the relief of old cicatricial deformities. In cartilaginous and bony necrosis the sequestra should be removed at the earliest moment of sufficient separation. The relief of "saddle nose" may be obtained by the use of parrafin or suitable operative procedure. Gummata or ulceration in the trachea may be examined by the Jackson tubes and appropriate local treatment applied.

CHAPTER III

DISEASES OF THE BRONCHI

ROBERT D. RUDOLF

ACUTE BRONCHITIS

Acute catarrh of the respiratory tract is usually a widespread affection, involving more or less of the mucous membrane which extends from the upper air passages to the point where the bronchioles terminate in the air vesicles of the lung. The catarrh may not stop here even, but may involve the air vesicles themselves, producing the common complication of capillary bronchitis—catarrhal pneumonia.

Acute bronchitis is not a specific affection, but may be due to divers causes, and before attempting to take charge of a case it is necessary for the practitioner to endeavor to find out the exact etiological nature of it. Is it a primary infection of the respiratory mucosa, or is the catarrh secondary to some general condition, such as mitral stenosis, congenital heart trouble, or some toxemia, such as gout, uremia, etc.?

THERAPY

The amount of care necessary in a given case of catarrh of the respiratory tract depends upon two things: (a) The severity and extent of the inflammation; (b) the general condition of the patient. Thus, as regards the first factor, the treatment of a cold in the head and a laryngitis is a very much less urgent thing than when the same catarrh reaches down to the bronchioles. Again, as regards the second factor, what would in a healthy adult be a very trifling attack of bronchitis, requiring very simple treatment, may, in the case of a frail and aged person, be attended with the greatest risk to life, and must be combated in every possible way. For these reasons, many writers classify their cases of bronchitis as regards the therapy into: (1) catarrh of the trachea and larger tubes; (2) catarrh of the smaller bronchi and bronchioles. The division is rather artificial, as the classes merge so gradually into one another; but, although it is not done in this chapter, the reader will always use his discretion as to how much therapy a given case requires.

Environment.—People with a tendency to acute bronchitis should be carefully guarded against exposure to chills and to rapid changes of temperature, such as the leaving of a heated room for the colder air outside. Often it seems also that hot stuffy air itself is the cause of an attack, even if not followed by exposure to cold, and many people have learned by bitter experience to avoid crowded and heated rooms on this account.

Patients, however, should be cautiously hardened against the evil effects of chill by free exercise in the open air and by the careful use of cold baths and sponging followed by a rapid and vigorous rubbing with a coarse towel. Salt baths are here specially useful, the salt seeming to have a stimulating effect upon the skin, thus promoting a good reaction. To make a salt bath, rock salt should be added to the water to make a 1 per cent. solution. The strength may be increased to 5 per cent. if the reaction from the weaker bath be not sufficient. If a cold bath or sponging is doing good, it should be followed by such a reaction as to produce a sensation of glowing; if this does not occur, but instead the patient remains shivery, with "goose skin" and bluish extremities, then the cold water should not be used, being replaced by a warmer solution. A short immersion in really cold water will often produce a better reaction than will a longer one in less chilly water. As a rule the bath should be between 65° and 75° F.

It often becomes necessary for people with a tendency to bronchitis to avoid the winter months in a cold climate altogether. Where this is possible, they should select a place having a warm and equable climate. Bermuda, Florida, Arizona, New Mexico, and Southern California, on this side of the Atlantic, and the Isle of Wight, the Channel Islands, Madeira, and Teneriffe, on the other, are all excellent in this respect.

The spring is usually the most trying time for such people, and one frequently sees the mistake made of their returning to their northern homes, after a winter spent in the south, too soon, with a resulting attack of acute bronchitis. No sufferer from bronchitis who has gone south for the winter should return until all probable danger of cold weather has passed. It is a good plan for them to come gradually north, stopping occasionally for a few days at intermediate places, rather than to do the long journey in one stretch.

By thus avoiding the winter for one or two seasons, predisposed individuals may lose their predisposition, and afterwards may go safely through the trying cold season without an attack.

Where, for financial or other reasons, it is out of the question for the individual to go south, then it may be necessary for him to remain indoors during the cold months. This point will be further discussed under the heading of chronic bronchitis.

Nothing predisposes so much to an attack of acute bronchitis as a previously existing chronic inflammation of the mucous membrane, and

hence patients with this chronic condition should be specially looked after and guarded against any of the causes of an acute attack. When he goes into the cold air he should be cautioned to breathe through the nose, and the wearing of a respirator is often advisable, especially in the aged. Where the upper air passages are the seat of adenoids, enlarged tonsils, or nasal polypi, these abnormalities should be attended to and if necessary removed, as they cause mouth-breathing and, further, are apt to be the local cause of a catarrh, which may then become more widely spread. The nasal passages are the natural warmers of the inspired air (*vide* Chronic Bronchitis).

An individual actually suffering from acute bronchial catarrh is best in bed, and he should remain there as long as there is any fever. In such an environment he will get over the attack more speedily than he will otherwise do, even if he stay in one room. Even where the catarrh is limited to the upper air passages, recovery will be more speedy if the patient take to his bed for a day or two.

The air of the room should be kept fresh by free ventilation, but should not be cold, and the patient should be kept out of draughts. Many modern clinicians believe that the temperature of the sick room does not matter much so long as the air be pure, but, in the writer's opinion, bronchitic cases should not be exposed to such cold as may with impunity and even benefit be allowed in cases of lobar pneumonia and pulmonary tuberculosis. Cold air acts as an irritant to the inflamed bronchial mucous membrane, apart from any danger of chilling of the surface of the body, and a bronchitic patient soon finds how a breath of cold air makes him cough.

An atmosphere at a temperature of about 65° F. is probably the best, and care should be taken that the room does not become much colder than this. The greatest risk of this is in the early hours of the morning, when the furnace is apt to become low.

A Turkish bath will sometimes cut short an acute bronchial catarrh if taken at the very beginning of the attack. Short of a Turkish bath, a thorough sweating, produced by the use of a hot air bath, may act in the same beneficial way. Folding cabinets for this purpose are obtainable and are often very efficacious. The patient is undressed and wrapped in a blanket and allowed to stay in the hot air bath for from ten to twenty minutes. While there he should have a cold wet towel round the head and should drink freely of lemonade or some alcoholic drink as directed. The Imperial Drink, made by dissolving a teaspoonful of acid tartrate of potash (purified cream of tartar) in a pint of boiling water and then adding a slice of lemon peel and sugar to taste, and taken cold, is useful here as a diaphoretic and diuretic, and is very refreshing to the fevered patient.

The Turkish bath, or hot air bath, should only be used where the patient can go at once to bed, and if this be impossible it is best not to use either at all. Many an individual gets more harm than good from taking a Turkish bath and then going out in the cold soon after it.

A moist, warm atmosphere has a soothing effect upon the inflamed mucous surfaces, and, in severe cases, it is well to surround the patient's bed with a tent, into which steam is introduced.

The steam may be got from a "bronchitis kettle" made for the purpose, but one may be easily improvised by attaching a cone of brown paper or thin cardboard to the spout of a kettle. The steam should not be directed toward the patient's face, but rather in the direction of the foot of the bed. This is a practical point, which is often neglected, with the result that the respiratory tract is irritated by a too hot vapor.

The patient should be kept very quiet, the act of speaking often being sufficient to produce a fit of coughing. With this end in view it is often wise to exclude friends.

In the dry, irritable stage of the disease, especially when the larynx is involved in the catarrh, the act of coughing tends to further irritate the mucous membrane, and thus a vicious circle is established. To tell the patient not to cough is often a counsel of perfection, and yet, by getting him to so endeavor, many unnecessary spells of coughing may be avoided, and thus the inflamed parts are at least partially rested.

In severe cases the calls of nature must be attended to in bed, and in all cases the patient should be specially protected from chills when attending to these needs.

Every sufferer from bronchitis has *some* dyspnea, and this may be so marked that he may require to be propped up in bed. As he improves this propping up will be less needed, and the fact that to-day he can do with a pillow less than yesterday is one of the most certain signs of improvement.

In severe cases the patient should not be left in one position too long, and the nurse must be instructed to shift him from side to side at frequent intervals in order to lessen the chances of circulatory and bronchial *stasis* in any one part of the chest.

William Ewart (20) emphasizes the value of mechanically aiding expiration in cases of acute bronchitis complicating emphysema. The expiration, which should normally be a passive act, becomes, as a result of the loss of elasticity of the lungs, an active one, and hence tends to tire the patient. The trained nurse, or the physician, should place the hands over the axillary bases of the lungs and exert carefully timed pressure here, synchronously with expiration. The effect is to tend to eject some of the secretion further up the respiratory tract, whence it may be more easily coughed up. The method is specially valuable and necessary in

the aged and feeble. It should be repeated for a few minutes several times in the twenty-four hours.

Diet.—Patients suffering from acute bronchitis have fever, and on general principles their diet should be light and digestible, as here, as in all cases of fever, the digestive powers are more or less limited. Milk should be the staple food, and, in addition, milk puddings, gruel, jellies, soups, and other light things may be added.

Warm mucilaginous or slightly alkaline drinks are comforting to the patient, and in the early and dry stage of the catarrh act as expectorants, diminishing the tenacity of the sputum and in this way aiding the cough. Barley water, linseed tea, thin gruel, and oatmeal water are all useful here, and soda or potash water with milk is an excellent drink.

The addition of some whiskey, cognac, or rum to such drinks at bedtime in many cases, especially with aged patients, secures a better night's rest.

Although a largely fluid diet is generally advisable in acute bronchitis, it may occasionally be wise to allow adult patients, who happen to dislike fluids, to have more solid articles, such as lightly boiled eggs, puddings, with bread and butter.

In the slighter cases of acute bronchial catarrh a hot bath, a hot bed, a hot drink of gruel and whiskey, with ten grains of Dover's powder, at bedtime may be sufficient to bring him back to the normal by next day.

If there be any constipation it is well to give a mercurial purgative, such as calomel or blue pill, followed in either case by some saline next morning, at the commencement of the attack.

Specific Treatment.—Bronchitis is not due to any one infection as a rule, and it is usually beyond our powers to attack it by any specific therapy. Within recent years various vaccines have been used, but these have chiefly been employed in the more chronic and persistent forms of the disease (*vide* Chronic Bronchitis).

Camphor.—Many people think, and probably with some reason, that they can cut short or lessen a respiratory catarrh by the early and free use of camphor internally. One grain (0.066 gm.) may be given every two hours or so, either by itself in pill or capsule form, or it may be combined with other ingredients. A useful prescription is one suggested by Dr. Arthur Newlin, as follows:

℞			
	Codeinæ sulphatis	gr. 1/16	0.004 gm.
	Camphoræ monobromatæ	" 1/2	0.030 "
	Aspirin	" v	0.300 "

Misce et fiat capsula.

Sig. One capsule to be taken every three hours.

Quinin.—Quinin is much used by the laity for checking a catarrhal fever, and seems to have some good effect. A useful prescription in feverish colds is as follows:

℞ Quininæ sulphatis ..... gr. i 0.06 gm.
Phenacetini ..... " ii 0.15 "
Sodii salicylatis ..... " iii 0.20 "
Misce et fiat capsula.
Sig. Take one capsule every four hours.

It is often a good plan to give two of these capsules for the first dose and then follow with one every four hours.

Symptomatic Therapy.—The natural tendency of an acute respiratory catarrh is to disappear, and, in most cases, as already said, if the patient be kept warm and at rest, the disease will more or less rapidly go through its phases of congestion, secretion and final drying up of this, and will leave the mucous membrane none the worse for the invasion. In coryza, where inflammation of a mucous membrane may be watched and directly studied, the first stage is seen to be one of engorgement, the membrane being swollen and reddened, so that more or less complete obstruction of the nasal passages occurs. Next follows the stage when there is free secretion of a watery exudate, which is accompanied by great relief of the engorgement and consequent ease to the sufferer. In the third stage the secretion becomes scantier and mucopurulent, and then gradually dries up and disappears. In catarrh occurring further down in the respiratory tract very much the same stages are gone through. As a result, the patient first has a dry and irritable cough, with some dyspnea due to obstruction from the swelling of the mucous membrane. There are usually also substernal discomfort and even pain from the same cause. Next, as the secretion becomes established, the cough grows freer and productive of a thin and often frothy expectoration. Finally this secretion becomes thicker and scantier and then disappears.

Much may be done by appropriate treatment to lessen the patient's discomfort as he passes through these stages, and, by a proper medicinal and other therapy, we are often able to hasten his return to the normal, and even to bring this about when otherwise it might not occur.

At the onset of every acute respiratory catarrh, as already mentioned, it is a wise plan to give a purgative. A useful one is the following:

℞ Pilulæ hydrargyri
Pilulæ colocynthidis et hyoscyami āā gr. ii to v (0.15—0.35 gm.).
Misce, fiat pilula.
Sig. One at bedtime, followed by a Seidlitz powder in the morning.

Or the following:

℞ Pilulæ hydrargyri
Extracti colocynthidis compositi
Pilulæ rhei compositæ..... āā gr. 1½ 0.10 gm.
Extracti hyoscyami..... gr. ½ 0.03 "
Misce, fiat pilula.
Sig. One at bedtime, followed by a saline next morning.

Or the patient may be given half to two grains (0.03 to 0.12 gm.) of calomel at bedtime, with a saline next morning.

Local Treatment.—Linseed Poultices.—In the early stage of acute bronchitis the application of *linseed poultices* to the chest gives great relief. The poultices must be light and as hot as they can be borne, and, if properly made, are a great comfort to the patient. But a badly made, perhaps lumpy, heavy, and half-cold poultice is worse than useless, and if the practitioner cannot be sure of having them well made he had better do without them.

Poultices should be renewed every two hours. It is often a good plan to put one on for two hours, then replace it by a cotton wool jacket for two hours, then a poultice again for two hours, and so on.

Mustard Poultice.—A mustard poultice over the upper sternal region is often useful. It may be left on for ten to twenty minutes, and upon removing it the skin will be found to be reddened, and should then be smeared with vaselin. On no account should the poultice be left on indefinitely, or, as one sometimes hears, for "as long as the patient can stand it," for after some minutes the oil of mustard acts as an anesthetic and, without much discomfort to the patient, a severe burn may be inflicted. Slight burns from this cause are commonly seen, but very severe ones may occur, as in a case seen by the writer, where an infant was so badly burned that it died, and at the *post mortem* it was found that the ribs and sternum were included in a deep slough.

Mustard Leaves.—"Mustard leaves" are used in the same way and may be left on for about the same time, although they are less severe than the poultice.

Turpentine.—Turpentine is a favorite external application in acute bronchitis. It may be sprinkled upon a cloth, which is then applied for ten to twenty minutes, or it can be used in the form of a *turpentine stupe*. The stupes should be renewed every four hours, and after the first one or two the turpentine is best omitted.

Stimulating Liniments.—In the slighter cases of acute catarrh, and in most cases later on, *stimulating liniments* are valuable. They are usually rubbed over the whole chest night and morning and, by keeping the skin reddened, seem to relieve the deep congestion.

Turpentine is the drug most commonly used for this purpose, either in the form of the *linimentum terebinthinæ,* or, if this be not strong

enough to redden the skin, then as the *linimentum terebinthinæ aceticum* (*B. P.*). The latter is an imitation of the celebrated St. John Long's Liniment. A useful addition to the ordinary turpentine liniment is the one suggested by Kingston Fowler, which consists in the adding of a drachm of the tincture of iodin to each ounce of the liniment. In severe cases, where the dyspnea is marked, dry, or even wet, cupping over the roots of the lungs in front and behind is a useful measure.

Leeches.—The application of six or eight *leeches* over the roots of the lungs is often valuable in such cases. Where leeches are used it must, of course, be seen that the bites have stopped bleeding before the patient is left, as neglected leech bites may bleed very severely. The bleeding is easily stopped, as a rule, by the application of powdered alum, over which pressure is applied by means of tightly rolled absorbent cotton kept on with strapping.

Cold.—Some practitioners prefer to apply cold rather than heat to the chest in acute bronchitis. An ice bag may be used, and it is necessary to see that this is only partially filled with finely broken ice, and that all the air is excluded before the bag is closed. If these small details be not attended to, the bag does not lie comfortably on the chest, or indeed on any part of the body. Or cold may be applied in the form of a cold compress. Such compresses should be changed rather frequently, say every 15 or 30 minutes, but even if left on for several hours seem to give relief; as long, indeed, as any moisture remains in them.

The Priessnitz compress, so highly recommended by Ortner of Vienna, consists of a cloth wrung out of water at room temperature, with a hot cloth bound over it. As soon as the inside compress is dry it should be renewed, and after it is finally removed the chest should be thoroughly rubbed, sometimes after it has been first sponged with cold water. As Ortner says, the action of this compress is not exactly understood, but it appears to be somewhat as follows: The cold application at first causes an active contraction of the cutaneous vessels. As soon as the cold bandage is warmed by the application of the hot one over it, this contraction gives place to active dilatation combined with a sustained tone of the vessels, which persists for some time and causes an active hyperemia of the skin. By the initial application of cold the nervous centers are reflexly stimulated, the breathing is momentarily deepened, and the nervous tone of the vessels is increased. By the alternate action of the heat and cold the innervation of the internal organs is stimulated reflexly and the secretion of the diseased bronchial mucous membrane and the circulation in the lungs are favorably affected. In some cases, owing to the low tone of the patient, the cold compress remains cold even after it is covered by the hot bandage, and the patient experiences an unpleasant feeling of chilliness until it is removed. In this case it is well to use,

instead of the outer flannel, a piece of oiled silk or rubber tissue. This will probably prevent the feeling of chilliness.

Vapors.—There are many means by which *applications* are directly made *to the inflamed mucous surface.* The most common one perhaps is the inhalation of vapor from hot water, either alone or impregnated with some medicinal agent. As already stated, when it is thought necessary to use a steam kettle, the spout, or cone connected with the spout, should not be directed toward the patient's face, but rather toward his feet, when the patient is in bed with a tent over it. *Compound tincture of benzoin*—Friar's Balsam—is commonly added to the water in the kettle, a teaspoonful or so being put in, and as a result the vapor becomes loaded with the volatile ingredients of the preparation. In slighter cases vapor may be inhaled from a jug over which a folded towel is so placed as to direct the vapor toward the face. The water in the jug should not be at boiling point, but at a temperature of about 150° F. This temperature may be roughly attained by mixing equal parts of boiling and of tap water. On the surface of the water may be thrown Friar's Balsam or any other medicament which it is desired to use. Such moist inhalations have a very soothing effect, and may be repeated with advantage every hour or so, each period of inhalation lasting for about five minutes. A pleasant preparation to be used in this manner is one recommended by P. Claisse (11), as follows:

℞			
	Menthol	gr. i	0.060 gm.
	Tincturæ benzoini	min. x	0.600 c. c.
	Olei eucalypti	min. v	0.350 "
	Alcoholis (90 p. c.).....	ad dr. i	4.000 "

Misce, fiat mistura.

Sig. This amount to be placed in a little hot water and inhaled for five minutes.

Sprays.—Sprays are often valuable in acute respiratory catarrh, especially when the inflammation involves the trachea and mucous membrane higher up than the bronchi. Seiler's solution may be used here, or a spray containing the following: Sodium bicarbonate, 10 grains (0.600 gm.); glycerin of carbolic acid, 1 drachm (4.0 c. c.), in an ounce (30.0 c. c.) of rose water. There are a great variety of such sprays used by the profession, the chief points of similarity between them being that they are alkaline and often saline and contain some aromatic antiseptic. Such sprays should be used warm and should be frequently repeated.

In the later stages of acute catarrh the inhalation of *eucalyptus* appears to lessen the secretion and give comfort to the patient. He may inhale the pure oil from a handkerchief or from a Burney Yeo zinc inhaler. A valuable mixture to be thus used is the following:

℞ Menthol 1 part
Eucalyptol 2 parts
Benzoinol 3 parts
Misce et fiat mistura.
Sig. Inhale frequently.

Even more soothing is the following:
℞ Menthol
Eucalyptol
Terebene
Chloroform, equal parts.

Turpentine may be inhaled in the same way, and is often useful in the later stages of a catarrh. It is too irritating for some patients, and may then be advantageously combined with equal parts of spirit of chloroform.

Internal Medication.—Laxatives.—As already stated it is well to begin the treatment of a case of acute bronchitis with a laxative.

Many drugs are used with the objects of lessening the fever and modifying the bronchial secretion.

As regards the latter indication, the bodies chiefly used in the early stages of the disease belong to the class of so-called soothing or nauseating expectorants, of which class ipecacuanha, antimony, and various alkalies are the chief members.

Expectorants.—The whole subject of the use of expectorants is at present in a state of chaos. From a pharmacological point of view many of the drugs which clinicians have found to be of most value are without expectorant effect, while, on the other hand, others which are most effective according to laboratory experimental evidence do not find favor with the practitioner. Probably a reason why these differences of opinion exist is that the two classes of observers are dealing with different tissues, the clinician using diseased subjects for his work, while the pharmacologist does most of his experiments upon normal animals or people. A diseased mucous membrane may react quite differently to a normal one. Moreover, the reports of different pharmacologists upon the expectorant action of the same drugs differ widely from each other in many cases; so much depends upon the way in which the experiments are done, the dose used, the kind of animal employed, the anesthetic given, etc., etc.

It must for the present be admitted that the employment of drugs in the treatment of bronchial affections is more of an art than a science. No doubt the tendency has been in the past to use expectorant mixtures with too free a hand, but they have their place, and, when skilfully employed, undoubtedly decrease the discomfort of the patient and hasten recovery.

F. Forchheimer (26) probably expresses the opinion of most thinking clinicians when he says: "Experiment has taught me that the expec-

torants are very untrustworthy, but I should not like to be without them."

In a mild case of acute bronchitis such a mixture as the following will be found to promote the patient's comfort and hasten the onset of free secretion:

℞			
	Vini ipecacuanhæ		
	Potassii acetatis	āā dr. i	āā 4.00 gm.
	Spiritus ætheris nitrosi	dr. ii	8.00 c. c.
	Syrupi tolutani	oz. ½	15.00 "
	Liquoris ammonii acetatis	ad oz. iii	100.00 "

Misce, fiat mistura.

Sig. A dessertspoonful in water every four hours.

If the cough be very irritating a little opium may be added to each dose—for example, ten drops of the camphorated tincture of opium (paregoric).

Antimony acts powerfully as a depressing expectorant. It is usually given as the wine of antimony, and quite small doses frequently repeated are useful, and, in fairly strong patients, are free from depressing effects.

℞			
	Vini antimonii	dr. i-ii	4.00-8.00 c. c.
	Liquoris morphinæ hydrochloridi	dr. ½	2.00 "
	Liquoris ammonii acetatis	oz. ii	60.00 "
	Syrupi tolutani	oz. ½	15.00 "
	Aquæ chloroformi	ad oz. vi	ad 200.00 "

Misce, fiat mistura.

Sig. A tablespoonful every four hours.

In sthenic individuals with high fever *aconite* is often used. It is best given in small, frequently repeated doses; thus one drop of the tincture (B. P.) is given every 15 minutes until the skin becomes moist and the pulse slower. Then this may be replaced by a mixture containing ipecacuanha or antimony, such as one of the above. It should be noted that the American tincture of aconite is double the strength of the British. It is well to remember that preparations of aconite quickly deteriorate and even with good preparations the effect is very uncertain.

Apomorphin is a good deal used as a depressing expectorant at the early stage of the disease. It may conveniently be given in a mixture, such as the following:

℞			
	Apomorphinæ hydrochloridi	gr. ½-⅔	0.02-0.04 gm.
	Acidi hydrochlorici diluti	ʒjs	6.00 c. c.
	Glycerini	oz. ½	15.00 "
	Aquæ destillatæ	ad oz. vi	200.00 "

Misce, fiat mistura.

Sig. A tablespoonful every two to four hours.

Pilocarpin is used a good deal in Germany for increasing the flow of bronchial secretion in early cases. It should be given in doses of 1-20 to 1-10 grain (0.003-0.006 gm.) thrice daily in the form of the nitrate, by mouth, or hypodermically in rather smaller doses.

The use of *opium* or its preparations in acute bronchitis requires great care and discrimination. When used in the dry and irritable stage of the disease in small doses it is often of the greatest value in easing the wearing and useless cough; but, on the other hand, it should never be given in cases attended with a profuse secretion, and in suffocative ones. In such patients we dare not lessen the sensitiveness of the mucous membrane and thus reduce the cough upon which the patient's very life may depend.

The following prescription is a useful one:

℞	Extract opii	gr. 1/8	0.008 gm.
	Extracti stramonii	gr. 1/6	0.010 "
	Misce, fiat pilula.		
Sig.	One every two hours.		

Codein is often a useful drug where an opium preparation is indicated. It goes well with ipecacuanha wine and spirit of chloroform, as in the following mixture:

℞	Codeinæ phosphatis	gr. vi	0.400 gm.
	Vini ipecacuanhæ	dr. ii	8.000 c. c.
	Spiritus chloroformi	dr. ii	8.000 "
	Aquæ	ad oz. iii	100.000 "
	Misce, fiat mistura.		
Sig.	A teaspoonful every four hours.		

Such a prescription would be appropriate in the early and dry stage of the acute disease.

Heroin hydrochlorid (diacetyl-morphin hydrochlorid) is an artificial alkaloid prepared from morphin, and has been advocated as a substitute for morphin in respiratory conditions. It appears to act more strongly upon the respiratory center than does morphia and less upon the cerebral functions. On the whole, according to A. R. Cushny, experimental and clinical evidence point to the fact that the drug deserves a place between morphin and codein. It may be given in doses of 1/24 to 1/16 of a grain (0.002-0.004 gm.) either by the mouth or hypodermically.

Soporifics.—Sleeplessness is often a marked feature in acute bronchitis and may require to be specially met. *Opium* should never be given in such a case to "obtain a good night's rest." *Veronal* in doses of 5 to 7 grains (0.300-0.400 gm.), *sulphonal* in doses of 15 to 20 grains (1.00-

1.30 gm.), or *paraldehyd* in doses of half to one drachm (2.00-4.00 c. c.) are preferable. The last named drug is very valuable as a non-depressing hypnotic. It has a most objectionable taste and odor, but may be fairly easily given as a mixture, flavored with syrup and licorice, or else in capsules. It may also be given by the bowel.

Chloral hydrate is often useful in the sleeplessness of acute bronchitis, but its effects must be closely watched. It is perhaps best to give a small dose, which may be repeated once or twice during the night at the discretion of the attendant. The B. P. syrup contains 10 grains of the drug in each drachm, which is a small dose.

Other useful and comparatively harmless hypnotics are *chloralamid,* which produces chloral by its decomposition in the body, and has less effect upon the circulation than has that powerful drug; *trional,* and lastly *bromural.* Chloralamid is given in doses of 15 to 45 grains in cachet, or dissolved in a weak spirituous or acidulated solution; trional, in 10- to 20-grain powders or in cachets; and bromural, probably the mildest of all of those mentioned, in doses of 10 to 15 grains.

If hypnotics require to be used for some time, it is wise to vary them, and as a rule not to give them oftener than every second or third night.

When, in acute bronchitis, the secretion is well established, expectorants are not much required, but many use here, with apparent benefit to their patients, the so-called stimulating expectorants. These give relief and appear to make the expectoration come away with more ease and then dry up rapidly and disappear.

Stimulating Expectorants.—The stimulating expectorants most commonly used are *squills, senega* and *ammonium carbonate.* For example:

℞	Ammonii carbonatis	½ dr.	2.00 gm.
	Tincturæ scillæ	3 drs.	12.00 c. c.
	Syrupi tolutani	½ oz.	15.00 "
	Infusi senegæ	3 ozs.	90.00 "
	Aquæ chloroformi	ad 6 ozs.	200.00 "

Misce, fiat mistura.

Sig. A tablespoonful every four hours.

If the cough be troublesome, a little opium may be added to this mixture, but, as already said, this must be done with great caution, if at all, when the secretion is very free.

Belladonna.—In bad cases of bronchitis, where the dyspnea is marked and there appears to be extensive involvement of the bronchioles, belladonna is valuable, in that it lessens the secretion and at the same time stimulates the respiratory center. The same is true when the bronchitis is complicated by pneumonia, and in such cases it is well to push the

belladonna until the pupils dilate and the mouth becomes dry and the skin flushed. In the bronchopneumonia of children this treatment seems to be of special value. When wheezing is a marked feature of a bronchial attack belladonna is useful in relieving this asthmatic tendency.

Sydney Ringer (67) and William Murrell (54) have both very strongly recommended the use of belladonna in the secreting stage of acute bronchitis, and the writer has frequently seen the great value of it here. N. T. Davies, of Sherborne (14), speaks of its "magic effects" when used in acute bronchitis, and, indeed, in asthma also, as an *inhalation*. He recommends one grain (0.065 gm.) of the extract of belladonna dissolved in half an ounce (16 c. c.) of warm water in a Dr. Siegel's inhaler. The writer has no experience of this method, but it should be valuable, as drugs are very rapidly absorbed from the respiratory tract, and one would get both the local and also the general effects of the atropin.

Lobelia.—The ethereal tincture of *lobelia* is also much used here, in doses of about ten drops. Its action resembles that of belladonna.

Measures for Relief of Cyanosis.—Cupping.—When any cyanosis exists the likelihood is that the right heart is overstrained and tending to give way, and remedies must be used for its relief. *Dry cupping* over the sternum and scapulæ is valuable here. It is indeed a remedy, the good influence of which has been independently discovered by most races the world over. Where the distress is very severe *wet cupping* may be employed. A scarifier is convenient, but by no means necessary, for this, as a few preliminary shallow incisions with a sharp scalpel are all that is required. A Bier cup is specially useful where wet cupping is to be done, as the suction may be regulated in a way that is not possible where the vacuum is obtained by burning spirit. A few leeches over the roots of the lungs act in much the same way. If these milder methods of relieving the cyanosis be not sufficient, then *bleeding* from a vein in the arm, or even from the external jugular vein, may be practiced, with great relief. The removal of 5 to 15 ounces of blood is usually sufficient. In very severe cases the blood may not flow from the opened vein, and it may be then assisted by gentle aspiration with a syringe.

Strychnin.—In these distressing cases hypodermics of strychnin are of great value, and 1/30 grain (0.002 gm.) may be given every three or four hours with advantage.

Inhalation of Oxygen.—The value of this measure is very differently gauged by different observers, but undoubtedly it has some action in lessening cyanosis, and in the writer's opinion should never be neglected in severe cases where this lividity is marked. Ortner says here (58): "In cases of dyspnea, cyanosis, marked diminution of the respiratory surface, and coincident weakness of the heart, the above mentioned hydropathic measures may be supplemented by the inhalation of oxygen. If 25 gallons at least are inhaled daily, good results often

appear, although we may not be able to explain them theoretically. The breathing and heart action are slowed, and the subjective symptoms are much improved, showing that, owing to the inhalation of oxygen, more oxygen has passed into the blood and tissues. Michaelis, of Leyden's clinic, has recently given confirmatory reports in this connection."

C. S. McVicar (49) two years ago, in a critical study of all the cases of bronchopneumonia treated in the Sick Children's Hospital in Toronto for the previous seven years, stated that more evident good resulted from the use of oxygen than from any other one method or remedy employed.

The idea naturally occurs that in desperate cases oxygen gas might be administered directly into the tissues, and several writers have urged the value of this method. Recently Dr. Sacquépée, professor at the Valde-Grace, read an interesting paper before the Société de Médecine Militaire Française on the use of oxygen in this way in acute respiratory conditions. The treatment is purely symptomatic, but rapid relief to the distressed breathing is seen, the heart beats are slowed and the blood pressure rises. Rapin mentions a case (66) where a child of 14 months was apparently *in articulo mortis* from diffuse bronchitis of both lungs. The child was unconscious, cold, cyanosed and the pulse was imperceptible. Various remedies were tried without effect, including the inhalation of oxygen. Then this gas was injected under the skin of the thigh. The immediate effect was to raise the temperature locally, and the lividity of the skin here was replaced by a rosy color. The dyspnea became relieved and the pulse perceptible. The treatment was cautiously continued, first in one thigh and then in the other, and the patient recovered. Experiments on rabbits gave the following results: (1) An animal which has received a prophylactic injection of oxygen under the skin resists asphyxia longer than does a rabbit not so prepared. (2) Existing asphyxia can be relieved by the hypodermic introduction of oxygen, and the pulse simultaneously improves. (3) If asphyxia is pushed until the corneal reflex is abolished, the injection of oxygen permits of recovery, even though the duration of apnea has been prolonged beyond the period fatal in control animals. The method would probably prove of service in any condition characterized by cyanosis and asphyxia. The apparatus is simple: a rubber tube is connected by a stop-cock with a gas bag full of oxygen. The other end of the tube is lightly plugged with sterile cotton wool, and then connected with a large-bore hypodermic needle. The method certainly seems to merit trial.

Emetics.—Occasionally, when the bronchial secretion is excessive and the power of coughing it up is insufficient, an emetic is valuable and even life-saving. Emetics are chiefly given in children; they should be used with caution where the pulse is weak. Any sign of pulmonary collapse, however, is an urgent indication for such therapy in strong patients. For an adult, 20 grains (1.35 gm.) of powdered ipecacuanha or half an ounce

of the wine will usually be sufficient. Mustard and water is a useful and relatively non-depressing emetic, and should be given in the strength of a tablespoonful of mustard dissolved in a tumbler of warm water. Apomorphin hypodermically administered is very certain in its effects, but gives rise to a good deal of depression and hence should be used with caution. The hypodermic dose for the production of emesis is 1/20 to 1/10 grain (0.003-0.006 gm.), and it usually acts within five minutes of administration.

When the acuteness of an attack of bronchitis has passed away and the fever is more or less gone, occasionally the cough remains trying and the sputum thick and difficult to get rid of. In such cases *potassium iodid* in small doses thrice daily is valuable.

Ammonium chlorid is also here much used. The dose is 5 to 20 grains (0.3 to 1.3 gm.), and the unpleasant taste may be partially covered with the liquid extract of licorice, or it may be given in a mixture somewhat as suggested in Squire's Companion to the British Pharmacopœia.

℞			
	Ammonii chloridi	dr. ii	8.00 gm.
	Syrupi limonis	oz. ½	15.00 c. c.
	Spiritus chloroformi	dr. i	4.00 "
	Aquæ	ad oz. vi	200.00 "

Misce, fiat mistura.

Sig. A tablespoonful every two to four hours.

The official lozenges, each containing two grains (0.3 gm.) of the drug, are useful.

Potassium bichromate has been recommended by E. G. Paxton (63) and others at this stage of the disease, where the sputum is thick and tenacious and hard to bring up. The usual dose is 1/64 grain (0.001 gm.) every hour or two.

On the other hand, in some cases, late in the disease, the sputum remains or becomes very profuse. Here the *mineral acids*, especially the nitro-hydrochloric acid in doses of 5 to 20 minims (0.3 to 1.3 c. c.), appear, in some obscure way, to lessen this excess. Most hospitals have an acid expectorant mixture for this purpose, such as the one at St. Bartholomew's, which is as follows:

℞			
	Acidi nitrohydrochlorici diluti	min. x	0.60
	Tincturæ aurantii	min. xx	1.25
	Aquæ chloroformi	ad oz. i	30.00

Misce, fiat mistura.

Sig. Thrice daily after meals.

With it may often be advantageously combined five to ten drops of tincture of *nux vomica*.

After the fever and all acuteness have subsided, the patient should be allowed out of bed and into the open air, and a change of air, especially to the seaside, is now nearly always of value.

He will probably require some tonic, most commonly cod liver oil or iron.

CHRONIC BRONCHITIS

Chronic bronchitis is a very common disease, and exists in all degrees —from a slight tendency to catarrh to one so severe that it and its complications frequently prove fatal.

Therapy

The indications for treatment are:

(1) *To, as far as possible, remove the cause of the primary condition and of the intercurrent exacerbations.*

(2) *To raise the patient's general health in every possible way.*

(3) *To use means to regulate the amount of the expectoration.*

(4) *To relieve all unnecessary cough, which cough not only tends to keep up the catarrh, but also increases the emphysema, may dilate the bronchi, and further tends to wear out the patient by causing sleepless nights and disturbed days.*

Environment.—A patient suffering from chronic bronchitis should be guarded from inclement weather. These patients are nearly always better and, indeed, often apparently well in summer, and it is frequently a good plan to advise that they, if possible, spend one or two winters in the south. By so doing and thus avoiding the acute exacerbations, which are so apt to occur in winter, they may completely recover and in time once more face a northern climate with impunity. The same winter resort will not suit every case. Generally speaking, if the case be one in which the expectoration is scanty and the cough harassing, a mild and humid atmosphere will be indicated, such as is found in Florida, Nassau, Bermuda, and the West Indies, on this side of the continent, and near the coast of southern California on the west. If, on the other hand, the expectoration be profuse, a dry air is indicated, such as is found in the inland parts of southern California, Colorado, Texas, Mexico, and Egypt.

Watering places are much used, especially abroad, in the treatment of chronic bronchitis, and often they are valuable. One might go into great detail as to the exact composition of this or that special water, but probably, as F. A. Hoffmann, of Leipzig, says, "the mineral springs themselves are practically all of equal value. They suit human nature best, far better than pure water, and a small amount of sulphur in the water makes a pleasant and useful change. If the stronger purgatives

are present, their action, of course, becomes important for corpulent patients and those having a tendency to constipation and hemorrhoids. Of course it is not a matter of indifference where we send patients, but the water itself makes little difference; the situation, the presence of forests, the freedom of the air from dust, the average amount of moisture are all of the greatest moment" (35).

Very often the best climate for bronchitic patients is a matter of experiment, and patients will frequently try several before they find the one that suits them best. Probably the most important point is to find a place in which the patient can be the greatest number of hours in the open air, especially when this is combined with sunlight.

In the summer months a bracing climate will generally be found to be the best. The prairies of the northwest offer a beautiful inland climate, and the seacoasts on both sides of the northern part of the continent are excellent where sea air is preferred. Muskoka, the Georgian Bay and the Thousand Islands are perhaps the favorite lake and woodland resorts. In all of them the pure air and absence of dust are marked.

The great majority of patients either are not ill enough to make it expedient for them to go away for the whole winter, or, even if they are, cannot afford the time or the money to do so. In the slighter cases it is sufficient to impress upon them the necessity of avoiding night air and damp, windy weather, but the more seriously affected ones who reside in a northern country often find that they can only have comparative ease by deliberately staying indoors for some months. In elderly people this is not much of a hardship.

Cases of chronic bronchial catarrh soon find out for themselves the evil influence of "catching cold." Often, however, in endeavoring to avoid this, they defeat their end by making themselves too sensitive to change of temperature. Such people are the better of a process of "hardening" (the German Abhärtung). This is best accomplished by the daily use of the cold sponge, douche, or plunge, and salt water seems to be specially serviceable here. Rock salt may be added to the water to make a one to three per cent. solution. Sea water contains about a quarter of a pound of solids to the gallon, and may be imitated very closely by adding common salt, 7 pounds; magnesium chlorid, 1 pound; magnesium sulphate, ½ pound, to 30 gallons of water. According to J. H. Kellogg (41), cutaneous stimulation will be increased by the addition of half to one pound of chlorid of calcium to the bath. The mistake must not be made of employing the substance commonly known as chlorid of lime, the proper chemical name for which is calcium hypochlorite. Some, such as Ortner (58), recommend a five per cent. solution of salt, and certainly this is useful if the hydropathy be limited to sponging. The salt more

certainly brings about a reaction than does the mere cold. By such cold applications the skin is trained to resist changes in the external temperature. Turkish baths are often useful, especially during any exacerbation. The patient, however, must take great care not to get chilled afterwards, and should quickly be got into a well warmed bed.

In the same way patients may be hardened to breathe cold air, but should be warned against mouth breathing. The nasal passages are specially adapted for warming the inspired air, as also for removing larger foreign bodies which have been inhaled. R. Hutchison reminds us (38) that air entering the nose at freezing point is warmed to a temperature of 81° F. by its passage through the nose alone. When a chronic bronchitic must be out on a raw day it is often wise for him to wear a respirator, or at least a muffler over the mouth to prevent mouth breathing, and he should be specially cautioned against talking in the open air, which necessitates mouth breathing for the time being.

Crowded rooms, where the air is both warm and impure, should be sedulously avoided, and going into the cold air after such an exposure is specially apt to make such cases worse.

Indoors, plenty of fresh air should be provided, but draughts must be avoided; and extreme cold, such as will occur in winter if the windows be opened in the bedrooms at night, however useful it may be for tuberculous patients, is not suitable for bronchitic ones. A temperature of about 65° F. is usually the most satisfactory one for the patient, and marked variations from this, either up or down, are not advisable.

Many cases are caused, or at least made worse, by the inhalation of dust. This is seen in many occupations, such as coal mining, stone cutting, etc. Where possible, such patients should be urged to change their work for one allowing of a purer atmosphere. But many better class patients are also affected by dust, and should avoid going out on the streets on dry, windy days, and if they must do so should wear a muffler or respirator. The way in which the streets of some cities are cleaned is a constant menace to these people.

Clothing.—The clothing of bronchitic patients is an important matter. Heavy clothing is objectionable in many ways, and yet the wearers must be kept warm. Perhaps the most suitable underclothing is that made of light and porous material, of which the patient can wear two sets in cold weather. In this way the total weight of the underclothing will be less than with one heavy suit, and yet he is more completely protected from chills by the air between the two layers. The suit next the body should be of some porous material, either cotton, linen or silk, and the outer one may be of light wool. Chest protectors are, as a rule, not advisable. When a patient lives in a cold climate and in heated houses, it is necessary to remember that the house temperature may be almost that of summer and hence does not call for thick clothing, and yet

the outside temperature may be somewhere near zero. Such a difference is best met by the use of a heavy overcoat.

Contagion.—People suffering from chronic bronchitis should avoid the proximity of individuals suffering from any acute catarrh, as such is often very contagious, and acute attacks must be avoided if possible.

Tobacco.—Inhalation of tobacco smoke often excites a bronchial catarrh, and must be avoided not only by advising against the inhalation of cigarette smoke, but also by pointing out the fact that the mere breathing of an atmosphere laden with tobacco smoke from the smoking of others is almost as bad as direct inhalation. One often sees nicotin poisoning in people who have been in such an atmosphere without having been smoking at all themselves.

Exercises.—Exercises, especially breathing exercises, are of great value in chronic bronchitis. It should be remembered that in these cases there is always more or less emphysema, and that hence the normal elasticity of the lungs, which in health is responsible for the expiratory act during quiet respiration, is more or less absent, which causes the expiration to become an active instead of a passive act. The result is that the excursion of the thoracic parietes is lessened, and stasis both of the respiratory tract and of the pulmonary circulation is apt to be more or less present. Regular breathing exercises, with special emphasis upon expiration, are hence valuable, and may with advantage be carried out several times a day. It is best that inspiration be done through the nose and expiration through the mouth. In this way the least possible obstruction is offered to expiration. H. E. Knopf (42) believes that he has been successful in curing cases of chronic bronchitis by systematic exercises in deep breathing. The exercises are done before a large mirror, with the chest bare, inspiration being performed through the nose and expiration through the mouth. These exercises improve the general health in a remarkable way. Knopf urges that this deep breathing is not only the most certain expectorant, but is also the only one that is entirely harmless. The only drawback is an occasional slight giddiness, which, however, soon passes off: it is no doubt due to a mild degree of acapnea.

Compression of the lower part of the chest is often of value. It should be done during the last part of expiration, and really continues this act in a passive way, so as to make the act more ample. It may be carried out by the nurse or physician, or, as G. Hoppe-Seyler (37) has pointed out, by the patient himself, who soon learns to do it. He is taught to place his hands on the sides of the chest, to press here at the last part of long expiration, and finally to bend forward as if bowing, which act forces the diaphragm upward and thus lessens the diameter of the chest in the vertical direction. Various forms of pneumatic apparatus have been advocated from time to time, especially abroad, but as a rule the practitioner will probably do very well without them. Postural treatment

of those cases in which the bronchial secretion is excessive will be referred to later on.

When a patient suffering from chronic bronchitis gets an acute exacerbation he is best in bed, and should be there treated as an acute case, and with even greater care than usual.

Diet and General Treatment.—Cases of chronic bronchitis are generally below weight and low in general health, and usually require to be fed up, especially with fatty foods such as milk and cream. In some cases a general dyscrasia, such as gout or uremia, may be the cause of the condition and may be best met by appropriate diet. In many of the German and Swiss spas, where chronic catarrh of the respiratory organs is treated, such as Ems, Ischl, Reichenhall, etc., the so-called "whey cure" is much used. It consists in the drinking of warm whey, either alone or mixed with mineral water, in definite quantities at fixed times. About 20 ounces (600 c. c.) are taken a day as a rule. It appears to relieve irritable laryngeal cough and to exercise a favorable influence over laryngeal and bronchial catarrh. The whey is not, of course, the exclusive diet, and it is usual to limit the amount of animal food taken and to augment the amount of fruit and vegetables. At the spas the whey is made from the milk of goats and sheep, as well as from cow's milk. I. Burney Yeo (81) speaks highly of it. Like all spa treatments, this may be carried out at home, but is not there so successful, as all the other good influences of the spa, such as rest, good air, regular hours, etc., are apt to be missing. In children some dietetic error may be at the bottom of a persistent bronchial catarrh, and the whole régime should be carefully gone into. Habitual over- or wrong feeding may be present, and other treatment will be of little avail until this is attended to. The dietary, as presented by Robert Hutchison for dyspepsia in children, is here useful. Starch puddings—such as rice, sago, tapioca, arrowroot, and cornflour—sweets, sweet cakes, sweet fruits, jam, honey, marmalade, potatoes, turnips, carrots, should all be given in very small quantity or cut out altogether. The diet should consist chiefly of stale bread, dry toast with butter or dripping, eggs, beef, mutton, fish, chicken, bacon, tongue, green vegetables in moderation, custard, plain puddings, stewed prunes, figs, etc. The child should be permitted to eat only at meals. Tea, coffee, and other stimulants should be avoided. J. Allen calls attention to the value of this diet in the persistent bronchitis of children (3).

When chronic bronchitis occurs, as is not infrequent, in obese people, it usually proves very intractable. In such cases the obesity acts unfavorably, as is pointed out by Geo. A. Sutherland (74) in three ways: (a) Vascular obstruction occurs from increased resistance in the fatty tissues; (b) cardiac weakness is present from deposit of fat about the heart muscle; (c) pulmonary obstruction exists from excess of carbonic acid gas in the blood. It is necessary to remove the excess of fat, which is

best done through three measures: (1) a lean meat diet; (2) a saline aperient every morning; (3) water to be freely drunk between meals.

Cod Liver Oil.—Cod liver oil, which may be here considered rather as a food than a drug, is invaluable in the common thin type of the disease, and many patients, especially children, take it during the entire winter with great benefit. G. A. Sutherland (75) truly says, "The patient who has bronchitis every winter will probably benefit more from cod liver oil taken throughout the cold months than from any other therapeutic measure." As a rule it is not so necessary, nor indeed so well borne by the stomach, in the summer. If there be any anemia, then it is well to combine with the oil some salt of iron. This may be done in the form of one of the numerous emulsions of cod liver oil and iron which are on the market, or one may give the plain oil and the syrup of the iodid of iron either separately or mixed immediately before being taken. Probably the chief advantage of cod liver oil lies in the fact of it being a fluid containing fat in a very fine state of division, and those preparations of it from which the fat has been removed are not of the same value.

In many cases it is possible, by appropriate dietetic and other treatment, to remove the underlying cause of the chronic catarrh; this is the case in gout, uremia, alcoholism, and some other toxemias. Where the heart is primarily at fault, a bronchitis will improve as this organ becomes stronger and more competent.

Vaccine Therapy.—Under removal of the cause should be considered vaccine therapy, by which the actual cause of the bronchial catarrh is attacked through the raising of the patient's specific resisting power to the special infection present. The treatment is still upon its trial, but in some long-standing cases of chronic bronchitis it has seemed to prove of great value, and it is likely that, as the technique improves, still better and more constant results will be obtained.

An autogenous vaccine is the most reliable, and where the infection is a mixed one, as is usually the case, the chief form of organism present should be made into a vaccine. A. C. Latham (43), who has done much work here, says that one should begin with a small dose, say one million dead bacteria. The effect should be an improvement in the patient's sensations. Any rise in temperature means that the dose has been too big. According to Latham, the remedy may equally well be given hypodermically, or by the mouth in a little normal saline on an empty and healthy stomach.

Samuel West mentions several cases of chronic bronchitis in which an almost pure culture of *pneumococci* was got from the sputum. A vaccine consisting of ten to thirty millions of dead pneumococci was used, but the results were not at all encouraging.

The treatment of bronchitis by vaccines is yet in its infancy, but in long-standing cases it seems to open up an encouraging field for investi-

gation. It is, however, expert work and cannot yet be looked upon as a routine treatment.

Serum Therapy.—Serum therapy has been tried in bronchitis but without any striking results, unless indeed one include diphtheritic bronchitis, where brilliant cures have been frequently effected. G. Carrière (9) has published a case of chronic bronchitis of streptococcic origin which was markedly improved by the use of antistreptococcic serum.

In all cases of chronic bronchial catarrh the *bowels* should be kept regular. A fractional dose of some saline every morning is a useful way of bringing this about. In plethoric cases an occasional mercurial purge is to be advised in addition to this.

Symptomatic Treatment.—Expectorants.—The use of expectorants in chronic bronchitis has been built up entirely on empirical lines. The majority of the laity still believe that every case of cough should have a cough mixture. No doubt the profession also have tended too much in this direction, and now there is a swing of the pendulum in the other direction. Expectorants, however, hold an important place in the treatment of chronic bronchitis, and when carefully used, after a full consideration of the nature of the case, are often extremely useful in allaying the symptoms.

In the majority of cases of chronic catarrh the cough is not excessive, and if the expectoration be brought up easily, then expectorants are not required, and our efforts should be directed toward the prevention and lessening of the acute attacks and the raising of the general health by the use of tonics, proper feeding, etc., in order to bring about a more healthy condition of the bronchial mucous membrane. Where, however, the sputum is scanty and tough and the patient coughs much with little result, those expectorants which tend to make the secretion more watery are indicated. The ones that act most definitely in this way are ipecacuanha, antimony, chlorid of ammonium, the various alkalies, and pilocarpin. The iodids also act in this way and are specially indicated in gouty cases and in those cases where, along with a tough and scanty sputum, there is a tendency to wheezing and asthma. They are best given well diluted half an hour before meals, and the dose need not be more than two to five grains. Iodipin is a valuable body, and may be given with little risk of disturbing the digestion or producing other symptoms of iodism. It is said not to be split up in the stomach, but to be absorbed from the intestine. The greater part of the iodipin is oxidized in the body, and when this oxidation takes place all the iodin separates out as iodid. This action, however, is slow, and iodin may be detected in the urine for weeks after the treatment has been discontinued, according to James Burnett (6). The 10 per cent. solution can be given in one- or two-drachm doses mixed with a little warm milk, or the solid form may be used. This is a brown substance and may be had in tablet form.

In many patients the chief difficulty is in the morning. On first waking, the patient coughs and coughs until he brings up some tough sputum which has accumulated during the sleeping hours. He may even vomit before he succeeds in emptying the air passages. Having at last coughed up this material, he may be fairly comfortable for the rest of the day. In such cases, and they are very common, a warm alkaline aromatic draught taken on first waking usually gives great relief, by rendering the secretion more fluid and thus easily got rid of.

Such a prescription as that added to the Brompton Hospital Pharmacopœia at the suggestion of Dr. Burney Yeo may be used. It is as follows:

℞			
	Sodii bicarbonatis	gr. xv	1.00 gm.
	Sodii chloridi	gr. v	0.35 "
	Spiritus chloroformi	min. v	0.35 c. c.
	Aquæ anisi	ad oz. ½	15.00 "

Misce, fiat mistura.

Sig. To be taken in a glass of hot water on first waking in the morning.

Another useful remedy with the same object is Ems water, of which three or four ounces should be taken in hot milk on first waking; or the old-fashioned rum and milk may be used with advantage.

In cases where, during the night, the cough is dry and the sputum difficult to cough up, the alkaline mixture given above may be used with benefit at bedtime as well.

Liniments, Poultices, and Sprays.—Liniments are frequently of value in chronic bronchitis. They are the same as recommended in acute bronchitis and used in the same way (q. v.). Poultices and fomentations are not required in chronic bronchitis, but during any little exacerbation a "mustard-leaf" over the upper part of the sternum often gives relief. In cases of chronic bronchitis with scanty sputum mild alkaline sprays are often of value, such as Seiler's solution.

Cough.—By the use of means, such as those indicated, to make the secretion more fluid, the cough may be so much relieved that it needs no special treatment. But frequently the cough remains excessive, and is indeed the chief symptom complained of. It may, by keeping up an irritation in the upper air passages, make the catarrh worse and a vicious circle is established—the cough causing the irritation, which in its turn causes the cough. In every case of cough it is most necessary that the practitioner, before employing any remedies for its easement, fully consider if the cough be a useful one and, if so, whether it be excessive or not. As an example of an absolutely useless cough one may cite that produced by a dry pleurisy, and as a type of a useful one that set up by the

presence of a removable foreign body in the air passages. The first, of course, may be freely checked, while the latter should be encouraged or at least left alone. The same rule holds good in the coughs accompanying bronchitis. In one case a dry, irritable cough may be making the patient miserable, and yet is only doing harm and should be checked, while again another patient may be coughing only to get rid of a quantity of secretion which is threatening to asphyxiate him, and such a cough, of course, should be encouraged.

Insomnia is frequently produced by coughing, and the late Dr. Gustave Schorstein, of the London Brompton Hospital, used to say that the best hypnotic in chronic bronchitis was strychnin. It, of course, acts by helping the cough and thus clearing the tubes of secretion, the presence of which keeps the patient coughing and hence awake. It may be given in the form of the hydrochlorid or sulphate in doses of 1/60 to 1/20 grain (0.001 to 0.003 gm.) either by the mouth or hypodermically, or nux vomica may be used in doses of 5 to 10 minims of the tincture, either by itself or added to any other medicine that the patient is taking. A useful prescription for cases with moderate secretion is as follows:

℞			
	Tincturæ nucis vomicæ	min. v to x	0.35-0.70 c. c.
	Tincturæ scillæ	min. xx	1.25 "
	Ammonii carbonatis	gr. iii	0.20 "
	Syrupi tolutani	dr. ½	2.00 "
	Infusi senegæ	ad oz. ½	

Misce et fiat mistura.
Sig. Thrice daily after meals.

An old recipe which the writer has often found useful in cases having a good deal of cough and a small amount of sputum is the following:

℞
Tincturæ camphoræ compositæ
Oxymellis scillæ
Syrupi tolutani āā ℥i (30 c. c.).
Misce, fiat mistura.
Sig. A teaspoonful from three to six times daily in water.

Often the cough is largely kept up by an irritable condition of the pharynx, and in such cases barley water, flavored with lemon, is a pleasant and efficient remedy and will frequently relieve an irritating nocturnal cough, if sipped as required. In cases of this kind it is important to tell the patient not to cough if he can possibly help it, the cough keeping up the irritation. Such advice is on a parallel with telling an individual with an itchy eczema not to scratch. In both cases many unnecessary irritations of the inflamed parts may thus, by the exercise of the will, be stopped.

In cases with much irritation of the upper air passages, sprays, as already mentioned, are useful. Also inhalations from the handkerchief or through a Burney Yeo or some other form of inhaler. Ten drops of a 20 per cent. solution of menthol in alcohol poured on the sponge and used for hours may give much relief. Or the following:

℞ Menthol 1 part
Eucalyptol 2 parts
Benzoinol 3 parts
Misce, fiat mistura.
Sig. Inhale from an inhaler or handkerchief.

As a rule, opium is contraindicated in chronic bronchitis, but in these irritable cases it is often of value and may be used cautiously in small amounts. Paregoric, compound ipecacuanha powder, and pill of ipecacuanha with squills are good preparations here. A useful prescription for controlling unnecessary coughing is the following:

℞ Liquoris morphinæ hydrochloridi	dr. i	4.00	c. c.
Acidi hydrocyanici diluti	dr. ½	2.00	"
Syrupi pruni virginianæ	oz. ½	15.00	"
Infusi rosæ acidi	ad oz. iii	100.00	"

Misce et fiat mistura.
Sig. A teaspoonful without water as often as every four hours.

This forms a mixture which is very soothing in an irritable cough. Its action seems to be partly local and hence is best marked when the medicine is taken undiluted. As a rule, however, in such chronic coughs as we are discussing, the use of sedative cough mixtures, if employed at all, should be reserved for the night.

[I have seen patients with chronic bronchitis become addicted to the opium or morphin habit, the result of taking these drugs in the form of a cough mixture. In one instance I saw the codein habit established, indirectly the result of a cough mixture containing morphin, the codein being employed to cure the morphin habit.

When all other means mentioned in this article have been conscientiously tried, especially the postural treatment, opium and its derivatives are not required.—Editor.]

Profuse Expectoration.—With very profuse expectoration the medicinal treatment is quite different. Here the cough is life-saving and nothing must be done to check it; but, on the contrary, if the patient be weak and the muscular power low, it should be encouraged. This can be best done by the use of strychnin. Our efforts should be directed toward lessening the amount of secretion, both by raising the general tone

of the patient by the use of tonics, good food, etc., and more directly by the use of certain drugs which have the power of directly lessening the abnormal secretion. Such drugs are belladonna, the mineral acids, and the so-called aromatic expectorants.

Belladonna acts powerfully as a drier up of secretion, and also as a respiratory stimulant, but must be used with care as it tends also to dry up the saliva and other secretions, and may give rise to discomfort in consequence. Its active principle, atropin, is a very powerful stimulant of the respiratory center; it also lessens the respiratory reflex, dulling the terminations of the vagus, and thus tends to ease the cough; but this dulling action is not so marked as it is in the case of opium, and the other contraindications are not present. The tincture of belladonna may be given in doses of ten minims (0.6 c. c.) thrice daily, and will certainly lessen the amount of secretion. Sometimes, however, it will be found that, although the secretion be lessened, the patient is not so comfortable.

The *mineral acids,* especially the nitro-hydrochloric acid, are valuable in lessening expectoration, as in the later stages of acute bronchitis (q. v.).

The *aromatic expectorants,* such as *creosote* and *terebene,* tend to lessen bronchial secretion. They are specially indicated where any fetor exists in the secretion, and will be referred to later.

When the bronchial secretion is excessive, *posture* is an important factor in the treatment of the condition. As is well known, in health the *ciliæ* of the epithelial cells lining the respiratory tract are constantly tending by their movements to bring the normal secretion, and with it any particles of dust which may have alighted upon it, toward the outlet of the respiratory tract, where it is swallowed or expectorated. But, when the epithelium is changed, as it is in chronic catarrh, and the *ciliæ* no longer are there to thus move the secretion onward, this material, often excessive in amount, collects in the air passages and must all be coughed up. If patients with excessive secretion can be made to sleep with the foot of the bed a little raised, gravity helps, or at least no longer retards, the passage of this secretion toward the outlet. F. Forchheimer (25) specially emphasizes the value of this postural treatment. The foot of the bed should not be raised more than two or three inches at first, but gradually can be put up to double that height. Beds are now made by various manufacturers, the ends of which can be conveniently raised or lowered to any desired degree by means of levers acting on cogs.

In rare instances the expectoration in cases of chronic bronchitis becomes *fetid.* In such instances there is always a suspicion of actual dilatation of the bronchi, which may be marked enough to merit the term of bronchiectasis (q. v.).

Aromatic Expectorants.—*Creosote* is much used, and is best given in pearls or capsules containing two or three minims in each. Or it may

be given as the *mistura creosoti* of the B. P., or combined with cod liver oil. *Guaiacol carbonate,* a derivative of creosote, is a useful expectorant here, and if given in doses of five to ten grains thrice daily or every four hours (in capsule form), it will soon show its characteristic odor in the breath. *Tar,* in doses of five to 10 minims (0.3 to 0.6 c. c.) in capsules, may be given with the same object.

Turpentine may also be used in such cases, and can be given in capsules containing five to ten drops, or in a mixture as follows:

℞	Olei terebinthinæ	dr. i	4.00 c. c.
	Mucilaginis acaciæ	oz. ii	60.00 "
	Emulsionis amygdalæ	ad oz. vi	200.00 "

Misce, fiat mistura.

Sig. A tablespoonful thrice daily after food.

Terebene is another aromatic which is employed in such cases. Its odor is more pleasant than that of turpentine, which it otherwise resembles. It is given in doses of five to fifteen drops, conveniently dropped upon lump sugar, or it may be dispensed in capsules, or as a draught, such as that of the Victoria Park Hospital, which is as follows:

℞	Terebeni	min. x	0.60 c. c.
	Mucalaginis tragacanthæ		
	Glycerini	āā dr. i	4.00 "
	Aquæ cinnamoni	ad oz. i	30.00 "

Misce, fiat mistura.

Sig. To be taken thrice daily after meals.

Or the aromatics may be inhaled, and thus more directly applied to the diseased mucous membrane. Such a mixture as this is useful:

℞ Terebeni
Acidi carbolici liquifacti
Spiritus chloroformi āā ʒij (8.00 c. c.).

Sig. To be inhaled from a Burney Yeo inhaler for hours daily.

Or one as recommended by J. C. Briscoe (5):

℞	Creosoti	dr. iii	12.00 c. c.
	Thymol	dr. ii	8.00 gm.
	Acidi carbolici liquifacti	dr. i	4.00 c. c.
	Spiritus chloroformi	ad oz. i	30.00 "

Misce et fiat mistura.

Sig. To be inhaled frequently.

Or one may use the inhalation containing menthol and eucalyptol in benzoinol already given.

Various sprays may also be employed here, such as one of Seiler's solution, or one of ipecacuanha wine, as recommended by Ringer and Murrell.

Among the newer and less commonly used methods of treatment of chronic bronchitis one may mention the following:

X-Ray.—The *X-Rays* have been tried in chronic bronchitis, and some good reports of the results have been published. Thus Dr. Schilling (70) of Nuremberg at the German Congress of Medicine in 1906 stated that he had treated a number of patients in this way. With one exception the results were favorable and the bronchial secretion decreased. Even in cases of months' duration the expectoration became less copious, and in some instances totally disappeared without any undesirable complications. The general health of the patients was improved and their respiratory difficulties were lessened. One would, of course, like to know more about these patients—for example, whether any of them were of years' duration, as many a subacute bronchitis lasting a few months clears up completely.

Incandescent Light Baths.—A. v. Strümpell (73) strongly advises the use of Kellogg's incandescent light baths in chronic bronchitis. In his hands the treatment seemed to be very successful. It is specially advised in the dry form of the disease. The light produces hyperemia of the skin and sweating, and should have some counterirritating effect, if nothing more.

Other Remedies.—As has been already said more than once, cases of chronic bronchitis are of all degrees, from those that are so slight as to be scarcely considered ill to those who are more or less completely invalided. These severe cases tend to get gradually worse in spite of all treatment, and, eventually, from increasing emphysema and failing right heart, become completely invalided. In such cases, where the dyspnea is marked and there is more or less cyanosis, the inhalation of oxygen is of some temporary value. The gas should be bubbled through water at the rate of about 120 bubbles per minute.

Strychnin hypodermically helps these sufferers very much and should be freely given. Alcohol, especially good brandy, is often valuable, particularly in the aged. The heart must be supported in every way possible in these advanced cases, and digitalis is usually given freely and with some benefit occasionally, but the chief strain is on the right heart, where this drug has relatively less action, and moreover the heart muscle by this time is usually far from sound.

When cyanosis is marked, *bleeding* helps to keep the patient going a little longer sometimes, and may be repeated at intervals of a few days with temporary benefit on each occasion.

BRONCHIAL ASTHMA

Whatever be the exact nature of an attack of asthma—and this is probably not the same in every case—there seems to be no doubt that there is a passing narrowing of the *lumina* of the smaller bronchial tubes, with consequent obstruction of the breathing. In all cases of acute asthma there must also be present some degree of bronchial irritation, as, eventually, mucin is expectorated, in the form of Curschman spirals. These may generally be found if the sputum be examined early and carefully enough.

Attacks of asthma may be precipitated by the most varied causes, and when undertaking the treatment of a case of the disease it is most essential that the practitioner go very thoroughly into the history; there is no disease, perhaps, where this is so necessary.

Types of Asthma

According to the predominating cause, the different types of asthma have received appropriate names; thus, when the neuromuscular irritability is very marked, so that the attacks seem almost to be spontaneous, it is termed *nervous asthma.* When this irritability is due to some toxin, the name *toxic asthma* is often used. When the exciting cause of the attacks is a bronchitis, then it is termed *bronchitic asthma,* and where it is induced by some irritation of distant parts, such as the skin, nose, ear, etc., it is often styled *reflex asthma.*

Hay asthma, in which there is great congestion and swelling of the nasal and conjunctival mucous membranes, often associated with bronchial spasm, will be specially considered hereafter.

Treatment Between the Attacks

Environment.—It is essential that in undertaking the care of a case of asthma, the surroundings that will best suit him must be ascertained if possible. Sometimes by merely changing his environment he may be completely cured.

Hospital physicians know well how difficult it is to get a case of asthma to demonstrate to a clinical class, the mere bringing of the patient into the hospital being usually sufficient to stop his attacks for the time being. Fowler and Godlee (27) speak of "Saturday and Sunday asthma" as being very common at the Brompton Hospital Outdoor Clinique. The state of the nervous system in these people is so sensitive to the slightest change in the routine of life, such as occurs at the week-end, that they may then have attacks, although they are free from them during the rest of the week.

Even the changing of residence from one side of the street to the other may be sufficient to allay the attacks, and some patients are worse in one room than in another in the same house.

Climate.—In those common cases associated with bronchitis the environment best suited for that disease will be the best for them (*vide* Bronchitis). As a rule this will be a mild, equable, and rather humid climate, such as is found in winter in Bermuda, the West Indies, and the Southern States. Yet the dry climate of Egypt suits many asthmatics well, although here there is a great difference between the temperature of the day and the night, which *a priori* would seem to be about the worst thing possible.

In summer most cases of bronchitic asthma are at their best, and any fine bracing place may suit them. On the other hand, when the trouble arises from the smell or pollen of certain plants, cases of asthma often learn to dread the summer. They must try to live in some place where the special plant that troubles them is not present. The climates of the Adirondacks, Virginia, Muskoka, and the sea coast are all good summer ones.

Every asthmatic patient is a law unto himself as regards climate, and those who are able to do so often travel far and wide before they find the one that best suits them.

I recently came across an example of this: A mother and married daughter, both asthmatics, tried many places, and what would suit one would not suit the other, and *vice versa*. Eventually they compromised by living together in a large city.

As regards general hygiene, it is well to lay down some definite rules for the patient as to exercise, gymnastics, baths, etc.

Exercises.—Exercise in the open air, especially that associated with some non-strenuous game, such as golf or some sport, is good. It is the general experience of practitioners that exercise thus taken is much more valuable than that taken for health's sake alone. The pleasant exhilaration of the mind makes the walking a pleasure instead of a mere duty.

Calisthenic Exercises.—Calisthenic exercises are useful when regularly carried out. There are various systems of exercise, all of which are of value when no more exhilarating ones can be regularly had. Wooden dumbbells, light Indian clubs, etc., all have their place.

Breathing Exercises.—Breathing exercises, say six or eight long breaths slowly taken night and morning, are good, and are easily carried out while going about. One of the best exercises is that in which the person, while lying flat on his back and in very light clothing, slowly raises his feet, with the knees extended, as highly as possible, and then as slowly lowers them again. This may be done several times night and

morning, and, if long breaths be taken between each act, a very thorough exercise of the respiratory muscles is obtained.

Baths.—Cold baths and cold douches, followed by friction with a coarse towel, are useful if the patient gets a good reaction; otherwise they are harmful. Compressed air baths have been recommended, but require special apparatus for their administration. C. Theodore Williams speaks very highly of the method (79).

Electricity.—Electricity has been a good deal used in asthma, and, when one considers that the condition is really a neurosis, it is easy to understand how it might do good, especially if administered with great assurance. Schäffer (69) strongly recommends the use of the faradic current. An electrode is placed on each side of the neck about an inch below the angle of the jaw; the current should be fairly strong and should be used twice daily for 10 to 15 minutes at a time. High frequency currents have also been recommended. The method given by W. J. Dugan (17), of Philadelphia, is the d'Arsonval one, which may be administered by means of the "auto-pad" or the "condensation couch."

The urine should be carefully watched in asthma, and, if there is any suggestion of the trouble being of alimentary origin, an examination of the stools should be made.

Dietary.—Some cases of asthma are much influenced by diet, in fact so much is this the case that the term *peptic asthma* is often used here. These people may only suffer when they have eaten some special and (to them) toxic article of food. On the other hand there are many who are in no way affected by errors of diet, this being specially seen in those depending upon some abnormality in the nasal passages, and in purely reflex cases.

In general terms, one may say that every case of asthma should be put upon a simple, easily digested diet, and should avoid taking the chief meal late in the day.

Pork, hard-boiled eggs, nuts, pickles, dried and preserved meats and cheese are all apt to make these patients worse, but idiosyncrasy is here most marked, and sufferers as a rule soon find out by bitter experience what they must avoid. Friedenwald and Ruhräh truly remark (29) that many asthmatics give up many articles of diet that are in reality indicated in their condition.

Tea, coffee, and alcohol should be largely interdicted, with the exception that *during* an attack these things are occasionally useful. Harry Campbell (8) urges the value of curtailing the starches, sugar, and fats. Stout patients are much benefited by a dietary directed toward the reduction of their weight. Such a régime should include (a) a lean meat diet; (b) a saline aperient every morning; (c) free drinking of water between meals. If the obesity be very marked it may require some further care,

and often the Oertel exercises are here of value. The heart participates in the general obesity, and is greatly benefited by such a course. The same remark applies to the Schott treatment of resisted exercises and effervescing saline baths. Foods that cause flatulence should be specially avoided in all cases.

Milk.—Milk cures have often proved of value in stubborn peptic cases, the patient being put upon a diet of milk alone for several weeks.

Removal of Cause.—In every case we must endeavor to get at the cause of a case and, if possible, remove it. Some article of diet (to other people harmless), some odor, some district, some disease or dyscrasia may be at the bottom of the whole case, and until we can remove or lessen the special cause our therapy can only be palliative.

Frequently some abnormality of the nose, such as polypi, deflected septum, or adenoids may be at the root of the trouble, and the proper treatment of this may be followed by complete relief. This source of bronchial asthma has, however, been too much emphasized by some, and very many operations for slight abnormalities of the nose are performed which are entirely unnecessary. Much harm may be done by the galvanocautery.

Where any bronchitis exists, it must be carefully attended to.

In many cases it is impossible to remove the cause, and thus directly make the attacks cease. Then our endeavors must be directed toward (1) lessening the irritability of the neuromuscular apparatus of the bronchial tract, and (2) lessening the amount of reflex irritation as much as possible.

There is a very close analogy between asthma and epilepsy, and as in the treatment of fits we try to remove every source of reflex irritation (such as a tight foreskin) and then soothe the hyperexcitable nervous system by bromids, etc., so here the principles are the same.

Where the increased irritability of the nervous system is due to a toxin such as that of gout, this must be treated by careful dieting, etc., and these cases are the ones which do specially well under iodids. If the increased irritability be inherited it can only be lessened by placing the patient in less racking surroundings and getting him to avoid fatigue, nerve strain, alcohol and tobacco, and everything which tends to deplete the nervous energy.

By due attention to climate and environment, by the careful regulation of the diet, by the removal of some special *bête noire,* or physical reflex source of irritation, we may often cause the attacks to cease, and no medicinal treatment may be necessary. Too often, however, strict attention to these details leaves the patient little or no better, and then drugs must be resorted to.

Drugs.—Many drugs have been recommended for the relief of asthma,

and their very number is an indication of how uncertain the results are. In most cases their use is quite empirical and they must be judged entirely by results.

Iodid of Potassium.—Iodid of potassium is the drug which most frequently is of value in the treatment of asthma. It should be given continuously for weeks in small doses—say five to ten grains thrice daily, best between meals. Some, however, as R. O. Moon (53), prefer to give it in a single large dose at bedtime. It somewhat increases the bronchial secretion, and has a decidedly eliminative action, which may perhaps to some extent account for its beneficial effects. Some recommend that, for prolonged use, the sodium salt should be substituted on account of the depressing action of the potassium base; but the amount of potassium given in the above doses is so minute as to be negligible. W. E. Dixon (16) states that a vegetarian often takes as much as two ounces of potassium chlorid by the mouth in the day's food, and yet no depressing symptoms occur. This would seem to be a high estimate, but, even putting the potassium at half this quantity, it would far exceed any amount that is ever given medicinally. The drug may be given in capsule form, or as a mixture. The disagreeable taste is best covered with licorice, sarsaparilla or ginger. It may also be agreeably given in milk. It is best given between meals, but, if it disturb the stomach, then may be taken about an hour after each meal. Many other preparations of iodin have been tried, such as iodipin, but the iodid of potash remains the favorite.

Arsenic.—Arsenic is much used in asthma, either alone, in two to five drops of the Fowler's solution, or combined with the potassium iodid mixture. Its mode of action is quite obscure.

Belladonna.—Belladonna has long been used here. Atropin has a paralyzing effect upon the terminations of the vagus nerves in the lung. It has been shown by Dreser that electrical stimulation of the vagi causes contraction of the bronchial tubes, but that this does not occur if the animal be previously treated with atropin. Albert Abrams (1) has described a lung reflex of dilatation and contraction, the former being produced by rubbing the surface of the chest and the latter by vigorous percussion. Both these reflexes are abolished by atropin. It is, hence, easy to understand, at least in part, how belladonna and atropin have proved so useful in asthma. It must also be remembered that atropin raises the blood pressure by its action on the circulation, stimulates the respiratory center, and dries up the secretions, all of which effects may have some influence upon such an elusive neurosis as asthma.

Paul Febray (23) mentions a case which had lasted for 20 years, in spite of many remedies tried with no benefit, except a temporary one from the hypodermic use of morphia. The case was promptly and permanently cured by the use of atropin. The treatment extended over six weeks, and commenced with ½ milligram (1/130 gr.) of atropin, gradu-

ally increased to 2 milligrams (1/32 gr.) daily. The drug may be given by the mouth in the form of pills or tablets, or hypodermically. Sometimes dryness of the throat and disturbance of vision call for a suspension of the treatment for a day or two. The good effect, Febray explains, is due to the antispasmodic action of the drug.

Hyoscin and Hyoscyamin.—Hyoscin and hyoscyamin act twice as strongly as atropin in paralyzing the nerve terminations in the lungs, and hyoscyamus is often used in place of belladonna. A useful prescription in asthma is such a one as the following:

℞	Potassii iodidi	dr. ii	8.00	gm.
	Liquoris potassii arsenitis	dr. i	4.00	c. c.
	Tincturæ belladonnæ	dr. ii	8.00	"
	Extracti glycyrrhizæ liquidi	oz. ½	15.00	"
	Aquæ chloroformi	ad oz. vi	200.00	"

Misce, fiat mistura.

Sig. A dessertspoonful in water thrice daily after meals.

Nux Vomica.—Nux vomica has been used by many practitioners, either for a long period in small doses (as suggested by Musser), or else in ascending doses until the patient begins to show some of the physiological effects of the drug.

Calcium Salts.—C. Kayser (40a) describes 13 cases, in which he gave calcium chlorid as a prophylactic. The patients all felt easier in a day or two, and were free from attacks. He gave 20 gm. of the chlorid with syrup, in 400 c. c. of water, of which the patients took a tablespoonful every 2 hours for 8 days.

Caffein Iodid.—P. B. Williams (80) speaks very highly of the value of caffein iodid in warding off attacks. He gives 3 to 5 grains (0.2 to 0.3 gm.) thrice daily.

Bromids.—In nervous cases the bromids are useful, and are best given combined with arsenic in order to lessen the chances of bromism occurring. The strontium salt is probably the best here, being less apt to disturb the stomach than are those of potassium and sodium.

℞	Strontii bromidi	oz. i	30.00	gm.
	Potassii iodidi	dr. ii	8.00	"
	Liquoris potassii arsenitis	dr. i	4.00	c. c.
	Syrupi zingiberis	oz. i	30.00	"
	Aquæ	ad oz. vi	200.00	"

Misce, fiat mistura.

Sig. A dessertspoonful thrice daily in water after meals.

Many other drugs have been given from time to time in the treat-

ment of asthma between the attacks, but probably the ones mentioned are all that have stood the test of any lengthy experience.

If the patient's general condition require it, iron, hypophosphites, and cod liver oil may be indicated, the last being specially useful in asthma associated with emphysema and bronchitis in emaciated subjects.

G. Treupel (76) would have us believe that asthma is a form of neurasthenia, and that it may be cured by impressing this fact and its curability upon the patient, and obtaining his coöperation. The main point is to influence and control the dread of suffocation and to regulate the breathing. The latter is accomplished by various exercises, training the patient to breathe deeply with a slow inspiration, at the same time raising the arms over the head, and then, during the expiration, applying the hands to the front and sides of the chest and squeezing the walls together to aid the expelling of the air. These exercises should be repeated night and morning for 15 minutes at a time. P. Strübing (72) in the same way found that it was possible to train healthy persons to imitate an attack of asthma. He believes that an asthmatic may also be trained to control his attacks and finally to overcome them altogether. There is room for great doubt about the cure of a well-marked case of bronchial asthma by psychic treatment alone, but, at the same time, in dealing with a disease which is so manifestly a neurosis, assurance on the part of the physician, and firm belief and a strong determination to get well on the part of the patient, will no doubt help greatly toward that end.

Treatment During a Paroxysm

During a paroxysm of asthma the patient presents, in the words of Bamberger, "the picture of a most laborious, tormenting, and, at the same time, fruitless struggle." He is suffering from want of oxygen and retention of carbonic acid gas and other waste products, and the air of the room consequently should be as pure as possible. It will often be found that the patient himself struggles to an open window. The chest will be seen to be in a position of inspiration, the difficulty being always to get the air *out* of the chest.

Nitrites.—The nitrites are usually the first thing tried here, and they are often rapidly followed by relief of the spasm. *Amyl nitrite,* in three minim doses, inhaled from a handkerchief, should be given at once. It may be repeated several times, the only objection to its free use being the headache that is apt to result.

Nitroglycerin in doses of 1/100 grain (0.0006 gm.) by the mouth acts in the same way as does the amyl nitrite, but is less powerful here, probably because the latter is inhaled and hence acts partly directly upon the contracted tubes.

Chloroform.—Chloroform is a valuable antispasmodic, and may be

safely inhaled if the patient be allowed to merely wet the inside of a tumbler with it and then cork the bottle before beginning the inhalation from the tumbler. There is little likelihood of the habit being formed.

An immense number of inhalations have been introduced and largely used, many of them being patent "asthma cures." Most of them owe what efficacy they may possess to the fact that they contain *datura stramonium, lobelia,* and *nitrate of potash.* They are burned and the fumes inhaled. Sir James Sawyer (68) points out that the popular knowledge of such fuming inhalations dates from about thirty years ago, when the late Earl of Beaconsfield used them in his last illness. They were then frequently mentioned in the lay press and thus became advertised. Such a powder as the following is a good one, and represents about the average composition of many others:

℞			
	Potassii nitratis		
	Pulveris anisi fructi	āā oz. ½	15.00 gm.
	Pulveris stramonii	oz. i	30.00 "

Misce, fiat pulvis.

Sig. A teaspoonful to be burned and the fumes inhaled through a paper cone during an attack.

Tobacco.—To non-smokers tobacco is often valuable, and is best used in the form of cigarettes, the smoke of which should be inhaled.

The various fuming inhalations are often used also to ward off an impending attack, the patient inhaling when he feels the premonitory sensations, which he knows from experience mean that an attack is threatening. For this purpose, many burn some every night in the bedroom on retiring.

J. Kingston Fowler (27) sounds a note of warning against the too constant use of such inhalants, as they are apt to lose their effect when most needed, and moreover appear to weaken the heart.

Cocain.—Cocain is a valuable remedy in asthma. It may be used either as a spray or else painted on the nasal mucous membrane.

A spray such as the following, as suggested by P. B. Williams (80), is a good one:

℞			
	Cocainæ hydrochloridi		
	Atropinæ sulphatis	āā gr. ii	0.100 gm.
	Sodii nitritis	gr. x	0.650 "
	Glycerini	min. xx	1.350 c. c.
	Aquæ rosæ	ad oz. ½	15.000 "

Misce, fiat mistura.

Sig. 5 to 10 drops to be inhaled through the nose by means of a fine spray. Repeat at intervals of half an hour.

A somewhat similar one is given by F. Schaefer (69):

℞			
	Cocainæ nitritis	gr. xvi	1.028 gm.
	Atropinæ sulphatis	gr. viii	0.800 "
	Glycerini	oz. i	30.000 c. c.
	Aquæ	ad oz. iii	100.000 "

Misce et fiat mistura.

Sig. To be inhaled as a fine spray from atomizer.

If it be desired to use the drug as a pigment for the nasal mucous membrane, it should be as a solution of two to five per cent. strength in water or albolene.

Cocain, however, is a most insidious drug and, if used in a disease which is apt to be of such long duration as asthma, may become a habit.

Of all drug habits, the cocain one is probably that most easily and quickly acquired and is the most distressing and hard to get rid of. Hence the physician who decides to prescribe the drug should do so with a full understanding of the risks, and at least should always mark his prescription with the words *ne repetatur* in order to lessen the chance of the patient getting it repeated without an order.

So much has the danger of the drug been impressed upon the Canadian Government that no patent medicines containing it may be sold in the Dominion under any circumstances.

Adrenalin Chlorid.—Adrenalin chlorid is greatly used in paroxysms of asthma and in the distress of hay fever. The drug, according to Abrams (1), evokes the lung reflex of contraction, which permits the longitudinal fibers of the bronchial muscular coat to expel the residual air imprisoned by the spasm of the circular fibers.

The drug may be used both as a spray and internally. C. Matthews (50) reports the successful use of the spray in 13 cases of the disease. The result was always immediate relief, lasting for longer or shorter periods. He used the 1 in 1,000 solution diluted with equal parts of water and sprayed into the nose with an ordinary atomizer. Matthews found it to act equally well when given as a suppository, and others have reported good results from the administration by the mouth. But probably it is when given hypodermically that the drug gives the best effects. Abrams employs 8 to 15 minims (0.5 to 1.0 c. c.) of the chlorid solution (of 1 in 1,000 strength) thus, and says that it will generally inhibit an attack, and that it is seldom necessary to repeat the dose. He has found it equally serviceable in many forms of dyspnea, even when morphia was without effect, and this would agree with the writer's experience.

B. Melland (51) also claims that the effects of hypodermic injections

are very marked. He gives 10 minims (0.6 c. c.) of the 1-1,000 solution and seldom requires to repeat it.

As much larger doses than this of adrenalin, when given by the mouth or even hypodermically, have no marked effect upon the blood pressure, apparently the action in asthma is not a vascular one at all. N. V. Jagic (39) mentions this fact and says that half a cubic centimeter of one in a thousand adrenalin solution has no effect upon the blood pressure, yet often cuts short an attack of asthma, and I. I. Lemann calls attention to the same thing (43a).

Morphia.—Perhaps the most reliable way of checking an attack of asthma, however, is by the hypodermic use of morphia, either alone or, better still, combined with atropin. For obvious reasons a patient should not be entrusted with a hypodermic syringe, but the physician may use it freely upon him. A quarter of a grain (0.016 gm.) of morphia combined with 1/150 grain (0.0004 gm.) of atropin may be sufficient, but it is often necessary to repeat this at the end of an hour or two. Morphia should not be too freely resorted to, on account of the rapid dependence that the patient soon develops for the drug. It is only in very bad attacks and when all other methods (except perhaps the use of cocain) have been tried in vain that one is justified in using the remedy.

Heroin.—Heroin (diacetyl-morphin) in doses of 1/24 to 1/6 gr. (0.0025 to 0.010 gm.) of the hydrochlorid has been much recommended lately in place of morphia. Stengel, in editing the article on asthma in Nothnagel's Encyclopedia of Practical Medicine, says that "the consensus of opinion seems to speak for the efficacy of the drug, while recommending that, as a derivative of morphia, it should be dispensed with discrimination."

Pilocarpin Nitrate.—Pilocarpin nitrate, in doses of 1/20 to 1/10 gr. (0.003 to 0.006 gm.) hypodermically, is occasionally useful in a paroxysm. The smaller doses should be used in a patient who has not taken it before, as occasionally a large one may produce untoward results in the form of a pouring out of bronchial secretion sufficient to embarrass the respiration, which already has too much to do.

Aspirin and Novaspirin.—Aspirin and novaspirin have lately been tried a good deal in the treatment of asthma and apparently have some effect in relieving an attack and even in averting it; if taken when the first threatening occurs. E. von Gresic speaks very highly of them. He gives 15 grains (1.00 gm.) of either early in the attack and may repeat once in two hours if required. In severe cases he says that it is well to combine 1/6 grain (0.010 gm.) of morphia with each dose, and this would best be given hypodermically, while the other would, of course, be given by the mouth. Aspirin is believed to act by reducing the excitability of the nervous fibers in the bronchial muscles, with a consequent arrest of the spasm.

Chloral Hydrate.—Chloral hydrate is an old favorite in the therapy of attacks of asthma. It should be given cautiously in ten-grain doses, which may be repeated every hour for several doses. It is rather an insidious drug and should not be put too freely in the patient's hands.

Emetics.—Emetics are occasionally useful, especially when the directly exciting cause of the attack is an indigestible meal. They are, however, depressing, and if the heart be weak may cause serious collapse. Ipecacuanha in doses of 20 grains (1.30 gm.) is perhaps the best here. Probably, however, the therapy of asthma would not lose much if emetics were never used.

Local Applications.—Local applications of heat to the chest, in the form of simple fomentations or, better still, as the turpentine stupe, are useful and comforting during the attack. The placing of the feet in hot water or a mustard bath, made by dissolving a tablespoonful of mustard in the foot bath, is useful as a derivative.

An attack of asthma is practically never fatal, although Fagge (22) relates the case of a patient in whom life was only saved by timely artificial respiration. The very cyanosis tends to relieve the spasm, and William Ewart recently suggested (at the British Medical Association Meeting of 1911) that the inhalation of carbonic gas might be used for this purpose. It certainly follows nature's own way of dealing with the trouble.

A good, immediate prognosis may be given in even the most desperate attacks, as they are self-limiting, the very cyanosis bringing about relief of the spasm. But repeated attacks tend to wear the patient out, and, moreover, gradually lead to emphysema and dilatation of the heart. Hence, from a life insurance point of view, asthmatics are not "first-class risks."

HAY FEVER

For the purposes of treatment, *hay fever, hay asthma, rose fever, vasomotor rhinitis,* and *paroxysmal rhinorrhea* may all be regarded as one affection. Hay fever is considered by some, e. g., Goodhart and Spriggs (32), as the same condition as bronchial asthma, but most writers look upon it as a different affection, although it frequently is complicated with some bronchial asthma.

Prophylaxis and General Treatment

In true hay fever, where severe attacks of sneezing and profuse discharge from the nose and eyes occur only during the season of the flowering of plants, the most satisfactory treatment is to send the patient away from the vicinity of such plants to some immune region. Such resorts as the White Mountains, the Isles of Shoals, N. H., Banff in the

Canadian Rockies, and Muskoka, are all well known in this way on this continent, while in Europe many mountain and seaside resorts are made use of. Perhaps the best is Heligoland, where there is little verdure, and sea on every side. It is frequently advisable that the affected individual take a sea voyage during the season when he usually suffers. But most people cannot or will not afford the time and the money to thus flee the country, and such must avoid as far as possible the districts where the special plant grows which is to them noxious; they must keep out of draughts and dust as far as possible.

The general health should be supported in every way, many people only suffering when they are run down, overworked or depressed by worry or illness. A long holiday is often necessary in such cases.

Diet.—The diet should be light and nutritious, and as a rule stimulants should be used in great moderation or avoided altogether. Iron and strychnin are often indicated, and a prolonged course of arsenic is frequently invaluable. Some would place arsenic in the first place in the general treatment.

Local Treatment.—The nasal passages should be examined by an expert, and if any abnormality be found there it must be carefully treated. Many cases may be practically cured by treatment of the nose. Spurs, polypi, hypertrophy of the turbinates may be the cause of the trouble and must be dealt with surgically. Total turbinectomy is a severe operation, and one which is probably seldom required here. E. S. Young, in his recent work (82), and also elsewhere, states that excision of the tubercle of the nasal septum, combined with other intranasal treatment, produces the best results. Even where no gross abnormality is found, the improvement following the application of the galvanocautery to the anterior ends of the inferior turbinated bones is often marked. But it must be repeated that such work is for the expert, and may be overdone.

Treatment During an Attack.—Most of what has been said in regard to the treatment of bronchial asthma (q. v.) during an attack applies here. During the early stage of an attack the application of cold to the surface of the body in the shape of baths or spongings seems to aid, by restoring the vasomotor tone.

Exercise is valuable and should be taken in the mornings and evenings rather than in the heat of the day in summer, when these cases are usually at their worst. The bright light is also trying and, if these patients must go out in it, then dark glasses will give much comfort.

Locally a simple alkaline spray, such as Seiler's solution, should be given and a plain lanolin or weak menthol ointment to the nares is comforting. Probably cocain will give more relief than any other drug here, but it should seldom if ever be prescribed, as the prolonged nature of the disease and the neurotic temperament of most of the sufferers make the

risk of cocainism too great to be run. An oily spray of albolene or liquid vaselin, containing 3 to 5 per cent. of menthol to the ounce (30 c. c.), is valuable, or one containing this with a similar amount of camphor.

I. Burney Yeo speaks highly of a spray of deodorized cod liver oil.

Sprays of adrenalin and atropin may be of much use here, as they are in true asthma (q. v.).

The distressing itchiness of the conjunctivæ may be lessened by an eyewash containing ten grains of borax dissolved in an ounce of camphor water.

Pollantin.—W. P. Dunbar (18) some years ago showed that the pollens of certain plants, usually of the grass family, contain a soluble toxin which causes hay asthma, in the susceptible, when it reaches the conjunctiva and nasal mucous membranes. He and Sir Felix Semon produced a serum, by injecting such toxin into horses, and this serum is called pollantin. Recently L. Noon (57) has found it possible to produce a partial immunity in the susceptible by the hypodermic injection of an extract of pollen from various grasses (chiefly timothy grass). For some years pollantin was much used in the treatment of hay fever, but recent reports are not encouraging, and, according to Fetterol (24), it makes some cases worse.

PLASTIC BRONCHITIS

Plastic bronchitis is a rare disease, the essential nature of which is far from clear. It is characterized by the periodical formation in the bronchial tubes of a fibrinous material, which, after causing much distress from dyspnea, is thrown off and expectorated in a more or less intact condition as casts.

Treatment.—So little is known about the essential nature of this disease that we can give no general directions to our patients, beyond those bearing upon the improvement of the general health. No diet has any perceptible effect upon the condition.

When an attack occurs, the one drug that has proved of undoubted value is the iodid of potassium; it no doubt acts by causing a pouring out of thin bronchial secretion, which helps to loosen the adherent casts. It should be given in repeated doses of say 5 to 7 grains every four hours. These small doses have a more marked tendency to produce iodism than have the larger ones, and this is what we want here.

Pilocarpin acts in the same way, and may be given by the mouth in expectorant doses of 1/20 to 1/10 grain (0.003 to 0.006 gm.) of the nitrate or hydrochlorid every four hours.

Apomorphin also acts as a producer of freer secretion, and may be given in small doses for this purpose. Doses of 1/32 to 1/10 grain (0.002 to

0.006 gm.) of the hydrochlorid given by the mouth every two to three hours will soon produce an abundant secretion. The emetic action of this drug is not nearly so well marked when it is given by the mouth as when given hypodermically; on the other hand, the expectorant action is better developed, and hence it should be given in this way in this disease.

In severe cases it may be advisable to use an *emetic,* with the double object of producing a free secretion from the bronchial mucous membrane, which always accompanies nausea; and also to procure vomiting, which may at the same time expel the contents of the bronchi.

Ipecacuanha in 20-grain (1.3 gm.) doses will act well here; or perhaps, better still, a hypodermic injection of 1/15 to 1/10 grain (0.004 to 0.006 gm.) of apomorphin. When, however, the patient is very distressed and cyanosed, it becomes a nice question to judge whether one should or should not run the risk of heart failure from the use of an emetic. In a case seen with Dr. R. J. Dwyer the patient was so near death from asphyxia that we feared to put any further strain on the heart already much dilated. However, after the patient had become almost black from cyanosis, pulseless, and apparently practically dead, she herself vomited and soon brought up a quantity of sputum containing an almost complete cast of the respiratory tract below the trachea, and then completely recovered. In a similar attack, which occurred some months later, she died before skilled assistance was obtained.

The fact that the casts are soluble in lime water led to the suggestion by Biermer that an inhalation of atomized lime water be used, and a case of its successful employment was reported by Waldenburg. No recent reports of its use have been made. Inhalations of creosote vapor have been suggested by Fowler (27) and might be tried. It can be conveniently inhaled from a Burney Yeo zinc inhaler, and if too irritating may be mixed with equal parts of spirit of chloroform.

Morphia is, of all drugs, the one most contraindicated here and should never be used to relieve the distress. It dries up the secretions, lessens the lung reflex, and tends to weaken the respiratory center. In one case within the writer's knowledge it seemed on several occasions to precipitate an attack.

BRONCHIECTASIS

Environment.—It is most essential that the patient's general health should be kept up by abundance of pure fresh air and lots of nourishing food. This is the most important part of the treatment.

"Not drugs, but a suitable place of abode and appropriate occupation are the important factors in the treatment of the disease. The patient must above all things avoid the haunts of men; crowds are hotbeds where the infections most to be dreaded multiply" (Hoffmann, 35).

A dry, bracing climate is the best here, such as is found in Southern California, on the tablelands of South Africa, or the high elevations on islands in the West Indies. Egypt is a good place. The prairies of the Northwest of this continent are eminently well adapted for these cases. The air there is dry and pure to such an extent that dead things such as game tend to dry up rather than decay, and the constant inhalation of such air may do much to lessen the putrefaction in the cavities. It is important to remember, when advising patients as to traveling, that, while the fetor exists to any marked extent, it is difficult for them to travel with comfort on this account. In choosing a climate it is most necessary to find one where the patient may be the greatest possible number of hours in the open air and sunshine.

Chills and dampness are to be avoided, as they tend to bronchitis; and this is a bad thing in these cases in many ways. Whenever there is any fever the patient is best in bed, and slight intercurrent febrile attacks are very common.

Warm sea water bathing, or at least salt baths followed by a cold douche and a brisk rubdown, are valuable. Exercises, especially those calling for slow and ample breathing, are serviceable in expanding the chest and improving the general circulation. Special exercises, undertaken with the object of emptying the bronchiectatic cavities, are referred to later on.

Diet.—In many cases there is much loss of weight, which calls for as liberal a diet as the patient can assimilate (v. Chronic Bronchitis).

Specific Treatment.—No medicine or other remedy can, of course, directly restore the caliber of the diseased bronchial tubes, but in acute cases, such as occur chiefly in children, there still remains a tendency to such return to the normal, which may be aided by remedies which lessen the amount of the infection of the sputum and relieve the strain of coughing, and especially by every measure which tends to the restoration of the general health. Where the infection is chiefly a single one, something may be hoped for from vaccine therapy.

It is most important to empty the cavity frequently, and the patient soon finds the posture in which this most easily occurs. If he lean forward, or assume some other position, a cough comes on and he brings up more or less of the contents of the cavity; the altered position has caused some of the secretion to gravitate into a more normal part of the bronchus, and the reflex cough then set up does the rest. A. Quincke, William Ewart, and others have developed this idea of posture in great detail and have elaborated methods for both the occasional and the continuous emptying of the cavities. G. Hoppe-Seyler also lays great stress upon the importance of posture and proper exercises, and urges that in every case of the disease, but more especially in the aged, every effort should be made to ensure complete emptying of the cavities and air passages.

Benefit may be derived from breathing exercises supplemented by compression of the lower part of the chest during expiration. The patient may be taught to carry out these for himself and should do so night and morning. In sacculated bronchiectasis of the lower lobes it is difficult to evacuate the secretion, but this may be aided by making the patient recline in a slanting position with the shoulders low. The Trendelenburg position may be assumed with benefit. Such postures are surprisingly effectual, and the patient may train himself to recline in this slanting position for an hour or two night and morning, changing from one side to the other until the position is found in which the most copious evacuation of the contents of the cavity occurs.

Surgical Treatment.—In some cases, where the bronchiectatic cavity can be clearly localized and appears to be single, surgical interference has proved of value and has brought about a cure, which could scarcely have been hoped for otherwise. The cavity is opened and drained through the parietes. [One or more ribs should be resected so that the walls of the cavity can collapse and finally healing take place.—Editor.] Such treatment, however, should not be lightly undertaken. In the first place, the localizing of the cavity is far from easy and, even when it has seemed to be quite definite, the cavity has proved to be only one of several, some of which could not be reached. This is notably the case in children, as was shown some years ago by John Thompson, of Edinburgh. F. A. Hoffmann had collected, up to 1904, records of 23 cases operated upon, with 11 recoveries and 12 deaths. Hofmockel, in discussing the results in 80 cases operated upon for abscess, gangrene, and bronchiectasis, says that the best effects were obtained in abscess and the worst in bronchiectasis. Roswell Park (62) reported, some years ago, 23 cases operated upon, with 9 deaths. He pointed out that in the absence of pleuritic adhesions the operation is difficult and dangerous; otherwise it is easy, especially if the cavity be superficial.

For the present one may say that only exceptional cases should be operated upon. Those following definite fibrosis of the lung are more likely to be single than are those complicating bronchitis, and are hence the ones most likely to be benefited by operation. Samuel Robinson (67a) says here: "If the cavity is bronchiectatic, it should almost never be drained. A bronchiectatic fistula and chronic sinus may persist. Numerous smaller cavities in the immediate neighborhood of the one drained continue to secrete profusely. The disease continues its course. . . . The surgery of bronchiectasis consists in two possibilities: immobilization of the lung by nitrogen gas injections into the pleura, or resection of the ribs." Forlanini, according to Robinson, reports two complete cures by the nitrogen injection treatment, and it would seem to be an excellent thing to try, as it has been used so successfully in cases of pulmonary tuberculosis with cavities, and is practically free from risk.

Symptomatic Treatment.—The symptoms which call for treatment are chiefly (a) emaciation, (b) cough, (c) profuse expectoration, (d) fetor.

Emaciation (*vide supra*).

Cough.—The cough is a useful one and seldom needs to be directly treated, much less checked. It will, as a rule, be a grave therapeutic error to administer opium or its derivatives with the object of lessening it. But often, in addition to the bronchiectasis, there exists a more or less generalized catarrh of the respiratory tract, which keeps up a frequent and (partly at least) useless cough, and in such cases soothing remedies (even containing opium in small amounts) are indicated.

Fetor.—The most reliable remedy for lessening the fetor of the sputum is creosote. The drug may be inhaled in various ways, or it may be given internally.

Creosote Bath.—The creosote vapor bath, as originally suggested by Arnold Chaplin, is probably the most efficacious medicinal treatment of bronchiectasis known. The details of this method, as given by Godlee and Fowler (27), are as follows:

A small room should be set apart for the purpose, and should be cleared of furniture, except such articles as wooden chairs and a table. In order to prevent the vapor of the creosote from penetrating them, the patient should have over his clothes a garment with sleeves shaped somewhat like a smock frock. The eyes should be protected by well-fitting goggles similar to those worn by Alpine climbers when on the snow, or a mask may be worn, made of surgical strapping, with two watch glasses between the adherent surfaces corresponding in position with the eyes, and tied with tapes at the back of the head. Plugs of cotton wool should be inserted in the nostrils. Women should cover the hair with a cap similar to that used when bathing. Ordinary commercial creosote should be poured into a metal saucer on a ringed iron tripod, and the saucer heated by a spirit lamp placed under it. If the floor is of wood, the tripod should be placed upon a large flat stone slab, as the creosote may run over the edge of the saucer. As the creosote is heated dense fumes rise and fill the room. The effect upon the patient is to produce violent cough attended with profuse expectoration, nearly two-thirds of the daily amount being often expectorated during a bath. Vomiting may follow the cough. The process is certainly not a pleasant one, but it is remarkable how quickly the patients become accustomed to it. They usually state that the breathing is much freer after the bath, and that they enjoy a much longer interval of almost complete freedom from cough and expectoration. At first the bath may be given on alternate days for 15 to 20 minutes, but when the patient has become accustomed to the treatment the bath may be given daily, and the duration gradually increased to an hour or an hour and a half. In severe cases it may be well to give the bath twice daily. Under such treatment the fetor may disappear within a short time, but this

does not always follow. In some cases the quantity of expectoration greatly decreases; in others it is little affected. The treatment should be persisted in for several months. There is often a marked increase in weight under its use.

Short of the creosote bath, great benefit may accrue from inhalations of creosote from some special inhaler, such as that recommended by Burney Yeo. A. McPhedran (47) speaks of a case which was successfully treated by the inhalation of creosote from a nebulizer operated by compressed air. The case followed influenza.

Many other aromatic inhalations may be used with the same object, especially menthol and eucalyptus, as in the following:

℞ Menthol 1 part
Eucalyptol 2 "
Benzoinol 3 "
Misce, fiat mistura.
Sig. To be inhaled from a handkerchief or from an inhaler.

Oxygen.—W. H. Herringham suggests the inhalation of oxygen from a Dr. George Stoker's inhaler. It should be used for six hours daily. Great improvement may result. He describes a case in which this treatment was alternated with the creosote vapor bath, and the patient improved much more, both as regards the fetor and the quantity of expectoration, under the oxygen than under the creosote. A point in favor of the oxygen is that it is much less unpleasant than is the creosote. The method certainly deserves a further trial, and should be specially useful in children. These various inhalations should be used just after the patient has more or less emptied his air passages by coughing.

Expectorants.—Taken internally the aromatic expectorants have some action in lessening the fetor and diminishing the quantity of expectoration. Creosote, terebene, and guaiacol carbonate are the ones chiefly used here.

Creosote should be given in small doses, gradually increased as the patient can stand it. It may be given in capsule form or in a mixture, and is often well combined with cod liver oil. Two drops thrice daily is a sufficient initial dose.

Terebene is well given in capsules containing 5 to 10 drops, or it may be administered as the *haustus* of the Victoria Park Hospital. This is made up as follows:

℞	Terebeni		10 min.	0.65 c. c.
	Mucilaginis tragacanthæ			
	Glycerini	āā	1 dr.	4.00
	Aquæ cinnamomi	ad	1 oz.	30.00

Misce, fiat mistura.
Sig. Thrice daily after meals.

The *guaiacol carbonate* should be given in 5 to 10-grain doses (0.35 to 0.65 gm.) thrice daily, or even every four hours, and will soon make itself evident in the breath.

Vivian Poore (64) suggested the use of garlic and reported very favorably upon it. A clove of garlic is chopped up and mixed with beef tea or given in capsules. The *essential oil of garlic* (*oil of allyl*) may be given in drop doses in capsules thrice daily instead, and soon causes the characteristic odor in the breath. *Myrtol* has been advocated in the treatment of putrid bronchitis and bronchiectasis. It is a volatile oil obtained from the leaves of the common myrtle, and when taken internally is eliminated chiefly by the respiratory tract, and acts as an antiseptic and deodorant. It may be given in capsules containing 2 minims (0.12 c. c.) taken frequently. If the sputum be thick and tenacious and is only brought up with difficulty, iodid of potassium is of value. It should be given in doses of 3 to 5 grains (0.2 to 0.3 gm.) thrice daily. An alkaline aromatic draught taken first thing in the morning is useful in thinning the sputum and thus allowing of it being got rid of more easily. Such a one as that mentioned under Chronic Bronchitis is a good one.

Injections.—*Intratracheal injections* have been much employed in this condition. They were first introduced by A. Rosenburg for tuberculosis of the lungs and larynx. In 1886 Sehrwald and Reichert, by experiments on dogs, calves, and sheep showed that fluids so injected made their way into the finest bronchioles. Sehrwald's conclusions were: (1) that large quantities of fluid could be injected without discomfort; (2) that the fluids not only passed into the alveoli, permeating the surrounding structures, but also reached the peribronchial and pleural fibrous structures and even penetrated the cartilages; (3) that the lungs absorb more actively than does the digestive tract, or even the subcutaneous tissues, the rapidity of absorption depending upon the extent of absorbing surface—so much so, indeed, that the lung of a dog can absorb four times its own weight in less than five days; (4) that medicines thus introduced act in smaller doses and more rapidly than when introduced in any other way.

A formula frequently used for injection is the following:

℞ Menthol 10 parts
Guaiacol 2 "
Olive oil 88 "
A drachm to be injected.

Colin Campbell (7) improved the method by employing Price's distilled glycerin instead of olive oil. Other glycerins are too irritating for use. Menthol and guaiacol have been most used in this way, but more recently Campbell has substituted *izal*. He generally empties a syringe holding 100 minims (6.5 c. c.) at one squirt and repeats this two or

three times at each sitting. As much as three ounces (100 c. c.) may be given in a day. Colin Campbell's method, as quoted by Wm. Ewart (21), is as follows:

"The tube should be passed rapidly into the larynx, and should fit the curve at the base of the tongue and lie lightly against it, thus fixing the epiglottis and preventing spasm. The squirt should be delivered like lightning—either with inspiration, or during a slightly prolonged interval following expiration. If the operation be properly performed, the taste of the fluid injected should not be perceived by the patient," neither is there cough, pain, or asphyxia. The daily use of such injections may produce a great improvement in the degree of fetor and the quantity of expectoration.

BRONCHO-ADENITIS

Inflammation of the bronchial glands, as a sequel to acute infections of the lungs and bronchi, is very common. It is specially apt to occur in children as a complication of bronchopneumonia and bronchitis. It is also an almost constant accompaniment of whooping-cough; in fact, the spasms in this disease have been attributed to the enlargement of the glands, although with little evidence. In measles and influenza the condition is common. The adenitis complicating these acute infections as a rule clears up completely in time and does not call for any special treatment. But in the tuberculosis of children involvement of the bronchial glands is extremely common and may be of serious and even fatal import.

Therapy.—The treatment of the latter is largely that of tuberculosis in general, and may be summed up as the placing of the patient in the best possible environment for the raising of his general health and consequent resisting power. Fresh air and abundance of good and nourishing food are essential. Residence at the seaside is of the greatest and almost specific value in this condition of tuberculous adenitis and should be insisted on wherever possible. The sea air, in some not clearly understood way, helps these patients to a very marked degree. Adolphe d'Espine, of Geneva, published several years ago a list of 119 cases of recognizable enlargement of the bronchial glands, all treated with eight months' residence at the seaside, with a cure both local and general in 55 cases, i. e., 46 per cent. In 54 children the physical signs of enlargement remained, but the general health, often seriously impaired, had been reëstablished. The value of sea air has also recently been emphasized by L. W. Ely (19), the heading of his article itself being suggestive, viz., "Treatment of Cervical Tuberculous Adenitis at *Sea Breeze Hospital.* (The italics are ours.)

Iron, especially in the form of the syrup of the iodid, is generally use-

ful, and cod liver oil is always indicated during the cold months, when it can be taken. It will frequently be found that where a child cannot take any of the emulsions on the market he will take the pure oil quite well. There often seems to be a craving in these tuberculous children for fat, which the oil appears to meet.

Tuberculin finds a very hopeful field in these cases of adenitis, and a course of it is the best thing possible in the way of active interference.

Commencing with a very small dose of the old tuberculin, say 1/20,000th of a milligram, it should be administered once a week, and as a rule the dose should be doubled each time. If there be any local or general reaction, then the dose is probably too large, although it should be said here that recently some authorities are advocating these larger doses. The course of treatment should last for several months. Carmalt Jones (40) recently gives the results of this treatment, in tuberculous glands generally, as carried out at the Westminster Hospital, London. There were 79 cases treated, and of these 27 were cured, 22 much improved, 18 better, 8 unchanged, and 4 worse. He says that "in any average eight cases, in which inoculation is adopted (with correct dosage), five will probably show marked improvement, of whom two or three will be cured; two will probably improve slightly, and one or two will fail. The best results are to be anticipated in young children and again in young adults between 15 and 25. The worst results come between 10 and 15 years."

As a rule, the tuberculin should be given hypodermically, although some workers, e. g., A. C. Latham (43), think that it acts as well when given by the mouth.

The bovine type of the disease, to which class these cases mostly belong, seems specially amenable to the human type of tuberculin. This point is brought out by Nathan Raw. He commences with 1/10,000 of a milligram of Koch's old tuberculin and doubles the dose each week until 1/10 mg. is reached, beyond which he never goes. If the case requires it, he begins a second course, after a short interval, this time commencing with a larger dose and therefore more quickly reaching the maximum. Under the tuberculin treatment, which, of course, should only accompany all other necessary therapy, cervical glands may be seen to improve very rapidly and the less easily observed bronchial ones may be presumed to follow the same course.

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CHAPTER IV

DISEASES OF THE LUNGS

ALBION WALTER HEWLETT

CIRCULATORY DISTURBANCES

GENERAL CONSIDERATIONS: PHYSIOLOGIC AND PHARMACOLOGIC

The pulmonary vessels offer but little resistance to the flow of blood through the lungs because of their short length and the large area of their combined cross section. Indeed, the circulation in from one-half to three-fourths of the lungs may be stopped by ligature without materially raising the pressure in the remaining open arteries, or affecting the systemic blood pressure. It would appear, therefore, that these vessels dilate with unusual ease when it is necessary for an additional quantity of blood to pass through them. Owing to the low resistance in the pulmonary system, the pressure in the pulmonary artery is only about one-third of that maintained in the aorta. The pulmonary vessels are probably supplied with vasomotor nerves, but these have little influence upon the pulmonary circulation, for their action is overshadowed by changes in the amount of blood delivered to the lungs by the right ventricle or taken out by the left. Drugs also seem to exert more influence upon the pulmonary circulation through their cardiac action than through their direct action upon the pulmonary vessels. An increased amount of blood in the lungs occurs in pulmonary congestion and in certain forms of cardiac asthma and pulmonary edema. A reduction of pulmonary pressure in these conditions, as well as in hemoptysis, is an important therapeutic indication, and we shall, therefore, discuss briefly the factors which may raise the pulmonary pressure and the principles involved in attempting to reduce it.

In the first place, increased pulmonary pressure may be due to an increased expulsion of blood from the right ventricle, owing either to a primary increase in the action of this ventricle or to an increased inflow of blood from the great veins of the body. In order to reduce this inflow, we may bleed from the superficial veins or constrict the extremities

in such a way as to interfere with the venous return flow. Experimental studies indicate that hemorrhage sufficient to cause a definite and permanent lowering of the pulmonary pressure reduces the pressure in the systemic circulation also (Miller and Matthews, 8), which effect limits the usefulness of bleeding. Experimental data concerning the effect which constriction of the extremities produces upon the pulmonary circulation do not seem to be available. Such constriction will, however, reduce an abnormally high pressure in the systemic veins of man (v. Tabora, 16), and it will probably, therefore, reduce the amount of blood flowing into the lungs. Dyspnea tends to raise pulmonary pressure because the increased respiratory movements serve to pump blood from the large abdominal veins into the right heart. They, also, assist the blood flow through the thin-walled right ventricle to a greater extent than through the thick-walled left ventricle (Rubow, 14). Any drug which tends to depress the excessive respiratory movements of dyspnea, such as morphin, will tend to reduce an associated pulmonary congestion. Finally the pulmonary pressure will be reduced by drugs which depress the right ventricle. This explains the fall of pressure which has been produced experimentally by cardiac depressants, such as chloroform, aconite, and pituitary substance (Wiggers, 19).

In the second place, the pressure within the pulmonary circuit may be raised by the damming back of the blood into the pulmonary circuit, as in mitral stenosis, mitral insufficiency, and relative weakness of the left ventricle. In such cases, in addition to attempting to reduce the amount of blood sent into the lungs by the right ventricle, we may try to increase the amount expelled by the left. When the systemic pressure is high, vasodilator drugs are indicated, while a primary weakness of the left ventricle demands cardiac stimulants, such as digitalis and caffein. When the general arterial pressure is high, bleeding will tend not only to reduce this, but will lessen the amount of blood flowing to the lungs.

Finally, changes of pressure within the pulmonary circuit may be due to changes in the caliber of the pulmonary vessels. As has been said, however, such changes, whether due to nervous influences or to drugs, are usually overshadowed by changes in the rate or strength of the cardiac contractions, and practically they need not be taken into account.

Numerous experimental studies have been made concerning the effect of various drugs upon the pulmonary circulation. The variable results and still more variable interpretations by different observers indicate the complexity of this problem. Furthermore, as those various results have usually been obtained on normal animals with relatively large doses of the drugs, they cannot be directly transferred to the therapeutic doses used in the treatment of pathological conditions of man. Nevertheless,

it seems advisable to summarize some of the results obtained by experimental methods. Those desiring more complete data should refer to the papers of Bradford and Dean, Wood, Plumier, Pic and Petitjean, Wiggers, E. Frey, etc. The following summary is based largely upon Wiggers' (18, 19) and Frey's (6) papers.

Epinephrin, when producing definite effects upon the pulmonary pressure, has raised both the arterial and venous pressure, and has increased hemorrhages from the arteries, veins, and capillaries. A fall of pressure in the left auricle is attributed by Wiggers to the increased activity of the left heart. According to most observers, digitalis and related drugs produce similar, though less marked, effects. Ergot preparations have yielded variable results in the hands of different observers. Wiggers, who worked with ergotoxin, found that the pulmonary arterial pressure was first reduced and then raised, while the pressure in and the hemorrhage from the veins was diminished, owing to a constriction of the smaller pulmonary vessels. After severe hemorrhage both these effects passed off. The nitrites and nitroglycerin have usually caused a rise of pulmonary pressure in normal animals, with increased hemorrhages from the arteries, veins, and capillaries. After considerable hemorrhages, however, they may produce a fall in the pulmonary as well as in the general arterial pressure.

A fall of pulmonary pressure may be produced by large doses of chloroform, owing partly to its depressant action on the heart and partly to a depression of respiration. Aconite is also said to cause a fall of pulmonary pressure. Pituitary substance, according to Wiggers, causes a fall of pressure in both the pulmonary arteries and veins, owing to a depression of the right ventricle. This occurs even after hemorrhage. As this fall of pulmonary pressure is associated with a rise in the general arterial pressure, pituitary extract would seem to be indicated theoretically in pulmonary hemorrhage.

1. Active Congestion

Active congestion of the lungs in the clinical sense is nearly always associated with local infection, and in the majority of cases with a mild or beginning pneumonia. Its treatment is that of the earlier stages of pneumonia. The patient should be kept in bed. The room should be well ventilated. The diet should be light, and if there be much fever it should be restricted to liquids. A cathartic, such as calomel, at night, followed by salts in the morning, should be given. Various forms of counterirritation over the chest have been advocated for the purpose of diverting blood from the lungs. Although this action is questionable, nevertheless, such local counterirritants frequently afford distinct relief from pain and the sense of thoracic constriction. The use of dry cups to the front

and back of the chest is a favorite method of applying counterirritation. Warm mustard poultices are also much used. These are made by adding one part of powdered mustard to from four to six parts of flour, and mixing in enough warm water to make a thick paste. This paste is spread rather thickly between two layers of cheese cloth and applied over the affected area. Hot water (over 140° F.) should not be used, as this destroys the ferment in the mustard. The poultice should be left on from five to thirty minutes, or until the skin has become red. If it is desired to use the poultice for a longer time, less mustard may be used in making the mixture (1 to 10). Blistering either with mustard or cantharides should be avoided, for the reason that, if the patient develops pneumonia, the blisters cause serious discomfort and interfere with other local applications.

Bleeding may be resorted to in a plethoric individual with a large full pulse and distended veins. As a rule, from two hundred to five hundred c. c. of blood are removed from a superficial vein of the arm. Good results have repeatedly followed bleeding in suitable cases, and the removal of three hundred to five hundred c. c. of blood has been shown to reduce an abnormally high venous pressure in man (v. Tabora, 16). More than one bleeding at the onset of a serious illness, or bleeding in those who are not robust, is of doubtful value. Constriction of the extremities may ward off a threatening edema during the course of a pneumonia (v. Tabora, 16). Aconite has enjoyed a considerable reputation in the treatment of the acute congestion of beginning pneumonia. It depresses the heart and reduces pulmonary blood pressure (Wiggers, 19). To robust individuals it may be given in doses of three drops of the tincture every fifteen minutes for several hours, or until the heart is slowed. In wet cups we have a combination of counterirritation and bleeding, though it seems better to meet these indications separately. Morphin is often useful to relieve pain and dyspnea. Emetics, especially tartar emetic, have been used occasionally for the purpose of combating an inflammatory edema, and with good results, but their depressing action should be borne in mind. They are contraindicated in those with feeble heart action or with arteriosclerosis.

2. Passive Congestion

Passive congestion of the lungs is due to a damming back of the blood from the left heart while the right is still sufficiently active to distend the pulmonary blood vessels. Passive congestion of a greater or less degree always accompanies stenosis or regurgitation at the mitral orifice. It also occurs when the left ventricle is unable to expel sufficiently well the blood coming to it from the lungs, either on account of a primary myocardial disease or a high systemic blood pressure. Under these cir-

cumstances the pulmonary vessels are distended, and the pressure in the pulmonary circuit is increased. The treatment of chronic passive congestion is identical with the treatment of the underlying heart condition, digitalis or its allies being the drugs of preference. These act especially well in mitral disease and in auricular fibrillation.

The paroxysmal dyspnea of heart disease, cardiac asthma (Rubow, 14), is caused in part by an acute passive congestion of the lungs, in part often by an accompanying mild edema. The treatment of acute attacks of passive congestion, therefore, will be discussed under pulmonary edema.

3. Hypostatic Congestion

Hypostatic congestion tends to develop in dependent and motionless portions of the lungs in old and in asthenic individuals. It shades imperceptibly into the hypostatic form of pneumonia. Prophylaxis is important. During long and protracted fevers, such as typhoid, whenever a patient is comatose from any cause, and after operations or fractures, especially in the old or weak, changes in posture are very important. The patient should be turned regularly, so that he lies at least half the time on one side or the other. Such patients should sit up as soon as possible after operations and fractures, for the sitting posture increases the excursions of the lower chest and aids expectoration. Where the circulation seems poor, strychnin and digitalis may be given, the former for its general stimulating effect, especially upon respiration.

When hypostasis or a hypostatic pneumonia has developed, then, in addition to the care about changing position and the free use of heart stimulants, expectorants of a stimulating type should be used.

4. Pulmonary Edema

Etiology.—Pulmonary edema may be due to a number of causes, and it seems certain that not all pulmonary edemas are of the same nature. In one group the edema occurs secondary to infections of the lungs, such as pneumonia or tuberculosis, and in some cases the acute active congestion of an infection may produce an acute edema without signs of consolidation. This infectious form of edema, the importance of which has been insisted upon especially by Sahli, doubtless occurs as a secondary or as a terminal event in many chronic diseases. The serous expectoration which occasionally follows paracentesis of the chest is probably due to a pulmonary edema occasioned by the sudden expansion of the compressed lung (Riesman, 13). Edema of the lungs sometimes follows anesthesia, and Pedersen (10) has collected and analyzed 16 such cases, including his own. Various other causes have been described. Most frequently, however, edema of the lungs occurs in connection with renal, cardiac, or vascular

disease, and especially in patients showing high blood pressure or disease of the first portion of the aorta or coronaries. In such cases the edema may be a terminal event or it may occur as a recurrent or paroxysmal form, to which especial attention has recently been directed in this country by Riesman (13) and by Stengel (15). Pilocarpin injections, as sometimes used in nephritis, predispose to or may precipitate attacks of pulmonary edema, and these cases deserve separate consideration for the reason that in them atropin, a physiological antidote of pilocarpin, may be particularly efficacious.

The exact nature of the pulmonary edema which occurs in connection with cardiac, renal, or vascular disease has been much debated. Changes in the quality of the blood, damage to the vessel walls, and infection have all been held responsible for its occurrence; and, while these are of unquestioned importance in certain cases, attention has been centered rather on the mechanical factors involved, for these would seem to give more definite indications as to the cardiovascular remedies to be employed. According to the theory of Welch and Cohnheim, pulmonary edema results from a disproportion between the working power of the left ventricle and the right ventricle of such a character that, the resistance remaining the same, the left heart is unable to expel in a unit of time the same quantity of blood as does the right heart. Owing to this disproportion, there is a collection of blood in the lungs with a rise of pressure in the pulmonary vessels. This favors or may directly cause the edema. Mechanical edemas of this type have been produced experimentally by ligation of the upper thoracic aorta of rabbits, by obstructing the left coronary artery so as to damage the left ventricle, and by acute obstructions at the mitral orifice. In the edemas produced experimentally by chemical agents a rise of pulmonary pressure frequently occurs, although it is not essential to the production of the edema (Miller and Matthews, 8). It is interesting that the conditions in which pulmonary edema has been most frequently observed clinically, viz., aortic insufficiency, coronary sclerosis, nephritis, and arteriosclerosis, are apt to be associated with strain or weakness of the left ventricle, and that many patients show high blood pressure either continuously or during the attacks; both of which facts can easily be brought into accord with the mechanical theory of pulmonary edema.

Treatment.—Rarely is the physician confronted with a more alarming group of symptoms than in pulmonary edema. "The patient suddenly grows deathly pale and wears the anxious expression of terror of one who fears instant death. The hands, feet, and whole body grow cold and become bathed in a dripping sweat. Later, as the respirations grow more and more difficult, cyanosis becomes associated with the pallor. . . . He struggles for breath and soon becomes additionally oppressed by paroxysms of suppressed cough, in which a little frothy and often blood-

tinged serous fluid is brought up. Later larger quantities of the same sort of frothy serum may be expectorated or may literally well up from the lungs" (Stengel). Death usually seems imminent and indeed frequently occurs; yet, if we may judge by the variety of drugs recommended as useful in combating the attacks, as well as by the occasional recoveries without treatment (Riesman, 13), we should admit a decided tendency toward recovery, at least in the recurrent form of edema.

The use of morphin during the seizures has been objected to on the ground that the patient is apt to be suffocated by the fluid in his lungs; and this objection may, indeed, hold good to large doses of the drug. Practically, however, its use has proved invaluable in the hands of many clinicians (Riesman, 13); and Stengel (15) and Hewlett (7), who have had numerous opportunities to test its efficacy in the recurrent form of edema, especially recommend its use. Stengel advises the hypodermic administration of gr. ¼, repeating in fifteen minutes, if necessary. He considers that the morphin acts not only by allaying the shock and mental disturbances associated with the paroxysm, but also, perhaps, by relieving an associated bronchial spasm, or by quieting and steadying the heart. The reduction of the sense of suffocation also allows the patient to breathe more easily, thus lessening the consumption of oxygen by the respiratory muscles and diminishing the amount of blood pumped into the lungs by the excessive diaphragmatic movements during dyspnea (Rubow, 14). Chloroform, which was recommended by Lissaman, probably acts in a similar manner to morphin, but it possesses obvious disadvantages as compared with the latter. Atropin (Davis, 4; Riesman, 13) has been repeatedly recommended in the treatment of pulmonary edema, often on the assumption that it dries up the excessive "secretion." Quite apart from the argument that the fluid in pulmonary edema is not a true secretion, its practical value has been repeatedly questioned, and Stengel, for example, who compared its action with morphin, found it decidedly inferior. Nevertheless, he believes that the addition of gr. 1/250 of atropin sulphate to each dose of morphin is advisable. In one form of pulmonary edema, that due to poisoning by pilocarpin or muscarin (toadstools), atropin acts as a physiological antidote, and it seems possible that some of the good results attributed to atropin were obtained in this class of edemas (Miller and Matthews, 8).

Oxygen inhalations are indicated when the patient becomes cyanosed. These may raise the partial pressure of the gas within the alveoli sufficiently to tide the patient over a dangerous crisis. Lowering the head so as to facilitate the removal of the fluid from the lungs has been practiced with benefit in cases of edema due to pilocarpin and following anesthesia (Pedersen, 10). It is doubtful, however, if a patient with serious heart disease would allow himself to be brought into this position. Artificial respiration has been found useful on animals (Emerson, 5), and at least one report of its use on man is on record (Barringer, 2).

We have already said that edema of the lungs in many cases seems to depend upon a mechanical overfilling of the pulmonary vessels due to a relative weakness of the left ventricle. This seems to be particularly true of the paroxysmal and recurrent form. Our therapeutic efforts, so

far as the circulation is concerned, may be directed either toward attempting to increase the activity of the left ventricle, or toward reducing the amount of blood expelled from the right ventricle into the overloaded lungs. Various procedures have been advocated for accomplishing these purposes, the most common being the administration of nitroglycerin and bleeding. High blood pressure is extremely common among patients who suffer from edema of the lungs, occurring, for example, in five of Stengel's six patients, and in all of Hewlett's cases. The pressure during the attack of edema itself has been determined occasionally, and in some cases at least it has been found to be increased (Petrén, 11). In such cases, where the left ventricle is subjected to this additional strain, the use of the nitrites would seem to be most rational. One drop of the spiritus glycerylis nitratis dropped on the tongue begins to produce effects in from two to three minutes, and this lasts half an hour or more. This dose may be repeated every ten minutes, under control of blood pressure determinations and the general condition of the patient. In this manner the systemic arterial pressure of those suffering from hypertension may be reduced from twenty to fifty mm.

Bleeding from the superficial veins is regarded as one of the most effective measures for combating pulmonary edema. It is especially indicated when distention of the peripheral veins indicates high venous pressure. From 200 to 500 c. c. of blood should be removed. Bleeding is said to be particularly effective in the inflammatory edema which develops at the onset or during the course of lobar pneumonia. It would also seem to be indicated in pulmonary edema when associated with high arterial pressure, for by this means both the high arterial pressure and the amount of blood flowing to the right heart are reduced.

When the systemic arterial pressure is already low, vasodilator drugs should not be used. In such cases cardiac stimulants are preferable, and subcutaneous injections of caffein sodiosalicylate or of camphor, or the intravenous injection of strophanthin (gr. 1/120 to 1/60—.0005-.001 gm.) may be resorted to. Adrenalin is said to be effective in some cases, possibly because it relieves bronchial spasm, but it should be remembered that pulmonary edema may be produced in animals by intravenous injections of this drug. When the blood pressure is low or the patient is anemic, ligation of the extremities is preferable to bleeding. Wide rubber bands are placed about the extremities near the trunk with sufficient force to obstruct the venous outflow without at the same time obliterating the arterial pulse. Tabora has shown that this will reduce an abnormally high venous pressure, and that it may abort an attack of pulmonary edema during pneumonia (16). The bandages should be removed very cautiously in order to avoid a sudden liberating of the blood imprisoned in the extremities.

After-treatment.—The after-treatment of cases in which one or more

attacks of pulmonary edema have occurred should be directed especially against the underlying conditions, such as a nephritis, a myocardial insufficiency, or a high blood pressure. The iodids are said to be contraindicated immediately following an attack, and pilocarpin should always be avoided. The avoidance of fatigue, excitement, exertion, overloading of the stomach, and flatulence will tend to protect the patient against further seizures. The chlorids in the diet should be reduced to a minimum.

5. Pulmonary Thrombosis and Embolism

Thrombosis of the larger branches of the pulmonary artery is a rare event, and is usually associated with advanced heart disease. No definite rules can be given for its prevention. Its treatment is the same as that of embolism.

Large pulmonary emboli usually arise from the dislodgment of thrombi which have developed in the right side of the heart or in the peripheral veins, and have become free in the circulation. Thrombosed veins of the legs from any cause or of the pelvic veins following puerperal sepsis or gynecologic infection are the most common peripheral sources of pulmonary emboli. Where such venous thrombosis exists care should be taken to avoid the dislodgment of thrombi. Massage of such a swollen leg is strictly contraindicated until complete organization has taken place, which may take weeks to be accomplished. Venous thrombosis from any cause demands a prolonged rest in bed.

Extensive pulmonary embolism may cause death so rapidly that no time is given for treatment, or, on the other hand, small bland emboli may lodge in the lungs without serious symptoms. Between these two extremes we have the cases in which definite symptoms demand the employment of therapeutic measures. For the relief of the severe dyspnea and the symptoms of collapse which occur in such cases morphin is indicated. This should be given in doses of gr. ¼ (0.016 gm.), repeated in fifteen to thirty minutes. Its action here is probably similar to its action in pulmonary edema, and is there discussed (q. v.). Neither cyanosis nor a small pulse need restrain us in the administration of this drug under these circumstances. Morphin is also frequently indispensable in the treatment of the pain associated with the subsequent infarct, though here local measures, especially the mustard poultice, dry or wet cups, compresses, etc., should first be given a trial.

The embarrassment of the right heart and the venous stasis with cyanosis may be relieved by bleeding, and the author has seen marked improvement follow this procedure in a case of embolism associated with heart disease.

Hypodermic injections of camphor and ether, followed later by strychnin and caffein, have been recommended to support the heart. Rest

should be absolute, and even examinations of the thorax should be as limited as possible. The hemoptysis following a pulmonary infarct is rarely of sufficient severity or duration to require other treatment than the rest and quiet demanded in the treatment of the infarct itself. Should a pleural effusion follow the infarct, this should be treated as conservatively as possible. Tapping is required only if the effusion be very large, or if it persist for a long time without resorption. In such cases only a moderate amount of fluid should be drawn off so as not to bring too much early strain on the infarcted lung.

BRONCHOPNEUMONIA

Prophylaxis

Bronchopneumonia occurs most frequently at the extremes of life, among the very young and the very old, and, in these, as in others, it occurs especially when there is a lessened general resistance. For example, Holt (14) states that, of 246 children and infants who developed primary pneumonia, over half—126—had been previously delicate, rachitic, or syphilitic. All measures which have for their object an improvement in the general health of infants tend, also, to diminish the incidence of bronchopneumonia at this age. Bronchopneumonia often complicates other acute diseases, especially measles and pertussis in childhood, and the prolonged fevers, such as typhoid, in adult life. A careful treatment of these diseases with a recognition of this special danger tends to lower the incidence of bronchopneumonia. In infants, and to a lesser extent in older children, every attack of bronchitis should be regarded as a possible precursor of bronchopneumonia. Such patients should be kept within doors and protected from sudden changes of temperature until the fever and more acute symptoms have passed. Whenever a temperature of 100° F. or over persists for more than three days, some condition other than a simple bronchitis should be suspected. Such patients may already be suffering from a slight bronchopneumonia. [See my article on the treatment of measles, Vol. II, Section I, Chapter VII. —Editor.] Among elderly persons bronchopneumonia frequently complicates long-continued and wasting diseases, such as nephritis, heart disease, cancer, and anemia. In elderly persons also there is a special tendency to the development of hypostatic congestion with pneumonia when the patient is bedridden.

The class of patients, therefore, in whom bronchopneumonia is most prone to develop includes marasmic infants, infants suffering from the acute diseases of childhood, adults with wasting or exhausting diseases, and elderly persons in general. Such patients should be protected from

bronchopneumonia, so far as possible, by attention to personal hygiene and by protection from contagion. Fresh air is always important, and overcrowding in close, unhygienic quarters markedly predisposes susceptible individuals to the development of bronchopneumonia. During cold or changeable weather flannel should be worn next the skin. The general nutrition should be maintained at as high a level as possible. The resistance to sudden changes in temperature may be raised by the milder hydrotherapeutic procedures, such as, for example, a daily cool sponge in a warm room. Mouth cleanliness is important. During infectious diseases the mouth should be cleaned after each feeding, either by rinsing or by having the nurse swab out the mouth with a piece of gauze spread over an applicator. According to Wadsworth (20), alcohol (30 per cent.) is our most effective oral antiseptic against the pneumococci, while a little salt, alkali, and glycerin added to the solution accelerate diffusion. He has recommended the following as an excellent wash combining these elements:

℞			
	Sodii chloridi	ʒss	2
	Sodii bicarbonatis	gr. x	0.7
	Aquæ distillatæ	℥ii	62
	Glycerinæ	℥i	31
	Alcoholi	℥v	155
	Thymoli		
	Mentholi āā	gr. i	0.07
	Olei gaultheriæ	gr. iii	0.2
	Olei cinnamoni	gr. ii	0.15
	Olei eucalypti	gr. v	0.35
	Tincture cutbear	ʒiss	6
	Tincture rhataniæ	ʒss	2

Sig.—Dilute with equal parts of water and use as a mouth wash.

Finally, it is important to avoid hypostatic congestion of the lungs, as this may be followed by a hypostatic pneumonia. During protracted diseases patients should not be permitted to lie continuously in the dorsal position, but should be regularly turned in bed, and, following operation or fractures, older persons should be allowed to sit up as early as possible.

In addition to these measures, which aim to increase the patient's resistance to bronchopneumonia, precautions should be taken to avoid direct infection by contact with patients already having severe respiratory infections. The conditions most favorable for contagion are found in hospitals where numbers of patients peculiarly susceptible to bronchopneumonia are intimately associated with those already having respiratory infections. Edsall (4, 5) has emphasized the contagiousness of lobar pneu-

monia in hospital wards, especially among typhoid fever patients. Holt (14) states that he has seen two institutional epidemics of measles in which nearly every case of the disease was complicated by bronchopneumonia, and he has had a somewhat similar experience during a diphtheria epidemic.

Cases of pneumonia in an institution should, therefore, be isolated, so far as is practical, from other patients, and this is especially imperative when the other patients belong to a class peculiarly susceptible to the disease. If possible, the pneumonia patients should be kept in separate rooms or wards, and should be attended by separate nurses. Particular care should be taken in the disposal of the sputum and in the avoidance of direct transference of contagion from mouth to mouth by means of swabs, tongue depressors, etc.

When repeated respiratory infections occur in a child, the nasopharynx should be carefully examined and any possible primary site of infection treated: tonsils, adenoids, etc. Such a child should be kept out of doors as much as possible, if necessary going to the country or to a warmer climate. Mild hydrotherapeutic procedures should be used to harden it against sudden changes of temperature. Finally, in obstinate or protracted cases, an effort should be made to prepare autogenous vaccines from the bronchial secretions, and these may be injected according to the general methods of vaccine therapy. Failing to get an autogenous vaccine, mixed stock vaccines may be used.

Treatment

While in general the treatment of bronchopneumonia resembles that of lobar pneumonia, a number of important differences should be borne in mind. In the first place, bronchopneumonia usually occurs in debilitated individuals, is apt to run an asthenic course, and often continues for a long and indefinite time. For these reasons depressants should be avoided and especial attention should be given to the maintenance of the general nutrition. Furthermore, especially in infants, the obstruction of the smaller bronchi may play a very important part in the course of bronchopneumonia, and the absence of proper aeration of the blood may demand special therapeutic measures.

The methods of treatment of bronchopneumonia may be divided into (1) those aiming to exert a specific effect upon the microorganisms or the toxemia to which they give rise; (2) the hygienic and dietetic management of the patient, and (3) the treatment of individual symptoms and complications.

Specific Treatment.—The problem of a specific antibacterial remedy for bronchopneumonia is much the same as the problem of a specific antibacterial remedy for lobar pneumonia (q. v.). In the case of broncho-

pneumonia, however, the problem is rendered more complicated by the fact that in this disease organisms other than the pneumococcus are very common. For example, in Holt's (15) series of cultures from the bronchial secretions of 124 infants suffering from pneumonia (mostly primary bronchopneumonia), the following organisms were obtained: influenza bacillus in 47 patients, pneumococcus in 94 patients, streptococcus in 63 patients, and staphylococcus in 116 patients. Pure cultures were rare, although quite frequently one organism predominated in the secretions. In the acute stages of bronchopneumonia the use of vaccines or of antibacterial sera has not yielded very promising results, and the prevailing theoretical views hardly encourage their use. When, however, a bronchopneumonia runs a prolonged course, or when repeated attacks occur, the use of vaccines made from the prevailing organism would seem to be rational as a curative or prophylactic measure, and Holt (15) records an apparent cure following the use of a staphylococcus vaccine in a prolonged case of bronchopneumonia complicated by boils.

Hiss has suggested the use of leukocytic extract in the treatment of acute infections. He conceives that the leukocytes contain substances which tend to neutralize the endotoxins of infecting organisms, and that these leukocytic substances may be depressed in the early stages of an infection. By injecting a leukocytic extract obtained from rabbits, patients may be supplied with more of these "antiendotoxins." The clinical use of leukocytic extract, though somewhat promising (Floyd and Lucas, 8), has not passed the experimental stage, and its value is not determined.

Various drugs have been recommended for the treatment of pneumonia on the assumption that they produce a specific effect upon the disease. Among these may be mentioned quinin and creosote preparations. Massive doses of the former have been recently recommended by Galbraith (10) and by S. S. Cohen (3). For example, Cohen recommends subcutaneous injections of the soluble hydrochlorid of quinin and urea in doses of fifteen to twenty-five grains two to four times daily for the first two or three days after the patient comes under treatment, and he believes that the treatment improves the general condition of the patient and that it probably reduces the mortality from both lobar and lobular pneumonia. Others have recommended the use of creosote carbonate or related drugs (Ferrata and Golinelli, 6) in massive doses (Fletcher, 7; Wilcox, 21). The general attitude toward these specific remedies for pneumonia has been one of skepticism, an attitude which is likely to prevail until evidence of their value is supported by more extensive statistics.

[Neither of these methods should be applied to children. Quinin is a most valuable drug, especially in influenza pneumonia. In adults the dose need not be so large as is recommended by S. S. Cohen, 0.30-0.60 gm.

(gr. v-x) of muriate of quinin, three or four times daily, being sufficient, and in children the normal dose for the age of euquinin. Creosote is valuable symptomatically; I have never observed any specific effects from its administration. It should be given in the stage of resolution in doses not to exceed 0.30 c. c. (℥ v) three or four times daily, either as such or in the form of one of its various combinations, of which benzosol is my favorite. When the moist stage of resolution lasts too long, this drug is invaluable. This is the case notably in such subjects as have either latent or active tuberculosis.—Editor.]

Hygiene.—In the absence of effective specific therapy for combating the infection of bronchopneumonia, the treatment of this disease becomes for the most part hygienic and symptomatic, the aim being to maintain the general resistance of the body and to aid when specific dangers threaten.

Particular attention should be directed toward the digestion, on account of the frequently protracted course of the disease. An initial purge is advisable, and subsequent to this the bowels should be kept regular by enemata given every other day when necessary. Should tympanites become marked, it should be actively combated by means of turpentine stupes, turpentine enemata, and the rectal tube left in the rectum. While the diet for adults should be reduced to liquid or soft articles, efforts should be made to furnish a diet rich in calories by using large quantities of cream and of carbohydrates, such as has been recently recommended for typhoid fever. In infancy the general rules for feeding sick infants should be followed, milk being made the chief article of diet. If the dyspnea interferes with nursing, the breasts should be pumped and the infant fed with the spoon or the medicine dropper. The mouth is kept clean by gargles or swabbing, as described under prophylaxis.

Flannel should be worn next the skin. The oiled silk jacket is useful in the pneumonias of infancy and childhood. It is indicated especially when the body temperature is low, and should be dispensed with if the temperature is high. This jacket is made of three layers, the outer being of oiled silk, the inner of cheese cloth, and the middle of cotton batting about one-half an inch thick. The jacket is made of two halves fitted to the front and back of the chest respectively, and extending over the shoulders; the two portions being tied together with pieces of tape. The possible danger following the removal of such a jacket at the end of the illness can be avoided by clipping off lower portions of the jacket daily until the arm holes are reached.

[There are many objections to the oil silk jacket; it irritates the skin, which is always moist under it; so that, if there is such a thing as catching cold, we have a most favorable predisposing condition produced

by it. The fear of catching cold is so great that patients are reluctant to remove it. I have seen one instance in which an oil silk jacket was worn for seven years, and not changed too frequently. If any good can be expected from external applications, and I believe that this is the case, the indication can be carried out better in various ways, especially by hydrotherapy. When very warm applications are required, the much-maligned poultice is still the best.—Editor.]

Care should be taken to avoid prolonged postures in one position, as this favors the occurrence of hypostasis, bronchial obstruction, and atelectasis. Adults and elder children should be systematically turned from side to side, and should never be allowed to lie continuously on the back. Where the strength is sufficient, a sitting posture should be maintained for a few hours each day, as this greatly aids the movements of the lower thorax. Small infants should be taken up and held in the arms of the nurse six or eight times each day.

Fresh air is an essential. A large room, preferably with a fireplace, should be chosen as the sick room. Gas and kerosene stoves should be forbidden. The inclosure of the sick bed in a tent, for the purpose of steaming the air, is objectionable, on the ground that the ventilation is insufficient. A grate fire is most serviceable for airing the room, and, as a rule, the windows should be kept open, taking care that the patient be protected from direct drafts. Once or twice each day infants and smaller children may be carried to another room, and the sick room thoroughly ventilated. Concerning the question of temperature and humidity of the air in the sick room, a notable change in the attitude of the profession has occurred in the last few years. It was formerly the custom to maintain a warm, even, and moist atmosphere about the patient, using, if necessary, the tent method; but at present a strong feeling has set in in favor of the open-air treatment, similar to that used in the treatment of pulmonary tuberculosis. In so far as this innovation signifies a rejection of the old badly ventilated sick room, all are agreed as to its advantageousness. Recent experiences in the large hospitals of New York (Thompson, 19), Philadelphia (Norris, 18), and Baltimore (Chatard, 2) indicate that in lobar pneumonia the open-air treatment, even when the weather is cold, gives better results than treatment within doors. The patients are usually less restless, they sleep better, and the cyanosis often lessens. The mortality figures are also probably better than under the older methods of treatment. The open-air treatment, while less tested for bronchopneumonia, is said to be quite as effective as in lobar pneumonia (Forchheimer). According to La Fétra, cold air is particularly indicated in cases with little bronchitis and during convalescence, while during the acute congestive stages of pulmonary infection with considerable bronchitis warm and moist air is preferable.

[After an experience of thirty years with the fresh-air treatment of pneumonia, I have come to the following conclusions: It should be used in all forms of acute pneumonia. It should be employed in all stages of the disease. It is indicated regardless of age, sex, or condition of the patient; it matters not whether the cough is loose or dry. It may occur that the temperature of the room may have to be raised, as very cold air increases the tendency to coughing. When the other symptoms are increased by heating the room, the physician must determine which is most important for the patient. Whoever has become familiar with this mode of treatment will never again return to the older method. Fresh air reduces the toxicity of the blood; it stimulates the respiratory centers; it increases the depth and diminishes the frequency of breathing, and it increases the urinary secretion. By it nervous symptoms, cyanosis, cardiac wear and tear are reduced. The number of respirations is reduced about ten per minute, the general comfort of the patient is materially added to, and, above all, the mortality is reduced very much.

This can be verified by any one who will take the trouble to watch a pneumonia patient with windows closed and with windows open. If there is any doubt on the subject, the patient is usually able to settle the matter. I have often seen mothers close the windows for fear of catching cold and then open them as they see their child's condition grow worse. —Editor.]

Howland has shown that the blood pressure is maintained at a higher level when the patient is exposed to cold air, which may protect against the dangerous circulatory collapse. It is evident from the discussions of recent years that fresh air is of the utmost importance in the treatment of bronchopneumonia, and that cold and dry air is probably at least as effective, if not more so, than the old method of keeping the room warm and moist.

Fever and Toxemia.—As a rule, the fever in bronchopneumonia does not require active interference, and temperatures up to 104.5° F. are not in themselves indications for treatment. When the temperature exceeds this limit, or when the symptoms of toxemia, such as headache, restlessness, or delirium, are marked, antipyretic measures should be adopted. Occasional doses of phenacetin or aspirin may be given for this purpose, but their continued use or their use in large doses is objectionable on account of their depressant action. Our main reliance should be placed on hydrotherapeutic measures. Debilitated patients with bronchopneumonia do not, as a rule, react well to the cold full bath that is used in the treatment of typhoid fever, so that when this is given the circulation should be carefully watched and much friction used. [The hot bath is valuable in nervous children; it quiets them and reduces temperature.—Editor.] As a rule, in this disease it is better to rely on the

simpler hydrotherapeutic procedures, such as cold sponges, wet packs, and cold compresses over the chest. The latter, Priessnitz applications, are made by wrapping the chest with one layer of flannel that has been wrung out of water of room temperature, and covering this with three or four layers of dry flannel. This application can be changed every two or three hours. These procedures are often very effective in allaying nervous symptoms, and, if repeated frequently, exert an antipyretic effect. Where a high temperature is associated with cyanosis and cold extremities Holt recommends the warm mustard bath.

Cyanosis, Dyspnea, etc.—The cyanosis and dyspnea of bronchopneumonia may be due to cardiac insufficiency, but we wish to discuss first the cyanosis and dyspnea which result from an insufficient aeration of the blood, owing to changes in the lungs; especially the edema, the obstruction of the finer bronchioles, and the development of atelectatic areas. Various procedures have been adopted to relieve the cyanosis and dyspnea of this origin. Local applications to the chest have been much used for the purpose of diverting the circulation to the skin. Among these may be mentioned the use of dry cups applied thickly over the chest, as has been recommended especially by Henoch (13). The mustard poultice serves a similar purpose, but it should be used cautiously so as not to produce a dermatitis. The full mustard pack recommended by Lenhartz is made by spreading out a thin layer of warm mustard paste upon a sheet, which is wrapped about the patient and surrounded by a blanket, taking care not to allow the fumes to reach the eyes. The patient is left in this until the skin is reddened, which usually happens in from five to fifteen minutes, and the mustard is then washed off with warm water. Priessnitz applications to the chest are often effective in relieving the milder types of dyspnea and cyanosis, and may render the use of cups or mustard unnecessary.

Emetics, such as tartar emetic or ipecac, have been extensively used in the past for the purpose of removing bronchial secretions, but at the present time their use is generally discouraged, owing to their depressant action. They are contraindicated in very young infants and in all very debilitated patients, and their use is permissible only in the early stages of a bronchopneumonia in a comparatively robust patient. Tartar emetic is given in small doses (gr. 1/20-1/10 for children—0.003 to 0.006 gm.), repeated every 15 minutes, until vomiting occurs. Inhalations given by means of the steam kettle or the vaporizer, with the patient inclosed in a tent, are of doubtful value, inasmuch as they necessitate a restricted ventilation. When there is much bronchitis, however, the air of the sick room should be kept fairly moist, either by a steam kettle placed over an open fire or heated by an electric boiling apparatus.

The importance of change in posture for the prevention of atelectasis has already been discussed. One of the most effective measures for combating atelectasis is to cause the infant to take sudden deep inspirations.

For this purpose the child or infant is seated in a warm bath reaching to the lower ribs, and after about five minutes several cupfuls of cold water are thrown on the chest and shoulders. The resulting gasps and deep inspirations tend to open the bronchioles and dislodge secretions. Finally, when cyanosis develops, oxygen inhalations should be used. A funnel is attached to the rubber tube coming from the oxygen tank, and this is held about an inch from the child's face, so that the oxygen will be mixed with air. These inhalations may be given continuously or intermittently, their effect being judged by the diminution of cyanosis.

Morphin and other opiates are usually to be avoided during the cyanosis caused by bronchial obstruction and atelectasis, for the reason that they diminish the tendency to cough, and the sensitiveness of the respiratory center. Respiratory stimulants, such as minute doses of atropin or full doses of strychnin and caffein, may be given to tide over a crisis, but their continued use in protracted cases is of doubtful value.

Circulatory Collapse.—The classical studies of Pässler and Romberg have shown that the circulatory failure of the acute infectious diseases depends in the main upon a failure of vasomotor tone. To this may be added in bronchopneumonia the effect of the obstruction in the pulmonary circulation upon the right heart. One important claim for the open-air treatment of pneumonia is based on the fact that the cold air raises the blood pressure, and so tends to prevent circulatory collapse (Griffith, 11). Alcohol has been extensively used as a circulatory stimulant in the bronchopneumonias of both young and old. The greatest differences of opinion prevail as to its value. On the one hand, there are those who would not treat a case of pneumonia without alcohol, while, on the other, its use is decried as tending to depress still further the vasomotor tone which threatens a circulatory collapse. It is claimed that alcohol tends to combat the infection. Its food value can be supplied by other articles of diet, and its quieting effect can be attained by other drugs. While the use of alcohol has doubtlessly been abused, the weight of clinical opinion favors its use in moderate quantities. Alcohol is best given in the form of diluted whiskey or brandy, or, when these are refused, wines, such as sherry, may be used. Infants one year old may be given half an ounce of whiskey or brandy during the course of a day. Adults may be given half an ounce every three hours. These doses may be doubled, but more than that is rarely advantageous, and very large doses certainly do harm. Alcohol has been particularly recommended in the bronchopneumonias secondary to measles, diphtheria, scarlet fever, and other infectious diseases. It is especially indicated when the pulse is small, soft, and rapid. An increase in the volume of the radial pulse commonly follows its administration, but it is doubtful if this is more than a local effect.

Of other stimulants special mention should be made of strychnin, caffein, and camphor. The first is given in doses of 1/60 to 1/30 grain

(0.001-0.002 gm.) every three hours to adults. It acts also as a respiratory stimulant. Caffein may be given subcutaneously in the form of the soluble salt of caffein sodium benzoate, in doses of one to three grains (0.065 to 0.250 gm.) every three hours. Camphor may be given hypodermatically as the 10 per cent. solution in olive oil in doses of one to one and one-half grains (0.065 to 0.10 gm.). [In children and infants proportionate doses should be given.—Editor.] These stimulants are often useful for tiding over a crisis, but their routine administration for many days or for weeks is of doubtful value.

Pain and Cough.—These are rarely of sufficient severity to require special treatment in bronchopneumonia. Local applications, such as the Priessnitz applications, the ice bag, and the warm mustard poultice, usually suffice to control local pain. Where they fail, or where the cough is dry and hacking, codein is indicated. Where, however, there is cyanosis or an abundant secretion, opiates should be avoided so far as possible, on account of their unfavorable influence upon the respiratory center.

[In children opiates should never be given, not only on account of the effect upon the respiratory center, but also because removal of secretions from the bronchi is inhibited. When this occurs relapses are apt to occur.—Editor.]

Complications.—The treatment of the various complications of bronchopneumonia does not differ from the treatment of these conditions when arising independently of the pneumonia. It is important that the physician be on the lookout for pleural effusion, tuberculosis, abscess or gangrene of the lungs, and middle-ear complications, and especially so when symptoms not readily explained arise. The occurrence of diarrhea necessitates the ordinary treatment of that affection. In severe diarrheas opium is sometimes necessary, in spite of its depressant effect upon the respiratory center.

Convalescence.—Owing to the tendency of bronchopneumonia to relapse, convalescence should be carefully watched. The patient should not be allowed to leave the room early, and an abundant diet with tonics, iron, etc., should be used. If possible, the patient should be sent to a warm climate, where the conditions are favorable to life out of doors.

CHRONIC PNEUMONIA

Chronic and subchronic pneumonic processes are characterized pathologically by the growth of granulation tissue and by the development of fibrous changes in the framework of the lung. Certain types of fibroid lungs, such as those due to tuberculosis, syphilis, and pneumonoconiosis,

are discussed elsewhere (q. v.). Omitting these from consideration, chronic pneumonic processes may be due to a variety of causes, and differences of opinion exist as to the relative importance of these. A small number seem to follow acute lobar pneumonia; Fraenkel (2), for example, out of 1,000 cases of pneumonia, observed this termination in seven. It may also occur after bronchopneumonia, especially that which complicates pertussis and measles in children. It is not altogether certain, however, that those pneumonias which subsequently become chronic do not differ from the onset from the ordinary forms of lobar and lobular pneumonia; in other words, there may be a "primary" chronic pneumonia. Chronic pneumonias are especially apt to occur in individuals already debilitated by such conditions as cardiac or renal disease, alcoholism, arteriosclerosis, or age. Certain cases arise from inflammatory changes in the pleura, from leakage into the lung owing to a diseased esophagus, from occlusion of a bronchus, etc. Chronic pneumonic changes may be secondary to other inflammations in the lungs, such as abscess, gangrene, and bronchiectasis, the infection spreading either by direct extension or by aspiration of infected material. Of forty-six cases of chronic pneumonia autopsied at Guy's Hospital, the etiology was classified as follows: 2 primary chronic pneumonias; 12 secondary to disease of the pleura; 14 after bronchopneumonia and bronchiectasis, especially after measles and pertussis; 7 after bronchial occlusion; and 11 of doubtful origin (Pye-Smith, and Fawcett, 5).

It is apparent that the prevention of chronic pneumonia depends upon the prevention and treatment of a variety of other diseases as well as upon the maintenance of nutrition in debilitated patients, especially those who have acute or chronic respiratory affections. Particular attention has been directed toward cases where a lobar pneumonia has failed to resolve within a reasonable period of time. Such patients should be placed in the best hygienic surroundings, and nutrition should be maintained at a high level. So long as there is fever they should be confined to bed. For such patients special methods of treatment have been advocated, but their value is difficult to determine on account of our inability to predict what would have occurred in any individual case had the patient received no specific treatment. Of such special methods advocated for the treatment of delayed resolution, the injections of fibrolysin (Krusinger, 3) and the use of the X-ray (Edsall and Pemberton, 1) deserve special mention. The latter is believed to hasten the autolytic processes normally associated with resolution. The patient should not leave his bed until fever and expectoration have disappeared, or at least have been very much reduced. To limit the shrinkage of the lung so far as possible after unresolved pneumonia, Fraenkel advises pulmonary gymnastics. These consist of (1) movements of the arms laterally to the vertical position and back to the side, (2) arm movements in the hori-

zontal plane similar to the movements used in swimming, (3) bending the trunk toward the sound side, (4) torsion movements of the trunk while the pelvis is fixed by the sitting posture, (5) deep respirations. These exercises should be taken for 5 to 20 minutes twice daily, and gradually increased in amount. As the patient acquires strength, dumbbells and pulley weights may be used to increase the exercises.

In advanced chronic pneumonia we can hardly hope to employ measures which will act directly upon the changes in the lungs. Our therapeutic efforts, therefore, should be directed (1) toward building up the general health of the patient, (2) toward the avoidance of factors favoring progression of the disease, and (3) the prevention and treatment of complications. So far as the building up of the general health of the individual is concerned, the necessary measures do not differ essentially from those used in the treatment of chronic pulmonary tuberculosis. Life in the open, rest when there is fever, and abundant nutrition form the principal measures that should be adopted. Among factors favoring the progress of the disease, dust should be especially mentioned, and residence in a warm, equable, and dust-free climate is particularly advisable. The commonest complications are chronic inflammations of the bronchi and, in the later stages of the disease, cardiac insufficiency. The former are best provided against by the hygienic measures already indicated and by a careful hardening of the individual against respiratory infections by graded hydrotherapeutic measures, such as are outlined in the discussion of the treatment of emphysema. Briefly, these consist in daily sponges with tepid to cold water, care being taken that the reaction should be perfect after each procedure. When there are cough and expectoration, these should be treated in accordance with the rules governing the treatment of chronic or of fetid bronchitis. Should cardiac insufficiency intervene, exercise should be restricted and cardiac stimulants used, as in the treatment of myocardial insufficiency.

PNEUMONOCONIOSIS

By pneumonoconiosis we mean the pulmonary changes resulting from the deposition of inhaled particles in the lungs. Various types have been described, such as anthracosis from coal dust, siderosis from iron dust, chalicosis or lithosis from stone dust, and kaolinosis from clay dust. The effect of such depositions upon health varies according to the substances inhaled. They are due in part to the direct irritative effect of the foreign bodies, and in part to a lessening of the resistance to infections, notably to tuberculosis. While pneumonoconiosis, in the pathological sense, refers only to demonstrable deposits of foreign particles and the resultant changes in the lungs, the hygienic and prophylactic aspects of

the subject make it advisable to include in the discussion some reference to other dusty trades, even though these do not cause demonstrable deposits in the lungs. Poisonous dusts will not be considered.

Our chief information concerning the effect of dust inhalations upon the health has been derived from statistical compilations of the mortality in various trades. These show an unusually high incidence of tuberculosis and other respiratory affections in certain classes of workers. In the interpretation of such data, other conditions surrounding the industries must be taken into account, such as the general hygiene of the work rooms, the degree of poverty and overcrowding of the workmen, their tendency to dissipation, etc. Some have held that the symptoms attributed to pneumonoconiosis proper are due entirely to an associated fibroid tuberculosis (Barnes, 1), and some believe that this latter develops independently of or primary to the dust deposits (Ribbert, 9). The weight of opinion, however, favors the view that certain forms of pneumonoconiosis produce chronic bronchitis, emphysema, and cirrhotic changes in the lungs, independently of any tuberculous infection, and that the latter, when present, is often secondary to the dust deposits.

Etiology

Certain trades have long been regarded as particularly dangerous on account of the high percentage of tuberculosis and other respiratory affections among the workers. This is especially true of those engaged in steel grinding, which has been carefully studied in Sheffield, England. For example, Scurfield (10) states that in all England the proportion of males to females over 25 years who die of tuberculosis is as 3 to 2, whereas in Sheffield it is as 6 to 2; and that, while the mortality in Sheffield from pneumonia among males up to 35 years does not differ from that of all England, after this age the disease among Sheffield males is much more common, although among females the ratio does not change. The following statistics compiled by him from trade unions' records show the high incidence of pulmonary disease among the Sheffield metal workers:

Average Mortality in Sheffield from All Causes and from Tuberculosis and Other Respiratory Diseases, 1905-07 Inclusive

	Number of Males Over 20 Years	Average Death Rate per 1,000		
		All Causes	Phthisis	Other Respiratory Diseases
Grinders	3,375	34.2	16.3	5.7
Cutlers	2,500	40.8	7.2	8.4
File cutters	1,850	32.1	4.5	5.4
Silver, etc., workers	2,380	26.9	5.5	4.9
All males	127,000	16.2	2.6	2.1

These figures are all the more impressive when we realize that the dangers of these occupations have been greatly lessened in recent years, and that, while the average life of the steel grinder in 1865 was said to be 29 years, it is now said to be 43 years (Oliver, 6).

The manufacture of pottery is another notoriously dangerous occupation, especially on account of the fine dust which is produced in the brushing or scouring of the china after removal from the kilns. Among coal miners pulmonary affections are on the decline in England, and the death rate among this class of workmen is not above the average, although the ratio of pulmonary affections is somewhat high. The coal miners of Scranton, Pa., show a relatively low death rate from tuberculosis and a very high rate for "asthma" (Wainwright, 11). It is doubtful if ordinary soot deposits in the lungs materially influence the health of the individuals affected. Work in metalliferous mines, on the other hand, is relatively dangerous, and this is especially true when dry rock drills are used. Haldane (2) found that the average age at death among the Cornish miners who had never worked rock drills was 53 years, while the average of those who had worked these drills was only 37.2 years. The Rand gold miners of South Africa also show a large number of cases of miners' phthisis (Oliver, 8). Similarly stone masons, quarry workers, etc., show a high incidence of pulmonary trouble. The crushing of slag, which results as a waste product from the Gilcrist or basic process of steel manufacture, and is used as a fertilizer on account of the contained phosphates, is said to predispose to pneumonia (Oliver, 6). Finally, a number of occupations aside from those which lead to gross deposits of fine particles in the lungs, but in which the workers are exposed to excessive quantities of dust, definitely predispose to tuberculosis and other respiratory diseases. The following tables will serve to illustrate the relative mortality in various dusty trades from tuberculosis and other respiratory diseases (Hoffman, 4):

Death Rate per 1,000 Due to Consumption Among Occupied Males in Certain Occupations in England and Wales, 1900 to 1902, by Age Groups *

Occupation	Death rate per 1,000 due to consumption in each age group						
	15–19 years	20–24 years	25–34 years	35–44 years	45–54 years	55–64 years	65 years or over
Tool and instrument makers	0.17	1.57	2.94	5.90	7.13	5.26	1.97
Brass workers	.49	2.17	2.93	4.53	4.61	2.58	.44
Printers	1.03	3.41	3.65	4.85	4.27	3.42	1.60
Total—Occupations with exposure to metallic dust	.73	2.73	3.33	5.05	5.22	3.91	1.54
Glass workers	.56	1.81	2.88	4.56	4.87	2.97	....
Potters	.62	1.34	2.00	3.97	7.14	4.37	.97
Paperhangers and whitewashers	.41	1.06	1.22	3.98	3.62	4.01	1.53
Lithographers	.77	2.68	2.70	3.13	4.27	4.33	1.44
Total—Occupations with exposure to mineral dust	.55	1.44	2.01	3.96	4.91	3.94	1.13
Cotton manufacture	.82	1.65	2.01	2.89	3.66	2.76	2.13
Hosiery-mill employees	.60	2.35	2.46	2.48	4.23	3.47	.79
Lace makers	1.13	1.12	2.84	2.39	2.57	2.22	.74
Cordage makers	.24	2.09	2.59	2.48	1.18	3.77	1.50
Paper makers	.54	1.29	1.95	2.13	1.78	1.86	1.02
Cabinet makers	.69	1.65	2.18	3.79	3.83	2.71	1.86
Wood turners	.63	1.54	2.89	3.79	5.52	2.96	1.36
Total—Occupations with exposure to vegetable fiber dust	.75	1.63	2.18	3.16	3.80	2.79	1.63
Furriers	....	1.77	3.46	4.74	3.86	7.33	5.88
Hatters	.61	3.47	3.70	4.11	4.76	2.17	....
Silk workers	.23	1.82	2.40	2.05	3.95	3.69	2.00
Woolen and worsted mill employees	.69	2.38	1.81	2.25	2.84	2.27	1.86
Carpet and rug makers	.64	2.59	1.41	3.14	2.94	2.42	1.00
Total—Occupations with exposure to animal and mixed fiber dust	.61	2.49	2.20	2.68	3.24	2.65	1.81
All occupied males—England and Wales	.54	1.55	2.03	2.74	3.04	2.16	1.11

*Table XI. From Part II, Supplement to the Sixty-fifth Annual Report of the Registrar-General of Births, Deaths and Marriages in England and Wales.

Death Rate per 1,000 Due to Other Diseases of the Respiratory System Among Occupied Males in Certain Occupations in England and Wales, 1900 to 1902, by Age Groups *

Occupation	Death rate per 1,000 due to other respiratory diseases in each age group						
	15–19 years	20–24 years	25–34 years	35–44 years	45–54 years	55–64 years	65 years or over
Tool and instrument makers	0.23	0.56	1.14	2.01	5.40	10.42	25.46
Brass workers	.24	.52	.60	2.05	3.94	9.42	19.06
Printers	.36	.37	.55	1.24	2.17	5.16	20.76
Total—Occupations with exposure to metallic dust	.30	.45	.69	1.62	3.55	7.94	22.46
Glass workers	.28	.60	.99	2.43	5.76	10.75	28.68
Potters	.46	.58	.64	3.29	10.78	23.10	35.04
Paperhangers and whitewashers	.15	.46	.78	1.36	3.91	8.89	17.09
Lithographers	....	.21	.79	.99	1.71	4.33	27.42
Total—Occupations with exposure to mineral dust	.27	.50	.78	2.12	6.05	12.86	24.50
Cotton manufacture	.25	.60	.81	1.51	4.18	9.80	28.50
Hosiery-mill employees	.20	.26	.70	.75	2.93	6.01	27.06
Lace makers	....	.45	.34	.48	1.64	7.77	17.66
Cordage makers	....	1.57	.97	.71	3.16	8.95	29.28
Paper makers	.32	.43	.65	1.20	2.76	4.83	16.31
Cabinet makers	.31	.43	.64	1.29	2.95	7.27	17.95
Wood turners	.31	.62	.72	2.65	4.31	8.61	24.84
Total—Occupations with exposure to vegetable fiber dust	.26	.54	.73	1.46	3.61	8.33	23.35
Furriers	.93	1.32	.92	2.37	1.76	11.72	15.69
Hatters	....	.30	.77	1.33	4.92	10.85	23.87
Silk workers	.69	....	....	1.30	2.37	3.69	25.05
Woolen and worsted mill employees	.31	.23	.75	1.45	3.08	6.46	25.44
Carpet and rug makers	.32	.43	1.01	.97	2.29	9.09	28.94
Total—Occupations with exposure to animal and mixed fiber dust	.32	.29	.72	1.45	3.13	7.02	25.12
All occupied males—England and Wales	.24	.48	.77	1.66	3.32	6.54	17.77

*Table XII. From Part II, Supplement to the Sixty-fifth Annual Report of the Registrar-General of Births, Deaths and Marriages in England and Wales.

Prophylaxis

General Hygiene.—The essentially chronic character of pneumonoconiosis and of the associated cirrhotic or tuberculous changes in the lungs, together with our limited means for combating these, render prophylaxis of the highest importance, and especially so as it is possible to reduce the death rate materially by proper hygienic measures, as has been the case among English miners and metal workers. In the first place, the general hygienic conditions which surround workmen in dusty trades should be as good as possible. Alcoholic excesses, poor food, unsanitary dwellings or workshops, poor ventilation, contamination of the air by explosives, overheating in deep mines, unnecessary wettings and exposures are all important factors in increasing the incidence of respiratory diseases among dust workers, and improvement in these may be expected to improve the health of these classes.

Protection from Dust.—Of the several methods for avoiding dust, wetting, when applicable, is the most efficient. This has been proven by the difference in mortality between grinders who use the wet or the dry processes, and between miners who drill by a dry or wet method. Wherever possible, all dust-producing operations, especially those causing metallic or mineral dust, should be done under water. In mine drilling this can be accomplished by filling a downward sloping hole with water, or by using a water spray connected with the drill. Steel grinding by the dry process should be limited as much as possible, and efforts should be made to have dry processes converted into wet processes (as in the case of dressing grindstones, etc.—Johnston and Bennett, 5). The dust about rock crushers may be laid by sprays of steam or water.

When it is impossible to avoid dust by the use of wet methods, devices for catching and removing the dust should be used. These methods will naturally vary with the character of the dust and the types of machinery in operation. In some machines the dust-producing portion can be almost completely boxed in and provided with local ventilation by means of aspirated currents of air. In the case of dry grinding it is necessary to provide for various types of particles from those which are heavy and fly off at a tangent, and drop to those which remain suspended for an indefinite period of time, revolving, perhaps, with the currents of air about the grindstone. Types of hoods with connected aspirating system for this particular purpose are described by Johnston and Bennett (5). Again, where it is impossible to inclose the source of dust, it may be practical to apply exhaust ventilation close to the origin of the dust, as in the case of the rollers in a machine known as a spread board in flax spinning. As a rule, open exhaust ventilation to be effective must be applied to the immediate proximity of the source of dust, for the ef-

fectiveness of exhaust ventilation varies inversely as the square of the distance from the source of dust.

General ventilation of rooms in which much dust is liberated is very important on general principles, but to be effective for the removal of dust enormous volumes of air are required, and to avoid discomfort from cold expensive heating plants are necessary in cold weather. Local removal of the dust is usually preferable.

The use of respirators has not proven very satisfactory in practice, as may be judged from the following extract of a Parliamentary Report quoted by Hoffman (4): "The use of respirators capable of arresting dust is often recommended in connection with factory work as a substitute for efficient removal of dust. Experience has, however, shown that it is extremely difficult to enforce the use of respirators, as they are all more or less uncomfortable and inconvenient, besides being unsightly. It is also very difficult to keep respirators in working order and closely applied to the face. Often enough it is found that most of the air breathed by a person wearing a respirator leaks in between the face and the respirator, and is consequently unfiltered. This is particularly apt to happen after a respirator has been worn sufficiently long for the filtering material to become damp and clogged with moisture. Except, therefore, where dust is definitely dangerous, and cannot be dealt with by exhaustion, or by using wet processes, or in other ways, we are unable to recommend the use of respirators as an alternative to keeping the air clear of dust."

Medical and Governmental Supervision.—Finally, the health of workers in dusty trades should be supervised by a physician especially appointed for this purpose. Such a physician should see that only healthy adults engage in the trade, and that those with bronchitis, emphysema, asthma, and tuberculosis should be excluded. [Also mouth-breathers, from whatever cause.—Editor.] The exclusion of the latter group is particularly important on account of the special susceptibility of dust workers to tuberculous infections. The advantages of such medical supervision cannot be doubted, but its enforcement is beset with difficulties on account of related problems; such, for example, as provision for those who should, on account of ill health, give up the trade to which they have been trained. Although such personal supervision may be carried on at the expense of the employers, or of the workmen, it should be under the general control of the state.

The protection of workmen against dust and its dangers is but one aspect of the more general problem of protection against trade dangers. As a rule, such protection cannot be left entirely to the individual employers, for these are often more interested in their profits than in the health of their workmen, and they frequently do not or will not appreciate the necessity of rendering the work as hygienic as possible. The

workmen, on the other hand, are often singularly indifferent to the special dangers of their trades, which they accept as matters of course. In general, betterment can be expected only when proper laws for protection of workmen are enacted and enforced. To accomplish this an enlightened public opinion is necessary. Social workers, health officers, and physicians generally should aim to awaken such a sentiment. Much can be done by instruction of workmen individually and through their clubs and unions, and by the diffusion of a more general knowledge concerning the special dangers of certain trades and the means for combating these. The idea of personal liberty which has often protected the unscrupulous master or the careless workman should give way to a more general conception of the duty of the community to its individual members.

Treatment

The appearance of a chronic respiratory disease in a workman exposed to dust renders his immediate removal from the dust advisable. Even an acute bronchitis should receive special care, on account of its tendency to become chronic in this class of individuals, and patients should not return to their occupations until complete recovery has taken place. Repeated attacks of acute bronchitis, or of asthma, or the development of chronic bronchitis, emphysema, chronic shortness of breath, cirrhosis of the lung, or tuberculosis should necessitate an abandonment of dusty work, and residence in the open air, preferably in a dust-free climate. The treatment of the pulmonary conditions in those who have been working in dust does not differ from the treatment of these conditions in individuals who have not been so exposed, and is discussed under various diseases (chronic bronchitis, emphysema, cirrhosis of the lungs, and fibroid tuberculosis). Oliver believes that a mixture of iodid of potassium, nux vomica, and carminatives answers on the whole as well as any other medicines for the treatment of such patients.

CHRONIC PULMONARY EMPHYSEMA

Chronic pulmonary emphysema is a disease of the lungs characterized by overdistention of the alveoli with thinning of the interalveolar walls. From interstitial emphysema it differs essentially in that the air is contained within the alveoli and does not enter the connective tissues of the lungs or other parts of the body. Various forms of pulmonary emphysema have been described. The senile or small-lunged variety is usually regarded as an atrophic process of old age. Its practical significance is slight, and treatment is rarely necessary. Compensatory emphysema which occurs about atelectatic lung areas, pleuritic adhesions, etc., does

not necessitate treatment other than that required for the causative condition. By chronic pulmonary emphysema in the more restricted sense we mean the large-lunged variety. Clinically this is characterized by the signs of pulmonary distention, which consist of an increase in the anteroposterior diameter of the chest, a more horizontal position of the ribs, an extension of the pulmonary resonance upward, downward, and over the heart, a flattening of the dome of the diaphragm, and an increase in the residual air of the lungs (Bohr, 5). It is by no means certain, however, that all chronic overdistentions of the lungs are accompanied by the pathological changes found in pulmonary emphysema, or that all necessarily lead to the symptoms and sequels commonly attributed to this latter disease.

Pathogenesis

Pulmonary emphysema is usually a chronic and progressive condition. A knowledge of its etiology is important, because those especially exposed to its dangers and those in whom the disease has already begun to develop should be instructed how best to avoid future injury.

It is conceivable that pulmonary emphysema may be due either to a primary overdistention of the lungs or to a primary enlargement of the bony thorax, the lungs following the enlarged thoracic cavity. This latter view has been advocated especially by W. A. Freund on the basis of pathological changes found in the costal cartilages (12, 13, 14). According to this theory, a lengthening of the diseased costal cartilages and a fixation of the bony thorax in the position of inspiration cause an increase in the anteroposterior diameter of the chest, a flattening of the diaphragm, and a restriction of the respiratory excursions of the thorax. That a mechanical distention of the bony thorax may give rise to an emphysema seems to be borne out by observations such as that of Tendeloo (cit. in Pässler, 25), where a chronic widening of the lower thoracic aperture in consequence of a large ovarian tumor led to emphysematous changes in the lower portions of the lungs. Freund did not find the characteristic cartilaginous changes in all cases of emphysema, and others have expressed the belief that, even when present, they may be secondary to or coördinate with the changes in the lungs. The occurrence of thoracic immobility in emphysema is important, however, because it has led to the operative treatment of this disease.

Other investigators have sought the cause of pulmonary emphysema in the lung itself. Normally inspiration is an active muscular movement, while expiration is accomplished mainly through the elasticity of the lungs. Should this elastic force be diminished, there would be a tendency for the lungs to take the inspiratory position similar to that seen in emphysema. Lessened pulmonary elasticity has been ascribed to vari-

ous causes, which may be grouped in two general classes: (1) those depending on a primary loss of elasticity, and (2) those which result from excessive distention of normal or impaired pulmonary tissues. We know little about the first group of causes. Recent investigations have failed to show a reduction in the number of elastic fibers in most emphysematous lungs (Sudsuki, 31), though this may rarely occur (v. Hansemann, 18). On the other hand, the elastic fibers, though normal in number and appearance, may be poor in quality and may yield under long usage or unusual strains. Local disease may affect the elasticity of the pulmonary tissues. The case reported by Hugner (10), in which the emphysema appeared in a lung recovering from a pneumonic consolidation when the patient resumed his occupation of cornet player, bears out this hypothesis. On the whole, however, there is at present but little positive evidence in favor of the view that pulmonary emphysema is usually due to an uncomplicated loss of elasticity in the lung substance.

On the other hand, considerable evidence has accumulated concerning the conditions which tend to distend the lungs. Dyspnea, which increases inspiration more than expiration, causes the lungs to approach the inspiratory position (Bohr, 5; Hofbauer, 20), and, while after muscular exertion, for example, this pulmonary distention usually passes off within a few minutes (Bohr), it may last for hours or days (Durig, 8). Pulmonary distention is common in the chronic dyspnea of heart disease and other conditions (Hofbauer, 20). The increased pressure produced within the lungs by glass blowing and the use of musical wind instruments was at one time believed to be an important cause of emphysema, but studies of the last few years (Fischer, 9; Prettin and Leibkind, 27) have thrown doubt on this supposed etiology. Lommel (22) has recently shown that many of the glass blowers of Jena have unusual amounts of residual air in the lungs, although at the same time they suffer from none of the ordinary symptoms of pulmonary emphysema, and Becker (2) has reached similar conclusions after a study of those who play wind instruments. Furthermore, Schall (30) was able to increase the chest measurements of dogs by obstructing the exit of air from the mouth and nose, and yet these animals did not show the typical anatomical changes of emphysema. It is evident from these investigations that simple distention of the lungs with increased amounts of residual air is by no means synonymous with pulmonary emphysema (Bruns, 6, 7). A moderate and uniformly distributed distention may probably occur without serious loss of elasticity or of pulmonary substance, and normal lungs will probably withstand the strain of non-obstructive dyspnea, or even that of glass blowing or the use of musical wind instruments. On the other hand, when other conditions favoring emphysema are present, these factors may well be distinctly harmful.

Clinically pulmonary emphysema is very frequently associated with

chronic bronchitis and with chronic asthma. While emphysema predisposes to bronchial disease, it is quite certain that the reverse relationship is very common and that these diseases are among the most important causes of emphysema. An acute attack of asthma often induces an enormous pulmonary distention. This may not disappear entirely for weeks after the attack wears off, and with subsequent and repeated attacks the distention tends to persist until finally typical emphysema ensues. The same sequence is seen in chronic bronchitis. Several factors probably contribute to produce the emphysema in these cases. In the first place, coughing tends to drive air from portions of the lung more directly compressed into those portions with relatively little support, especially the apices and the anterior borders. In the second place, the obstruction within the bronchioles acts more markedly during expiration than during inspiration, thus tending to retain air in the alveoli. Finally, these diseases may directly affect the pulmonary elasticity.

Prophylaxis

Prophylactic measures against emphysema should be adopted when there seems to be an inherited tendency either to this disease, to chronic bronchitis, or to asthma. They should be adopted, furthermore, when early signs of emphysema, chronic bronchitis, or asthma have appeared in the patient. The measures adopted have for their main object the protection of the lungs against unnecessary distention and especially the avoidance of future attacks of bronchitis and asthma. Exercise to the point of marked dyspnea should be avoided. Glass blowing and the playing of musical wind instruments should be abandoned. Heavy lifting, straining at stool, coughing, and sneezing tend to drive air into unsupported pulmonary areas, and they should, therefore, be avoided as far as possible. The bowels should be carefully regulated. Abdominal distention from any cause tends to flare out the lower ribs, to limit the excursion of the diaphragm, and to disturb the heart's action. Measures to relieve intestinal flatulence should, therefore, be adopted, and large ascitic collections or large abdominal growths should be promptly treated.

Special attention should be given to the dangers of repeated attacks of bronchitis or of asthma. The dusty trades and those involving exposures to wetting or to sudden and marked changes in external temperature should be avoided. Mouth breathing increases the liability to bronchitis, so that marked nasal obstructions should be corrected. Should the patient be subject to "hay asthma," he should change his residence to a pollen-free district during the portion of the year when the attacks occur. A permanent change in residence should be considered in every case, for frequently this alone will check repeated attacks of chronic bronchitis or asthma. In this country a permanent residence in southern

California or winter sojourns in Florida meet the requirements in many instances.

Efforts should be made to harden the patient against respiratory infections by means of hydrotherapeutic measures. Daily sponges with cold water or, in hardy individuals, daily cool plunge baths will diminish the tendency to such infections. Those not accustomed to cold baths should begin with cool or tepid sponges. As the patient becomes accustomed to the procedures and is trained to react well, the temperature of the water may be gradually reduced, and persons of a more hardy constitution may pass on to the cool or cold plunges. In order to favor reactions it is important that the bathroom should be warm, that the individual should not be chilly at the onset, that the cold procedure should be short, and that dressing take place promptly and in a warm room.

Treatment

The indications for treatment are: (1) the elimination of harmful factors; (2) the improvement of the mechanics of respiration, and (3) the relief of complications. The first of these indications has been discussed under prophylaxis.

Methods of Improving the Mechanics of Respiration.—In uncomplicated emphysema it is chiefly expiration which is insufficient. The lungs remain in the inspiratory position, the ribs being more horizontal than normal, and the diaphragm abnormally low. Abdominal distention should be avoided on account of the unfavorable influence upon respiratory and circulatory difficulties. Overloading the stomach, constipation, and flatulence should be avoided or treated.

Aerotherapy; Mechanotherapy; Massage.—Various physical methods have been used for the purpose of reducing the volume of the overdistended emphysematous lungs. Expiration into rarefied air, while theoretically indicated, has not given in practice (Fowler, 10; Fraenkel, 11) the results expected of it. On the other hand, the compressed air cabinet, in which the patient breathes and is surrounded by compressed air, seems to have yielded better results (Fowler, Fraenkel), even though theoretical reasons for its action are not apparent. It is advised to increase the pressure within the cabinet gradually until it exceeds the atmospheric pressure by from one-fourth to two-thirds of an atmosphere. The total duration of the daily treatment is about two hours, of which about one-third is used in raising and lowering the pressure.

The use of massage for assisting expiration and reducing the size of the emphysematous chest by pressure during expiration was recommended by C. Gerhardt, and has been advocated since from time to time (Kirshberg, 21). Good results are reported from its use, especially when combined with breathing exercises. When the patient is unable to em-

ploy a competent masseur or is unable to make use of mechanical apparatus, he may assist his expiration by pressing on the anterolateral aspects of the lower chest with his hands during the latter half of the expiratory act. This maneuver has been especially recommended at the close of acute asthmatic seizures in order to diminish the pulmonary distention (Goldscheider, 16).

Of the various mechanical devices that have been used for compressing the bony thorax, two deserve especial mention: that of Rossbach and that of Boghean. The former (29) consists of a chair with a high back in which are inserted two large vertical rounds, which can be made to rotate by means of levers coming within reach of the patient sitting in the chair. When the levers are drawn forward the rotation of the rounds tightens a girdle, which has been fitted snugly over the chest of the patient, and so aids expiration. The advantages of this apparatus are its simplicity, cheapness, and the fact that the patient himself can manipulate it. The Boghean (4) apparatus is driven by a motor and consists of pads which compress the thorax to any desired amount and in a rhythmical manner. It not only relieves the patient of all effort, but teaches him to breathe in a given tempo, in this way affording a respiratory training. These mechanical methods of compressing the thorax have been highly recommended by those using them, and have apparently given very considerable subjective relief. Hofbauer (19) has recently advocated a device for pressing on the abdomen and so driving up the diaphragm during expiration. A binder is placed about the abdomen, and a large rubber bag on the inner side of the binder is rhythmically inflated from a tank containing air under pressure. Hofbauer believes that the resulting movements more nearly approach the normal type of forced expiration, and that the method is applicable even when the chest wall is rigidly fixed. In his hands, together with the breathing exercises, it has yielded excellent results, though, according to Goldscheider (16), it is not so effective as the Boghean apparatus.

Respiratory Exercises.—We have already stated that in any form of dyspnea the inspiratory efforts tend to be increased to a greater extent than do the expiratory efforts, owing to the fact that inspiration is normally an active muscular process, and the more used nervous impulses are increased when the patient feels the sensation of air hunger (Hofbauer, 20). Hofbauer, therefore, believes that patients with emphysema should be trained to lay more emphasis on expiration, and that they should learn especially to use the abdominal muscles for this purpose. He has advised three methods of treatment to bring this about. The first of these is the mechanical compression of the abdomen already described. The second consists of abdominal exercises by means of which the patient learns to retract the abdomen voluntarily, and then to associate this movement with the end of the expiratory act. This retraction of the abdomen

presses upon the abdominal contents, and tends to elevate the abnormally low diaphragm. Finally, he believes that the patient should fix his attention on expiration, and strive to make this more prolonged and more effective by using the abdominal muscles. An electric bell which mechanically sets a proper tempo will assist him to do this. By these means the duration of expiration is lengthened, the patient learns to breathe regularly, and expiration is assisted either by the mechanical apparatus already described or by the voluntary retraction of the abdominal muscles during the latter half of expiration. Hofbauer's results in the use of his combined mechanotherapy and breathing exercises have apparently been excellent both as regards the residual air in the lungs and the subjective sensations of the patients. On the whole, these mechanical treatments, together with the training of expiration, seem to have yielded fairly satisfactory palliative results in the treatment of pulmonary emphysema.

Operation.—We have already stated that, according to W. A. Freund, certain cases of emphysema are due to a disease of the costal cartilages which lengthens the cartilages and fixes the thorax in the position of inspiration. This fixation, whether primary or not, appears to be very common in emphysema, and operations which aim to relieve the thoracic rigidity by cutting or excising portions of the cartilages or the adjacent ribs have recently been used for the treatment of emphysema. The operation usually employed has been a unilateral (more rarely bilateral) resection of the costal cartilages, together with adjacent portions of the ribs. The cartilages chosen for operation are usually the second, third, fourth, etc., even as far down as the sixth or seventh. In 1910 Zesas (33) collected from the literature twenty-five operations of this character, and in 1911 Bircher (3) was able to add twenty more. Of the cases collected by Zesas three terminated fatally, one of pulmonary edema on the day of the operation, one nine days after of bronchiectasis and a cerebral lesion, while the third had tuberculosis. Aside from these fatalities, the immediate results of the operation were most striking. The side of the chest operated upon immediately assumed the position of expiration, respirations became easier, the patients who had been unable to sleep on account of dyspnea were often able to breathe without effort. Several returned to work. The results were at times not permanent, for the reason that the severed ends of the bones or cartilages reunited, thus reëstablishing the primary condition. For this reason more radical operations have been advised. For example, four to six centimeters of cartilage and adjacent bone, together with the perichondrium and periosteum, may be removed (Friedrich, 15), an operation rendered more formidable on account of the danger of opening the pleural cavity. Freund's operation was discussed at the thirty-ninth German congress of surgery in 1910, at which time Mohr (23) stated that at least thirty operations of this character had been performed, and Van den Velden (32) reported

ten personal operations. The operation was regarded favorably by the speakers. Several patients have been reported in good condition two and more years after operation (Pässler, 26).

Patients with a rigid bony thorax fixed in the position of inspiration are especially suitable for Freund's operation, whether the fixation be primary in the sense of Freund or secondary to a primary pulmonary condition. The degree of rigidity can be estimated by simple inspection, by fluoroscopic examination, and by the vital capacity of the lungs (Mohr, 23). Calcification of the costal cartilages can often be demonstrated by means of the X-ray.

[Whatever may be said in regard to Freund's operation for emphysema, calcification of the costal cartilages should not be looked upon as an indication for its performance in all cases. I have for some time studied the X-ray pictures in the Cincinnati Hospital, and have found calcification of the costal cartilages in many diseases in which it was impossible to find etiologic relationship, including many instances in which autopsy confirmed this view. It is only when the calcified costal cartilages produce deformity, according to Freund's view, that their existence can be looked upon as an operative indication.—Editor.]

The presence of a bronchitis is not a contraindication to operation, and following operation patients have found that they do not so easily acquire bronchitides, and that when acquired these seem to be less obstinate. Cardiac complications, on the other hand, render the patient much less suitable for operation, and in such cases medical treatment for the cardiac insufficiency should first be instituted.

It is as yet too early to formulate a definite opinion as to the future of the operative treatment for emphysema. We need especially more data concerning the dangers of the operation, the ultimate results, and the class in which the best results can be expected. At present, however, the operation promises to have a distinct place in the treatment of this condition, against which other methods have proven of so little permanent avail.

Treatment of Complications.—The complications of pulmonary emphysema which most often require treatment are the chronic bronchitis and the cardiac insufficiency. The prophylaxis of the former has been discussed, and its treatment is described in detail elsewhere (see Chronic Bronchitis, Vol. III, Section II, Chapter III). Special mention, however, should be made of the value of potassium iodid in this condition. The regular use of small doses (gr. 10 three times a day—0.6 gm.) frequently exerts a marked influence upon the dyspnea, loosens the expectoration, and makes the patient generally more comfortable. Inasmuch as it lessens bronchial obstruction, it also exerts a favorable effect

upon the pulmonary emphysema. It is doubtful if it acts directly upon the pulmonary tissue in any other way. Ammonium chlorid or ammonium carbonate may be tried for the same purpose as potassium iodid. Paroxysmal seizures of dyspnea which resemble those of bronchial asthma should be treated by the same methods as those of asthma. They are frequently prevented by the regular use of potassium iodid. The paroxysms themselves may be relieved by inhalations of burning stramonium leaves, injections of atropin or adrenalin, or, in severe cases, by morphin injections.

The cardiac insufficiency which so frequently complicates the later stages of pulmonary emphysema requires the same treatment as does cardiac insufficiency in general, viz., rest in bed, digitalis in adequate doses, and diuretin or other diuretics in case of edema. Quite commonly, under such treatment, compensation returns to a greater or less extent, but, inasmuch as the cause is still operative, the relief is usually only temporary. Indeed, the prognosis of this type of cardiac insufficiency is relatively unfavorable.

PULMONARY ABSCESS AND PULMONARY GANGRENE

Pulmonary abscess and pulmonary gangrene have so many features in common that they may well be considered together. The latter is distinguished by death in mass of pulmonary tissue, leading to the formation of sequestra, and usually, also, by an associated putrefactive decomposition which gives a peculiarly disgusting odor to the sputum and breath of the patient. Pulmonary gangrene without putrefaction is so rare as to be negligible. Clinically no sharp line can be drawn between the two processes except on the basis of the putrefaction, and, as this depends upon a special type of bacterial action rather than the necrosis of the tissue, it hardly seems a proper criterion. Indeed, those who have had the greatest clinical experience with these conditions, such as Friedrich (7), Quincke, Körte (12), Lenhartz, and Kissling (11), have shown a tendency to drop the distinction on account of the difficulty of classifying border-line cases. In both gangrene and abscess we have single or multiple foci of destruction of lung tissue due to infectious processes. By common consent collections limited to the bronchi, the pleural cavity, or the interlobar tissues are excluded from consideration; but, owing to the tendency of such collections to extend to the parenchyma of the lung, no hard and fast line separates collections limited to neighboring tissues and those involving the parenchyma itself. From a prognostic and therapeutic standpoint a division into acute and chronic processes is fundamental.

Etiology and Prophylaxis

One of the most important causes of pulmonary abscess and gangrene is the aspiration of infected material into the finer bronchi from the upper air passages and the mouth. This is especially apt to occur during periods of unconsciousness. Kissling states that, of his 120 cases of pulmonary gangrene, 5 occurred in epileptics and 46 in heavy drinkers, presumably because the periods of unconsciousness favored aspiration. During general anesthesia there is danger of aspiration of material from the mouth, and gangrene has followed the opening of a foul tonsillar abscess under general anesthesia (Kissling, 11). The removal of bits of carious teeth (Davies, 4; King, 10; Kissling, 11; Warruck, 29), pieces of chewing tobacco, and various other foreign bodies from gangrenous areas emphasizes the danger of aspiration, and, although Clarke and Marine (3) in 1906 were able to collect only 31 cases of gangrene following solid foreign bodies in the bronchi, Quincke (17) expresses a belief that infection by small particles passing the larynx is more common than has been generally held. It is evident that scrupulous care should be exercised to avoid aspiration of material at all times, and especially during periods of unconsciousness induced by anesthesia or otherwise. The practice of sleeping with a foreign body, such as a piece of tobacco, in the mouth occasionally leads to disastrous consequences. Aspiration is particularly common in children, and in those with disturbances of sensation or of motion about the larynx. Should a foreign body be aspirated, immediate efforts should be made to dislodge and recover it. Infants or small children may be held in the inverted position and slapped upon the back. Adults should lie face downward over the side of a bed with the head as near the floor as possible. If the cough is violent and uncontrollable, morphin should be given hypodermatically, so that the patient may control his cough and increase its effectiveness by inspiring quietly. Owing to the grave dangers attending aspiration of foreign bodies into the bronchi or lungs, a failure to recover by the simpler methods should be followed by an examination with the X-ray, and, in suitable cases, by bronchoscopy or pneumotomy. Aspiration of infective material from a putrid bronchitis or from a bronchiectatic cavity may lead to acute or chronic gangrene.

Among other important causes of pulmonary abscess and gangrene may be mentioned pneumonia (15 of Tilton's 20 cases) (19), especially that caused by the Friedländer bacillus (2 cases in Kissling's series) and the influenza bacillus (9 of Fraenkel's 85 cases of gangrene) (6). It may also follow contusion of the chest, tropical abscess of the liver, embolism from puerperal sepsis, otogenic sepsis, septic endocarditis, etc. The prophylaxis and treatment of these primary conditions may be ex-

pected to diminish the incidence of pulmonary infections. The same is true of the gangrene complicating diabetes mellitus.

Medical Treatment

Abscesses of the lungs may heal spontaneously by rupturing and discharging their contents through the bronchi. The spontaneous cure is most apt to occur in the case of small abscesses secondary to pneumonia, though it is uncertain how frequently this occurs on account of the difficulties of diagnosis. Anders and Pfahler (1) have reported such a case. In acute pulmonary abscesses, therefore, it is proper to adopt an expectant form of treatment, and to persist in this for several weeks, with the hope that a spontaneous cure will follow. Should the sputum be putrid from the onset (gangrene), or should it become so later, then the outlook for recovery under medical treatment is much less hopeful, and surgical methods of treatment should be considered immediately. If these are contraindicated, owing to the existence of multiple lesions in widely separated parts of the lungs, medical measures again afford the patient the best chance, although recovery under these circumstances is extremely rare. [I believe that all cases should be treated medically for from two to four weeks, the only exception being the foudroyant form.—Editor.] Unnecessary delays before operation increase the dangers, by reason of such complications as secondary infection elsewhere in the lungs, septic metastases to distant parts of the body, interstitial pulmonary inflammation, fibrosis of the surrounding tissues, empyema, and the systemic effects of septic toxemia.

Of medical measures, rest in bed is important, not only because it preserves the strength of the patient and increases his ability to overcome the infection, but because it diminishes the tendency of the infection to spread to other parts of the lungs through the bronchial tree. Patients often discover that in certain postures the expectoration is increased, owing to a drainage of the cavity into a bronchus. As a rule, they are inclined to avoid such postures, and rightly so; but once or twice a day it is advisable to assume such a posture so as to empty the cavity as completely as possible. The diet should be light and nutritious.

Drugs may be used symptomatically to meet such symptoms as cough or loss of appetite. Whether or not it is possible to affect the disease directly by the use of drugs is doubtful. Drugs of an antiseptic character have been given by mouth for this purpose, such as creosote, gr. iss (0.1 gm.), in pill form, three times a day; guaiacol, ♏ viii (0.5 gm.), three times a day, in capsules; guaiacol carbonate, gr. viii (0.5 gm.), three times a day in cachets, etc. Traube recommended lead acetate, gr. ½-1 (0.03-0.06 gm.), every two hours, to diminish the secretion after

a large part of the pus had been expectorated, and gave tannic acid, gr. vii-xv (0.5 to 1.0 gm.), after the fever diminished.

Inhalations have also enjoyed a considerable reputation in the treatment of pulmonary gangrene. Inhalations of oleum terebinthinæ, recommended by Skoda, are given by adding a teaspoonful of the oil to a dish of boiling water, and keeping the patient constantly in a room saturated with this vapor. Electric boiling devices are preferable to gas flames on account of not contaminating the air in the room. Antiseptic inhalations may also be given by means of a metal mask through which the patient breathes continuously, except when eating. In the fore part of the mask is a sponge on which are placed such antiseptics as carbolic acid, gtts. x-xv (0.6-1.0 gm.), creosote, etc. The following is a popular mixture for this purpose:

℞ Creosoti
Spt. chloroformi
Alcoholis āā 3i (4.0)

Aside from their effect upon the disease itself, these inhalations of pungent substances are useful for the purpose of diminishing or disguising the offensive odor accompanying gangrene, which renders the patient obnoxious alike to himself and to his surroundings. In order to accomplish deodorization, Siegmund (18) has recommended that a 1 to 3 per cent. solution of chloral hydrate be placed in the sputum cup, and that the mouth be rinsed with weaker solution of this drug.

Surgical Treatment of Acute Abscess and Gangrene

The past decade has witnessed a remarkable advance in the surgical treatment of pulmonary abscess and gangrene. With the exception of the acute forms of pulmonary abscess and especially those following pneumonia, in which cases the process may heal spontaneously, the results of medical treatment have been very discouraging. Villier (quoted by Kissling) found a mortality of 80 per cent. among cases of pulmonary gangrene treated by internal means, and Kissling (11) states that, of 133 cases of gangrene treated medically in the Berlin hospitals from 1897 to 1900, 86 died, 30 improved, 7 were reported not cured, and 10 were cured, a mortality of 64.6 per cent. Those discharged not cured are always in danger of such secondary complications as toxemia, extensions, and metastases to other parts of the body. In contrast with these unfavorable results of medical treatment, we have numerous reports on the benefits of surgical treatment, among which the following deserve special consideration:

Author	Character of Cases	No. of Cases	Cured	Died	Mortality
Tuffier ref. Friedrich (7)	.....	66	46	20	30%
Garré and Sultan (9) Collected statistics up to 1902	Abscess	96	77	19	20%
	Gangrene	122	80	42	34%
Lord, 1906 (14) Mass. Gen'l Hosp	Acute	6	3(2+)	1	
	Chronic	5	1(1+)	3	36%
Tilton, B. J., 1907 (19) Collected from N. Y. Hospitals	Abscess and Gangrene	20	10	10	50%
Körte, 1908 (12) Personal statistics	Pneumotomy	28	20	8	28.5%
Abscess and Gangrene	Healed spontaneously	1	1		
	Putrid empyema after pulmonary gangrene	8	1	7	
Kissling, 1910 (11) Lenhartz clinic. Personal statistics	Gangrene	120	71	49	40.8%

+ Subsequent history not certain.

In the discussion of his results, Kissling states that, if he omitted from his statistics 5 patients with pulmonary tuberculosis, one with severe diabetes, and 17 in whom, on account of general prostration, a free surgical drainage could not be attained, he would have left 97 patients in whom pneumotomy was successfully carried out, with a mortality of 26.8 per cent. In Tilton's series all those with gangrenous abscesses died, while of those with simple abscess operated upon within eight weeks only one died. Lenhartz (13) remarks that one need not rely entirely upon the statistics, but should also consider the sudden change for the better which often follows free drainage in apparently hopeless cases, and those who have seen this occur will agree with him most fully. Finally, the complete restoration of the lungs to normal, which often takes place after early operative intervention in acute cases, not only prevents acute complications, but avoids a chronic abscess where surgical treatment must be more extensive and is less certain of effecting permanent cure.

Indications for Operation.—We have already stated that in acute, nonputrid abscesses, especially following pneumonia, it is proper to temporize with medical treatment for several weeks, in the hope that the

abscess will discharge itself through a bronchus and heal spontaneously. If, at the end of two or three weeks, there is no decided change for the better in the general condition, the temperature, and the amount of purulent expectoration, operation should be considered. In the case of putrid abscesses (gangrene) the outlook for a spontaneous cure is so much less hopeful that immediate operation should be considered. The diagnosis of abscess or gangrene is usually comparatively simple, but its exact localization, the determination of its extent, and the exclusion of other areas of infection, all matters of the greatest moment for the surgeon, are by no means easy to determine. Physical signs are notoriously deceptive, partly on account of the frequent central location of the disease, and these methods can never be relied upon to exclude multiple foci of infection. On the other hand, the X-ray has proved invaluable in this class of cases, both for localization and for the exclusion of multiple foci (Tuffier, 21). When the latter exist in widely separated parts of the lung, operation is in general contraindicated, but two or more foci in close proximity or in a single lobe may be drained by a single incision. The depth of the abscess cavity may be determined by stereoscopic plates or by turning the patient before the fluoroscopic screen. An effort should also be made to ascertain the condition of the pleura over the site of the infection, for the reason that pleuritic adhesions render the operation much more simple. The presence or absence of a Litten's shadow, the respiratory movements of the lower lung margin, and the movements of the abscess shadow and of the diaphragm, when viewed through the fluoroscopic screen (Brauer, 2), may prove of value in this regard, although experience has shown that it is not always easy to be certain as to the presence or absence of pleuritic adhesions. Aspiration for diagnostic purposes is usually condemned on account of the danger of infecting neighboring tissues, and especially the pleura.

Operation in Acute Gangrene or Abscess.—In acute cases the operation consists of excising portions of one or more ribs and in evacuating the abscess through the chest wall, taking care later to keep the wound open until all discharge ceases. The chief difficulty and danger lie in opening the pleural cavity. Garré (9) states that in 87 per cent. of the cases collected by him the pleural layers were adherent over the site of operation, but it should be remembered that these statistics included many late cases, and Kissling (11) states that pleural adhesions were found in less than half of his (mostly early) operative cases. Where firm adhesions are present the operation presents no especial difficulty and can be done in one sitting. Where the pleuræ are not adherent, there is danger of operative pneumothorax and of septic infection of the pleural cavity. Surgeons are not in accord as to the best method of procedure in such cases. On the one hand there are those (Garré, Tuffier, Körte, Friedrich) who prefer to operate in one sitting by opening the pleural

cavity cautiously and suturing the lung to the edges of the wound, and then proceeding to open the lung itself. The immediate danger of operative pneumothorax consists mainly in the lack of support for the mediastinum, which moves back and forth with each respiration and so interferes with ventilation of the sound lung (Garré). Should an extensive pneumothorax occur during the operation, the exposed lung should be drawn quickly into the wound so as to support the mediastinum. Others (Kissling, Perthes, 16) prefer to operate in two stages. In any but the most urgent cases Kissling removes the ribs and exposes the parietal pleura without opening it, and packs with iodoform or vioform gauze. After two days the adhesions are usually sufficiently firm to permit suturing, and the lung is opened without anesthesia. The use of differential pressure has been advised for the purpose of preventing collapse of the lung (Friedrich, 7), but it is not essential, and Kissling objects to its use in any form that interferes with the expectoration of pus.

We have already spoken of the results of operative treatment of acute gangrene and abscess. One of the chief arguments in its favor is the fact that healing is frequently very perfect, and the danger of chronic abscess and pulmonary induration is thereby avoided. In many cases the restoration of lung substance is so perfect that the X-ray has failed subsequently to show the site of the infectious focus, and even at autopsy the lung may show no trace of the former disease (case reported by Lenhartz, 13).

Chronic Abscess and Gangrene

Chronic suppurative processes in the lungs may arise from acute abscesses, owing to insufficient emptying through the bronchial tree, or to the fact that the wall of the abscess has become indurated and is mechanically incapable of closing. They may also arise by extension from chronic infectious processes in the bronchi, such as bronchiectasis or putrid bronchitis. Indeed, it may be difficult in a given case to determine whether the original infection was in the lung or the bronchi. Quite commonly the abscess cavity is surrounded by an area of indurative pneumonia.

Such chronic abscesses or gangrenous areas are, as a rule, not curable by internal measures. Many patients become better under inhalations, a careful dietetic and hygienic régime, and postural treatment similar to that used for bronchiectasis (q. v.). Life in a dust-free, dry, mild, and equable climate is often of great benefit. Operation may be indicated on account of the large amount or the offensive character of the sputum, on account of the tendency of the process to spread or to give rise to repeated attacks of pneumonia, or, finally, on account of the impairment of the general health.

According to Brauer (2), three methods of radical procedure are open in the treatment of such chronic suppurative cases, the choice of which will vary with the individual case. The first of these is to produce a collapse of the lung, either by extensive resection of the ribs or by inducing an artificial pneumothorax. On account of the frequent presence of pleuritic adhesions in such chronic cases, the latter method can only be used occasionally, but from his experience in a few cases he regards it as worthy of further trial. Extensive resection of the ribs may be advised in cases where the process is limited to a single lower lobe, and where the inability of a cavity to close serves to prolong the process and render the sputum more copious. As a rule, improvement rather than a cure is all that can be expected from this method of treatment, but the sputum may diminish so markedly and the general health be improved to such an extent as to justify the operation. A second method of treatment is pneumotomy, with the establishment of a fistula similar to that which has been recommended for acute abscess. In chronic conditions, however, even with an associated resection of the ribs, complete return to the normal is not usual, and the patient may be left with a permanent fistula or with a fistula that must be kept open in order to prevent a recurrence of symptoms. In such cases the excision of the outer portion of the sac at the time of drainage or later, or the excision of the whole sac, as in the case reported by Perthes (16), may lead to complete recovery. Finally, as an ideal operation, we may mention the excision of a large piece of diseased lung. This has been done on animals, and, with improvements in thoracic surgery, it may prove a suitable operation for the future.

TUMORS OF THE LUNG

George Blumer

Hitherto the treatment of lung tumors, whether malignant or non-malignant, has been, with a few exceptions, palliative. This was necessarily so for two reasons: one, the great difficulty of making an early diagnosis; the other, the imperfect development of the methods of lung surgery. There are two discoveries of recent years which make the outlook for the radical removal of pleural and pulmonary tumors much brighter: the X-ray, which furnishes a means of early diagnosis, and the use of differential air pressure, which has made lung surgery a practical possibility. It is not the purpose of this work to discuss methods of diagnosis, but it should be borne in mind, in making X-ray pictures of lung tumors, that not only their presence but their accurate location should be sought for. The physical signs are frequently too indefinite for purposes of localization, and the operator must rely upon the X-ray plate.

The use of differential air pressure, which was first placed on a firm basis by Sauerbruch in 1904, is a matter of such great importance that it is desirable to discuss at least its principles in this place. Its object is to remove what has hitherto been the greatest obstacle to successful intrathoracic surgery, namely, the traumatic pneumothorax which results from opening the chest. This can be prevented, as Sauerbruch shows, in one of two ways: either by positive air pressure within the air passages, or by negative pressure outside of them. As to the relative value of the two kinds of pressure there is still room for discussion, and some observers, Willy Meyer, for example, are convinced that the two forms of pressure do not act exactly alike in human beings. It is sufficient for practical purposes to know that both forms have been successfully used in thoracic surgery.

So far as portability and cost of apparatus are concerned, the positive pressure mechanism in its various forms has a great advantage over the negative pressure apparatus. In principle the positive pressure apparatus consists of a means of introducing the compressed air, a compressor with a manometer for registering the degree of air pressure, a duct for the return air protected by a valve, and an anesthetizing chamber usually provided with a by-pass so that the anesthetic can be excluded at will. It would be out of place here to go into great detail regarding the different forms of pressure apparatus.[1] The larger ones take the form of an air-tight cabinet, which contains not only the patient's head, but also the anesthetist. The apparatus of Robinson, which costs about $300, is of this type, and Brauer's apparatus, while it does not contain the anesthetist, is constructed on the same general principle. In the smaller instruments, such as Elsberg's modification of the Meltzer-Auer apparatus, Robinson's portable machine, or Flint's apparatus, compressed air is introduced through a mask or through a cannula inserted into the patient's air passages.

The negative pressure apparatus is much more cumbersome and much more expensive than the positive pressure apparatus, inasmuch as it is in the form of a cabinet large enough to contain the body of the patient (his head being outside), and the operator with his assistants and armamentarium. The air is exhausted from the chamber by means of a pump to a degree necessary to overcome the elasticity of the lungs, so that they do not collapse when the chest is opened. Fresh air is supplied through a water valve.

Willy Meyer, of New York, has devised an apparatus consisting of a positive pressure cabinet within a negative pressure cabinet, which allows of the use of either positive or negative pressure at will, or of a combination of the two. The change from one form of pressure to another

[1] Details of the different forms of apparatuses will be found in the articles mentioned in the bibliography.

can be rapidly made without harm to the patient. The Meyer apparatus is more spacious than those hitherto devised. The operator can see the patient's head and face, and the whole apparatus can be knocked down and transported from one place to another.

While there is little doubt that either positive or negative pressure can be used in the performance of an intrathoracic operation, objections have been made to certain features in the different types of positive pressure apparatus, which time may show are of practical import. Brauer's apparatus has been criticized because of the imperfect control which the anesthetizer has over the patient. The Meltzer-Auer method has been criticized because it necessitates the introduction of a cannula into the air passages, a procedure which is at times practically impossible, and which, when possible, may sometimes result in a dangerous hypersecretion of mucus within the trachea.

The methods employing masks have been criticized on the grounds that these may interfere with the proper handling of the patient during vomiting. All of these criticisms are at present academic. Operations on human beings have been done by the methods criticized and without the predicted ill results, but these have been too few in number to discredit the validity of the criticisms, and the question must be left open for the present. It is certainly justifiable to use the simpler positive pressure machine in emergencies where the larger cabinets are not available, and in hospitals where the expense precludes the use of the more elaborate apparatus. The criticism that the positive pressure is not available for extensive pneumectomy on account of hindrance to the collapse of the chest on the operated side has been removed by Flint, who has shown that it is an easy matter to use aspiration and leave negative pressure within the chest in place of the positive pressure.

One other difficulty to successful removal of the lung, the treatment of the stump so as to leave it permanently air-tight, has been overcome by the work of Willy Meyer. He has shown that by means of crushing and invagination perfect healing with an air-tight stump can be secured.

So far as past results in the removal of lung tumors are concerned, there are but few successes to record. Lenhartz successfully removed a carcinoma involving the right upper lobe. The patient survived the operation at least two years. Garré removed a carcinoma of the pleura successfully. Pean has successfully removed a chondroma, and Tuffier an angioma, of the lung. Kuttner has done palliative operations in carcinomata with Brauer's positive pressure apparatus. Future progress in the successful removal of lung tumors depends upon the development of more skilled operators, early recourse to the X-ray in doubtful thoracic cases, and the more widespread development of intrathoracic surgery. Grünmach, Holzknecht, and Otten have all diagnosed lung tumors with the X-ray. There is little doubt that the use of differential pressure will become more widespread, and in time well-trained thoracic surgeons will be found in all medical centers.

Even under the most favorable conditions only a certain percentage of lung tumors are operable. Seydel, who has studied this question on autopsy material, shows that 26.9 per cent. of lung sarcomata are operable, and only a little larger percentage of pleural sarcomata. Carcinoma of the lung presents a very much less favorable opportunity—only 9 per cent. being operable. Lung carcinoma metastasizes early, is frequently situated at the root of the lung, where it is not very accessible, and is often surrounded by dense adhesions. Carcinoma of the pleura is likewise operable in only about 9 per cent. of the cases. However, as Seydel's figures are based on post-mortem observations, it is fair to assume that, when our methods of early diagnosis are more perfect, the percentage of operable cases will be considerably higher.

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CHAPTER V

DISEASES OF THE PLEURA

JOSEPH A. CAPPS

HISTORICAL

The term pleuritis was used by the old Greek physicians to designate those inflammatory affections of the respiratory organs in which pain in the chest was present. Hippocrates distinguished pleuritis from peripneumonia and classified the varieties according to location into P. ascendens and descendens and P. anterior and posterior; according to cause into P. sanguinea, biliosa, pituitosa, and melancholia; according to the character of the exudate into P. sicca and humida. Herophilus and his followers believed the lung is always inflamed in pleuritis, but that the pain originated in the costal pleura and intercostal muscles.

The view that pleuritis is only a complication of lung inflammation was also held by writers of a more recent period (Sydenham, 1749). Pinel was one of the first (1818) to create for pleuritis the position of an independent disease of the serous membranes. It was reserved for Laënnec (52) (1825) to build the foundations of the pathological anatomy of pleuritis, and by his discoveries and observations in auscultation and percussion to develop the science of diagnosis in diseases of the chest. As a result of his teachings many contributions to the subject have been made, chief of which in importance ranks the universal treatment of pleural effusions by thoracentesis.

Thoracentesis.—Paracentesis of the chest for the purpose of withdrawing fluid exudate has been practiced from the earliest periods. The history of this operation from its inception in ancient times, through centuries of neglect, to its revival in the nineteenth century is one of the most interesting chapters in medical therapy. What a remarkable tribute to the influence and dominance of the Greek school of medicine that for over two thousand years its teachings and tenets were accepted as authoritative and final!

Hippocrates advocated paracentesis for the identical conditions in which it is practiced to-day, namely, for effusions of every kind whether they

be simple dropsy, purulent hemorrhagic exudates, or a combination of fluid and air. The last named condition of hydropneumothorax he was especially successful in treating, because he had discovered a reliable sign for its recognition in the so-called succussion sounds. Doubtless better results in the treatment of the other forms of pleural exudates would have been obtained had he been able to make accurate diagnoses. As a consequence of this uncertainty in recognizing simple effusions, however, tapping was resorted to only when enormous distention of the chest had taken place, with a bulging of the interspaces from the pent-up pus, or when a traumatic pleurisy with pneumothorax had occurred. The opening was made by bistoury or actual cautery either through an intercostal space or a perforated rib. The fluid was allowed to flow until the cavity was empty, and, if necessary, the opening was cleared out from time to time with a metal sound.

Galen and Celsus accepted these Hippocratic teachings, but apparently had little experience with the procedure.

During the Dark Ages paracentesis received very little attention, except as to the relative merits of cautery and knife. In the seventeenth century Goulu (1624), Lusitanus (1644), and other surgeons who were performing abdominal paracentesis advocated tapping for hydrothorax as well as for empyema and claimed favorable results. The danger from air entering the chest during the evacuation of fluid was the subject of many polemics at this period. Bartholin observed that in penetrating wounds of the chest recovery was most rapid when the wound was closed, and from this he reasoned that the opening made in paracentesis should be closed as soon as possible. Bontius, on the other hand, looked upon air in the chest as harmless. This fear of pneumothorax, however, increased and led to the introduction by Scultetus (1669) of evacuation by aspiration and suction. Not long afterward Drouin (1675) and Lurde (1765) recommended for thoracentesis the use of the trocar, such as was employed in abdominal puncture, but the instrument was considered too crude by the leading physicians of that day. The chief objections to the trocar were the danger of penetrating the lung, of injuring the intercostal artery, and, finally, of withdrawing the fluid too rapidly. To obviate the last mentioned difficulty only a small portion was drawn off every day. With the advent of Laënnec came a new order of things. Speculation gave way to careful observation; guessing to exact diagnosis. It became possible to detect the presence of pleural effusion and to locate it. Nor was Laënnec slow to follow up his pathological and clinical discoveries with logical suggestions for treatment. With rare discernment he stated that acute pleuritis with rapidly forming exudate offered a better prospect of cure by tapping than the chronic cases of empyema. His experiences in draining empyema by the trocar met with little success. Strange to say, Laënnec's own countrymen were slow to adopt the operation, since

it was nearly twenty years later that Trousseau (92) read his celebrated memoir before the academy, and by his influence and extensive experience established thoracentesis as a safe and valuable method of treatment. In England the innovation was brought about by Davies (1835), Roe (1844), and Hughes (1846). Likewise, in Germany, Becker (1834) and, in Austria, Schuh and Skôda (1841) were the champions of the procedure.

America is indebted to the writings and observations of Bowditch (12) for the introduction of this treatment. He relates that in 1848 "the general voice in this country is against operation in any case, and that when advised at all the operation is incision"; Wyman improved the old trocar by devising a smaller instrument which was connected with an aspirating pump. It was this apparatus that Bowditch employed. The indications given by Bowditch are to tap whenever the chest is full, in either acute or chronic cases; in cases where there is alarming dyspnea even if the quantity of fluid is small; in all acute cases where absorption is slow.

The introduction of aseptic principles has had its effect in minimizing the dangers of infection and has thereby served to popularize the operation. Otherwise no important advance has been made in this form of treatment except in the improvement of the apparatus.

CLINICAL PATHOLOGY

In order to intelligently assist nature in the treatment of pleuritis it is necessary for the clinician to have a clear understanding of the nature of the inflammatory process, to discover, if possible, its origin, to comprehend as fully as may be the physical, chemical, and physiological steps by which spontaneous absorption and resolution take place.

In pleuritis there is always an exudate which is composed of blood cells and liquid. When the inflammation is very mild the pleural lining is preserved, but when it is severe a thick layer of fibrin forms, and the endothelial cells perish in the process of coagulation necrosis. There are many varieties of exudate, but the chief forms are the fibrinous, or dry, pleurisy; the serofibrinous, in which a considerable amount of clear fluid is present; the hemorrhagic; and the purulent, in which the fluid is cloudy and thick from the presence of pus cells.

Absorption of Exudates.—For the first few days of the inflammation secretion is actively carried on by the endothelial cells, and under the influence of chemotaxis the leukocytes are poured out by the blood to participate in the fibrin formation. The outflow of serum from the blood is largely regulated by osmosis.

When the irritation ceases and the inflammation subsides absorption begins.

Absorption of Fibrin.—The absorption of fibrin is preceded by a gradual disintegration and solution of the solid material. Opie (67) has shown that the polynuclear leukocytes produce an enzyme, called leukoprotease, which in an alkaline medium digests the fibrinous substance and thus prepares it for absorption. At the same time, new blood vessels make their way from the serous layer into the coagulated mass and the *organization* of connective tissue is inaugurated. In the course of time the operation of these three agencies—digestion, absorption, and organization—brings about the disappearance of the thick false membrane and leaves a thinner layer of tough fibrous tissue. This scar tissue remains indefinitely as an adhesion.

Absorption of Fluid.—The absorption of fluid exudates is more simple and expeditious. Under favorable circumstances the liquid may disappear entirely in two or three weeks, but with surprising frequency the fluid may show little or no tendency to diminish for a long period of time. What is the reason for this failure on the part of the system to rid itself of a harmful secretion? As the exudate is carried away by the lymphatics and blood vessels, it is apparent that any mechanical obstruction of these channels would seriously interfere with its removal.

The *lymphatics* principally concerned in the drainage of pleural exudates are those situated in the costal and mediastinal pleura. Fleiner injected India ink into the pleural cavity and found the pigment was taken up by the parietal pleura and deposited in the intercostal lymph glands; also by the mediastinal pleura and deposited in the tracheal lymph glands, but never in the bronchial glands. The diaphragmatic pleura did not absorb pigment. Interesting in this connection is the observation that pigmented fluid in the abdominal cavity is transported to the lymphatics of the diaphragm but *does not reach the pleural cavity.* This impermeability of the diaphragmatic pleura protects the pleural cavity from draining off the abdominal fluid in ascites. Bacteria, on the other hand, seem to penetrate the diaphragm with ease. Auerbach (4) states that out of 179 cases of subphrenic abscess 101 developed pleurisy.

The efficiency of lymphatic drainage depends not only on the patency of the ducts, but also on the respiratory movements of the thorax. Dybkowsky (26) claims that the antagonistic action between lungs and intercostal muscles during inspiration is of great importance in absorption. In rarefied air inspirations are more forceful, the intercostal spaces are depressed, and absorption is rapid. In compressed air, on the other hand, the respiratory movement is limited and absorption is slow. For the same reason a large collection of fluid tends to immobilize the affected side of the chest and thereby interferes with the lymphatic circulation.

Absorption of pleural fluid by the *blood* depends to a large degree on osmosis. Starling and Tubby injected 50 c. c. of a 10 per cent. solution of NaCl (hypertonic) into a healthy pleural cavity, and three hours and

a half later found 170 c. c. of fluid in the chest, thus demonstrating the osmotic flow of liquid *into* the pleural cavity. When they injected a hypotonic solution (NaCl, .75 per cent., or distilled water) into the thorax absorption rapidly took place, thereby showing the osmotic flow *out* of the pleura. An isotonic solution (NaCl, .92 per cent.), however, was absorbed with a rapidity equal to that of the hypotonic solution, a fact that cannot be explained by osmosis. It is necessary to assume, therefore, that the endothelial cells are directly active in absorption and that when they have reached their limit the passage of fluid is determined by differences in osmotic pressure.

Another factor influencing absorption is the *intrathoracic pressure*. In the light of the experimental work of Emerson (28) it is probable that absorption is favored by moderate pressure of fluid within the thorax. Excessive pressure exerted by a large accumulation of fluid impedes the return of the venous blood to the heart through the inferior vena cava and thereby diminishes the systolic output of the heart and lowers the systemic blood pressure.

Purulent exudates may undergo absorption, but unless evacuated by artificial means they often digest the surrounding tissues and rupture through the bronchial tubes or the chest wall. Encapsulation and caseation are occasional end stages of the spontaneous cure.

Absorption of Gases.—Rosenbach (78) established the fact that O and CO_2 are more quickly absorbed by the pleura than N. A. Schmidt (83), after injecting 1,000 c. c. of O into a healthy pleural cavity, found that absorption was complete in three to six days. Air required six to twelve days. He repeated these experiments in cases of pleurisy, and noted that the absorption of all gases as well as fluids was much delayed. Often evidence of the gas could be detected by percussion weeks after its introduction.

The absorption of gas is interfered with not only by inflammation of the pleura, but also by a high intrapleural tension which restricts the movements of the lung and the diaphragm. For this reason gas is more slowly absorbed when the amount is excessive or when a large amount of fluid is present.

Permeability of the Mediastinum.—In contrast to the diaphragm the tissues of the mediastinum are highly permeable. If normal salt solution is injected into the pleural cavity of a dog in liberal quantities a large proportion makes its way through the mediastinum to the opposite pleural cavity before absorption takes place. Cottonseed oil is absorbed very slowly by the pleural membrane, but it has no difficulty in penetrating the mediastinum.

Clinical experience likewise indicates that transudates of mechanical origin (e. g., cardiac dropsy) shift readily from one side of the chest to the other. Pleuritic exudates of inflammatory origin, however, do not

display any such tendency. The exudate remains localized on one side. We must, therefore, assume that the serous inflammation destroys the permeability of the mediastinal membrane.

Mechanical Effect of Exudate.—Garland (42) was one of the first to demonstrate that pleural fluid first collects at the base of the chest between the under surface of the lower lobe and the diaphragm. A large quantity may collect in this region before dulness is apparent. The fluid compresses the lung in an upward direction, and by its weight tends to depress the diaphragm. The mere obliteration of lung space, however, is a less serious event than the impairment of respiratory action owing to the presence of a foreign body between the intimately opposed surfaces of lung and diaphragm. With further accumulation of fluid the lung retracts still more, until it usually lies close to the spinal column. By this time the diaphragm is flattened out and occupies a low position and ceases to move on the affected side with respiration. Similarly the intercostal muscles on the affected side are inactive. The heart is displaced toward the healthy side, and the mediastinum is pushed over, especially at the lower levels.

The retracted lung becomes atelectatic, and unless relieved of the pressure of fluid may be so bound by adhesions that it cannot reëxpand, or, at best, only partially.

The Intrathoracic Pressure of Exudates.—Quincke (73) measured the tension of pleural effusions and found an absolute pressure varying from 0 to 26 mm. Hg, with an average of 10 mm. The pressure, as a general thing, is proportionate to the amount of fluid present within the thorax. The positive pressure tends to be neutralized, and may even become negative during the act of inspiration. The more mobile and expansile the chest wall, and the more active the opposite lung, the greater is the tendency to a low positive or to a negative pressure. For this reason the exudate in children is under a lower pressure than in old people. The presence of adhesions by immobilizing the ribs gives rise to a higher pressure of an effusion. Schreiber (86) is of the opinion that the difference in pressure of the effusion between expiration and inspiration, or the *fall* in pressure during inspiration, is a reliable measure of the compensating activity of the healthy lung. Furthermore, he considers a strongly negative pressure after tapping an evidence of normal expansion of the well lung and, therefore, a favorable prognostic sign.

Influence of Exudates on Circulation.—If fluid is injected into the pleural cavity of an animal the general *arterial pressure* maintains a constant level until the space is almost filled, then quite suddenly the pressure falls to a low point and death is imminent. Lichtheim's (56) experiments teach us that four-fifths of the lung vessels can be excluded from the circulation by ligatures without causing any marked change in the *systemic* arterial pressure. This is by no means a proof, however,

that the various parts of the body are well supplied with blood. The pressure in the *pulmonary* artery is increased even by a moderate effusion, and the preservation of a normal tension in the systemic arteries is merely an evidence that the right heart is capable of performing its additional work.

Accumulation of fluid in the chest not only impedes the flow of blood through the lungs, but by lowering or destroying the normal negative pressure within the thorax obstructs the flow of blood from the body veins. Under normal conditions each inspiration creates such a strong negative pressure that the blood is sucked into the thoracic veins from the peripheral veins. The presence of fluid impairs this inspiratory flow, and the pressure in the *body veins* steadily rises. Usually the venous stasis is partly overcome by compensating inspiratory movements, i. e., by deeper inspiration.

It should be emphasized that the mere obliteration of lung space is of little consequence. More serious in their effects are the obstruction of the pulmonary circulation, which is compensated for by the right heart, and the impairment of the negative intrathoracic pressure, and resulting stasis in the body veins, which is compensated for by deepened respiration.

Cause of Death from Pleural Exudate.—Many explanations have been advanced for the occurrence of sudden death in cases with a large pleural effusion. Trousseau and Leichtenstern supported the view that *heart failure,* induced partly by the high pulmonary tension and partly by displacement and tension of the organ, was the cause. In order to accept this view we must suppose that the heart muscle has been greatly weakened by the toxins of disease. Yet experience teaches that sudden death often takes place from a rapid collection of fluid long before the infection could badly cripple the heart. Moreover, the researches of Romberg and Pässler (77) have given ample proof that the heart can successfully resist infectious toxins for long periods, and that terminal collapse marks a breakdown on the part of the vasomotor system, rather than of the heart. Rosenbach (79) attributes the fatal collapse in pleural effusions to an obstruction of the venous flow from the body into the thorax. A contributing factor is produced by the violent action of the diaphragm on the healthy side, which twists and perhaps kinks the inferior vena cava. Quite apart from any kinking of the vein, there seems to be abundant reason for accepting this view. The progressive obstruction to the venous flow finally brings such a small volume of blood to the heart that the systolic output is inadequate to fill the arteries, and the general pressure rapidly falls.

It is nearer the truth to say that the *venous circulation fails* to supply the heart with blood than to say the heart fails.

PAIN SENSE IN THE PLEURA

Pain is perhaps the most constant and important symptom of pleuritis. A careful observation of the distribution of pain is essential to a correct diagnosis of the seat of inflammation. In an experimental and clinical study of pleural pain, we (18) have reached the following conclusions:

1. The *visceral* pleura is not endowed with pain sense.

2. The *parietal* pleura is richly supplied with sensory fibers from the intercostal nerves. Irritation of the pleura induces sharp pain that is *accurately* located by the individual over the spot that is touched. Such irritation in our experience never gives rise to "referred pain" in the neck or in the abdomen. The power to locate sensory impressions seems more highly developed in the anterior and lateral portions of the parietal pleura than in the posterior.

3. The *diaphragmatic* pleura derives its sensory supply from two sources, the phrenic nerve and the last six intercostal nerves. The *central* portion of the diaphragmatic pleura is innervated by the phrenic nerve. Irritation of this portion sets up pain in the neck. A peripheral rim of the diaphragmatic pleura, which is 2 or 3 inches wide anteriorly and laterally, and a segment corresponding to the posterior third of the membrane, are innervated by the sensory fibers of the *last six* intercostal nerves. Irritation of these areas gives rise to pain in the lower thorax, in the lumbar region, or in the abdomen.

The *neck pain* arising from irritation of the central portion of the diaphragmatic pleura is a true referred pain, the afferent impulses reaching the cervical cord through the phrenic nerve trunk and exciting efferent impulses in the skin and superficial tissues supplied by the third and fourth spinal segments. This pain is characterized by a point of maximum pain and tenderness and by a surrounding zone of cutaneous hyperesthesia and hyperalgesia. The maximum point of pain has a remarkable tendency to appear along the ridge of the trapezius muscle (fourth spinal segment).

The pain elicited by irritation of the peripheral or posterior portion of the diaphragmatic pleura is also a true "referred pain." The pain is usually distributed in segmental areas over the lower thorax and epigastrium, sometimes extending downward over the whole abdomen on the same side (seventh to twelfth dorsal segments). The pain is both spontaneous and is associated with hyperesthesia and hyperalgesia of the skin and superficial tissues on pressure.

The *distribution* of the pain is determined by the degree of irritation and by the part that is touched. The more intense the irritation of the pleura, the greater the tendency of the pain to spread down over the lower

abdomen. Rarely from strong pressure the pain is *bilateral*, extending over both sides of the abdomen. When the posterior portion of the diaphragmatic pleura is irritated the pain is most marked in the lumbar region.

4. The *pericardial pleura* receives its sensory innervation chiefly if not exclusively from the phrenic nerve. Irritation of this part of the pleura is followed by pain in the neck of the same character and in the same locations as that induced by irritation of the central portion of the diaphragmatic pleura. This pain is a "referred pain," characterized by a maximum point of tenderness and pain, by hyperesthesia and hyperalgesia to pressure of the surrounding skin, and by muscular rigidity.

5. In an extensive series of cases of diaphragmatic pleurisy in some of which the diagnosis was confirmed by autopsy, pain of the segmental type over the lower thorax, abdomen, or lumbar region was present in the great majority. In about one-half the cases pain in the neck was complained of. This cervical pain was always in the region supplied by the third and fourth spinal segments, showing a preference for the trapezius ridge. There was always a point of maximum pain and a surrounding area of hyperalgesia and hyperesthesia of the skin.

THE ONSET

The onset of pleurisy is so protean in its manifestations that only a rough picture can be drawn. Two types may be described:

1. The attack begins abruptly with chilly sensations or an outspoken chill followed by fever, pain, sweating, and cough. Such is the origin of pleurisy accompanying pneumonia or of a primary pneumococcus infection. Many tuberculous pleurisies also have a stormy onset.

2. The initial stage is insidious, often without any symptoms pointing to the chest. A rapidly developing anemia, the appearance of a digestive disturbance with loss of appetite and weakness, or of shortness of breath on exertion, lead to a physical examination and the discovery of fluid in the pleural cavity. The pleurisy can develop de novo or come on as a complication of a chronic disease, such as cancer or Bright's disease.

CLINICAL COURSE

The further course and prognosis cannot be predicted from the nature of the onset, for an acute stormy attack may progress favorably and end in complete spontaneous absorption and recovery, whereas the slowly forming exudate with little febrile disturbance sometimes displays a remarkable persistence and a tendency to reaccumulate even after evacuation. The

helpful factors in determining the course of the affection are to be found in the underlying cause and in complications. A pneumococcus or tuberculous exudate is likely to absorb unless it becomes purulent, whereupon artificial drainage is imperative. Occasionally from a pneumococcus pleurisy a pneumonia starts up and places the subject in jeopardy. In tubercular pleurisy a secondary involvement of the lung or of the bronchial glands is not uncommon and the outlook is rendered more grave.

A pleurisy complicating carcinoma usually results fatally, because it tends to reappear after repeated tappings. On the other hand, the pleural effusion complicating rheumatic arthritis nearly always ends in recovery.

Empyema, whether primary or a sequel to a serous exudate, is a dangerous condition which, as a rule, ends in fatal sepsis when left to nature. In rare instances, however, absorption takes place or spontaneous rupture occurs into a bronchus or externally through an intercostal space.

End Result after Absorption.—The end result in cases which recover under natural means is often a matter of surprise. A year after the attack an examination will reveal, perhaps, no evidence of thickening and a complete return of function on the part of the lung. In a less favorable case some retraction of the chest on the diseased side is found, and a moderate restriction of the respiratory excursion. In more chronic and obstinate cases, particularly those with purulent exudate, the side of the thorax is flattened, the ribs and diaphragm move very little with respiration, the percussion note is dull from the thickened pleura, the lung is functionless, and the heart displaced. Needless to say the last described termination can generally be obviated by modern methods of drainage.

TREATMENT

Prophylaxis is a term that can be used only in a relative sense in connection with pleurisy. In an infectious disease like typhoid fever definite preventive measures to safeguard water and food are truly prophylactic. The possibility of carrying out prophylactic precautions in pleurisy resolves itself into an effort to prevent the primary disease to which the pleural inflammation is secondary, or to avoid those exciting influences which induce the complication of pleurisy. Thus a phthisical individual should be more careful than a healthy one in avoiding exposure to cold, over-exertion, or exercises that subject him to trauma. The same warning is necessary for the subject of chronic heart or kidney disease.

A causal therapy also has its sharp limitations, since for most forms of pleuritic infection no specific treatment has been perfected. It is true that some authors speak of the salicylates as specific for the rheumatic forms of pleurisy, but it cannot be fairly claimed that salicylates are a cure for the ordinary rheumatic arthritis. More reasonable is the belief

in the specific action of the iodids in syphilitic pleurisy. Unfortunately these cases are not numerous and always are difficult to recognize. The last few years have seen a growing tendency to search the body over for a primary focus of infectious material, and to eradicate this source of blood contamination, whether it be a middle-ear abscess, a carious tooth, or a pus pocket in the tonsil. Feidler in 1895 called attention to the frequency of pleurisy following tonsillar infection, either alone or associated with arthritis. The removal of such a focus by tonsillectomy has given many brilliant results and is deserving of more frequent trial in the future.

General Indications

Rest.—Regardless of the special origin of the pleurisy, rest is the first essential of treatment. There is no doubt that rest conserves the forces of the body organism and thereby increases its resistance against the invading poison. When the onset is acute, with fever, the patient should be confined to bed and remain there until the temperature has returned to normal. The patient often fails to realize the necessity of complete rest. Hence it is incumbent upon the physician to explain the danger of extension of the process from pleura to lung, and especially of the development of a chronic tuberculosis. Physical exercise does not simply increase the work of the heart, it also heightens the respiratory movements and directly irritates the inflamed tissues.

Fresh Air.—Fresh air is of great benefit in pleurisy, as it is in all other affections of the respiratory apparatus. Whenever possible, a sleeping porch or tent should be utilized. The patient out of doors breathes more slowly and with greater ease and secures sounder sleep. Why a person is more comfortable out of doors than in a room with open windows is not generally understood, although the testimony of tuberculous patients to the fact is overwhelming. Hill (47) and Pflüge (71) have shown by experiments that indoors the expired air as a rule remains for some time in the vicinity of a person's face, so that he inhales air containing a considerable proportion of his own breath. They find that the chemical changes in the character of this reinspired air, such as an excess of carbon dioxid, or deficiency of oxygen, exercise no deleterious effect on the individual. The sensations of discomfort are due to the heat and moisture present. Out of doors, on the other hand, there is almost always sufficient shifting of air currents to quickly carry the expired breath away. In other words, motion of the air combats the harmful effects of heat and moisture thrown off by living bodies, and is therefore necessary for perfect ventilation. The use of the electric fan in crowded wards or in the sickroom should be more generally adopted.

FIBRINOUS PLEURISY

The fibrinous, or "dry," pleurisy is the most common variety. The majority of subjects coming to autopsy exhibit adhesions between the pleural blades, yet comparatively few during life have been aware of an attack of pleurisy. It is probable that many instances of so-called intercostal neuralgia or rheumatism are associated with a limited fibrinous exudate which may entirely escape the attentive ear of the physician. To designate these casual adhesions as invariably tuberculous is beyond the warrant of our knowledge. Until further light is shed on their origin we must attribute them to various causes, including bacterial, mechanical, and toxic. E. Grawitz (44) believes that many of these adhesions are due to the inhalation of particles of dust, which find their way through the lymphatics to the pleura. Such pleurisies, he thinks, progress favorably and give rise to few symptoms. Dry pleurisies in the vicinity of the apex and upper lobes, where the respiratory movements are slight, are especially prone to be latent. Hence the physician is rarely consulted in the early stage of these quiet or latent cases. It is only in advising an after-treatment that he can be of service.

The treatment of acute fibrinous pleurisy of an outspoken type is largely symptomatic, the etiological factors having much to do with the later management of the case.

Acute Fibrinous Pleurisy

The symptoms of acute dry pleurisy are *pain,* often described as a "stitch in the side," cough that is sharp and unproductive, rapid and *shallow respiration,* and fever. The pain is aggravated by cough or deep breathing, and is most intense in the region where the friction rub is heard with the stethoscope.

Pain.—Strapping the affected side with a broad strip of adhesive plaster sometimes brings relief by lessening the excursion of the ribs. In our experience, however, the procedure is not often successful and has the disadvantage of being a hindrance to auscultation.

Hot and cold applications to the seat of the pain are both employed. A hot compress or hot water bag is usually grateful to the patient. Cold, in the form of an icebag or a compress, is preferable, since it acts favorably on the fever. A remarkably efficacious way of applying cold for the relief of pain is by the use of strips of linen, cut twelve inches long and two inches broad, first laid on a cake of ice and then applied parallel to the ribs. The strips should be frequently removed and replaced with others freshly chilled by ice. By this method the author has seen the severest pain gradually subside in the course of a few hours.

Opiates are valuable and at times indispensable. At the onset, with febrile symptoms, 10 grains (0.6 gm.) of Dover's powder, or 1/6 grain (0.01 gm.) of morphia, is helpful. The morphin may be repeated the following night if the pain persists. At the same time, the cough is benefited by this narcotic.

The bowels should be cleared out at the onset with calomel, followed by a saline. It is desirable to continue the use of Epsom salts or Hunyadi water every morning until the fever subsides. Under these measures the ordinary case of pleurisy makes a speedy recovery. For several weeks after the disappearance of all symptoms especial care should be taken to avoid chilling, violent exercise, or great fatigue.

Serofibrinous Pleurisy

The treatment of pleurisy with effusion resolves itself into four lines of effort: firstly, the treatment of the infection itself; secondly, the relief of distressing symptoms; thirdly, the attempt to limit the secretion and encourage its absorption; fourthly, the evacuation of fluid by operative means.

Treatment of the Infection

At the onset of an acute attack much may be done to modify its severity by the prompt administration of calomel, followed in the course of eight hours by a full glass of Hunyadi water or an ounce of Epsom salts. If fever sets in abruptly a hot bath is advisable to promote diaphoresis. Medicinal remedies with a specific germicidal action on the infectious agent are wanting. Since Feidler showed that pleurisy often has the same infectious origin as rheumatic arthritis, many writers have advocated large doses of the salicylates as an efficient antiseptic. Rosenbach (79) advocates this remedy because the derivatives of the salicylates are found after internal administration in pleural exudates and transudates.

That salicylic acid reduces the temperature and notably alleviates pain is not open to question, but we believe with Unverricht (94a) that the clinical data at hand do not justify the statement that it materially changes the course or duration of the disease. It is best given in the early stage and in large doses (40 to 100 grains a day—3.0 to 7.0 gm.).

Quinin is considered by many to favorably influence the disease. Carrière (21) recommends giving 5 to 10 grains (0.3 to 0.6 gm.) per diem throughout the febrile period.

Symptomatic Treatment

The relief of *pain* is obtained by the measures described for dry pleurisy. Since the pain is usually severe and lasts but a few days the

injection of *morphin* is altogether the most effective remedy. Next in value is the use of *cold applications,* or, in weak individuals with poor circulation, of hot compresses.

Dry Cupping.—Dry cupping over the painful area acts as a derivative, withdrawing blood from the congested pleura. It is a simple procedure and often yields excellent results.

Painting.—Painting the skin with tincture of iodin has less to recommend it. Inunction of the skin with oils containing salicylic acid has been defended, because absorption undoubtedly takes place. In order to bring about any considerable absorption, however, the rubbing must be continued for twenty minutes or more, and this is a trying experience for the patient.

Cough.—The cough is at times a troublesome symptom, as it increases the pain. As before stated, small doses of morphin or codein (grain ¼) (0.02 gm.) can be given often enough to afford relief.

Fever.—Fever is seldom so high as to demand vigorous means for its reduction. Salicylate of soda or aspirin are preferable to antipyrin, phenacetin, and other coal tar derivatives, as the latter exert a depressing effect upon the heart and circulation. Sponging the body with cool water or with alcohol and water is perhaps the best method of lowering the body temperature. Some prejudice exists against cool baths in pleurisy, but the success of this form of hydrotherapy in pneumonia is the most convincing answer to criticism.

Measures to Check Secretion and Aid Absorption of Effusion

The *dry diet* of Schrott is a popular therapeutic practice in Germany. This consists of lean roast veal, stale rolls, and only sufficient water for deglutition for the first three days; then a half pint of red wine is permitted, and by the end of the week is increased to a pint. The custom of *limiting the liquids* ingested has many adherents, but is not altogether supported by physiological reasons.

In approaching the whole question of the treatment of effusion we must clearly distinguish between transudates and exudates.

Transudates and Exudates.—Transudates are of noninflammatory origin and represent the outpouring of serum into the body cavities. They are caused by mechanical obstruction of the veins—venous stasis, whereby the serum escapes into the tissues (diapedesis)—or by chemical processes affecting an outflow of serum (osmosis). In transudates the blood vessels and lymphatics remain patent. Hence it is easy to understand that all measures tending to reduce the body fluids (catharsis, diuresis, bleeding, etc.) have a direct influence on the transudate and promote its absorption by lymphatics and blood vessels. The evacuation of a large quantity of ascitic fluid in cardiac dropsy leads to a rapid absorption of

pleural transudate. The complete disappearance of pleural transudate in two or three days is often seen, also, after a great outflow of urine or a watery diarrhea.

Exudates, on the other hand, are for the most part a secretion of the endothelial cells, and the quantity of fluid thrown out depends not primarily on stasis nor on osmosis, but on the degree of irritation of the cells and their inflammatory reaction. An exudate can form even when the body is exsiccated by loss of fluids, as, for example, in dysentery. The small blood vessels and lymphatics are obstructed by the inflammation.

Thus it happens that the removal of body fluids by any of the above-mentioned methods does not bring about rapid absorption necessarily. Absorption of an exudate seems to depend rather on some reaction in which the serous cells begin to absorb instead of secrete, and perhaps, too, on the activity of proteolytic enzymes by which the lymphatic ducts and capillaries are cleared of their coagulated contents.

With a full knowledge of these facts it must be recognized, however, that an effusion may be a combination of exudate and transudate. Furthermore, it is possible that even in a pure exudate some of the lymphatics may remain permeable and respond in some degree to depleting measures.

Cathartics.—Hydrogogue cathartics, such as the compound jalap powder (3ss to 3i) (2.0 to 4.0 gm.) taken at bedtime, or a saline quaffed on rising, are more useful in relieving abdominal distention and, indirectly, the dyspnea than in promoting absorption of the fluid. One should be careful to avoid the exhausting effect of prolonged and excessive purging. A daily morning dose of sodium phosphate (3ii—8.0 gm.) in a cup of hot water throughout the illness admirably serves the purpose.

Diuretics.—Diuretics, so efficient in transudates of cardiac and renal origin, are of less value in pleural exudates. Not infrequently it happens that, while diuretics are being given, a copious flow of urine starts up and simultaneously the pleural fluid diminishes. Rosenbach considers the diuresis a result of increased absorption from the pleural cavity, a sequence that is observed when no medication is being carried out. Of all diuretics caffein or diuretin [gr. xv (1.0 gm.) three times per diem] are the most reliable in their stimulation of renal cells.

Cardiovascular Stimulants.—These are indicated if the blood pressure is low or if the heart shows evidence of weakness. *Digitalis* is most successful in those cases where, in the wake of an exudate, an additional transudate is created by a failing heart muscle. The improved heart action reduces the amount of fluid, and, at the same time, causes copious diuresis. Digitalis is best prescribed in the form of the tincture, ten minims (0.6 c. c.) four times a day, or of the powdered digipuratum, gr. ¾ to 1½ (0.05 to 0.10 gm.) three times a day.

Caffein is valuable for a small weak pulse, as it raises blood pressure. A convenient method of administration is the subcutaneous injection of

the caffein and sodium benzoate, one grain (0.065) every four to six hours.

Diaphoretics.—Diaphoretics have little to recommend them. Pilocarpin is especially objectionable because it stimulates bronchial secretion and thereby adds to the embarrassment of breathing. Drugs having some chemical property that promotes absorption of fluid have been extensively employed. Inunctions of mercurial ointment, as advocated by Meininger, are not recommended.

Iodids.—The iodids have long enjoyed the reputation of aiding absorption of exudates. Rosenbach states that iodids find their way into transudates but not into exudates. It has been claimed that iodids render the vessel walls more permeable and increase the activity of the leukocytes, but there is little evidence to back up this hypothesis. Holding to the belief that some pleurisies are of syphilitic origin, Steintzig looks upon iodid as a specific in these cases. Cushny (23) contends that the undoubted efficiency of iodids in removing syphilitic gummata has led to the unwarranted belief that other forms of exudate are similarly influenced. How much of the prevalent faith in the absorptive power of iodids in serous exudates is based on mere tradition and how much on sound empiricism must be determined by future investigations.

When the exudate is absorbed and the fever has subsided the after-treatment requires the greatest skill and judgment. The patient may be allowed to walk and indulge in other mild exercise. He should practice deep breathing, and spend a few minutes each day swinging light Indian clubs or dumbbells in order to encourage deep respirations and the filling out of the retracted lung. Later on, rowing and swimming are ideal forms of recreation.

For at least one year following a pleurisy with effusion every effort should be made to live in the open air and sleep out of doors. Lord (57) does not overstate the gravity of the condition when he says that "treatment should be based on the ascertained fact that three-fourths of all primary cases with effusions are due to tuberculosis and that two-fifths of primary cases develop some form of tuberculosis within four to six years." Is the subject a young person in school, he had best give up the confinement of study for one year and live in the country or on a ranch. Is the patient a clerk or other city worker with long hours at a desk, he had best change his employment to some task that keeps him in the open air. Of course among the poor it is not often possible to change employment or residence, but with little expense a sleeping porch can be added to the house.

Operative Measures

Since the time of Trousseau, when thoracentesis had more enemies than friends, the operation has steadily grown in favor. To-day one seldom hears the question discussed as to whether tapping is justifiable.

The interest in the subject is directed to the consideration of the most favorable time to operate and the best methods for its accomplishment.

Indications.—Indicatio Vitalis.—The *indicatio vitalis* is the most firmly established of all. Trousseau (92) was the first to realize that fluid may collect so rapidly that by its mere mechanical pressure it can cause death. He graphically relates several instances where in his earlier experience, with a large effusion accompanied by dyspnea, he timidly delayed tapping and needlessly sacrificed a life. In some acute cases the fluid accumulates with remarkable rapidity. Within two or three days the pleural cavity may be entirely filled. Rapid and labored breathing, orthopnea, and cyanosis are the symptoms which should warn the physician of danger. When physical examination reveals the upper border of fluid as high as the third rib in front, or the spine of the scapula behind, and rapidly rising, it is not safe to postpone paracentesis longer. Under these circumstances the pulse rate and pressure can be ignored, as they cannot be depended upon to forecast a dangerous or fatal collapse. The pulse is capable of maintaining a good pressure, though the volume usually diminishes, up to the breaking point. Then its tension quickly falls and death is imminent. The respirations, on the contrary, show signs of embarrassment at a much earlier stage, becoming rapid, labored, and at times irregular. If the fluid reaccumulates after tapping, evacuation may be repeated without detriment.

Large Effusions.—Large effusions of slower development must be withdrawn for the same reasons. Nearly every clinician with hospital experience can recall instances of large pleural exudate where thoracentesis was delayed on account of the absence of alarming symptoms and the patient suddenly died. It has been already mentioned that in *pleuritis acutissima* the pulse is of little value as a warning signal of danger. This is also true in the large effusions of slower onset. Furthermore, in these latter effusions even the respirations may be quiet and cyanosis be slight or absent, and yet the danger lurks near by. The rapid development of alarming symptoms in these cases depends not on an exacerbation of the pleurisy with free exudate, but on a failure of absorption. Fluid may remain in the chest for weeks and months, and it is constantly working injury to various organs. The lung is impaired by pressure; the heart is at the same time hampered in its action and poisoned by the infection; the diaphragm is forced down by the weight of fluid and its tonus seriously impaired. The weakening of the diaphragm and intercostal muscles interferes with the mechanism by which, during inspiration, the venous blood is sucked from the body to the thoracic cavity, and this flow is further impeded by the presence of fluid in the chest, with its resulting positive pressure.

After struggling under this tremendous load for a long period, a trivial tax on the patient's strength, such as excitement, coughing, defecation, or

slight muscular effort, may bring on circulatory failure. A safe rule is to remove the fluid if it has reached the level of the third rib anteriorly.

Moderate Effusion with Slow Absorption.—At the present day no one questions the propriety of operative procedure for the removal of a large collection of fluid or of fluid increasing at a rapid rate. Any disastrous results of expectant treatment in such cases can be attributed to either gross carelessness or procrastination. The patient with a moderate effusion that is absorbing very slowly runs less risk of sudden death but more risk of permanent injury. An effusion of moderate size, not requiring immediate evacuation, is often left to the care of nature. Weeks and months may elapse with no appreciable shrinkage in the volume of fluid. The patient may be walking about, short of breath and easily tired by exertion. Upon physical examination the presence of fluid can often be detected only by the most careful percussion, since the dulness may be attributed to the thickened pleura. Tapping and evacuation of the exudate in these cases are followed ordinarily by a rapid improvement in breathing and in general strength.

Other Considerations.—Other considerations that demand relief by tapping, quite apart from the amount of fluid present, are a marked displacement of the heart and other neighboring organs, and the development of dyspnea or cyanosis. A relatively small collection of exudate may be circumscribed and so situated as to cause a serious disturbance of the pulmonary circulation. The presence of myocarditis with dilatation of the heart, or an impairment of the respiratory function from an associated disease of the lungs, such as pneumonia, emphysema, etc., may necessitate the removal of comparatively small effusions.

Choice of Time for Operations.—For several days after the onset of an acute attack of pleurisy the fluid continues to accumulate. A time is reached when the inflammation subsides and the secretory activity of the pleural membrane becomes quiescent. This is the ideal time to perform thoracentesis unless immediate intervention is demanded by rapid or excessive accumulation. Generally a week or more elapses before the fever and secretory reaction decline. Since the time of Traube (91) fever has been looked upon as a sign of inflammatory activity and a contraindication to tapping. It is desirable, whenever possible, to wait for the temperature to fall, but Unverricht (94) has challenged the attitude of indefinite waiting because of its presence. The existence of the exudate is perhaps a contributing cause to the fever; at any rate, evacuation frequently is followed by a fall in temperature, just as is commonly witnessed in emptying a pus cavity.

Contraindications.—In the opinion of many authorities there are no contraindications to thoracentesis in an outspoken pleural effusion. Rather would we speak of the desirability, in certain cases, to delay puncture and to withdraw a comparatively small quantity of fluid.

Königer (51) has made a careful study of the influence of pleuritic effusion upon an underlying tuberculous infection. He finds the inflammatory reaction has a decidedly favorable effect on the course of the disease and often leads to spontaneous cure. The virtue of the pleurisy lies both in the compression and enforced rest of the lung and in the production of chemical antibodies, which tend to bring about immunity. Upon these grounds he advocates late tapping, preferably two weeks after the onset of a primary pleurisy. Moderate effusion in a secondary tuberculous pleurisy will often do more good than harm, and does not always need drainage. In an outspoken pulmonary tuberculosis with cavity formation the effusion may be allowed to remain indefinitely or, at least, only a small portion need be removed.

Location of Puncture.—The axillary space offers an excellent place for penetrating the chest wall, for in this region the muscular covering is thinnest and there is least injury inflicted upon soft parts. The intercostal spaces are wider here than posteriorly. The fifth and sixth intercostal spaces at the anterior or midaxillary line are usually chosen if the fluid is present in large amount. With a smaller exudate the posterior route is preferable, entering the sixth to the eighth interspace near the angle of the scapula or in the scapular line. One should bear in mind that a small effusion can frequently be drained posteriorly when a dry tapping is encountered laterally or anteriorly. As the fluid recedes the anterior portion of the chest becomes resonant, while posteriorly an area of dulness remains. For this reason a puncture in the back is more likely to yield a flow than one in front or in the side. Still another advantage of the posterior site is that the patient is not able to observe the operation and is less frightened. Unverricht (94) considers the danger of perforating the diaphragm much less when the trocar enters the back than when it pierces the axillary space. For the inexperienced operator the posterior site is to be recommended on the ground of safety.

No rule can be laid down for the puncture of encapsulated exudates and for interlobar effusions. The location of the most outspoken physical signs of fluid, as determined by auscultation and percussion, must be the guide for the trocar. In obscure cases several places may be tried before the result is successful. Musser (63) states that a circumscribed pleurisy is sometimes located by the presence of an overlying area of tenderness to pressure.

Position of Patient.—In our country it is customary to have the patient assume a sitting posture either on the edge of the bed or astride a chair, with the head and arms resting on the back for support. In this way the back and axilla are well exposed, and by elevating the shoulders the interspaces are widened. The chief advantage of this position is based on the idea that good drainage can be secured only from the lowest point of the chest, where the fluid tends to gravitate. This reasoning is quite

erroneous, for the rate of flow and the amount of fluid that escapes depend less on the hydrostatic pressure of the exudate than on the tension of the lungs and the activity of the intercostal muscles and diaphragm. A simple illustration of this fact is seen by the familiar observation that a large effusion often refuses to flow spontaneously, while a smaller effusion may gush out under high pressure.

Moreover, there are several objections to the sitting position, namely, muscular exertion is increased, especially on the part of the diaphragm; the tendency to cough is enhanced; the blood supply to the brain is diminished, thereby favoring faintness and vasomotor weakness.

The *recumbent position* with the shoulders raised by pillows or a lateral position with the affected side uppermost is recommended as a routine practice. The exceptions to this rule are cases of uncompensated heart disease, asthma or marked dyspnea, in which the upright posture is necessary for comfortable breathing.

Preparation.—Absolute cleanliness and attention to *aseptic* details should be rigidly enforced as in any other surgical operation. The instruments should be sterilized in boiling water, and care should be taken to see that the lumen of the trocar is patent. The skin is cleansed with soap and water followed by boiled water and alcohol. Over the immediate vicinity of the point selected for puncture the skin is then painted with tincture of iodin. We have found a very satisfactory disinfectant in the place of iodin to be a saturated solution of phenol, which is applied over a spot the size of a silver dollar and washed off in twenty seconds with alcohol. The phenol not only cleanses the skin but exerts an anodyne effect on the superficial nerves. Ethyl chlorid sprayed over the skin until freezing takes place also deadens the pain to some extent. The sharpest pain occurs not with piercing the cutaneous structures, but with that of the parietal pleura. Hence a deep injection of cocain is necessary to anesthetize all the tissues. Most clinicians find, however, that the preliminary injection of cocain is quite as distressing as the direct trocar thrust. General anesthesia should never be employed in tapping serous effusions, even in weak or hysterical individuals, on account of the danger of pulmonary congestion or respiratory failure.

Choice of Instrument.—Shall the trocar or hollow needle be used? This is a question that has elicited much discussion and that must be decided partly on the ground of personal preference. A simple hollow needle with a lateral foramen near the point can be introduced with less force and with less pain to the patient than a trocar. The lumen is easily cleared out by a stylet should any obstruction to the flow occur. The risk of tearing the lung with the sharp point, and of consequent production of pneumothorax or of bleeding into the pleural cavity, is more theoretical than actual, for such accidents are rare when one considers the innumerable times this operation is successfully performed. A more serious dan-

ger is encountered in the mere scratching of the visceral pleura toward the end of evacuation when the expanding lung comes in contact with the point with each respiratory movement. This irritation ordinarily gives rise only to cough, but exceptionally it may set up reflex disturbances of the heart and vasomotor system.

The *trocar* cannula, after the withdrawal of the cutting point, is less likely to irritate the visceral pleura and is, therefore, the safer instrument. In choosing a trocar it is well to select one of the largest size which can be readily inserted between the ribs, in order to provide for the free flow of a thick or stringy exudate.

Method of Evacuation.—The trocar inserted into the pleural cavity and the stilette removed, the fluid flows out spontaneously. The flow is intermittent, increasing with expiration and diminishing or even ceasing altogether with inspiration. A similar ebb and flow takes place in draining a small collection of ascitic fluid, but the variation is far less marked. There is always sufficient positive pressure in ascites to drain off most of the fluid. In a pleural effusion similar conditions do not always exist. If the effusion is very large the fluid is under sufficient positive pressure to expel the first portion in a continuous stream, then another portion during expiration only, then no more escapes, although the cavity may still contain two pints or more. If the effusion is of moderate or small proportions none may flow spontaneously because of the negative intrathoracic pressure. Under such circumstances aspiration is necessary.

Another phenomenon seen in draining the thorax, that is not observed in tapping the abdomen, is the tendency to suck in air during the act of inspiration and thereby to create a pneumothorax. This difficulty is overcome by attaching to the trocar a rubber tube about three feet long, which is filled with sterile water and allowed to carry off the pleural effusion by siphonage.

Aspiration.—Since the introduction of modern apparatus the aspiration method for evacuation of fluid exudate has become quite general. In skilled hands there is very little risk, and the operation can be completed expeditiously. For the inexperienced, on the other hand, the perfect control of the flow is a temptation to withdraw the flow too rapidly and to get "the last drop." The method of siphonage avoids these pitfalls, as the flow is necessarily slow and the cavity is never completely emptied. In the great majority of cases siphonage removes as much fluid as is desirable. If the spontaneous flow is too small, then a slow current can be established by means of gentle suction.

Apparatus.—*Exploration.*—For the purpose of exploration it is common practice to employ a Luer syringe of 5 or 10 c. c. capacity, fitted with a long needle of large caliber. Sewall (88) has devised a simple apparatus consisting of a needle connected by a line of rubber and glass tubing with the bottom of a bottle half filled with water. From the

upper portion of the bottle another glass tube passes through the rubber cork, and to this is attached a rubber tubing and mouth piece. The muscles of the mouth serve as the piston, and the tip of the tongue as the valve of the syringe. It is simple, easily constructed, and can be used with a needle or trocar of any size.

Exploratory puncture to determine the presence of fluid and its location is often used in the office of the physician or at the bedside, with the deliberate intention of draining the cavity at a later time. When the diagnosis is reasonably certain the preliminary puncture should be dispensed with and the operator be prepared to withdraw the fluid at the first tapping.

The trocar should have a sharp stylet which fits tightly in the cannula. The cannula at its junction with the sharp point should be ground down to smoothness. The outer end of the cannula has two outlets, one with a stopcock for the admission of the stylet, the other placed laterally for the rubber connection, which need not be disturbed when the cannula is cleared out. By the siphonage method about three feet of rubber tubing leads to a water-containing receptacle. By elevating or lowering the free end of the tube a varying degree of suction is obtained. All connections should be air tight, although the danger from the entrance of a moderate quantity of air has been exaggerated.

A good way to obtain a dependable aspirating force is to partially exhaust the air in a large bottle of a capacity of at least 2,000 c. c. One method of accomplishing this result is by setting fire to a small charge of alcohol in the bottle and quickly inserting the stopper before the flame is out. The rubber tubing connecting with the cannula at one end and the glass tube emerging from the stopper of the bottle at the other end are provided with a clamp for the control of the suction. A more convenient but expensive apparatus is that of Potain, in which a vacuum is made in the bottle by means of a pump. By means of a cock on the tube connecting cannula and bottle the negative pressure can be turned off. A low pressure is desirable.

Precautions in Tapping.—A finger of the left hand is placed firmly in the interspace to be pierced, and the trocar forced through in a vertical direction. An oblique insertion causes pain with every respiratory movement. The point should glide over the lower rib to avoid the intercostal artery, which lies underneath the upper rib. In his zeal to keep away from the artery the novice is likely to wound the highly sensitive periosteum of the under rib needlessly.

Before using the aspirating cannula on the patient test its potency by sucking up sterile water. This is also an assurance that the bottle is properly exhausted. We once, by a wrong attachment of the pump, produced a positive instead of a negative pressure in the bottle. When the

cock was turned air was forced into the pleural cavity, fortunately with no ill result.

Rate of Withdrawal.—The more slowly the exudate is withdrawn the safer is the operation. Slow drainage likewise gives the retracted lungs a better opportunity to expand without exciting congestion. Rapid evacuation of fluid tends to disturb both the pulmonary and systemic circulation. The arterial pressure tends to fall and the brain has an inadequate supply of blood. On these grounds we strongly recommend simple siphonage whenever the method succeeds in maintaining a flow; otherwise the minimum suction required for the purpose is advised.

Amount to Withdraw.—No definite routine can be carried out in determining the amount of fluid to be withdrawn. The question is best settled in each instance by the size of the effusion, by the ease of drainage, and by the condition of the patient during the procedure. Generally speaking, an effusion that escapes spontaneously indicates a good tonus of the lungs and a return of lungs and diaphragm to their normal position. Hence one may remove as much fluid as can be obtained by siphonage. On the other hand, an effusion requiring considerable aspirating force to induce its flow characterizes lung tissue less capable of reëxpansion; consequently less fluid should be removed. 1,500 c. c. is a large quantity for evacuation. Beyond this amount great care is necessary. Certain clinicians have advocated the removal of only a few cubic centimeters, on the theory that absorption will take place, provided the excess pressure is relieved. Stintzing and Gerhardt both claimed some success with this treatment, but the results were not brilliant. [I have made it a habit for many years first to determine the character of the pleural fluid by withdrawing a few cubic centimeters with a hypodermic syringe. Unless there is need of hurry I wait for several days before withdrawing as much as I think is necessary. When this is done brilliant results may not be obtained, but a sufficient number of exudates are absorbed to make it worth while to try this method.—Editor.] Certainly the evacuation of the greater proportion of fluid promotes absorption effectively, besides relieving the displaced organs.

At any stage in drainage the onset of pain, severe cough, or faintness is a signal to stop the flow momentarily and, if the symptoms persist, to remove the trocar.

Untoward Symptoms During Thoracentesis.—The symptoms developing in the course of drawing off a pleural exudate demand the closest attention. They arise, in the main, from an inability of the viscera to adjust themselves to the sudden change of physical conditions. They therefore show a disposition to grow more pronounced or even to be a source of danger as the aspiration progresses unless the exciting cause, viz., the evacuation, is terminated.

Cough.—Cough may be expected to appear after two or three pints

have been removed. It arises from excitation of the vagus nerves in the congested lung, or rarely from the direct irritation by the trocar of the same nerves in the pleura. By partly withdrawing the instrument the latter factor can be eliminated. Should the cough persist the trocar must be withdrawn. Occasionally cough is a troublesome complication before any considerable amount of fluid is obtained. It may be paroxysmal and uncontrollable. To proceed under such circumstances exposes the patient to risk of tearing the lung or of rupture. A preparatory injection of morphin (grain 1/6—0.01 gm.) with atropin (grain 1/100—0.0006 gm.) will render a second attempt more successful. Siphonage will be better tolerated than aspiration.

Faintness.—Faintness emanates from two sources, the one psychic, in which the cerebral circulation is directly disturbed by the excitement of the ordeal; the other reflex, in which the disturbance of the pulmonary circulation reacts on the cerebral. The former is relieved by the administration of aromatic spirits of ammonia (℥ss—2.0 gm.) in whiskey (℥i—30.0 gm.) and need not interfere with the operation. The latter is not arrested by stimulants and demands a halt in the evacuation. In both types the pressure in the radial artery falls. In both the recumbent position soon restores the cerebral circulation.

Weak Pulse.—A weak pulse or a pulse of low pressure is not often encountered by the careful operator. The treatment mentioned for faintness is indicated. The serious forms will be described later.

Dyspnea.—Dyspnea is one of the exceptional incidents during aspiration and, as a rule, the result of paroxysmal coughing.

Pain.—Pain is ordinarily of no consequence when the trocar has once penetrated the parietal pleura. Its onset in the course of drainage may be explained by the pull of adhesions on the parietal or diaphragmatic pleura brought about by the expansion of the lung. Or the lung may come in contact with the cannula and produce painful movements of the instrument in the wound. We once saw an epigastric angina suddenly develop with an abrupt rise in blood pressure (50 mm. Hg) as a consequence of a needle point catching in the pleura. For severe pain of every description the withdrawal of the instrument is the surest remedy.

Dangerous Symptoms and Their Treatment.—Tapping the chest is a safe operation when carried out by an experienced clinician. Delafield reports two hundred cases aspirated in his hospital service without a death. Undoubtedly scores of patients with pleural effusion are sacrificed to ignorance or delay in receiving timely relief, while loss of life from operation is rare. Yet it cannot be said that puncture of the chest is as free from danger as puncture of the abdomen. Fortunately most of these dangers can be avoided by care and watchfulness.

Hemorrhage.—Hemorrhage from injury to the intercostal artery has been described. If the bleeding is profuse a ligature can be applied.

Pulmonary hemorrhage deserves more serious consideration, as it may be excessive and cannot be easily controlled. The liability to this complication is greatly enhanced by piercing a portion of consolidated lung, and especially a tuberculous focus. Unverricht emphasizes the prevalence of small aneurysms in tuberculous cavities, and attributes the bleeding to an acute engorgement of those vessels. Absolute quiet and morphin are the measures best adapted to check the loss of blood.

Infection.—Infection of the exudate with germs from the outside is not to be feared, provided the ordinary aseptic precautions are observed. Why accidental infection is not a more common occurrence has long excited the surprise of writers. True, a certain proportion of cases yield serous fluid at first and pus at a later tapping, but this change in the nature of the exudate may be spontaneous.

Pneumothorax.—Pneumothorax of small extent is frequent, because it is almost impossible to have all the joints of the aspirating instrument so tight that no air is sucked into the chest. Many look upon the entrance of air as a great menace, but in our own experience we have seen no harm result even from considerable quantities. Air driven into the chest under pressure soon gives rise to the same symptoms as are induced by an excessive accumulation of fluid. During the pleural drainage, however, the air drawn in preserves a relationship to the fluid withdrawn. The volume of air entering the chest seldom equals or exceeds the volume of effusion eliminated, so that no subjective symptoms arise. For days after an area of tympanitic quality on percussion can be demonstrated. After two weeks or so the air is absorbed. Pneumothorax resulting from a wound of the pleura has a worse prognosis, because the opening may persist and admit both air and infectious material from the bronchial tubes.

Subcutaneous Emphysema.—Subcutaneous emphysema is evidence that the trocar has pierced the lung and along the wound air has found its way to the subcutaneous tissues. The skin is elevated, and on pressure emits a crackling sound like the crushing of dry leaves. The air infiltration may be localized about the site of puncture or extend over a large portion of the body.

Edema of the Lungs.—This is at the same time the most formidable and insidious of the complications attending thoracentesis. The onset usually comes at the end of the drainage or within a few hours after. The attack may begin with cough with abundant sputum. The secretion is frothy, contains serum and blood, and may be expelled in enormous amount. The French have described the condition by the name of "expectoration albumineuse."

The explanation of this phenomenon is ascribed to a great wave of hyperemia in a lung that has been long retracted and bound down by adhesions and unable to suddenly expand upon the release of the pressure of the exudate. The vessels in the compressed lung have lost their tone,

and in this condition of paralysis the blood exudes into the tissues. Some authors favor the theory of Cohnheim that the vessels become morbidly permeable because of the impaired nutrition of the cells.

The factors that seem to bring on pulmonary edema are rapid evacuation, the removal of very large quantities, and the use of strong aspiration. Rarely an attack comes on when a small effusion has been drained by siphonage.

The complication is sometimes fatal. Preventive measures are obvious, namely, to evacuate fluid slowly, to limit the amount, and to use little aspirating force. Uncontrollable coughing is sometimes a forerunner of edema. For relief of the immediate symptoms morphin and atropin have given the most satisfaction. Adrenalin has been recommended, but as it actually causes pulmonary edema when given to rabbits it should be condemned.

Collapse and Sudden Death from Thoracentesis and Irrigation of Pleural Cavity.—In addition to the accidents already discussed there are cases of collapse and sudden death occurring either at the time of puncture, during aspiration or some hours after, or in connection with irrigation of the pleural cavity. Although the fatalities are few in comparison with the great number of successful operations, yet the condition deserves the fullest consideration in order to determine the causative factors and the means of combating them.

Leichtenstern (54) in a critical review of the literature divides the cases into three groups:

1. Those in which death occurs during aspiration, coming on suddenly and without warning. He cites four cases of this character.

2. Those in which death follows aspiration, in a few minutes to several days. He finds fourteen examples of this group.

3. Those in which a fatal issue attends irrigation of the pleural cavity. Five such cases he reports, some characterized by general or partial convulsions.

Auberne (3) and Weill (96) describe convulsive seizures accompanying irrigation of the pleural sac, sometimes followed by syncope and death, sometimes by recovery. The convulsive movements are said to be more pronounced on the side of pleurisy.

Wilson Fox (37) analyzed the manner of death in twelve cases where, excluding instances of hemorrhage and edema, the patient succumbed within forty-eight hours of withdrawal of fluid. Seven died of syncope, two of asphyxia, three of convulsions. No organic lesions could be found in any case to account for the attack.

Russell (80) contributes the most instructive discussion of the subject at our command, and furnishes an unusually rich experience. He reports three fatalities from exploratory puncture, all of them subjects of pneumonia. The syncope originates, in his opinion, in a direct injury to the

vagus nerve fibers in the lung tissue, from which reflex impulses are carried to the heart. The same reflex mechanism is set in motion by an acute congestion of the lung in aspiration. He is not so convincing in his explanation of death from irrigation, for he considers the pleura is not concerned in the reflex, a conclusion entirely opposed to our own. In his animal experiments he found it impossible to excite such reflexes from the pleura.

Sears has recently published a fatality occurring fifteen hours after exploratory puncture. He also gives a full bibliography.

The subject has been studied by Lewis and the author (20), experimentally and clinically. In healthy animals we found very little circulatory disturbance from tapping the chest or from injecting and aspirating moderate quantities of oil. Nor was any untoward effect produced by irritation of the pulmonary pleura. Where, however, a pleurisy with effusion was produced by a previous injection in the pleural cavity of oil and turpentine the results were different.

In the first place, the forceful thrust of the trocar against the chest in its introduction often caused a transitory fall in arterial pressure which was attributed to direct mechanical displacement of the heart. In a dog the chest is narrow, so that this effect is exaggerated. But even with the broader thorax in man, with the heart already dislocated and embarrassed by effusion, a forceful puncture has a distinct inhibitory influence on the heart action, lasting usually a few seconds. This influence is greatest in the yielding chest of children.

Irritation of the inflamed visceral pleura by the trocar point or by chemicals in the process of irrigation in some cases caused a fall in arterial pressure that occasionally was fatal.

Clinically we observed a fatal syncope at the beginning of aspiration when only a few ounces had been withdrawn. In a number of cases of pleurisy during evacuation we have found that scratching the pleura with a needle point or cannula is followed by a fall in arterial pressure which if protracted leads to faintness.

Similar evidences of circulatory disturbance were noted in some instances in which aspiration was rapid or the amount of fluid withdrawn excessive. The salient features of these attacks of syncope are:

1. In fatal cases no anatomical lesion can be found to explain the accident.
2. The symptoms may develop suddenly (a) at the moment of puncture as a result of direct cardiac inhibition. (b) At any time during aspiration, but especially toward the end. The risk is increased by using strong suction and by withdrawing too much fluid. The chief factor is the irritation of the pleural nerves by the trocar or the pulmonary nerves by the congestion of the lungs. (c) immediately after or within the forty-eight hours following aspiration due to the congestion of the lungs, (d) during irrigation of the pleural cavity with antiseptic solutions, e. g., formalin, iodin, etc. The chemicals irritate the pleural nerves and excite reflex circulatory disturbances.

The treatment most to be emphasized is preventive. The instrument selected for thoracentesis should be sharp, so that no undue force is demanded to penetrate the chest wall. At the same time, it should not irritate the visceral pleura after introduction any more than is absolutely necessary. The trocar meets these requirements better than the needle. The *trocar* should not be inserted to a greater depth than is needed

to obtain fluid. Great care should be taken during the drainage of an empyema especially to *avoid a long projection of the drainage tube* inside the cavity. Swabbing the pleural surface is attended with danger. Finally, *siphonage* or slow aspiration is desirable. The emergency treatment of collapse is, first, to place the *head low,* as in shock, and to *elevate the foot* of the bed. *Artificial respiration* must be instituted if the respirations have ceased.

Few drugs are of any value. *Atropin* is useful when the heart is slow and irregular, but of no aid when the pulse is weak and rapid. *Adrenalin,* 20 minims (1.3 gm.) of a 1 to 1,000 solution, diluted in several cubic centimeters of salt solution and injected in a vein, is the most efficient remedy. If the pulse is gone it is better to inject the drug directly into the right ventricle of the heart.

Intrapleural Injections to Aid Absorption.—In 1895 Hamburger (45) completed his investigations which proved that fluid exudates in serous cavities must become isotonic with the blood serum before absorption can take place. Stimulated by this idea Lewaschew (55) and others practiced repeated tapping of old exudates, and followed this by injections of physiological *salt solution.* By equalizing the molecular density of the fluid with that of the blood they hoped to favor absorption. Unfortunately little success attended their efforts.

Achard (1) was one of the first to introduce *sterile air* in the thorax to stimulate absorption. More recently he has used ordinary air for the purpose of replacing the fluid and securing more complete evacuation of the exudate. By forcing in air as the fluid escapes he claims that even three or four liters can be removed with safety.

Oxygen gas is praised by A. Schmidt (83) as the superior of air or of N in promoting absorption, because the gas itself quickly disappears from the chest.

Thiosinamin has been advocated by Schnütgen (84) and others for the purpose of bringing about a digestive solution of fibrinous exudate and of preventing its absorption. One part of thiosinamin is diluted with five parts each of glycerin and water. Two minims of this preparation are injected into the muscles twice a week, and the dosage gradually increased to 1 c. c. It is stated that fibrinous adhesions are thus prevented, but it is apparent that reliable conclusions cannot be drawn from a small number of cases. On theoretical grounds a digestive substance capable of dissolving the fibrin obstructing the lymph spaces would be a great aid to absorption.

Adrenalin chlorid has the theoretical merit of constricting the blood vessels and diminishing the secretion of the pleural cells. Plant and Steele (72) first evacuate the serous collection as completely as possible and then inject through the cannula 1 drachm (4 c. c.) of adrenalin chlorid (1:1,000) diluted to 1 ounce of sterile water.

Ewart (30) advocates the injection of 10 minims (0.6 c. c.) of the above solution as a preliminary to thoracentesis. The result is often "a spontaneous reabsorption without any need for operation." Our own experience with adrenalin injections has not been so encouraging.

Autoserotherapy

Gilbert in 1894 first suggested the aspiration of a few cubic centimeters of serous fluid and its reinjection under the skin. He noticed that subsequently absorption was materially accelerated, although he did not venture any explanation of the phenomenon. Fede (31) commended the treatment, but had no theory of its working, except a belief in some stimulating effect from repeated mechanical irritation of the pleura with the trocar. Tschigaeff tried this method in nine cases, and found that always after the injection the effusion ceased to increase and absorption began. The duration of a serous pleurisy on an average was shortened to two weeks. The earlier the injection the prompter was the recovery.

Schnütgen (85) was also favorably impressed by his experience with the method.

Zimmerman (102) considers the results of autoserotherapy are to be attributed to a reactive leukocytosis that exerts an absorptive influence on the exudate.

Königer (51) has faith in the future of serotherapy for pleuritic effusion, but has found repeated injections by this method tend to light up an underlying tuberculous process.

CHRONIC SEROUS EFFUSION

There is a group of cases in which the exudate reaccumulates persistently in spite of all therapeutic measures, including repeated thoracentesis. Effusions accompanying endothelial tumors of the pleura exhibit such a tendency, and call for purely symptomatic measures. Other cases of unknown origin have been treated by thoracotomy with the hope of bringing the inflammatory reaction to an end. But, in the words of Forchheimer (35), "it is simply a matter of chance whether or not incision and drainage will correct the condition which produces the chronic pleurisy."

After-treatment.—In a certain proportion of cases repetition of the aspiration may be necessary once or many times. A reaccumulation of the effusion in a quantity to reach the level of the third rib is sufficient indication for another evacuation. A period of a week or more usually intervenes between the first and second tapping.

When the fluid has been entirely absorbed, or nearly so, and the fever

has subsided, the patient should be encouraged to take *moderate exercise* and practice *deep breathing*. *Walking* slowly out of doors with shoulders thrown back and taking full inspirations admirably fulfil these requirements. Later on the reëxpansion of the lung can be further assisted by the use of special apparatus. A simple device consists of two large Wolff bottles connected by tubing, the one empty, the other containing water. From the latter a second tubing emerges, fitted with a mouthpiece. The patient blows the water from one bottle into the other, and this exercise he repeats a prescribed number of times every day.

Diet.—The diet should be nutritious and liberal. To recover a pronounced loss of weight, milk, buttermilk, and eggs should be given between meals.

Hydrotherapy.—Hydrotherapy is an important aid in convalescence. A daily bath in cool water stimulates the circulation and improves the appetite.

Outdoor Life.—An out-of-door life should be enjoined for at least three months to a year, depending on the severity of the attack. One must keep ever in mind the danger of an extension of tuberculous pleurisy or of an invasion of tubercle bacilli upon the site of a recently healed pleurisy of some other origin. An extended sojourn by the sea, in the mountains, or in the country is highly important and should be insisted upon whenever possible.

EMPYEMA

Pyothorax and empyema are synonymous terms defining a collection of pus in the pleural cavity. Pus may form from a serous effusion either spontaneously or as the result of infection introduced by the trocar. More often empyema is secondary to pneumonia, lung abscess, or broken down tuberculous glands. Subphrenic abscess not infrequently penetrates the diaphragm and causes pyothorax. Perforation of the lung, external wounds, and actinomycosis are occasionally responsible for the condition. Rarely empyema develops in the course of a general blood infection.

The causative bacteria are similar to those responsible for serous effusions. The pneumococcus is the chief offender, since it is usually found in the metapneumonic types. The pus is thick and of a peculiar greenish-yellow color.

The pus of streptococcus or tuberculous origin is thinner; that of actinomycosis is thick and filled with the characteristic granules. A foul-smelling pus should lead one to suspect an infection of colon bacillus or proteus vulgaris.

Prognosis.—A pleural abscess has been known to be absorbed. Spontaneous cures, however, have generally been the result of perforation and drainage, either through the chest wall or through the lung and bronchial

tubes. Exceptionally, the pus burrows down along the spine and emerges at the groin.

Pure infections of pneumococcus and streptococcus are the most favorable for recovery. Tuberculous and mixed infections are less amenable to treatment.

Treatment

Thoracentesis and aspiration have proven entirely inadequate for the treatment of empyema. A few clinicians still adhere to this procedure, because some cases, especially in childhood, recover after one or two evacuations with the trocar. There is no reasonable objection to the use of the trocar for diagnostic purposes in suspected empyema, and if pus is obtained it is often advisable to withdraw a portion of the exudate for temporary relief of symptoms. But the discovery of pus in the pleural cavity demands the same radical measures as an abscess in any other cavity of the body, namely, free opening and continuous drainage.

An attempt to carry off the pus by frequently repeated aspiration nearly always results in failure, and the surgeon is called in to operate at a time when the patient's vitality is reduced and the chance for recovery greatly impaired. Bülau devised a method by which permanent aspiration could be used after ordinary puncture. Upon the entrance of the trocar a small catheter is inserted through the cannula and allowed to remain while the cannula is withdrawn. The catheter is held in place by a collodion dressing and connected with a long tube leading to a vessel containing an antiseptic solution. Thus a continuous siphonage of pus is secured, which is gradual enough to favor a slow reëxpansion of the lung. This procedure is recommended by Rosenbach (79) and Bohland (10) whenever it seems inadvisable to subject the patient to a cutting operation or when the shock of sudden evacuation is feared. The disadvantages of the method are the likelihood of the catheter coming out as the patient moves or coughs, and the tendency of the small lumen to be obstructed by flakes of fibrin.

Thoracotomy.—Thoracotomy, or incision of the chest wall, is in a general way more satisfactory, and either alone or combined with rib resection is the practice followed by most surgeons in this country. By preference the opening is made in the fifth or sixth interspace from the anterior axillary line backward two inches or more. The incision should be large enough to admit two fingers, thereby facilitating the breaking down of fibrinous masses which might interfere with the outflow of the pus. Permanent drainage is secured by the insertion of two large rubber drainage tubes that are kept from slipping inward by the use of a safety pin and are held firmly in place by a snug dressing. No effort is made to aspirate the pus, but it is allowed to escape slowly into thick layers of

gauze loosely applied to the chest and supported by a chest binder. Aspiration of the exudate is open to the objection that it favors the rapid development of pneumothorax and disturbs the pulmonary circulation and the respiration. The gradual entrance of air into the pleural space, however, is not an undesirable event. In fact, the sucking in of air with inspiration has the effect of maintaining a moderate positive pressure within the cavity and thereby helps to force out the fluid with each act of expiration. The respirations act in the manner of a pump which draws in a volume of air and displaces a corresponding quantity of fluid.

At first the dressings are quickly saturated with the copious discharge and need frequent renewals. In a short time the outflow becomes much smaller, and it is necessary to shorten the tubes so as to avoid contact with the advancing lung and diaphragm. As the discharge dries up and the wound fills in, the drainage tubes are replaced by tubes of smaller size until they can be dispensed with altogether. During this period a rise in temperature, chills, sweating, and increasing leukocytosis are sure signs of obstruction in the free exit of the pus, and require that the flow be reëstablished.

Some surgeons advise an opening as low down in the thorax as possible (the eighth or ninth interspace, midaxillary line), in order to obtain perfect drainage. Experience does not sanction such a site, for with a low incision the tubes soon are bent or obstructed by the rising diaphragm.

Resection of the Ribs.—This serves a double purpose of maintaining an opening adequate for thorough drainage and of procuring a contraction in the chest wall in long-standing cases where the lung cannot expand.

In children and some adults the spaces are so narrow that drainage tubes are with difficulty held in place, and smaller tubes than are desirable must be used. The excision of a portion of one rib is a simple operation and satisfactorily solves the problem of drainage, provided the lung retains its power of expansion.

When the lung, as a result of firm adhesions or of cirrhotic changes following long compression, is incapable of filling out again with air, simple drainage cannot effect a cure. As long as an open pleural space remains, suppuration will continue. For this situation resection of several ribs is indicated. *Estlander's operation* of removal of a few ribs, leaving the periosteum and intercostal muscles, is performed for the obliteration of a space of moderate size. The soft parts come in immediate contact with the lung, and the abscess cavity is filled in. Schede's operation is reserved for the most extensive and desperate cases. All the ribs are removed, as well as the intercostal muscles, so that only a flap of skin and superficial muscles remain to form a covering for the collapsed lung. These more formidable procedures are becoming less necessary as improvement takes place in the early diagnosis and treatment of empyema.

By many surgeons resection of one or more ribs is a routine practice in the treatment of empyema. But it should be emphasized that others customarily perform a *simple incision* only and claim equally good results. Where an open space exists and the lung cannot expand there is no difference of opinion—resection of the ribs is universally decided upon.

Irrigation.—Irrigation of the pleural cavity is rarely necessary. Statistics show that healing goes on more rapidly when irrigation is not employed.

Various antiseptic solutions have been enthusiastically commended, only to be later abandoned. From the use of carbolic acid and bichlorid of mercury several instances of poisoning are recorded. Salicylic acid, boric acid, normal salt, permanganate of potash, iodin, and formalin solutions have been successively popular.

The purpose of irrigation is to wash out shreds of fibrin or narcotic masses and to disinfect the pleural cavity. But the desirability of removing the flakes of fibrin is open to question. Rosenbach (79) contends that the introduction of fluid separates the pleural surfaces and destroys the meshes of granulation or repair tissue. From this point of view the procedure actually retards healing. With regard to the idea of disinfecting the cavity with strong antiseptics, some authors have been altogether too sanguine. The bacteria are not only in the fluid, but are so embedded in the fibrinous exudate as to be beyond the reach of antiseptics. Disinfection of the pleural cavity can no more be accomplished by irrigation than can that of a diphtheritic throat by antiseptic sprays.

Accidents Occurring During Irrigation.—Besides the doubtful expediency of irrigation in empyema, the practice has been further discouraged by the occasional development of alarming or even fatal symptoms. Fainting attacks may come on as they do in thoracentesis. A complication that seems quite peculiar to irrigation is the onset of *convulsive seizures* which sometimes end in death (Auberne, 3). In another group of cases *hemiplegia* occurs, which nearly always clears up in a few hours. Janeway (50) observed such a transitory paralysis on two different occasions while injecting peroxid of hydrogen. In the case of Bouveret (11) iodin was the solution used. Forgues (36) recorded a similar accident while adjusting the drainage tube that had come in contact with the lung. Death has taken place during the procedure. Billings (8) relates an experience with a child two years of age, from whose chest only three ounces of pus were withdrawn. Immediately after the injection of a 2 per cent. solution of formalin in glycerin marked dyspnea, rapid pulse, and cyanosis appeared and life was extinct within an hour in spite of treatment.

The conclusions of Lewis and the author (20) as to the cause of these attacks have been partly set forth. We found that absorption of chemical

poisons contained in the irrigating solutions ordinarily employed cannot explain the phenomenon, for it occurs also with nontoxic solutions. Neither is the change in pressure conditions within the thorax responsible, because often the amount injected is trivial. The cause is found in an irritation of the pleura by the antiseptic solution, which reflexly disturbs the whole arterial circulation and often the cardiac and respiratory centers. Iodin solution (Lugol's) was the least harmful. Hydrogen peroxid was more irritating, while formalin was frequently a menace to life. In human beings with an old thick exudate from chronic empyema the pleura is usually covered over, so that these circulatory disturbances are fortunately rare. When, however, even a small surface of the pleura is exposed by displacement of fibrin there is an element of danger in the use of antiseptic solutions.

Considering that the benefit is doubtful and the harm positive, both in its effect on the local process of healing and in subjecting the patient to occasional peril, we feel that *irrigation of the pleural cavity with antiseptics is undesirable.*

Treatment of Special Forms of Empyema

Empyema Necessitatis.—This is a condition in which a neglected pleural abscess becomes localized and bulges out the skin over an interspace. The incision should, of course, be made over this point.

Bilateral Empyema.—Bilateral empyema demands special consideration, because thoracotomy cannot usually be performed with safety. The production of a one-sided pneumothorax, which is well tolerated with a normal lung on the opposite side, becomes most precarious when this lung is also handicapped by an empyema. Aspiration of one side at a time is advisable. If one lung expands sufficiently under this treatment thoracotomy may be undertaken with great caution on one side, while the trocar is used for the other. The prognosis in these cases is grave.

Empyema in Children.—This runs a more favorable course than in adults, excepting in early infancy. During the first two years of life the mortality is very high.

According to Blaker (9) over 85 per cent. of all cases in childhood are secondary to pneumonia and usually are due to pneumococcus, which is the most benign infection.

In the treatment one should remember that children do not bear the shock of operation as well as adults. Since the chest is smaller and the normal rate of respiration more rapid than in adults, pneumothorax causes a greater embarrassment to respiration. For this reason, if the exudate is large, the preliminary withdrawal of part of the pus by the trocar will modify the shock of subsequent incision. The trocar should be sharp in order to avoid too forcible a thrust against the chest. At the

time of incision the wound should be partially closed by the fingers, so that the outflow will not be rapid. Where drainage is impeded by the narrowness of the interspace, excision of a rib should be readily resorted to, since the bone will completely regenerate.

Empyema Associated with Pulmonary Tuberculosis.—A great divergence of opinion exists in respect to the management of this condition. The conservatives point to the numerous cases in which operation for empyema has lighted up the lesions in the lung and even induced a miliary tuberculosis. They also cite instances of spontaneous improvement or even healing in the presence of exudate, both serous and purulent. They further claim that tuberculous empyema is in reality a "cold abscess," free from bacteria, from which toxins are not absorbed.

Other more radical clinicians believe that prompt drainage of tuberculous empyema will often save the patient's life, and that a large collection of pus is seldom absorbed, as often occurs in a serous effusion.

Bergeat (7) opens the chest whenever the opposite lung is in good condition and the strength of the patient permits (Braun, 14). Brewer (15) prefers aspiration, because with incision the danger of mixed infection is to be feared. The invasion of other bacteria results in septicemia.

Empyema developing with advanced or terminal tuberculosis certainly need not be disturbed out of consideration for the patient's comfort.

Empyema Associated with Actinomycosis.—According to Lord, the process usually begins in the lung and affects the pleura secondarily, causing a serofibrinous or more often a purulent exudate. Perforation of the chest wall is a common incident. The diagnosis is made by finding in the pus small granules which show the characteristic threads and club-shaped bodies. In addition to the evacuation of the pus, massive doses of potassium iodid should be given. Five hundred grains a day may be prescribed for two or three days, and repeated at intervals of ten days.

Encapsulated Empyema.—The difficulty of accurately diagnosticating a small pocket of pus stands in the way of a satisfactory therapy. The pus collection may be walled off between the lung and chest wall or between the lobes or between the lower lobe and the diaphragm. Perforation of the pus into the lung and bronchi is a fortunate occurrence, but perforation through the diaphragm leads to peritonitis. If the exploratory needle can locate the pocket, thoracotomy and drainage are indicated.

CHYLOTHORAX

By the term chylothorax we understand the presence within the pleural cavity of any fluid which has a milky appearance either from the presence of a true chyle or from chyliform exudate. The presence of

true chyle depends on some destruction or injury to the thoracic duct, whereby its contents are emptied into the pleural cavity. Traumatism, tumors pressing from without, new growths in the duct, destruction of the left subclavian vein, and parasites are the etiological factors in their order of frequency. The *chyliform* exudate contains not chyle, but fatty globules derived from degeneration of the pleural epithelium and pus cells. Carcinoma and tuberculosis are usually associated with this form.

Treatment.—The treatment of chylothorax is dependent on the cause of the complication and on the symptoms produced. A traumatic injury to the duct sometimes heals spontaneously. In cancerous cases palliative measures only are possible. Chylothorax of tuberculous origin may be evacuated with some hope of recovery. Operative measures are rarely successful.

HEMOTHORAX

Pleural transudates of cardiac or renal origin always contain red corpuscles, but seldom enough to impart a deep tinge to the fluids.

Hemorrhagic Pleurisy.—Hemorrhagic pleurisy is characterized by a larger amount of blood mixed with the serum. Most of these exudates originate in a cancerous or tuberculous inflammation of the pleura, occasionally in a pleurisy due to pneumococcus infection.

Remedial measures for a hemorrhagic pleurisy are essentially the same as for a serous, except that one should be more conservative in the amount of exudate withdrawn in the former type.

Hemorrhage may result from rupture of aneurysm or the erosion of any intrathoracic arteries or veins. Rarely bleeding from a tuberculous cavity enters the pleural space.

Traumatic Form.—The traumatic form of hemothorax is encountered in fracture of the ribs, contusions of the chest wall, or injury to the internal vessels by penetrating gunshot wounds. The treatment is surgical. Parietal bleeding may be stopped by ligature. Hemorrhage from the pulmonary vessels may gradually cease under absolute rest and the influence of opiates. Unfortunately, little can be done if the larger vessels are involved. Laying open the chest to find the bleeding point induces complete pneumothorax and endangers life. There is hope that with the negative pressure apparatus of Sauerbruch or the positive pressure device of Brauer pneumothorax can be avoided and the operation be made successful. By keeping the lung inflated the bleeding vessel can be more easily located. Moreover, the hemorrhage itself is favorably influenced, for it has been found by Sauerbruch that less blood flows through an inflated than a collapsed lung.

PNEUMOTHORAX

The harmlessness of a small or moderate quantity of air in the chest is shown by the fact that air has been many times injected into the cavity for therapeutic purposes without embarrassing respiration or circulation.

Accidental Pneumothorax During Thoracentesis

We have seen many instances of circumscribed or partial pneumothorax following thoracentesis, and it is exceptional that any symptoms arise therefrom. The air may enter through a leaky valve or through the cannula while clearing out an obstruction with a stylet. Such an accident need cause no apprehension, and calls for no treatment. When, however, by making the wrong connection with the Potain pump, air is forced into the chest, alarming symptoms may develop. The patient gasps for breath, respirations are shallow, the pulse grows feeble, and consciousness may be lost. Under such circumstances immediate release of the air through the disconnected trocar or by aspiration is required to save the patient's life. In the presence of fluid, air has been purposely allowed to enter the chest during inspiration in order to aid the spontaneous outflow of serum. So long as the column of air introduced does not exceed the volume of fluid evacuated, no harm results.

Pneumothorax Acutissimus

The "suffocative" pneumothorax, or pneumothorax acutissimus, is the most alarming form of this disease, and calls for prompt action on the part of the physician. It is caused by a "valvular" opening in the lung that permits the entrance of air with inspiration, but prevents its escape with expiration. Consequently air collects in the cavity until it will hold no more, and the patient's struggle for breath steadily increases.

At the onset *morphin* may be employed to arrest the pain and dyspnea. *Cardiovascular stimulants,* such as camphor and caffein, are helpful in combating signs of failure on the part of the circulation.

As soon as the diagnosis of pneumothorax can be verified by physical examination *thoracentesis* is indicated. It is better to allow air to escape through the cannula than to use suction; for aspiration of the gas tends to reopen the lung fistula. Puncture may have to be repeated. *Continuous drainage,* either by leaving the cannula in place or by insertion of a rubber tube in a pleurotomy wound, has been recommended and successfully practiced. Béclère (6) advised attaching to the trocar a rubber

tube twenty inches long, the distal end of which is immersed in a test tube of water. This prevents the inspiration of air. By this procedure the intrapleural pressure does not exceed that of the atmospheric air, and healing of the lung perforation is favored.

Traumatic Pneumothorax

The treatment in most cases of traumatic pneumothorax is symptomatic. A moderate amount of air is absorbed by the pleura and may cause little inconvenience. The chief danger lies in the *infection* of the serous membranes. Traumatic rupture of the lung is less likely to be followed by a pleuritis than perforation of the chest wall. If the wound seems clean, it should be disinfected and sealed, thus converting an open into a closed pneumothorax. Whenever it is evident that the pleura is infected a drainage tube should be inserted.

Spontaneous Pneumothorax

The amount of gas produced by organisms in the pleural cavity seldom is sufficient to excite symptoms. The treatment of the associated empyema is the important consideration.

Tuberculous Pneumothorax

The entrance of air into the pleural cavity is not always a misfortune to the subject of pulmonary tuberculosis. Oftentimes the resulting compression of the lung leads to healing (Spengler, 89). It is unwise, therefore, to withdraw the air by puncture unless urgent dyspnea and cyanosis develop, or unless there also exists an excessive serous or purulent exudate.

Pneumothorax with Serous Effusion

It has been emphasized that the air introduced into the pleural cavity generally carries with it organisms that excite a pleuritis with a fluid exudate. Hence, we are confronted with the necessity of treating two distinct diseases. Emerson (28) believes that in general the air may be disregarded and the effusion treated. Thoracentesis is not to be practiced as a routine measure. The size of the accumulation, the degree of dyspnea, and the rate of absorption must be the deciding factors. Whenever puncture is performed, siphonage is preferable to aspiration.

Pneumothorax with Empyema

Perforation of an empyema into the bronchi rarely leads to pneumothorax. Likewise, external spontaneous perforation (*empyema necessitatis*) creates such a small fistulous opening in the chest wall that air seldom enters the pleural cavity, as the pus escapes slowly and gives the lungs time to expand. On the other hand, the surgical operation of pleurotomy drains off the pus so rapidly that the lung expansion cannot keep pace, and air is sucked in freely. In fact, a certain degree of pneumothorax is desirable, since it promotes the evacuation of the cavity.

Treatment.—The treatment considers less the pneumothorax than the empyema. The air may often be ignored but the pus must be drained by a free incision. In all cases, of whatever nature, prompt surgical measures will give the patient his only chance of recovery.

Putrefactive Exudates.—Putrefactive exudates are of even greater menace than purulent, and call for the same radical treatment. Simple *puncture*, except for diagnostic purposes, has little to recommend it, and gives only temporary relief.

Supportive Measures.—Supportive measures are needed whether the treatment is expectant or operative.

A liberal, nutritious *diet* tends to build up the individual's strength and resistance. *Whiskey* and wine, alone or in an eggnog, are serviceable. One of the best stimulants for the circulation is *coffee*.

As previously stated, *morphin* should be freely employed in pneumothorax because of its sedative influence on the respirations and its relief of pain. It should be given hypodermatically.

TUMORS OF THE PLEURA

A variety of tumor growths are encountered in the pleural membranes, including carcinoma, sarcoma, lipoma, enchondroma, fibroma, as well as the echinococcus cysts. Most of these neoplasms are *secondary* to growths in neighboring organs, more especially in the mammary gland, the stomach, the liver, and the mediastinal lymph glands. Fränkel (38) has described the endothelial carcinoma of the pleura, which he looks upon as primary.

Treatment.—Palliative measures only can be carried out. Withdrawal of the exudate by puncture is indicated if dyspnea is present. The operation should be repeated as often as expedient. In the presence of a rich hemorrhagic effusion greater caution is necessary. The patient is entitled to the benefit of opiates if pain is pronounced.

Echinococcus Cysts.—Echinococcus cysts have been successfully drained with the trocar, but, as Lord (57) points out, the procedure has been attended with too high a mortality to be recommended. The cyst

should be removed without rupture, and to accomplish this costatectomy is the operation of choice.

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CHAPTER VI

DISEASES OF THE MEDIASTINUM

GEORGE BLUMER

MEDIASTINAL TUMORS

The treatment of mediastinal tumors is by choice curative, but, unfortunately, in many instances there is no hope of effecting a cure, and only palliative treatment is available. This is partly due to the fact that the symptoms of mediastinal tumor are due to the pressure of the neoplasm upon the important structures which lie in the mediastinum, so that, by the time these symptoms appear, the growth has already reached a considerable size in most instances. Another factor of importance is the very close relationship of malignant tumors to the important structures within the chest, which renders complete removal of the growth impossible. A third difficulty—the inaccessibility of such growths to surgical interference—has been very largely removed by the introduction of operations under positive or negative air pressure.

Curative Treatment.—The curative treatment of mediastinal tumors depends partly upon the nature and partly upon the situation of the growth. In the case of non-malignant tumors—such as adenomata of misplaced thyroid tissue, enlargement of the thymus gland, lipomata, or fibromata—surgical intervention is always indicated when pressure symptoms have appeared, and should not be delayed until the general condition of the patient is so poor that the resistance to the effects of hemorrhage, or of infection, is diminished. When, as occasionally happens, such tumors present in the neck, above the sternum or the clavicles, their removal is a comparatively simple matter, as it does not necessitate the resection of ribs or of portions of the sternum. Furthermore, such tumors are usually encapsulated, and the danger of opening the pleural cavity or injuring the great vessels is comparatively slight. In the case of the thymus the gland is usually easily removed on splitting the capsule. Under such circumstances ordinary surgical principles, such as hold in the removal of any non-malignant neoplasm, should be followed.

When mediastinal tumors—even non-malignant ones—are situated so

that they cannot be reached from the neck, the problem of their removal becomes a much more complicated one. Nevertheless, surgical interference offers the only hope for recovery even in non-malignant growths, for, unless they are removed, death will result from mechanical pressure on the vital structures within the chest. In malignant growths surgical intervention is practically valueless so far as complete removal is concerned, for the great vessels and nerves, the esophagus, the bronchi, or even the heart itself are so intimately involved in the neoplasm, in most instances, that complete removal is an impossibility. Growths originating from the posterior surface of the sternum or the ribs, and growing into the mediastinum, have occasionally been successfully extirpated, but such growths can hardly be regarded as mediastinal neoplasms in the strict sense.

The non-malignant mediastinal growths which have been most successfully removed by the knife are the dermoid cysts or teratomata, and this is because it has been possible to diagnose them in a fair percentage of cases. In practically all instances their removal has necessitated the resection of a certain number of ribs, and sometimes also of a portion of the sternum. It is not possible to lay down specific instructions as to the exact method of approaching these growths, because they vary very considerably both in size and in position. It is true that most of them are situated in the superior portion of the mediastinum. In a general way it may be stated that any operation for the removal of a mediastinal dermoid should be conducted within reach of either positive or negative pressure, obtained either by means of the Sauerbruch cabinet or by some of the simpler methods—such as that devised by Flint. The use of the methods of lung surgery in these cases may be necessary, because it is often impossible to avoid the production of a pneumothorax during the course of the operation, and this has, in some instances, resulted in a fatal outcome. The second point to be borne in mind is that resection of a sufficient number of ribs and, if necessary, of a sufficient quantity of sternal tissue, to give free access to the tumor, must be accomplished. Most surgeons who have operated on such tumors have laid stress upon the fact that there is usually a considerable formation of adhesions, although von Eiselsberg claims that their importance has been exaggerated. The fact remains that, of fifteen cases of operation collected by von Eiselsberg in 1903, the removal of the tumor was complete in only three, and in two of these three instances it was very small. While complete removal is certainly desirable, and is strongly urged by surgeons, it is obviously not always practicable. When impracticable, as much as possible should be removed, and the interior of the remaining portion of the cyst should be treated so as to encourage the formation of granulation tissue, which will subsequently cicatrize and lead to the obliteration of the sac. For this purpose some surgeons recommend curettage of the lining mem-

brane, while others recommend that it be painted with caustic solutions. Whatever method of treatment is adopted, there is always danger when portions of the cyst wall are left behind that secondary hemorrhage may occur, or that local infection will extend to the other structures of the mediastinum, or will cause general sepsis. In order to avoid a pneumothorax, many surgeons recommend that, when a portion of the cyst is left, this should be sufficient to allow the edges to be drawn into the external wound and sutured to the skin. This procedure not only tends to prevent pneumothorax, but also makes more difficult an extension of infection, and is of great advantage in the treatment of secondary hemorrhage, should this occur.

The success of operative treatment in cases of dermoid cyst of the mediastinum has been very encouraging. Of twenty operative cases collected by R. S. Morris in 1905, fourteen (or 70 per cent.) survived and were cured, or else greatly benefited, by the operation. There is no reason why other non-malignant tumors of the mediastinum should not be as successfully removed. As a matter of fact, the difficulty lies not so much in the removal as in the diagnosis. Non-malignant tumors—other than dermoids—are usually accidental, post-mortem finds.

There have been occasional cases of mediastinal dermoid which have yielded to measures less radical than extirpation, and this has been especially true of cases where the cystic character of the growth has been the predominant one. Kidd has reported such a case where the tumor presented in the epigastrium and where complete recovery followed simple incision and drainage. Such cases are exceedingly rare, but this method should be considered where the situation of the neoplasm allows it to be carried out.

Palliative Treatment.—The palliative treatment of mediastinal tumors may have for its object an effect upon the tumor itself, the relief of the intrathoracic pressure by surgical means, or the relief of symptoms.

There is a type of malignant mediastinal neoplasm usually described in the literature as lymphosarcoma which seems amenable to amelioration as a result of the action of a variety of agencies. These may be either physical, chemical, or infectious, and the action of all of them is presumably dependent upon the fact that the cells of certain varieties of sarcoma are extremely susceptible to their destructive power.

In some instances a temporary diminution in the size of mediastinal growths of this type has been observed to follow an infection, such as erysipelas, and there is little doubt that the cases of malignant neoplasm which have been favorably influenced by Coley's mixed toxins of the streptococcus and prodigiosus have been so affected by a destructive effect of the toxins on the tumor cells.

In a certain number of cases arsenic is stated by Ruff to be a medica-

ment acting in this way, and operative procedures, such as exploratory incisions with mere exposure of the tumor, have sometimes had a similar result.

The remedy, however, which may frequently be relied upon in certain types of mediastinal growth to produce a very definite and decided effect is the X-ray. There are now in the literature a considerable number of cases of malignant mediastinal growth in which temporary amelioration has followed exposure to the X-ray. The method of employing this agent is not always accurately stated by the reporters, but apparently results have been obtained both with long exposures at comparatively infrequent intervals and with short exposures at frequent intervals. On account of the danger of X-ray burns, the latter method would seem to be the preferable one. Pfahler recommends a high vacuum tube with one ampère of current and a focal distance of 15 to 18 inches. He exposes the patient from 20 to 30 minutes six days in the week, and in some of his reported cases has kept this up for 5 months. Kienboeck exposes an area about 12 centimeters in diameter for 5 or 6 minutes with a hard or moderately hard tube at a focal distance of 12 centimeters. He suggests mapping out the chest wall over the tumor into areas of 12 centimeters in diameter, and exposing a new area at each sitting. After the front of the chest has been exposed, the interscapular region and the lateral chest walls should be similarly mapped out and exposed. After a preliminary series of 30 such exposures a few days should be allowed to elapse, and a second shorter series of 4 or 5 exposures should be begun. This should be repeated 3 or 4 times with a period of rest between the period of exposures. Clopatt uses a similar method, but makes the interval of rest as long as 10 days. There is no doubt that the effect of the X-ray treatment would be increased by means of a compression apparatus such as that devised by Jessen and Rzewuski, which diminishes the susceptibility of the skin and allows of the use of a more powerful X-ray.

As stated above, the type of growth which yields most satisfactorily to X-ray treatment is the so-called lymphosarcoma. However, Pfahler has observed a decided improvement in a number of cases of secondary mediastinal carcinoma following mammary cancer. In one case of this kind reported by him the patient survived 6 years after the treatment.

The results in these cases are due to the destruction of the tumor cells with definite diminution in the size of the growth, as demonstrated by the X-ray shadow and the physical signs, and the consequent disappearance of the pressure symptoms. In some patients a decided improvement in the symptoms has been noticed after the second session, and in most of those who reacted well the dyspnea and cyanosis disappeared to such an extent that the patient was enabled to return to work. As far as can be judged from the literature, a permanent cure has never resulted. All of these patients eventually relapse. In the case of lymphosarcoma

amelioration may last as long as two years. When relapse occurs a second regression may occasionally be produced by X-ray treatment, but, as a rule, all curative treatment is ineffectual. In some cases radiation produces absolutely no effect.

Aside from the use of X-rays, arsenic, and other forms of treatment directly influencing the neoplasm, the palliative treatment of mediastinal growths is purely symptomatic.

Operative interference, in the form of resection of a portion of the sternum or of portions of one or two ribs over a tumor presenting externally, seems justified in some cases, from a palliative point of view. Such a procedure is comparable to decompression in an inoperable brain tumor. It may relieve the symptoms due to compression of the structures within the mediastinum, render the patient decidedly more comfortable, so far as dyspnea is concerned, and prolong life.

The relief of dyspnea, which is the most distressing symptom in mediastinal growths, is always indicated. The possibility of relieving it depends upon its cause. If due to general pressure, resection of the ribs or sternum may be indicated as described above. If partly due to pleural effusion, as is often the case, removal of the fluid by tapping must be considered. Powell suggests that complete removal of the fluid is inadvisable, as the altered pressure conditions so produced actually favor increased rapidity of growth in the neoplasm, while, on the other hand, the positive pressure of the fluid retards growth. For this reason it seems advisable to remove just enough fluid to relieve the urgent dyspnea. When the difficulty in breathing is due to the inclusion of the trachea or bronchi in a mass of neoplasm and the subsequent direct pressure, operative interference is of little avail. Tracheotomy has been occasionally performed, and it has sometimes been feasible to introduce a long tube through the tracheotomy wound beyond the point of compression, but there is grave danger in such cases of ulceration of the growth, with infection spreading to surrounding tissues, or producing perforation. In most cases a resort to drugs is necessary. Inhalations of oxygen produce relief in some patients. No rules as to dosage can be laid down; some patients take very large quantities with apparent benefit. Powell recommends a mixture of iodid of sodium (grains iii—0.2 gm.) and chloral (grains v to vii—0.3 to 0.5 gm.) every three, four, or six hours. When paroxysms of dyspnea occur, Abram advises the inhalation of chloroform, but this must certainly be used with great caution, as the patient is so dependent on the accessory muscles of respiration that if these are paralyzed a fatal result may ensue.

For the relief of severe pain in mediastinal tumor, as in other conditions, opium in some form is the only drug of real value. When the pain is not very severe, the deodorized tincture orally administered may suffice and is desirable

on account of its less constipating effect. If the pain is severe, morphia hypodermically will be needed.

The sleeplessness from which many of these patients suffer may, in the early stages, be relieved by veronal, trional, or sulphonal, but later, especially if associated with dyspnea and pain, chloral or a mixture of morphia and chloral will be necessary.

MEDIASTINITIS

Suppurative Mediastinitis

Inasmuch as suppurative mediastinitis sometimes results from operations in the lower part of the neck, great care should be exercised in such operations to avoid infection. When foreign bodies gain access to the esophagus or trachea these may, if neglected, cause ulceration and mediastinal suppuration, and for this reason they should be removed as promptly as possible.

During the early stages of mediastinitis, before actual suppuration has occurred, the application of ice to the front of the chest by means of the ice bag, or applications of heat by means of compresses or poultices, should be made in the hope that the inflammation will subside without suppuration taking place.

The treatment of suppurative mediastinitis, after pus has formed, is based upon the principles which govern the treatment of empyema. If it is suspected that the disease has suppurated, but no demonstrable changes on the surface of the chest are apparent, an exploratory aspiration with a large needle done under local anesthesia is justifiable.

In a certain number of cases the treatment is comparatively simple, for the pus points between the ribs. In such cases the treatment is exactly the same as for empyema. An incision is made over the fluctuating area, the pus is evacuated, and, to insure a permanent opening for free drainage, a piece of rib 5 or 6 centimeters long is resected and a drainage tube is introduced. If it has been determined by aspiration that pus is present, but the exact situation and extent of the pus formation are doubtful, trephining of the sternum must be resorted to. This is a very old procedure, and was successfully carried out by Galen. After a trephine opening has been made, exploration can be carried on through this. If it is found that the trephine opening is above the most dependent portion of the pus pocket, a counter opening must be made either by trephining the sternum a second time or by resecting a portion of rib so that thorough drainage may be established. If, as is apt to occur with tuberculosis, abscesses, etc., the sternum itself is diseased, the affected

portion of the bone must be removed. Milton has reported a case in which almost the entire sternum was removed in this way with subsequent recovery of the patient.

In some instances, where the superior portion of the mediastinum is affected, the abscess points in the neck, either above the manubrium or one of the clavicles. In these cases simple incision and evacuation often suffice to relieve the urgent symptoms, but seldom allow free enough drainage. A counter opening should also be made in these cases, and this, of course, necessitates resection of a rib or trephining of the sternum. In connection with Pott's disease or penetrating foreign bodies from the esophagus, it may be necessary to open the posterior mediastinum. When this occurs in the superior portion it may be possible, as Haidenhain has shown, to reach the pus pocket from the neck. When the inferior portion of the posterior mediastinum is involved, a more difficult procedure is required. Faure recommends the resection of the first rib posteriorly near its spinal attachment. This, he claims, allows a wide opening into the posterior mediastinum. Other surgeons recommend resection of the transverse processes of several vertebræ. The great danger in such an operation appears to be death from suffocation due to an extrapleural pneumothorax, but this should be avoidable if the operation is done under differential pressure.

TUBERCULOSIS OF THE MEDIASTINAL LYMPH NODES

Prophylaxis

The prophylaxis of tuberculosis of the mediastinal lymph nodes is that of tuberculosis in general, though it must be remembered that the patients will be mostly children.

While it has not been proven that tuberculosis of the mediastinal glands is commonly due to bacilli of the bovine type, pure milk should be insisted upon. The common source of infection is no doubt droplet and dust infection from careless adults, so that the education of infected adults is of great moment in prophylaxis.

In the house, owing to their low stature and their almost constantly dirty hands, children are especially likely to be infected from contaminated carpets or floors. The carpet should be banished from the sleeping room, and, when feasible, from the other rooms largely occupied by children, and moist sweeping and dusting should be insisted upon. The children's sleeping room should contain plenty of fresh air, and should be properly screened against flies, as, indeed, should the whole house.

Children who are under weight, anemic, or suffering from local disease which predisposes to tuberculous infection should receive special at-

tention. Adenoids and enlarged tonsils should be removed. The underweight and anemic children should be placed in open-air schools and should be encouraged, as should healthy children, to indulge in outdoor games. Such encouragement is needed especially by girls. The diet should be simple, but nutritious and easily digestible. Eggs, milk, butter, cream, cereals, the easily digestible vegetables, and meat in moderation should form the basis. When possible, children should have an annual change of scene to a climate somewhat different from that to which they are usually accustomed.

Treatment

A radical cure of tuberculous lymph nodes in the mediastinum by surgical methods has hardly ever been attempted, and, on account of the frequency of spontaneous recovery, and the difficulty of accurate diagnosis, even with the X-ray, scarcely seems justifiable, as a rule. Nevertheless, there are instances where the enlarged glands threaten life from pressure on vital structures, when surgery is justified. Occasionally it has been possible, even when life was not endangered, to remove tuberculous bronchial glands with comparative ease. Such a case has been reported by Thiemann. The cases in which surgical interference is warranted will, however, be few in number.

The medical treatment may be general and supportive or symptomatic. The general supportive treatment relates mainly to the hygiene of living, and differs at different stages of the disease.

The climate which has been found best suited to patients with glandular tuberculosis is the seaside, and, when change of climate is desirable, and possible, this should be chosen. The patient should be in the fresh air twenty-four hours a day, and, if not confined to bed, may be allowed, if old enough, sea-bathing in moderation provided the baths are brief, are followed by a brisk rub with a rough towel, and result in good skin reactions. In warm weather exposure to the sun in a bathing suit has a tonic effect.

Children under two years of age, and very thin, delicate children, of greater age, do not bear sea-bathing well; for them baths of heated salt water are of benefit. The temperature of the bath for such children should not be below body heat. In inland climates baths of artificial sea water, or salt rubs, are of value.

A proper degree of rest is essential, even when there is no fever or other signs of marked toxemia. When the maximum temperature regularly goes above 99.5° or 100°, or there are definite signs of toxemia, absolute rest is demanded. In cases where the patient is able to be about there should be a definite period of rest in the middle of the day, and plenty of time for sleeping at night.

The food should be easily digestible, rather rich in fats, and abundant in quantity. Care must be taken, however, not to stuff patients to such an extent that the digestion is upset and the metabolic processes are overtaxed in burning up unnecessary waste. The patient should be systematically weighed, as this is one of the best indices of progress.

Of the drugs which have been empirically proven of value, iodids, especially in the form of syrup of the iodid of iron, stand first. Arsenic is of value in some cases. The hypophosphites and phosphates are highly recommended by some. Cod liver oil is still highly recommended, though it is doubtful whether it is of greater value than other easily digested fats. It should never be prescribed if it upsets the stomach. [I have obtained the best results in these cases by the administration of some creosote preparation, benzosol, for instance, before meals, and the syrup of the iodid of iron after meals.—Editor.]

If the diagnosis is perfectly clear specific therapy by means of tuberculin should be tried, if the daily maximum temperature is not above 99.5° or 100°. It is especially advisable in mediastinal gland tuberculosis, because ordinarily surgical interference is seldom justified. The dose to be used must be very carefully determined on account of the well-known great difference in susceptibility to tuberculin. As little as 0.00001 milligram may be sufficient to cause a reaction, and, although reactions occur less easily than in pulmonary tuberculosis, violent ones are certainly to be avoided. Whether Wright's method of employing very small doses, insufficient to cause a reaction, and increasing them but little, or the German method of beginning with small doses and increasing them considerably is most desirable is an open question. Good results have been obtained by both methods. The frequency with which tuberculin should be given is also a question open to discussion. Certainly not more than twice a week. The value of the opsonic index, unless carried out by one constantly doing the work and skilled in the technique, is dubious. The practitioner with ordinary resources had better depend on the vital signs and the general condition of the patient. The variety of tuberculin to be used is a matter of opinion. Many consider the old tuberculin as valuable as its successors. Some use bacillin-emulsion, which is less toxic. L. Brown advises a mixture of equal parts of bacillin-emulsion (B. E.) and broth filtrate (B. F.). In the administration of tuberculin it should be diluted with 0.25 per cent. carbolic acid in normal saline. The dilutions deteriorate after a couple of weeks. In order to insure accuracy a regular tuberculin syringe should be used, the needle should be small and sharp, and the injection should be introduced beneath the skin of the interscapular region. No skin preparation except cleansing with alcohol or the application of iodin is necessary.

Symptomatic treatment may be necessary in some patients. Fever should be combated by bathing. A salt sponge (5 per cent. salt) at 90° F.

may be given at night, and can with advantage be followed by an alcohol rub. If the temperature is not reduced a cold pack to the trunk is advisable.

Some authors advise the reduction of fever by drugs, such as aspirin or novaspirin, lactophenin, or pyramidon. All of these are unsuitable for continuous use, and, if lactophenin or pyramidon are given, their effect on the heart and blood should be remembered.

Dyspnea, if urgent, must be treated as in other mediastinal tumors. Tracheotomy with passage of a tube beyond the obstruction is justifiable as a temporary procedure at times. Inhalations of oxygen and the use of the various sedatives mentioned under mediastinal tumors may be tried. Dysphagia may be temporarily relieved by the passage of sounds, but this is a questionable procedure, as rupture of a softened gland may occur. It is in cases with urgent dyspnea or severe dysphagia that radical operations should be considered.

INDURATIVE MEDIASTINOPERICARDITIS

Up to a few years ago the treatment of mediastinopericarditis was the treatment of valvular heart diseases, for the effect of binding the heart to the anterior chest wall and the surrounding structures is, in the long run, to cause failure of compensation, demanding the usual treatment for this condition (v. Chronic Myocardial Insufficiency, p. 690).

The introduction by Brauer in 1902 of the operation, termed by him cardiolysis, opened a new field in the treatment of mediastinopericarditis. Reasoning from the point of view that it was the rigid chest wall which was mainly responsible for the extra work thrown upon the heart muscle, Brauer suggested resection of a portion of the chest wall overlying the heart, with the idea that the greater freedom of action thus obtained would lead to improvement in the cardiac musculature. This hope has, in the limited number of cases so far operated upon, been realized to a considerable extent.

According to Brauer and others who have had success with the operation, the procedure should only be attempted if the heart still shows evidence of a good degree of competency. If there are a well-marked systolic retraction, a diastolic shock, and general indications that the break in compensation has not reached an advanced stage, the operation is permissible.

The name "cardiolysis" gives altogether a false impression of the gravity of the operation, even to the professional mind, inasmuch as it indicates actual manipulation of the heart itself. As a matter of fact, the operation is not much more complicated than the ordinary operation for empyema, and, of more than twenty

cases now reported, only one has resulted in death directly referable to the operation. The term "precordial thoracolysis" is preferable, we think, to cardiolysis, or perhaps "precordial thoracostomy" would be even better.

The technique of the operation now varies slightly from that originally proposed by Brauer, but is essentially unchanged. The operation can be easily done under local anesthesia in cases in which a general anesthetic is contraindicated. A semilunar flap with its convexity toward the median line is made to the left of the sternum in such a position that the costal cartilages and the adjoining parts of the third, fourth, and fifth ribs may be exposed. The flap should, of course, include all the soft parts down to the bone, and should permit the exposure of at least ten or twelve centimeters of the cartilages and ribs mentioned. It is now considered sufficient to remove subperiosteally from six to ten centimeters of each of the third, fourth, and fifth costal cartilages and adjoining ribs. Bleeding is then controlled and the flap is replaced. The procedure is, therefore, a very simple one as now advised, and differs from some operations previously done in that no attempt is made to remove any portion of the sternum, and removal of the perichondrium and periosteum is not considered necessary. While technically new bone might result with the periosteum left behind, the experience gained from König's case shows that the amount of bone formed has no deleterious effect; on the other hand, removal of the periosteum adds greatly to the difficulty of the operation, increases the likelihood of shock, and adds the danger of injury to the heart and perforation of the pleural cavity. Inasmuch as the operation has been performed in a number of cases in which indurative mediastinopericarditis was not present, the suggestion of William MacKenzie, that a portion of the fifth rib be removed first to form an exploratory opening, is worth considering. As this author points out, if we are unable to feel the intrapleural area through such an opening we know that adhesions exist.

The results of the operation described above are, as a whole, very satisfactory. In some cases the operation has been undertaken at a period when the damage to the heart muscle was too great to be even temporarily repaired; in such cases failure has naturally resulted. Of twenty-eight cases collected by Roux-Berger in 1910 five resulted fatally. Of these one was not mediastinopericarditis and two were also suffering from endocarditis with valve leaks. The ultimate results in many patients cannot be followed up in the literature, but in many the immediate results were very striking; often the heart became more regular as soon as the ribs were removed, and the subjective symptoms diminished markedly a few hours after the operation. Recession of the signs of cardiac incompetency in remote organs took place more gradually, but was often progressive, and in many instances the patient was able to return to work after a protracted invalidism previous to the operation. Several of the

patients remained in good condition one year after the operation, and one survived as long as four years, and died of miliary tuberculosis. The operation is certainly one that should be much more extensively employed.

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III. DISEASES OF THE CIRCULATORY SYSTEM

CHAPTER I

DISEASES OF THE PERICARDIUM

ALEXANDER McPHEDRAN AND WILLIAM FLETCHER McPHEDRAN

HISTORY

Before taking up the treatment as generally practiced in the present day it will be of interest and of no little advantage to look briefly at what was done for pericarditis after it was first discovered to be a distinct disease.

Its earliest treatment is well presented in the writings of Latham, New Sydenham Society (1789-1874), in the early part of last century, and, later, by those of Sir Thomas Watson.

Blood-letting, mercury, and opium were the remedies in these diseases of the heart, as also in acute rheumatism and other acute diseases. "In the treatment of acute rheumatism, it might be laid down as an axiom to treat the rheumatism and let the joints take care of themselves. But where there is a question of the heart being affected it is the latter which must receive attention. Mercury to salivation is indispensable to the cure of every case of pericarditis." (Latham.)

His pupil and successor, Sir Thomas Watson, regarded the disease as one of great importance because of the danger (1) of speedy death from the great quantity of effusion which often occurs, and (2) of other effects which often result in dangerous sequelæ. Following the teaching of his time, he regarded bleeding as the most potent means of arresting the disease. This was the view of the most distinguished both at home and on the Continent. Bouillard declared that by the bold use of the lancet it is possible to extinguish the inflammation and jugulate or slaughter the disease at its birth. Watson had found that this could only result if the copious bleeding were done before the to-and-fro friction sound occurs, but not after. But he thought that, even after the to-and-fro friction sound is heard and adhesions are beginning to form, repeated

free cupping of the precordium may do good. At the same time the patient was to be brought under the influence of mercury as soon as possible, that the gums might swell and become tender. It was found, unfortunately, in this as in other diseases that the system frequently resisted with great obstinacy the influence of mercury. He therefore urged that calomel should be given in frequently repeated doses, guarded, if need be, by opium from the first. When the gums began to rise there were always a prompt subsidence of distress and mitigation of the symptoms—less pain, less palpitation, and less dyspnea.

In cases with high temperature and dry skin, tartar emetic, grain 1-6 to ¼ (0.01-0.15 gm.), was given, to cause free perspiration. If the pulse was strong and full a large blister was applied to the precordium.

It was soon recognized that this heroic treatment should be reserved for the plethoric and vigorous patients, and that the debilitated should be treated much less vigorously. This led in time to the recognition of the fact that "many seem to recover under any treatment, or even with none at all." (Watson.) It is remarkable how keenly alive at this early period these master minds were to the danger of future adhesions in all cases of pericarditis. They warned against being too sanguine as to permanency of recovery, as months or even years may elapse before secondary effects are evident. "No medium between complete cure and sudden death." (Latham.) How confident they were of the efficacy of their heroic treatment is shown by Watson's faith in it. "I am of opinion that by the cautious employment of the lancet and leeches, and by early and unshrinking use of mercury, the mischief may be greatly limited and the consecutive changes staved off to a distant period." And yet he recognized that many cases of pericarditis recovered "under any treatment or with none." It was this knowledge, scarcely realized at first, but the importance of which became more and more appreciated year by year, and gradually filtered downward through the profession in general until the fuller light dawned, which awakened the medical world to the fact that while bleeding and mercury were doubtless able to do some good, they were also potent for evil, and that the injury that resulted from their indiscriminate use greatly exceeded the good they did, and that "many recover under any treatment or with none." It is almost impossible to realize the difficulties to be overcome and the obstacles to be removed before the more rational methods of our day were reached—methods on which we pride ourselves and which may be left by our successors fifty years hence as far behind as we have left those of our predecessors of fifty years ago.

PERICARDITIS

Prophylaxis

As rheumatic fever is much the most common cause of pericarditis, it follows that great care should be taken to prevent attacks of it in children who have bad family histories, or who have undergone a previous attack. The latter are not only very liable to contract rheumatic fever, but are also much more likely to have cardiac manifestations. The danger of cardiac infections decreases rapidly as the child grows older, and at all times the endocardium is more apt to be the seat of the disease than the pericardium. Occasionally one finds pericarditis the only, as it may be the first, manifestation of an attack of rheumatism in a child. But when rheumatism or chorea has occurred once—even if the attack is very slight—the physician must use every effort to prevent recurrence of the attack by a careful examination of the gateway of infection—the tonsil. It is not enough to decide that because the tonsils are not so hypertrophied as to meet in the center line they are not at fault. Much mischief often comes from small, deep-set tonsils, whose crypts are plugged with mucus and degenerating epithelial cells. These are very apt to become infected or to be subacute infected areas at all times. The tonsils should be examined by probing the crypts while pressure is at the same time applied outside on the neck. Any tonsil that is the seat of chronic inflammatory change should be removed—not amputated by a guillotine, but dissected out. Too much attention cannot be devoted to this almost universal point of infection in the rheumatic child. Similarly, all local areas of infection from which possible pericarditis might arise are to be treated carefully. The need for such precautions will, of course, be greater if former attacks of pericarditis have occurred. It is doubtful if an attack of pericarditis can actually be prevented, but diseases of which pericarditis is a part or complication are well within the bounds of preventive medicine.

In the mildest attack of rheumatism, even when there is only a slight "growing pain," the child should be put to bed. Not only the rest, but the warmth to be had in bed, may prevent, or, at least, moderate, the severity of the attack. At the same time, the heart beats less rapidly, and so the liability of extension of the rheumatic process to the cardiac structures is reduced materially. The rheumatic fever should be energetically treated so that as early a recovery as possible may be expected. Once the heart has been affected its resistance to a new infection is reduced, and so new attacks occur the more readily.

The prophylaxis of pericarditis, then, depends in acute rheumatic fever, as in other diseases, on a preservation of the bodily health. Should

any disease occur, by keeping the patient quiet both bodily and mentally, there will be less danger of pericardial involvement.

Treatment

In all cases in which the symptoms suggest the possibility of pericarditis, such as increased rate of pulse at rest and marked disturbance of it in slight exertion, a sense of discomfort in the precordial region, and, it may be, some shortness of breath, and as yet no to-and-fro friction rub or sign of effusion, there should be complete rest in bed in the recumbent position. Probably the hope of mitigating, if not preventing, an attack is vain in most cases presenting such premonitory symptoms. The patient should be supported comfortably on pillows. He will probably be more comfortable semi-recumbent on the left side, but his comfort and lack of dyspnea must be the best indications of the excellence of this position. The bed should be firm and narrow, so that the patient may be easily moved by the nurse or attendant. The use of a double inclined plane, such as is used in surgical beds for the maintenance of the Fowler position, will be of very considerable comfort and benefit to the patient. The back may be raised at will to any height desired. Such a bed as described by Gatch is in the writers' experience excellent. He should not be

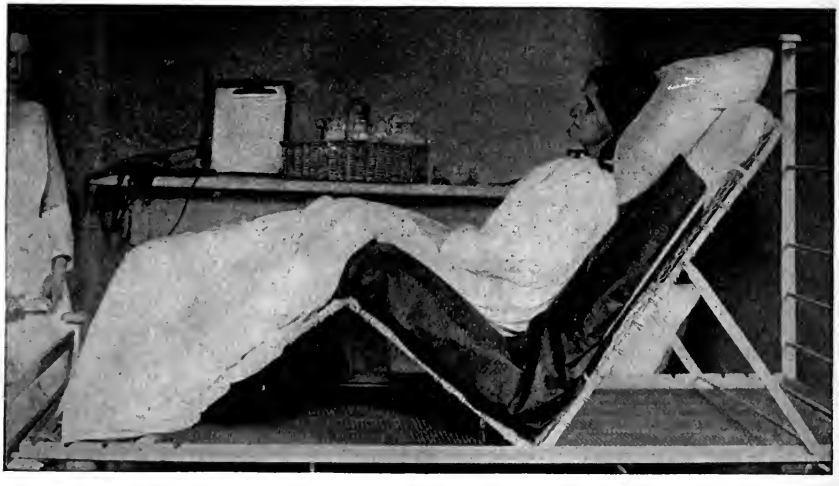


Fig. 1.—The Gatch Bed

permitted to stir for food, voiding of urine, or movement of the bowels. This position in bed should be maintained until the acute symptoms have subsided and until the circulation is efficient, and the heart not unduly accelerated on getting up for short increasing periods of time. Sir William Gull once went to see a patient with an old house officer. The man

had a pericarditis, which the physician had not recognized. He was expressing his chagrin at the oversight to his old chief when the latter patted him on the shoulder and said: "Never mind, my lad; had you recognized it, you might have treated it."

This sums up the treatment of the mild cases of pericarditis.

In cases in which some or all of the physical signs of pericarditis are found on careful repeated examinations, it has been said that moderate movements by the patient should be permitted, as they aid in preventing adhesions by causing the heart to alter its position with each new posture. This is a doubtful inference, and in any case the benefits from it must be too slight for it to be wise to run the risk of other dangers for the doubtful good to be gained. In cases in which the weakness, disturbed action of the heart, and increase in the area of precordial dulness make it probable that there is considerable myocarditis and some effusion, complete rest is of the utmost importance, as sudden movements, especially changing to the erect posture, may cause faintness or even a fatal collapse. Here the symptoms are due to the myocarditis. It has been suggested that the action of the heart may be inhibited by the inflammation of its serous covering just as is the case with the intestine in peritonitis. This is very doubtful, for in fatal cases the cardiac muscle is always found to be profoundly affected. So constantly is this the case that it is doubtful if even large effusions can do more than hamper the action of a healthy heart muscle, but the hampering might be sufficient to turn the scale if the myocardium were severely, although not fatally, damaged. If there is cough it should be subdued by repeated doses of codein, gr. ¼ (0.0515 gm.), and heroin, gr. 1-12 (0.005 gm.). There should be no straining at stool. To secure a soft and easy motion a plain enema may suffice; if not, some mild laxative, such as sulphur, olive oil; or, if a more active drug is needed, compound licorice powder. Castor oil answers well, and is more effective, but should not be given if the stomach is irritable, as the excitement of the heart's action by vomiting should be avoided.

Diet in Acute Pericarditis.—In the mild cases the patient may have whatever he desires, with no restriction, except as to the amount of fluid. In the more severe cases it is of greater importance that the food should be attractively prepared, and always given in small quantities. This method of feeding prevents overloading of the stomach with the distressing cardiac symptoms arising therefrom. In addition, one must remember that the stomach is liable to rebel against the quantities of salicylates which the medical attendant will use in the treatment of the common rheumatic form of this disease. The diet should be simply and easily cooked (for great demands are to be made upon the household) and soft, so as to be easily digested as well as to avoid irritation to the inflamed tonsils. There should not be too much residue for bowel evacua-

tion. While soft, the nourishment must be fairly concentrated, since highly diluted food means the introduction of a large amount of water. This tends to increase the work of the heart and also provides fluid for a possible or existing effusion. For this reason a wholly milk diet is inadvisable. On the other hand, too much nitrogenous food may cause a relapse of the rheumatic fever. [It is more than likely that it is not the muscular fiber or the nitrogen contents which do damage, but the quantity of nuclein contained in meats. Nuclein-metabolic end result is uric acid, which favors bacterial invasion and multiplication.—Editor.] Soft-cooked eggs, soft toast, scraped beef done into balls with a little butter and broiled are valuable additions. Kephir and kumyss are of particular use, because they are easily digested, and on account of the lactic acid bacilli (of which they are cultures) are good antidotes to meteorism. It will be advantageous to increase the nutritive value of the milk by the addition of cream, and of the milk and kephir by the addition of lactose—say, ʒi (gms. 4) with each feeding. It is tasteless, high in nutritive value, and shows slight tendency to fermentative changes. The milk can be given as cocoa or in the form of soups, flavored, if desired, with vegetables, or it might be advantageous to give gruels of well-cooked oatmeal, with cream, to replace one of the milk feedings. The eggs are best cooked by placing them in a warm bowl, covering them with boiling water, and letting them stand covered for five minutes. A small amount of seasoning is admissible, but, while the whole problem of exudation and edema in relation to salt intake is under investigation, much salt should not be allowed. The number of calories in this diet is quite sufficient to maintain the body for some time in bed—as the patient progresses more and more may be added to the diet. But for some little time the administration of frequent small meals—say, five per day—will save the heart a great deal of unnecessary work, because there will be easier digestion and less danger of distention of the stomach and intestines.

The following table would be satisfactory for some time. The milk items might well be given as milk soups, because there is the danger of the patient rebelling against a monotonous dietary. The fluids total 1,400 c. c., and there is ample room here for about 200 or 300 c. c., i. e., ʒvi, of water, which had best be given between feedings or in sips of cracked ice. To allay the thirst a trace of lemon juice might be added, but due regard must be paid the alkaline treatment secured through the copious doses of the bicarbonate of soda. To give water more freely would tend to dilate the stomach and increase the probability of effusion.

Diet—

7 a. m.—Milk. 200 c. c. ʒvii.
Cream. 50. ʒii.
Lactose. 4 gms. ʒi.
9 a. m.—Soft eggs. 2.
Toast. 2 pieces, 10-15 gm. each.

11 a. m.—Kephir. 200 c. c. ℥vii.
Lactose. 4 gms. ʒi.
1 p. m.—Scraped beef. 50 gms. ℥ii.
Toast. 2 pieces.
Custard made of: milk, 200 c. c., ℥vii; eggs, 2; sugar, 4 gms., ʒi.
4 gms., ʒi.
3 p. m.—Kephir. 200 c. c. ℥vii.
Lactose. 4 gms. ʒi.
5 p. m.—Soft eggs. 2.
Soft toast. 2 pieces.
Milk. 100 c. c. ℥iiiss.
Lactose. 4 gms. ʒi.
7 p. m.—Kephir. 200 c. c. ℥vii.
Lactose. 4 gms. ʒi.
9 p. m.—Milk. 200 c. c. ℥vii.
Cream. 50. ℥ii.
Lactose. 4 gms. ʒi.

			Calories.
Totals:	Milk + Kephir,	1,300 c. c. =	884
	Cream,	100 c. c. =	250
	Lactose,	28 gms. =	106
	Scraped beef,	50 gms. =	100
	Eggs,	6 =	450
	Bread,	12 gms. =	40
			1,830

Local Treatment.—Of local treatment the application of *cold* to the surface over the heart is, as a rule, the most effective. In recent years the local use of ice in deep-seated inflammations has become more and more general. When it first came into use it roused much prejudice. It was regarded as unpleasant and likely, not only to increase pain, but also cause extension of the inflammation. Experience has proved that these fears are groundless and that, on the contrary, the pain is usually relieved, and the inflammation lessened or even arrested. Ice produces both of these results with much more certainty than hot poultices, and is much cleaner. The icebag offers, as a rule, the most convenient means of applying cold. It may be applied directly to the surface of the precordium. If the direct application is too severe the bag may be wrapped in a flannel cover or have a piece of flannel placed under the icebag. In this manner the cold can be tempered, and as the surface becomes accustomed to it the flannel may be removed. In cases in which it is inadvisable to apply extreme cold, as in children and old people with feeble circulation, Leiter's tubing may be substituted and the water used gradually lowered in temperature to any desired degree. In all cases, especially where there is precordial distress or oppression, it will be well to have the bedclothes raised on a cradle. The icebag or Leiter's tubing may be suspended from this so as to take all possible weight off the sensitive region.

We do not know how cold produces the effect. Probably it acts by causing contraction of the arterioles of the parts in relation to the surface to which it is applied. It may stimulate the vasoconstrictor nerve or possibly the muscular walls of the vessels themselves. For example, dipping the hand in cold water causes actual diminution in size of the radial artery. That is, the area to be supplied with blood can control, by its sensory stimuli, the amount of blood brought to the area. Sir Lauder Brunton has shown that ice applied over the sternum of rabbits causes blanching of the bronchial mucous membrane, and that, if the cold is continued, the vessels dilate and the membrane becomes hyperemic. Remission of the cold application causes a new vasoconstriction and blanching. Until the mode of action is proven by investigation, we must rest content with theories.

Local blood letting may be resorted to with benefit, especially in the robust. It is best done by applying eight to ten or more leeches over the cardiac area; and after their removal the bleeding may be encouraged by warm fomentations. This procedure usually relieves pain, and often probably lessens the tension in the chambers of the heart when they are overdistended. The abstraction of blood must have some direct influence on the distention of the vessels and heart. But the relief cannot be wholly due to that; for, if so, the application of a bandage around the thigh tight enough to obstruct the venous flow, while allowing the arterial to enter, should produce greater effect. It seems reasonable to infer that the irritation of the leeching should cause reflex contraction of the distended vessels of the pericardium. This would cause more rapid flow of blood, that is, a better circulation, the pain relieved by the lessening of pressure of the distended vessels on the nerve terminals and the increased force of blood flow aiding the heart to expel its contents into the pulmonary vessels.

Blisters to the precordium is an old method of treatment for the relief of pain and distress, but it is little resorted to now. It is more severe and not more successful than are the means above described. Some, however, prefer the application of a series of small blisters which are allowed to heal up rapidly. Their action must be due to the effect of the irritation of the surface on the vessels of the pericardium. Their use in effusion, which is slow in absorption, may be wise, because in some cases their application is rapidly followed by removal of the fluid.

[The galvano- or Paquelin cautery has been recommended. If counterirritation is indicated at all, it can be applied in this way with an amount of precision impossible in any other way.—Editor.]

Drugs.—Of drugs we have none that are specific in pericarditis. Bleeding, mercury, and opium, the sheet-anchors of the practice of our forefathers, having failed to cure, or even probably to affect for good the course of the disease, have long fallen into disuse. As the acute form of

pericarditis is but one of the local manifestations of a general disease, we should endeavor to control the local through treatment of the general disease on which it depends. The great majority of cases are due to rheumatic infections; of the remainder most of them are due to such grave forms of septic infections as pneumonia and septicemia, in which drugs are of little if any avail.

For the treatment of rheumatism we have in the salicylates a drug which is, if not a specific, at least one that has marked influence on its development and course. To obtain its full benefit it is necessary to give it sufficiently freely to bring the system under its full influence as soon as possible, that is, until it produces slight toxic effects as shown by *tinnitus aurium.*

I am strongly of the opinion that the quantity usually given is not adequate for the purpose in view—the arrest of the disease if possible, and, if not, the mitigation of its progress. For this purpose about 20 grains (gm. 1.3) of sodium salicylate given every two hours will be required to act promptly; or even 40 to 60 grains (gm. 2.6-4) as a first dose and followed by the smaller quantity.

Unfortunately salicylates frequently irritate the stomach and cause vomiting; this effect is probably due in most instances to the breaking up of the salt. Vomiting, even nausea, does grave injury to a patient whose heart requires the greatest possible rest. Therefore to prevent the setting free of salicylic acid 30 to 40 grains (2.0 to 2.6 gm.) of bicarbonate of soda should be added to each dose of the salicylate; the bicarbonate serves the second purpose of a useful addition in the treatment of rheumatism. The earlier such treatment is begun in the rheumatic attack the more likely is it to prevent infection of any of the structures of the heart. After the heart has become infected the administration of the salicylates is regarded by many able observers as, in the first place, being without value because they exercise no influence on the cardiac infection, and, in the second place, dangerous from their depressing effect on its action, since in every case the myocardium is infected and therefore liable to dangerous depression. It is doubtless true that the salicylates fail to influence the progress of some cases of pericarditis, just as they unfortunately fail in not a few cases of polyarthritis. Possibly this failure is because the infection in these cases is not rheumatic and so not amenable to salicylate treatment. Then the more frequent failures in cardiac infections may be due to the partial withholding of the salicylates on account of the fear of dangerous depression of the heart, a fear that I have not in my experience seen to rest on good grounds. Only quite pure salicylates should be given. The natural is usually best tolerated and least likely to cause vomiting. Salicin has been much used in England instead of the salicylate, but it is found to be less effective, probably because less soluble.

As in rheumatism so here the treatment should be continued for some days after both symptoms and signs of pericarditis have been lessened or disappeared. It is better to continue the salicylates for too long than for too short a time.

Other treatment is not commonly required in pericarditis. The icebag usually relieves the pain and distress, and aids in reducing the fever, which, however, is rarely high. If the icebag, for any reason, is not well borne, it may be necessary to replace it with hot applications. These sometimes give the patient greater relief than cold, just as they do occasionally in pleurisy. Unfortunately they excite the action of the heart and their use should therefore be avoided if possible. If the pain continues small doses of opium, as in Dover's powder, grains 1 to 5 (gm. 0.06-0.3), according to the symptoms usually suffice to give relief and, at the same time, quiet the irritability of the patient. If the action of the heart is irregular and tumultuous and the fever high, quinin in 3 to 5-grain (0.2-0.3 gm.) doses, repeated three or four times daily, usually does much good. In nervous patients a bromid may be needed and usually brings the needed quiet. Veronal, trional, and sulphonal have no effect upon the pain, hence do not give good sleep. Chloral is dangerous because of the unpleasant cardiac symptoms occasionally following its use.

Stimulants.—Persistent disturbed action and weakness of the heart are doubtless due in all cases to the associated myocarditis and require cardiac stimulants in addition to the greatest repose. Of the former the most effective is digitalis. It should be given early, as soon as the first symptoms of disturbance of the heart's functions show themselves. The object is to so stimulate the muscular fibers that they will maintain efficient systolic contractions of the heart and thus prevent acute dilatation. In cases in which there have been chronic affections which weaken the heart, as valvular lesions, chronic nephritis, chronic anemia, etc., digitalis should be given very early; before the heart shows any symptoms of disturbance. Of course due regard must be given to its effect on the preëxisting chronic affection. If chronic degeneration has already occurred in the wall of the heart from the old disease, the additional infection incident to pericarditis may cause marked irregularity of the heart's action and other symptoms of failure of its power. In such cases often neither digitalis nor other stimulant steadies or relieves the symptoms. Here morphin, gr. ⅛ to ¼ (0.008-0.015 gm.), given hypodermically at bedtime is usually followed by a good night's rest and much steadier action of the heart. Then digitalis will have full effect in restoring the efficiency of the heart as far as that is possible.

In acute cardiac failure with collapse, dyspnea, and much precordial distress associated with pericarditis, strophanthin given intravenously may give prompt relief. In a man of fifty-five, with much distress—the pulse being about 140 and very irregular in rhythm—one milligram

caused the pulse to fall to 75. It became almost regular, and was followed by complete relief of the urgent symptoms. The transition was almost alarming to the physicians; a smaller quantity might have been ample for relief, although less striking in its effect.

After-treatment.—Convalescence should be slow. The patient can be raised to a sitting posture for half an hour per day, and the time gradually increased. Should there be no ill results he can stand upright in a week and walk a few steps. During this period careful observation of the pulse rate, with daily inspection of the apex beat and cardiac dulness, will determine his progress. In the prevention of adhesions a good course of cardiac exercises with the observance of due care to prevent strain is essential. Various courses of gymnastics have been recommended and are discussed under the head of diseases of the myocardium. The principal feature to be held in mind is that they all should be supervised by a physician. Passive movements and, above all, massage are of particular benefit. Such exercises should be carried to the stage of gentle fatigue only. Carbonic acid baths have also been recommended—with what success is at present uncertain. In the cases where there has not been myocarditis of an extensive degree, it is quite within the bounds of possibility to expect a complete return to normal.

Pericarditis with Effusion

If moderate and the heart shows no signs of embarrassment, no special treatment is required, since, as a rule, the effusion soon becomes absorbed. The patient should be placed in bed with complete rest, so as to relieve the heart of work as far as possible. If the effusion increases it soon fills the pericardial cavity so that the walls of the heart become subjected to positive pressure. This would soon lead to compression of the flaccid auricles, and, to a slight extent, lessen the dilating force of the ventricles, and therefore their suction power. Such a condition makes the heart's work inefficient, and is therefore characterized by a degree of dyspnea, precordial distress, and cyanosis in proportion to the derangement of function. Since the heart is unable to dilate properly, especially the auricles, to receive the blood, little, if any, benefit can be obtained from the administration of digitalis or other cardiac stimulants. The diuretics which act directly on the kidneys, such as caffein, diuretin, and theocin sodium-acetate, may greatly increase the urinary outflow and prove of much service. At the same time, the amount of liquid taken should be reduced to as low a quantity as the patient is able to tolerate.

Owing to the debilitated condition of the heart in all cases of pericardial effusion on account of the myocarditis as well as the hampering of its action by the pressure of the exudate, no treatment which in any way depresses its function should be resorted to; hence diaphoresis, by

hot baths of any kind, by hot packs, and by pilocarpin, are dangerous depressants, and not permissible. For the same reason we should not attempt to reduce the effusion by free purgation.

Paracentesis.—If, after due trial of these measures, the effusion persists, resort should be had to paracentesis. If the quantity of fluid is only moderate and not increasing perceptibly, there need be no haste to remove it, but if large and increasing its early withdrawal is necessary, especially so if the heart becomes weak, irregular, and its contractions increase in frequency. Under such circumstances the pressure of the fluid is not only obstructing the circulation by disturbing the action of the heart, but also by interfering with the coronary blood supply. The diminished coronary supply favors the increase of the degenerative changes in the structures of the heart, which are present in greater or less degree in all cases of pericarditis. In estimating the danger from the presence of the fluid, we have to consider three aspects of the matter: first, the quantity of the fluid; secondly, the rapidity of its exudation; and, thirdly, the degree to which it has embarrassed the function of the heart, and of these the third gives the most important signals of danger; since, if the heart itself is much damaged in its muscular structures, the pressure of a very small quantity of fluid may be enough to dangerously disturb its function.

In cases of moderate effusion and little disturbance of the heart we may content ourselves with first withdrawing a hypodermic, or, better, an exploring syringeful of the fluid both for diagnostic purposes and also in the hope that absorption may follow, as is occasionally seen in pleurisy with effusion. There being no urgent symptoms we may wait a few days before taking further steps. Then, if there is no improvement, the fluid should be removed by an aspirator, or a trocar and cannula, to which is attached a long tube to act as a syphon. The needle of the aspirator should have a sheath into which it can be withdrawn as soon as the cavity is entered in order to prevent the heart from being wounded. If the symptoms have been urgent, the relief following the removal of the fluid is very striking and gratifying. Paracentesis of the pericardium was first proposed by Riolan in 1649, and afterward by Senac in 1794. The operation was very slow in being recognized as justifiable, not to say advisable; as late as 1870, Billroth characterized it as a prostitution of surgical skill. Since then it has come to be recognized as the only efficient means of treatment in persistent effusion, and as imperative in all cases in which the exudate at all disturbs the function of the heart.

The operation causes only moderate pain, and therefore the danger of general anesthesia should in no case be incurred. Local anesthetics give moderate relief and serve the purpose fairly well. Of these the Schleich infiltration method is the most effective, but ethyl chlorid freezing does well, and the coldness induced by ether, or even of ice and salt, will serve the purpose in most cases.

Various sites are recommended as the seat of puncture, the difference of opinion arising chiefly from the varying views as to the position of the heart in the distended sac. Being of greater specific gravity than the fluid, it was formerly taken for granted that the heart sank to the most dependent part, that is, to the back in the recumbent or even the semi-recumbent position, the fluid filling the anterior part behind the precordial surface. Later observations have shown that this is often not the case; that in many cases of large effusion the heart lies in contact with the anterior chest wall, or nearly so. In a lad of 12, from whose pericardial cavity I withdrew over 1,000 c. c. (35 ounces) of effusion due to tuberculous disease, the heart was touched by the sheathed needle almost as soon as it had entered the cavity. Many similar cases have been reported. There is no single point of choice which is preferable or even suitable for all cases. The several points recommended, beginning to the right, are: (1) The right fifth intercostal space, in the cardiohepatic angle into which the pericardium forms a triangular projection, and which early becomes filled in pericardial effusion. Rotch has been especially insistent on the advisability of selecting this site. Puncture has also been advised in the third and fourth right intercostal spaces close to the sternum.

(2) The angle formed by the ensiform cartilage and the left costal margin. This is the site preferred by many of the leading British and American writers. It was suggested by Larrey in the early part of the last century, but not regarded seriously. (Dock.)

If the needle is entered close to the costal margin and, as soon as the point reaches the posterior surface of the cartilage, is turned sharply upward and to the left behind and in contact with the posterior surface of the cartilage, it will at once enter the cavity of the pericardium, especially if it is depressed by effusion. If carefully done there is no danger of puncturing the peritoneum, liver, or pleura. It further affords an excellent guide to subsequent incision and drainage of the cavity if such should be advisable. As this is the point I have always selected, I am able to speak for both its safety and efficiency. It should be at least no more liable to accident than is any other available point; some risk attaches to each of them.

(3 and 4). The fourth or fifth left intercostal space, either close to the sternum or 2.5 cm. (about one inch) further to the left. In the former point there is much danger of wounding the internal mammary artery. In the second, the heart, if it lies near the anterior wall of the chest, is liable to be punctured, and that, too, in its thinnest and least contractile part, the right auricle. This would be a suitable and efficient site if there was assurance that the heart lay toward the posterior part of the cavity.

(5) The fifth or sixth intercostal space outside the left mammary line at a point midway between the cardiac impulse, if it can be made out, and the outer limit of dulness; if the cardiac impulse cannot be determined,

then a point about an inch internal to the left limit of dulness may be chosen. This is advised as a safe point so far as injury to the heart is concerned; the fluid, if present, is easily reached, and even if the heart is struck, it is in its thickest part, the left ventricle, which can scarcely be completely penetrated unless adherent to the wall of the chest. The pleura may be punctured, but with a sterile needle such an accident will cause no damage. If pleural effusion exists, it can also be removed as the cannula is being withdrawn.

The choice of the site is not a vital matter; they have all given good results and the choice will therefore depend on the special conditions to be dealt with, such as the shape of the precordial dulness, the position of the heart if it can be determined, etc. It is wise, first, to do an exploratory puncture. The patient should be in the recumbent position or propped up comfortably with pillows. Having determined that fluid can be reached an aspirating needle or trocar and cannula may be used; it should be firmly but slowly pressed in until the change in resistance is perceived, when the pericardial sac is entered. This is usually possible, unless there is much dense plastic exudate lying in contact with the sac. The size of the needle or trocar and cannula required will depend on the density of the exudate. For serous exudate one with one millimeter bore will be sufficient. For all thicker exudates the bore must be larger. Cole has suggested that in tapping a pericardium where one has reason to believe that the effusion is in the posterior part one should pass a fine rubber catheter inside the cannula. When the cannula has entered the sac the catheter is pushed forward and its softness enables it to follow the pericardial curves freely and without damage to the structures. Thus the back of the sac may be easily reached.

Failure to obtain fluid by puncture at any of these sites is not an infrequent experience. This may be due to various causes, such as absence of free fluid, the exudate being wholly fibrinous; a thick layer of fibrinous deposit on the wall of the sac; plugging of the needle by the fibrinous exudate, or a mass of fibrin floating in the fluid; the loculation of the fluid at the posterior part of the sac, etc. A "dry tap" may be, and probably often is, owing to the absence of fluid, the increased area of precordial dulness, even when very great, being due to a greatly enlarged heart covered by a thick layer of plastic exudate. That this is true is shown by the case of a young man from the Cobalt mining camp, who entered the Toronto General Hospital with marked signs of pericarditis. The precordial dulness was very large, extending nearly to the mid-axilla, and there was dulness with blowing breathing at the back below the left scapula. Two inches (5 cm.) inside the left border of dulness faint cardiac impulse could be felt. There was also dulness in the right cardiohepatic angle. The symptoms of cardiac embarrassment were very marked—dyspnea, a weak, very rapid pulse, livid facies, perspirations, and

faintness on any movement being made. It seemed certain that the pericardial sac was distended with a copious effusion. An attempt at aspiration was made in all the points described in the following succession—the left xiphocostal angle, the right fifth intercostal space, the left fifth intercostal space close to the sternum and an inch to the left, and halfway between the weak cardiac impulse and the left margin of dulness. No fluid was obtained at any of them, and the needle on penetrating two or three cm. within the pericardial cavity came into contact with the heart in all of them, except the one to the right of the sternum. There can be no doubt that the greatly distended pericardium was due to an enormously dilated heart covered by a thick layer of plastic exudate. Large doses of digitalis and of camphor were given, and within a day improvement began and progressed rapidly. He made a complete recovery. He returned two months later for examination; he showed no abnormal signs in connection with the heart and he was well and strong. Time alone will prove whether serious adhesion of the pericardial surfaces will occur. However, the prompt improvement which followed the administration of full doses of digitalis renders it probable that the infection did not seriously involve the areolar tissues around the pericardial sac.

HYDROPERICARDIUM

Occurs most frequently in the course of chronic nephritis, tuberculosis, or other cachectic conditions. It may result from some local obstructive pressure, such as tumor of the pericardium, or it may be due to an occlusion of the mouths of the lymph vessels by a subacute inflammation of the endothelial cells. It frequently occurs after scarlet fever. The academic question as to whether the effusion is a transudate, or due to a local inflammatory reaction, is, fortunately, without practical interest, because the treatment is not influenced by such a minute differentiation.

It is highly probable that unless the effusion is so great as to cause urgent dyspnea and tachycardia it will not be discovered, unless very careful routine physical examination is daily carried out. The main efforts in treatment must be directed, as already stated, to the principal disease, to which the pericardial effusion is secondary.

Experience with diuresis and purgation is varied. It is possible that something might be expected from such good diuretics as digipuratum (Knoll) or theocin sodium-acetate, or the two combined. Cathartics cannot be recommended in the depressed state of the cardiac muscle. But if the condition has progressed to such an extent as to be clearly recognizable, paracentesis alone will probably be efficacious. In the patient's weakened condition, and with the knowledge that it will almost certainly have to be repeated, the greatest care to maintain asepsis will be necessary.

In the light of recent treatment of old tuberculosis resistant to sanitarium treatment by artificial pneumothorax, it is interesting to note that Wenckebach has lately advocated removal of the pericardial effusion, and subsequently the introduction of sterilized air into the sac. He reports the case of a man 20 years of age, who had developed tuberculosis of the left apex, and who shortly after admission showed marked evidences of dyspnea, tachycardia, cyanosis, with signs of effusion into the pericardium. Thirteen hundred c. c. were removed, and after seventeen days 1,500 more. Following this second aspiration he had a severe hemorrhage from the left lung. His condition necessitated another aspiration, but the fluid returned so quickly that little could be hoped for from this procedure. Wenckebach had been in the habit of following all thoracentesis with the introduction of air, claiming that by so doing greater amounts of exudate can be removed—that there are not such acute changes in intrathoracic pressure, and that thoracentesis can be freely performed on cases where it would be otherwise impossible. At the next aspiration air was admitted to the pericardium by the apparatus used for artificial pneumothorax (q. v.). There was not so rapid a return of the effusion, it lost its hemorrhagic characters, and, after two more aspirations with the introduction of air, the patient was so much improved that he was able to leave the hospital. He came back to the clinic, but when another aspiration was done and no air admitted he soon complained of rapid filling of the pericardium with its attendant distress. Seven months after the ninth aspiration, when only 300 c. c. were removed, he was found to be much improved—no effusion was demonstrable, he breathed well, and, while his liver was much enlarged, he had good thoracic movements on respiration. The actual existing phthisis seemed improved.

It is only natural for one to consider that such a maneuver had saved his life, for previously the exudate quickly recurred and aspiration was followed by speedy pulmonary hemorrhage.

This is only an isolated case, but when the large number of patients afflicted with pulmonary phthisis have had new life and hope offered to them by the analogous operation of artificial pneumothorax, it is only right to offer a sufferer from tuberculous pericarditis a chance of having such an operation. He has nothing to lose and everything to gain.

PYOPERICARDIUM

In pericarditis occurring in the course of pneumonia and septic infection and in some cases of tuberculosis the exudate is usually purulent from its onset. Pus in the sac is an abscess, and must be treated surgically as such. An incision and free drainage are necessary. The incision is made about 3 cm. to the left of the sternum, or, probably better,

along the lower margin of the left seventh costal cartilage in the epigastrium and upward through the attachment of the diaphragm into the cavity of the pericardium, as advised by Cyril Ogle (Lancet, 1900, i, 693). This incision, being free and at the lowest part of the pericardium, permits of free drainage and of easy exploration and removal of fibrinous masses. It is well to remember that localized encapsulated collections of pus are as commonly met with in the pericardium as in the pleura. But the need for this grade of incision is not as striking as is the case when the pleura is involved, for here the interspaces are wider proportionately and there is less movement on respiration.

A paracentesis alone is not justifiable. The pus must be cleaned out thoroughly. In cases due to a local infection alone much could be hoped for from the injection of one or two c. c. of a 2 per cent. formalin solution in glycerin. This has been followed by excellent results in several cases of purulent pleurisy that I have seen. When the cases are part and parcel of a general septicemia the outlook is naturally very bad.

HEMOPERICARDIUM

Most cases of blood in the sac are due to serious internal hemorrhage. This may be from rupture of the ascending portion of the aorta, of the heart or of the coronary arteries. Hence the flow of blood is so rapid that all the usual means of treating internal hemorrhage are of no use.

The recent improvements of surgical technique in thoracic surgery offer a more hopeful outlook when the condition is traumatic in origin. But if the injury is severe and the outflow of blood great, the patient will die of cerebral anemia or of pressure of the extravasated blood upon the heart.

Cases of hemorrhagic exudate are to be treated as cases of hydropericardium if sterile and if the exudate does not clot. Otherwise they must be dealt with as pyopericardium.

PNEUMOPERICARDIUM

As it is exceedingly rare to find pneumopericardium unassociated with pus in the sac, the treatment must be the same as that of pyopericardium. Some authors advise the removal of the air by aspiration. This would relieve the heart temporarily. The condition and prognosis depend upon the primary disease. As it rarely arises, save late in the course of some severe constitutional disease, like carcinoma of the esophagus with rupture into the sac, or a rupture of a pyopneumothorax, the prognosis is grave.

ADHESIVE PERICARDITIS

Acute pericarditis, whether dry or with effusion, may heal completely, leaving as little trace behind as does an ordinary pleurisy. But if the process is long-drawn out, the probabilities are that there will be vascularization and growth of granulation tissue through the exudate. This process may result in adhesions between the visceral and parietal layers of the pericardium and between the pericardium and other organs. It is the extrapericardial adhesions which cause damage to the heart. Several cases, observed clinically and at autopsy, have shown that no damage results from obliteration of the cavity, if there are no important adhesions to the surrounding viscera or the chest wall. These extrapericardial adhesions may then be (1) to the diaphragm, (2) to the pleura, (3) to the posterior mediastinum, and (4) to the ribs, cartilages, and sternum. In the treatment of the first three the adhesions cannot be removed, and as the structures are all soft there should not be such intense opposition to cardiac work as in the case of the fourth class. In these cases accordingly the prophylactic treatment of cardiac failure is indicated—i. e., work, physical and mental, only to the stage of general slight fatigue—good hours—gentle systematic exercises and avoidance of all strain—digitalis and strychnin if followed by any improvement. Probably anemia will develop early in the course of the disease. This can best be treated with iron and regulation of diet. Cases of polyserositis can unfortunately only be treated symptomatically by aspiration of the effusion as it occurs in chest or abdomen.

In the treatment of the fourth class of extrapericardial adhesions, Brauer, of Marburg, had Peterson do an operation to relieve the condition. Brauer proposed "to relieve the heart functionally by breaking the strong, bony ring of ribs, not by a severe operation with the breaking up of extensive adhesions, but only by substituting a soft covering for the natural bony covering of the heart. The operation was tried upon a patient with adherent pericardium, broken compensation, ascites, and edema. Segments of the third, fourth, and fifth ribs, 7 to 9 cm. in length, were resected under light narcosis, the periosteum being carefully removed. The patient made an uninterrupted recovery. His pulse soon became stronger and more regular, the ascites and edema disappeared, and he was able to do heavy work without symptoms. The pulse still remained irregular."

To date I have been able to find thirty-two cases. Twenty-four of these have shown marked improvement; in some instances this was evident, even during the course of the operation.

The myocardium must be in good condition. As the fibrosis resulting in adhesions takes place there is a similar process infiltrating the muscula-

ture of the heart, which, it will be recalled, is always involved to some degree in pericardial inflammation. The physician must satisfy himself that this has not proceeded to an extraordinary degree. To ascertain the actual condition of the heart muscle, the patient should be observed in bed, and under the effects of exercise and drugs. Persistence of unmodified dyspnea, cyanosis, and edema are contraindications to the performance of the operation. I feel that in cases where a failure of circulation has occurred, and there are present evidences of well-marked adhesions to the chest wall—i. e., tugging in of the lower ribs, fixation of the left border of cardiac flatness on inspiration, immobility of the cardiac apex on change of posture, fixation of precordial region on inspiration—the operation should be brought to the attention of the patient and relatives at an early date. Surely, with these physical signs, especially if corroborated by a good radiologist, we need not wait till the failure that is bound to come occurs. If the operation is performed in a quiescent period, the chances of improvement are much greater than if during an exacerbation of the chronic heart failure. This quiescent heart period, moreover, makes the choice of an anesthetist much easier. The greatest attention should be paid to the selection and administration of the anesthetic to make the shock as small as possible. Schlayer is of the opinion that several cases of polyserositis have been subjected to this operation without adequate care being taken in the differential diagnosis. These cases naturally are not suitable ones for Brauer's operative interference.

The operation itself is fairly simple. A horseshoe-shaped incision is made over the third rib, extending from the sternum to the mammillary line, and downward to the sixth or seventh rib. The pectoralis, and all structures above it, are turned upward in a flap. Then the third, fourth, fifth, and sixth ribs and cartilages, or as many as will be found implicated, are removed for four or five inches from the sternum. The periosteum behind the ribs is left to avoid injuring the pleura. Some surgeons prefer removing the periosteum by dissection after the rib excision; others destroy the osteogenetic properties by cauterization. Some have pointed out that, as most of the cases are young and the cartilages are still uncalcified, there will be no growth from perichondral tissues. This matter must be left to the discretion of the surgeon doing the operation.

As post-operative care, a long convalescence with a course in cardiac gymnastics is much to be desired.

CHAPTER II

DISEASES OF THE CIRCULATION, EXCEPT PERICARDITIS

CHARLES SPENCER WILLIAMSON

ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS

Regarded merely as a motor, as the great central driving power of the circulation, the heart presents a number of features which the clinician should keep constantly in mind in order to obtain the necessary perspective for successful treatment.

The Work of the Heart.—The work done by the heart depends upon three factors: the systolic output of blood, the pressure in the aorta which must be overcome, and the velocity which the mass of blood attains. Assuming the volume of blood expelled by each ventricle to be 60 c. c., the aortic pressure to be 150 mm., and the pulmonary pressure to be 60 mm., we have:

Left ventricle	60 gms. $\times 0.150 \times 13.6 = 122.4$	gram meters
Right ventricle	60 gms. $\times 0.060 \times 13.6 = 48.96$	gram meters
	171.36	gram meters

The factor 13.6 represents the density of mercury. A certain amount of energy is expended, in addition, in imparting velocity to the blood. Assuming the velocity for the aorta and pulmonary artery to be 0.5 meter, and using the formula $\frac{WV^2}{2G}$, in which W equals the weight of the mass moved, V the velocity, and G the acceleration of gravity, we have the energy, calculated as mechanical work, expended equal to: $\frac{60 \times (0.5)^2}{2 \times 9.8}$ $= 0.76$ gram meter, or 1.52 gram meters for both ventricles. The total mechanical work done by both ventricles at each ventricular contraction will be, therefore, 171.36 plus 1.52 = 172.88 gram meters, i. e., the force necessary to raise 172.88 grams of blood through a height of 1 meter. This simple calculation makes it plain that nearly all the work of the

heart is expended in overcoming resistance in the arteries. If we assume a pulse rate of 70, in one day the heart's work would be $172.88 \times 70 \times 60 \times 24 = 17,426,284$ gram meters $= 17,426.284$ kilogram meters of mechanical work. In round numbers, this marvelous little motor performs work each day equal to that done in raising 17,500 kilograms through a distance of one meter. In a lifetime of sixty years this amounts to the enormous total of 381,629,000 kilogram meters of work.

Equally remarkable is the heart's adaptability, that quality of the human motor which, in a purely mechanical contrivance, would be called flexibility. The heart responds instantaneously to every demand made upon it, provided, of course, that the demand lie within the limit of its capacity. It accommodates itself with equal ease to the quiet of sleep or to the tremendous exertions involved in severe athletics.

The output at each contraction varies from 59 c. c. at rest to over sixfold that amount at heavy work (Plesch). Perhaps the very best test of the soundness of the heart is its ability to respond instantaneously to each and every one of the widely varied demands made upon it under the ordinary conditions of life.

Anatomical Structure of the Myocardium.—The arrangement of the muscular fibers of the heart is peculiar, and their study simplifies, in some measure, the understanding of the processes involved in the heart's contraction.

In the auricles the arrangement is a relatively simple one. The superficial fibers are common to and encircle both auricles. In addition to these each auricle has an independent system of fibers which arise from and are inserted into the auriculoventricular ring, running at right angles to the outer layer, and forming a series of loops.

The musculature of the two ventricles may be regarded as forming two independent systems, in spite of the fact that the muscle fibers are practically continuous. Keith has shown that the ventricles themselves have no definitely fixed point, but that their fixation depends upon their attachment by means of the great vessels at the base. In addition, the pericardium, which is fixed to the deep fascia and reflected onto the great vessels, forms another fixed point. At the apex a large number of fibers converge, forming the peculiar "whorl." These fibers, coming together from different directions, act in an antagonistic sense, mutually aiding in rendering the apex a relatively fixed point. According to MacCallum, there are three distinct layers of muscle fibers, so arranged that they form a wound-up scroll. This arrangement causes the most superficial layer of the left ventricle to dive down, as it were, and reappear as the deepest layer of the right ventricle, the muscle bundles thus passing from ventricle to ventricle. This has an important clinical bearing, as it shows why the ventricles beat synchronously, even after one of the branches of the bundle of His (left) has been cut through (Barker and Hirschfelder).

In addition, another muscle bundle, the mitroaortic ring, exists, quite independent of the others, which surrounds the two orifices named. This is regarded as being the homologue of the bulbus arteriosus. Of the three layers of muscle the middle layer is by far the most powerful, and is the greatest factor in furnishing the driving power. It must not be forgotten that the closure of both the auriculoventricular and semilunar valves is dependent, to a very considerable degree, upon muscular action. This is especially true of the auriculoventricular valves, as in them there is not the same solid basis of support as in the case of the aortic and pulmonary valves. Most of the so-called functional insufficiencies, especially of the mitral and tricuspid valves, are, in reality, "muscular insufficiencies," due to the failure of the muscle ring to narrow the opening so as to permit of effective closing by the valve segments. The longitudinal fibers of the ventricle, forming an internal and external layer, assist the circular middle layer in that they prevent the ventricle from elongating during systole.

The Apex Beat.—The apex beat is produced by the hardening of the muscle and by the changes in form which ensue in the ventricles during their systole. Briefly, these are as follows: During diastole the apex lies against the chest wall, but in a position lateral to the long axis of the heart; that is, if a perpendicular be erected to the base of the heart at its middle point, and this be taken to represent the axis of the heart, the apex during diastole of the ventricles lies to one side of this line. With the systole the heart erects itself and the apex approaches the perpendicular. As the heart muscle is soft and yielding during diastole, there is no impulse during that period; but, as the muscle hardens during systole, it overcomes the resistance of the intercostal muscles, and, pushing these outward, produces the apex beat. The apex itself does not move either up or down to any appreciable extent. In addition to this movement of erection, the apex turns about from left to right and forward. This movement of torsion is a complicated one, resulting in part from several different sets of fibers of the ventricle exerting traction in different directions. It is probable that the right ventricle may even have its wall, which is much thinner and, hence, less resistant than that of the left, pulled in during systole. The cross-section of the heart during diastole is an ellipse, with its shorter axis running anteroposteriorly. During systole the cross-section approaches a circle. It is important to remember that, in many instances, the apex beat may not be palpable with the patient lying on his back, nor, indeed, when sitting up, unless he leans forward or to the left. The apex is quite movable with change of position. This movability amounts to about 3.5 centimeters to the left and 1.5 centimeters to the right, measured with the patient in the corresponding lateral posture, from the position of the apex in the erect position.

Properties of the Heart Muscle.—The cardiac muscle shows, in some respects, marked differences from the skeletal muscles.

Rhythmicity.—The heart muscle is constantly undergoing contractions of a rhythmical character.

The "All-or-nothing" Law of Bowditch.—With each contraction the heart uses up its entire stock of energy, i. e., *every contraction is a maximal one.* The skeletal muscle contracts, when stimuli are applied to it, with varying degrees of force, and these are proportionate to the strength of the stimuli. The heart muscle, if it responds to a stimulus at all, responds with a maximal contraction. This is not to be taken as meaning that the heart always puts forth contractions of equal strength, for such is not the case; the force of its contractions depending largely upon its state of nutrition. But, for a given state of nutrition, the contraction is always maximal, and bears no relation to the strength of the stimulus, providing this be strong enough to produce a contraction at all.

The Refractory Period.—It has been known since Marey's researches that the heart fails to respond to electrical stimuli during the period of its systole. If an electrical stimulus be applied to the heart in systole, no contraction results, whereas the same stimulus applied during diastole produces a contraction. The period during which the heart fails to respond to stimuli is known as the refractory period. The latent period, which exists before the extra contraction, depends upon the time at which the stimulus is applied, being shorter as it reaches the heart later in the diastole. If, then, the heart shows a total lack of irritability during its contraction, it follows that all stimuli which reach it during this period are lost, so far as causing contraction is concerned. Associated with this phenomenon is that of the compensatory pause. If an extrasystole be produced by ventricular stimulation, this will be followed by a longer pause. The extrasystole, occurring early in diastole, liberates only a feeble contraction, and yet the contractile substance is entirely exhausted. It thus requires a pause to recover itself. The next auricular impulse, falling in the refractory period of the extrasystole, is not utilized, and the heart picks up its normal rhythm again with the second auricular impulse.

Cause and Origin of the Cardiac Beat.—It has been known since the work of Ludwig's pupils that the rhythmic action of the heart is dependent, in a large measure, upon the inorganic constituents of the blood serum. While a frog's heart will continue beating for some time when perfused with a physiological salt solution, yet, after a time, the contractions gradually become weaker and then entirely cease. If, for the physiological salt solution, a mixture of NaCl, 0.7 per cent., KCl, 0.03 per cent., and $CaCl_2$, 0.025 per cent., known as Ringer's solution, be substituted, the heart will continue beating strongly for a much longer time. The mammalian heart may be kept beating for many hours if perfused with

Locke's fluid and provision be made for supplying oxygen. Locke's solution consists of: NaCl, 0.9 per cent.; $CaCl_2$, 0.024 per cent., KCl, 0.042 per cent., $NaHCO_3$, 0.01 to 0.03 per cent., with dextrose, 0.1 per cent. The analysis of the results obtained from such perfusion experiments has shown very clearly that these inorganic salts play a very important rôle in the production of rhythmic action in the heart, and, moreover, that each of the three salts, calcium, sodium, and potassium, has its own especial part to play. If the terrapin heart be perfused with oxalated blood, i. e., blood from which all calcium has been precipitated, by sodium oxalate, it ceases to beat, but with the addition of calcium chlorid in proper proportions it resumes its rhythmical beat at once. A single ion may be toxic by itself, but useful in combination with other ions (balanced ion solution). Although many of the details in regard to these significant facts are matters of controversy, yet there is general agreement on the main points.

While these facts bring to us a more intimate knowledge of the conditions under which the cardiac contractions are carried on, they still do not settle the moot question as to whether the ions act by generating stimuli through the intervention of nerve tissue, or whether they produce contractions by acting directly on the cardiac muscle. The first of these ideas, the neurogenic theory, is the older, but most of the advances in cardiac physiology and pathology in recent years have been made by the advocates of the myogenic theory. It is beyond the scope of this résumé to enter upon a detailed discussion of this subject, but the main facts are as follows:

Neurogenic Theory.—According to this view, the cardiac contraction is originated within the nerve cells. Now, since the normal movements of the heart take their inception at, or near, the orifices of the great veins, it is assumed that they originate in the nerve cells in that part of the heart. These cells are regarded as forming an intrinsic motor center, which initiates the rhythmical contraction of the heart. Inasmuch as the sequence of the normal beat is invariably the same, it is assumed that the stimulus to contraction is transmitted from the sinus region where it started, along subsidiary nerve paths to other ganglia in the auricles, and from these the auricular musculature is excited. From these auricular nerve cells the stimulus is transmitted to other nerve cells lying in the vicinity of the auriculoventricular groove, which in their turn excite the ventricular musculature to contraction. This view regards the heart as possessing what may be called an intrinsic central nervous system, with a principal automatic motor center situated in the sinus region (ganglion of Remak), and subsidiary or branch centers in the auricles and in the neighborhood of the auriculoventricular groove. On this basis the orderly, consecutive cardiac contraction is due to the definite nerve paths followed by the stimulus. Under abnormal conditions

the subsidiary centers may develop an automatic action of themselves. The same assumption of definitely connected nerve paths explains the coordination of the contractions of individual muscle fibers, and, again, under pathological conditions, the phenomena of fibrillation.

The histological connections assumed by the advocates of this theory have not been satisfactorily worked out, at least in the requisite detail, but the main points in the arrangement of the cardiac nerve centers have been established, and they make this view at least possible. In the same way many, or even most, of the facts regarding the heart beat, both normal and pathological, are explicable on the basis of this theory.

Many attempts have been made to adduce a single fact which would demonstrate without doubt that, in the vertebrate heart, the nerve centers are responsible for the cardiac contractions. An observation of Kronecker to the effect that, if a needle be thrust into the ventricle of the dog's heart along the upper part of the septum, the ventricle at once falls into fibrillar contractions from which it does not recover has led many to consider that this is due to the destruction of a nerve center at that spot, as a similar trauma may be inflicted at other places in the ventricle with no such results. Carlson has found that in Limulus polyphemus, the horseshoe crab, a dorsal cord of nerve tissue is the cause of the cardiac contraction. Removal of this causes cessation of contraction. It must be observed, however, that the heart in the crustacea is of an entirely different character from that of the vertebrates, in that there is no refractory period. Hence, it is capable of giving submaximal contractions, and it can be tetanized by the application of appropriate stimuli. Tigerstedt remarks in regard to this that: "It is hardly admissible to conclude from this observation that the same thing is true of the vertebrate heart, for the physiological mechanisms of these two widely differing organisms may be absolutely different."

Myogenic Theory.—This, which has been developed in its modern aspect by Gaskell and Engelmann, assumes that the cause of the stimulus to contraction lies in the intrinsic properties of the cardiac muscle fiber itself (automatic rhythmicity). According to this view, the property of the rhythmic automatic contraction is most highly developed in the auricles just at the entrance of the great veins. This region, when isolated, can be shown to beat faster than the rest, acting, to use Erlanger's phrase, as a "pace-maker" of the heart. The adherents of this theory regard the nerve cells of the heart as connected with the extrinsic cardiac nerves, which in this manner exert a controlling influence upon the rate and the force of the heart beat, but which have no part in its origin. Gaskell has demonstrated that the heart muscle has the following intrinsic functions:

Stimulus Production.—It can, of itself, originate a stimulus which can cause the heart to contract.

Excitability.—By this is meant that it can receive the stimulus when it has once been originated.

Conductivity.—It is capable of transmitting the stimulus which it has originated or received from one fiber to another.

Contractility.—It has the power of undergoing contraction when stimulated.

Tonicity.—This latter function has been added to the four first enumerated by Mackenzie. When the active contractile movement has ceased the heart muscle still remains possessed of a certain degree of contraction, the extent of diastole indicating the degree of tonicity.

The *stimulus production* is assumed to be due to some product of cell activity which is secreted and accumulated during the period of the heart's pause, and, when a sufficient quantity has been stored up, a quasi-explosion occurs and the entire amount of accumulated material is used up in producing the contraction of the muscle cell. This process of building up and breaking down goes on continuously, under the presupposition that the heart receives its due quota of pabulum. The *excitability* of the muscle cell is well accounted for under this hypothesis. Immediately after the material has been used up in producing a contraction, there is no possibility of the cell responding to a further stimulus (refractory stage), as there is no available material to produce a contraction. This material immediately begins to reproduce itself, so that, as the time increases from the previous contraction, more and more material accumulates, and the function of excitability returns. Furthermore, the excitability returns just in proportion as this material accumulates. When the contraction occurs late in diastole it is correspondingly stronger, since it liberates a greater store of energy. It has been shown that, when the diastole is prolonged and the muscle becomes surcharged with the material, irritability is greatly increased.

The *conductivity* of the heart muscle cell is slower than that of the nerve fiber and is more readily exhausted. Like the excitability, it is temporarily in abeyance after having been exercised, and returns in the same way, that is, gradually. The rate of conduction varies in different portions of the heart, being greater, for example, in the auricles than in the fibers joining auricles and ventricles.

The *contractility* becomes exhausted, just as do the other functions, by the expenditure of all the energy-producing material. In the same way as the excitability, it depends for its strength on the amount of material capable of being set free at that particular moment, to initiate the contraction, being greater late in a long diastole, when the supply is greater, by virtue of the longer rest.

The myogenic theory has been of especial use in the elaboration of the modern theory of arrhythmia. A number of arguments may be adduced in its favor. Of these the most important are the following:

A dog's heart has survived for months after severance of all connections with the brain, spinal cord, and sympathetic system.

All experiments having for their purpose the production of the heart beat by stimulation of nerves have proved nugatory.

Kuliabko has shown that, in the human heart, removed at post mortem, contractions may be restored to both auricles and ventricles by perfusion with the artificial medium above-mentioned, saturated with oxygen.

That the heart muscle is the seat of very active metabolic processes is shown by the development in it of heat and electricity.

The most convincing argument of all is the fact that the embryonic heart has an established rhythm at a time when no nerve cells can be demonstrated.

Bits of heart muscle which contain no nerve cells show automatic rhythm.

Lastly, Engelmann has shown that, when the ventricle is traversed by a series of zigzag cuts from base to apex, in such a way as to insure the solution of continuity of all nerve paths, and with the individual cuts hanging together by only small bridges of muscular tissue, the contraction waves still go on.

Engelmann has classified the influences which act upon the four cardinal properties of cardiac muscle. He distinguishes:

Chronotropic influences, those which affect the heart rate.

Inotropic influences, those which affect the contractility, i. e., the force and size of the heart's contraction.

Bathmotropic influences, those which affect the irritability, i. e., determine the least stimulus to which the heart will respond by a contraction.

Dromotropic influences, those which affect the rate of conductivity of the heart.

Positive chronotropic influences cause an acceleration and negative a slowing of the heart's rate.

Positive inotropic influences cause an increase and negative a decrease in the strength of the cardiac contraction.

Positive bathmotropic influences cause an increase in irritability and negative a diminution.

Positive dromotropic influences cause an increased and negative a diminished conductivity.

Nerves of the Heart.—The two sets of efferent fibers which reach the heart from the central nervous system are known as the inhibitory and accelerator fibers, carried by the vagus and sympathetic nerves respectively.

Inhibitory Fibers.—The vagus gives off fibers both in the neck and in the thorax, the latter near the origin of the inferior laryngeal nerve. It is held that some of the inhibitory fibers may come from the latter

directly. These superior and inferior branches enter into anastomoses with the sympathetic fibers to form the cardiac plexuses.

Stimulation of the peripheral end of the vagus produces either a slowing of the heart beat or its entire cessation in diastole (negative chronotropic), and diminishes the conductivity from auricle to ventricle (negative dromotropic action). In addition to these, a weakening of the cardiac impulse may be produced by vagus stimulation (negative inotropic influence).

The vagus action exerts a predominant action on the auricle. According to Gaskell (terrapin), its action is limited to the auricle. This is inferred from the fact that, after inhibition of the auricle, the excursions of this chamber grow larger and larger until they regain their normal size. The ventricle, on the other hand, responds with its first contraction of a normal or even larger than normal size, as it has become surcharged with the energy-producing material. On this basis the ventricle fails to contract because of the failure of the normal auricular stimulus.

The cardioinhibitory center, a cell group situated in the medulla, somewhere in the vago-glosso-pharyngeal nucleus, is in a state of tonic activity. In other words, there are constant stimuli passing from this center, which render the rate of the heart less than it would be were this inhibition not present. This is evidenced by the simple section of the vagi, a procedure which instantly greatly increases the heart rate. It is believed that this action is not an automatic one, that is, that it is not due to the originating of stimuli in the center itself, but to a reflex tonus action. Many afferent nerve fibers might produce such a reflex tonus and the anatomical distribution of the vagus itself would make such a reflex from the stomach and perhaps some other abdominal viscera comprehensible. Goltz's celebrated experiment in tapping the abdomen of a frog and thereby producing cessation of the heart beat is an example of this kind of reflex inhibition. Gaskell believes that the essence of inhibitory action is to be found in a metabolic activity, the reverse of that which occurs during cardiac contraction. The contraction of cardiac muscle is attended with a breaking down of the contractile material; in other words, with a katabolic metabolism setting free heat and energy. When the heart is inhibited by vagus action the converse is true; that is, the metabolism is anabolic, and attended with the building up of the contractile material. This view regards the vagus as the anabolic nerve of the heart, which thus aids in assisting its nutrition.

Accelerator Fibers.—These belong to the sympathetic system and take their origin through the second, third, and fourth thoracic nerves (white rami communicantes), pass to the inferior cervical ganglion, and from there pass to join the cardiac fibers derived from the vagus, to be distributed in the cardiac plexus.

Stimulation of the accelerator fibers results in increasing the heart,

rate (positive chronotropic), and in most instances the force of the contraction as well (positive inotropic influence). This latter effect is by some supposed to be due to a special set of fibers (augmentors).

The accelerator fibers, like those of the vagus, are in a constant state of tonic action. Complete section of accelerator nerves slows the cardiac rate. There are, therefore, two sets of influences constantly in play, the one set tending to slow the heart, the other tending to increase its rate. This arrangement would seem admirably adapted to permitting the heart to respond quickly and with balanced action to stimuli of either kind.

The well known effects of psychical processes upon the heart make it clear that the centers of the cardiac nerves must be in a most intimate connection with higher centers. As has been already sufficiently explained, the fact that the heart is regulated in all ways by the extrinsic cardiac nerves makes it none the less true that the heart can survive and contract when cut off from all these.

In regard to the mode of action of the cardiac nerves but relatively little is known. Howell and Duke, in a recent series of experiments, have shown that after vagus stimulation potassium is liberated by the heart muscle, and may be recovered in increased amount in the perfusion fluid. Vagus inhibition seems to be, therefore, a potassium effect. A further analogy exists between the action of this element and vagus inhibition in the increase of the latter after large doses of this element.

Afferent Fibers.—The N. depressor probably ends in the walls of the aorta just above the heart. Stimulation of its terminal fibers, as in stretching by high pressure, produces a fall of the general blood pressure (C. Hirsch and Stadler). According to Wooldridge there are large numbers of sensory afferent fibers in the heart, by means of which the various reflexes affecting both heart and blood vessels are produced. Mackenzie holds that the clinical evidence of the existence of such fibers is incontrovertible, and clinical experience in angina pectoris seems to bear out such a supposition.

Conducting Paths.—Irrespective of which view of the origin of the stimulus to contraction was adopted the assumption of a propagation of the stimulus by the muscle fibers themselves met with many difficulties. These have recently been greatly lessened by the discovery in the myocardium of definite muscular conduction paths, and in particular of a direct muscular path of communication between the auricles and ventricles, bridging over what had previously been regarded as an insuperable obstacle to the transmission of stimuli by the muscular fibers, since the auricles and ventricles seem completely separated by the auriculoventricular tendinous septal ring.

In the lower types of animals, for example, the terrapin or the frog, there is an obvious connection between the auricles and ventricles in the form of a muscle band which has somewhat different properties from that

of either auricle or ventricle. The functions of this band were investigated and demonstrated by Gaskell in the eighties. No one had succeeded in demonstrating a similar structure for the human or mammalian heart, and it was believed that the fibrous atrioventricular ring separated completely the auricles from the ventricles and thus offered an impassable barrier to the passage of a stimulus conveyed by the musculature. About ten years later Kent discovered that, in the rat, there could be demonstrated a strong strand of fusiform muscle cells connecting the atria and the ventricles, and running in the membranous septum. Almost simultaneously His, Jr., described a similar bundle in mammals and in man. The discovery of this muscular connection between auricles and ventricles gave a strong impetus to the development of the myogenic theory, as it could now be shown that the muscular conduction of the wave was at least anatomically possible.

Tawara, working under Aschoff, discovered a muscular conduction system consisting of rather slender muscle fibers, surrounded by firm connective tissue. By serial sections Tawara succeeded in demonstrating that the Kent fibers and the His bundle were, in reality, Purkinje fibers, of which a rich network extends through both ventricles. These take their origin in a tissue node (atrioventricular node), near the entrance of the coronary sinus in the wall of the right auricle. It then passes over the auriculoventricular septum under the median cusp of the tricuspid valve. While traversing the septum it breaks up into two branches, a right and a left, these passing to the corresponding ventricles. In the left ventricle it widens out, in somewhat of a fanlike fashion, into a thin ribbonlike band, passing downward to the apex in the form of fine, delicate branches. In the right ventricle the fibers are less numerous, and it continues as a slender, rounded bundle terminating at the apex in fine branches which run to the muscle fibers. This is described as consisting of pale, faintly striated fibers. It is supplied by a definite artery of its own and receives filaments from the vagus and sympathetic nerves.

The auricular portion of the Tawara system has, in addition to that already described, a second node (the sinoauricular, or Keith's node), which lies between the vena cava superior and the right auricular appendix. Both these nodes lie in a portion of the heart built up from the sinus venosus which, in fetal life, initiates the stimulus for the contraction wave. The sinus venosus, according to morphological investigations, is taken up into the great venous trunks at their entrance into the auricle. There is, in the adult heart, no independent structure corresponding exactly to the sinus venosus of the embryo, but the Keith's node, just described, may be regarded as a remnant of the sinus portion of the primitive cardiac tube.

Initiation and Propagation of the Contraction Wave.—Just as the normal place for the origin of the stimulus to contraction in the frog lies in the sinus, so in man the contraction starts with that part corresponding

to the original sinus, that is at the entrance of the vena cava superior in the sinoauricular node. From here the stimulus is propagated simultaneously to the auricles, initiating their coördinated contraction. From the auricles the conduction path is through the bundle of His by means of the Tawara fibers along the septal wall to the apex, directly to the papillary muscles which contract first, then to the ventricular musculature which begins its contraction at the apex, the wave then spreading to the base. In this manner, after the fashion of a peristalsis, the blood is forced into the great arterial trunks. The serial sections of Schoenberg have further disclosed that numerous muscle bundles run from the vena cava superior across to the auricle, gradually fusing into larger bundles, separated by a tissue bearing many lymph and blood vessels. In the sulcus formed by the entrance of the vena cava superior into the auricle numerous fibers resembling Purkinje fibers are seen. This sulcus, in reality, represents the venosinal junction and the muscular fibers described take their origin in the sinus.

Events of the Cardiac Cycle.—The cardiac cycle embraces the time which elapses from any given phase of the heart's action until that phase recurs. If we begin at any phase of the cycle of events which is well defined and can be accurately determined, e. g., the closure of the semilunar valves, we may describe the sequence of events as follows: The second heart sound occurs precisely at the moment of closure of these valves, the ventricles are at this moment relaxing from their systole. At the same time the auricles are in diastole, and during the time of the relaxation of the ventricles the auricles are being dilated by the blood which flows into them from the great veins. With the ventricular relaxation completed the pressure of the blood from the auricle opens the atrioventricular valves. During the time which elapses from the opening of these latter to the beginning of auricular systole the blood from the great veins is filling both auricles and ventricles. As the pressure in the ventricles rises, i. e., as they become nearly filled, the cusps of the atrioventricular valves are floated up by the eddies produced by the influx of blood from the auricles and are thus placed in position for perfect closure with no backward leakage at the beginning of ventricular systole. In other words, during the entire time of ventricular filling there are forces at work in the shape of centripetal eddies, rebounding from the ventricular walls, which tend to close the atrioventricular valves. This, however, is prevented by the pressure exerted by the contraction of the auricle. The instant the auricular systole ceases these eddies produce closure of the orifice, even before the intraventricular pressure has developed to any considerable degree. At the end of auricular systole, therefore, the valve flaps are practically in apposition, and it requires but a very slight increase in the intraventricular pressure to close them tightly.

Several clinical phenomena are due to the auricular contraction. The

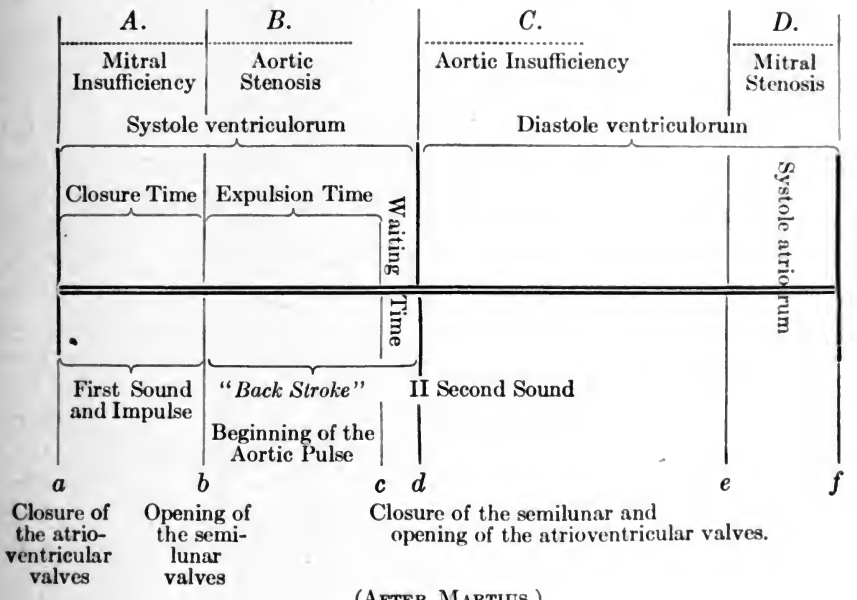
contraction of the right auricle produces a momentary retardation of the venous flow from the great veins, and this produces the normal (physiological, presystolic, or negative) venous pulse in the jugular, which is clearly shown in the tracings from that vein. Following the auricular systole and the closure of the auriculoventricular valves the ventricles contract. The first sound begins with the closure of these valves and hence is partly valvular in character. This is borne out by the clinical observation that, in certain cases of heart block, where there is no ventricular systole following the auricular contraction a sound is heard at this time. The duration of the first sound is almost exactly the same as the time in which the intraventricular pressure is rising, that is, it is completed before the opening of the semilunar valves and before blood enters the aorta. The first sound is loudest at its inception (decrescendo). At the base it has been shown that the first sound is heard just at the moment when the semilunar valves open, i. e., at the beginning of the expulsion time. In ventricular systole at least two important periods must be distinguished. In the first of these, the period of tension (closure) time, the pressure in the contracting ventricles is increasing to the point where it equals that in the aorta (or pulmonary artery), and suffices to open the aortic (or pulmonary) valves. It follows that during this period the semilunar as well as the atrioventricular valves are closed. Since this is the only phase of the heart cycle in which all the valves are closed it is known as the closure or tension time. When the pressure in the ventricles exceeds that in the aorta and pulmonary vessels the semilunar valves open and blood enters the great vessels. This period is known as the expulsion time.

Apex Beat.—The most striking objective phenomenon of the ventricular systole is the apex beat. While it has been settled beyond all doubt that the apex beat is a function of the systole and not of the diastole, yet there is still much discussion as to whether the apex beat lasts throughout the entire systole or whether during only a part of that time. It is certain that much of the discussion has been due to a misconception of terms. Clinically one means by the apex beat the protrusion which is felt, and no one would include (without doing violence to the clinical idea involved) the rebound. The physiological curves include this latter, and so, as a matter of course, the apex beat is pictured as lasting entirely or at least nearly through the systole. Now it is quite certain that the changes in form to which the apex beat is due occur nearly, if not entirely, during the closure time, and that the height of the apex beat is attained at approximately the time of the opening of the semilunar valves. As Martius, who is the chief exponent of this view, pithily puts it, "the apex beat is a function of the closure time." During the expulsion time, if the apex beat be fairly forcible, there can be seen and felt a sudden falling away of the beat, the classical "backstroke" of Hope. Following the expulsion time there is, according to Martius, a short period of time before the closure of the semi-

lunar valves occurs and before the diastole begins. This is of no especial clinical interest.

A third heart sound has been described and is frequently audible to well-trained ears, but it has attained no great clinical importance. The events of the cardiac cycle are well shown by the following diagram:

EVENTS OF THE CARDIAC CYCLE.



(AFTER MARTIUS.)

Time Relations of Systole and Diastole.—The average duration (Howell) of the separate phases, assuming a pulse-rate of 70, is as follows:

Ventricular systole=0.379 second.
Ventricular diastole and pause=0.483 second.
Auricular systole=0.1 to 0.17 second.
Auricular diastole and pause=0.762 to 0.692 second.

Martius places the duration of the closure time at seven hundredths (0.07) second.

SUCTION-PUMP ACTION.—Conceivably, the heart exerts, in addition to its force-pump action, some suction action. Inseparably connected with this is the question as to what produces the normal diastole. Experiments have shown that, at times at least, a negative pressure may develop in the ventricles. While some, for theoretical reasons, lay much stress on this, it is probably too small to be a factor of any consequence in the actual movement of the blood mass.

Coronary Circulation.—The older view of the coronary circulation (Bruecke) was that during systole the outflow of blood into the aorta caused the flaps of the valves to be laid back and so to cover the orifices of the coronary arteries, which were reinjected from the aorta after the closure of these valves. More recent experiments have conclusively demonstrated the erroneousness of this view. This is shown by the fact that the pressure-tracings in the coronary vessels are practically the same as in the peripheral arteries. Furthermore, with each systole there is an increase in the velocity of the coronary blood flow, showing that during this period the vessels are in unimpeded communication with the aorta.

More important is the fact that the coronary vessels lie deep in the musculature of the heart and must, of necessity, be pressed upon by the force produced by the systolic contraction of the latter. Curves of the velocity show a great increase at the beginning of systole followed by a drop to or below zero; with the end of ventricular systole there is a second acceleration due to reinjection from the aorta. Perfusion experiments show a systolic spurt from the open vessels. The combined proof of these experiments makes it certain that not only is the coronary circulation not impeded by the heart's own action, but that its flow is increased just in proportion to the strength and frequency of the heart's systole. This is a matter of the greatest clinical importance, as the demands on the coronary circulation vary enormously under different conditions.

The Circulation Time.—The time required to complete the circulation is, in general, that required for approximately 27 heart beats. This would, in man, be equal to about 23 seconds (Hering). More recent observers have found the time to be longer, some estimates placing it twice as great. Under conditions of severe work it may decrease enormously, in extreme cases to as little as 4.5 seconds. In anemias, where the hemoglobin content of the blood is very low, there may be a partial compensation effected by the increased rate of flow (13.5 seconds). The *bruit de diable* is by many believed to have this for its cause, it having been shown that there is a "critical" velocity for the blood which, when passed, produces various *bruits*.

Physiology of Hypertrophy.—Broadly stated, hypertrophy of the cardiac muscle results from long-continued excess of work thrown upon it. It must always be taken into consideration that, under normal conditions, the weight of the heart is directly proportional to the body weight as a whole. Strictly speaking, it is directly proportional to the weight of the skeletal musculature, being high in muscular and low in weak or fat individuals. It is proper, then, to speak of a heart as showing hypertrophy only when the ratio of its weight to the body weight is increased above the normal. This ratio varies with the animal chosen for the comparison. It was found by Bergmann that the ratio of heart to body weight was in the case of

Homo, 1 to 170 (male).
Homo, 1 to 183 (female).
Pig, 1 to 220.
Bull, 1 to 193.
Castrated bull, 1 to 258.
Hare, 1 to 132-140.
Deer, 1 to 186.

In general, wild animals have larger hearts than those under domestication, and it is found that there is an almost perfect parallelism between the development of the heart and that of the skeletal musculature. If we keep constantly in mind that the work of the heart determines its size we readily see why its size increases *pari passu* with that of the skeletal muscles. A great deal of confusion has been brought into the study of hypertrophy and dilatation by not taking the ratio of body weight to the weight of the heart into consideration. The usual custom of judging of the degree of the hypertrophy by the thickness of the wall gives discordant results, as this varies greatly, not only in proportion to the post mortem contraction, but with the degree of dilatation present. The only method which is capable of getting accurate results is the careful separation of the various chambers of the heart, weighing each separately (Mueller's method). Clinically we find that there are two different methods by which increased work is put upon the heart:

(a) The resistance which the heart, or one of its chambers, has to overcome during its systole may be increased, as in stenotic conditions of the ostia. This is the condition of primary hypertrophy, and is unassociated with dilatation of such a degree as may be clinically demonstrated.

(b) During the diastole there may be an increase in the amount of blood which is conveyed to the heart or to one of its chambers, and in consequence the blood mass to be moved at the next following systole is increased.

In both these cases the duration of systole is not appreciably increased, and thus it follows that the heart empties itself against an increased resistance, or expels an increased amount of blood in the same time as under normal conditions.

Both of these results are brought about by the intrinsic reserve power of the heart muscle. If either of these conditions lasts for a considerable period of time the heart, or the chamber affected, undergoes hypertrophy. The histological processes involved in hypertrophy consist largely in the increase in size of the individual fibers and not in their increase in number. The interstitial connective tissue is also increased.

Effects of Hypertrophy.—As stated above, the heart accomplishes an increased work by virtue of its intrinsic reserve power, that is, that amount of power at its disposal over and above the amount necessary to carry on

the ordinary activities of life. This leaves the heart with nothing left for emergencies; for, having used up its reserve power, any further unusual work thrown upon it would at once bring about a condition of cardiac insufficiency. If, then, the heart is to be able not only to carry on the usual routine of life, but to have a margin of safety, it must again accumulate a reserve force, and this it does by undergoing hypertrophy.

Practically a point of very great clinical interest relates to the amount of reserve power possessed by a patient with a hypertrophic heart from some cause such as a valve lesion. Krehl and Romberg consider that the reserve power under these conditions is nearly as great as the normal. Martius, on the other hand, maintains that it is considerably less than normal. Romberg found that animals in whose hearts he had induced hypertrophy as the result of an experimentally produced aortic insufficiency could overcome compression of the thoracic aorta as well as normal animals; in other words, their reserve power was as great as in normal animals.

Such experimental results may not be applied with too great literalness to human pathology, since, as a matter of ordinary experience, a large proportion of hypertrophied hearts have a reserve power very much less than the normal. This arises from a variety of causes. In many instances the same factors that led to the hypertrophy initiated a myocardial involvement, either an acute myocarditis which runs its course and heals out, leaving behind a damaged heart, but one in which the damage is not progressive; or, in other cases, the myocardial degeneration or inflammation may be steadily progressive and thus be the determining factor in the ultimate failure of the hypertrophied myocardium to respond to the demands made upon it. It is quite true, as Romberg remarks, that a hypertrophy does not necessarily involve the beginning of a future cardiac failure through a gradual weakening process, yet, for all that, the hypertrophied heart is not and cannot be regarded in the same light as a normal one. Again, in many valvular lesions, as soon as exertion has to be put forth the pathological factor itself increases in extent so that the normal difference between the energy required at rest and that required with exertion may be largely increased. Thus we may have a heart which manages to compensate the pathological lesion tolerably well while performing no unusual exertion fail utterly to do so when a moderate degree of muscular effort is put forth.

Pathological Physiology of Dilatation.—It is necessary to distinguish two well-marked and cleanly cut classes of dilatation: (a) compensatory (accommodative) dilatation; (b) stasis dilatation. The failure to recognize clinically and to distinguish sharply between these two classes has led to many serious errors in both diagnosis and treatment.

Compensatory Dilatation.—By compensatory dilatation is meant that enlargement of the heart which must follow and be maintained if the

lesion is to be compensated, and which is a necessary concomitant of, and an integral factor in, maintaining compensation. For example, in aortic insufficiency the amount of dilatation of the left ventricle is directly dependent upon, and in proportion to, the amount of blood which regurgitates, providing the heart muscle be sound. This dilatation is a compensatory or an accommodative process, and in this sense beneficent. In mitral insufficiency the same thing is true, for the dilatation of the left ventricle is a strictly accommodative process, and in both these instances the lesion could not be compensated without such dilatation. Dilatations occur always through an increase in the pressure which must be overcome during diastole. The terms primary dilatation, compensatory dilatation, and accommodative dilatation are all synonymous.

As a corollary to this compensatory dilatation a certain degree of hypertrophy must always follow. The chamber in question empties itself during its systole of an increased amount of blood; hence it does increased work and, hence, hypertrophies.

Stasis Dilatation.—This is, under any and all conditions, an evidence of incomplete systole, hence of myocardial insufficiency. When a chamber fails to empty itself as completely as under normal conditions a mass of residual blood remains, and this, added to the normal increment during diastole, produces a dilatation (secondary or stasis dilatation).

This secondary dilatation, dependent as it is upon pathological weakness of the heart muscle, has absolutely no compensatory significance and must always and under all conditions be regarded as a harmful process.

While in most cases it is not difficult to differentiate clinically between these two forms, yet when they are combined it may be quite impossible to say what part of the dilatation is compensatory, i. e., necessary and useful, and what part due to incomplete emptying of the chamber in systole. If one sees for the first time a case of aortic insufficiency in a stage of decompensation, and when a stasis dilatation of the left ventricle has been superimposed upon the compensatory dilatation of the same chamber, it would only be possible to estimate the part played by each of these processes in a very approximate way. If, on the other hand, the case had been seen during perfect compensation and the size of the left ventricle then determined, in other words, the amount of compensatory dilatation determined, it would be a relatively simple matter after decompensation had set in to determine the total size of the chamber. The added amount of dilatation would be due to stasis.

It must be emphasized that a mere determination of the size of the heart alone does not give satisfactory information as to its ability to carry on the circulation in a normal manner.

In well-marked cases of stasis the problem may be sufficiently simple, but in slight degrees one can scarcely be too conservative in the interpretation of apparently slight dilatations, as these often lie well within the limits of the normal variations in size.

Acute Dilatation.—The diagnosis of acute dilatation has always been one which has been made with considerable frequency, which frequency, according to the more modern views, it certainly does not deserve. By acute dilatation is understood a dilatation of the normal heart, as a result of great strain thrown upon it by physical exertion, and which is capable of rapidly returning to its normal size. The researches of de la Camp and August Hoffmann have shown pretty conclusively that in a really normal heart such a condition of things is highly improbable, and that when acute dilatation sets in as a result of overexertion the heart muscle could not have been normal. This exceedingly important question is regarded very differently by different authors. Romberg believes an acute dilatation out of the question with a normal myocardium. Gibson apparently thinks it is common. Krehl takes the view that while its possibility may not be disputed it is certainly uncommon, and this view seems to the writer to be the one which best harmonizes with the facts as we now know them. C. Hirsch aptly remarks in this connection that, in many of the cases, supposedly normal individuals, especially such as pursue a sedentary life, have not in reality a normal heart, as compared with those who lead a more athletic life, and who have, as a result, a better developed heart.

We may, for convenience sake, distinguish three groups of cases:

Myocardium Normal.—A strain which affects the heart to a point of moderate fatigue is not attended by an increase in the size of the heart's outline but, as Moritz has convincingly shown, by contraction of it; or, at most, the outline remains normal.

Myocardium Weakened from Any Cause.—The same degree of strain produces a dilatation which will be transitory if the strain be not too long continued.

Repeated Strains.—These lead to a permanent impairment of the heart's contractility. This is due to the fact that dilatation seriously interferes with the circulation of the coronary vessels, hence in time the myocardium becomes degenerate and permanent weakness sets in.

It is quite probable that the deciding factor in determining whether or not a given series of strains applied to a heart already slightly weakened will produce permanent damage depends on whether the dilatation is allowed to entirely subside before the heart is subjected to a fresh strain. If not we have, as it were, a summation of results. Up to very recently the entire question of cardiac dilatation had been regarded as a purely mechanical one. In recent years the conception of dilatation as a matter of impaired tonicity has become more and more prominent. Mackenzie regards dilatation as a function of depressed tonicity exclusively.

Insufficiency of Left Ventricle.—When the left ventricle, owing to impairment of its strength, empties itself incompletely in its systole the next following auricular systole finds the ventricle already partially filled, hence the auricle cannot empty itself completely. As a result of this the auricular pressure rises, and this increase of pressure is propagated backward through the pulmonary veins to the lung capillaries. These, because of their large diameter, permit of the transmission of the pressure to the pulmonary artery, thereby raising the pressure in the latter. If it should be the case that the right ventricle is sufficiently strong to empty itself perfectly, in spite of the additional work thrown upon it by the heightened pressure in the pulmonary artery, the rapidity of the flow in the lung capillaries will remain normal, even with the increased pressure which thus obtains, as in well-compensated mitral lesions. If the right ventricle cannot perform this extra work the pressure in the pulmonary artery does not rise, and there is less than the normal difference in pressure between the pulmonary artery and the pulmonary vein, with a consequent slowing of the current. In short, stasis develops.

Insufficiency of the Right Ventricle.—When the right ventricle fails to empty itself normally the right auricle, during the period of its systole, is unable to empty itself completely into the already partially filled chamber of the ventricle. As a result the pressure in the auricle rises, and this rise of pressure is transmitted backward into the cavæ. Because of this the pulmonary artery and the left heart receive less than their normal quota of blood and the systemic circulation is imperfectly filled.

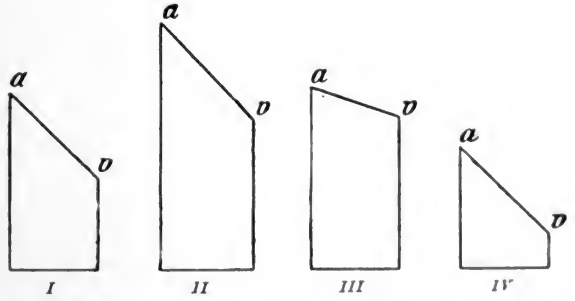


FIG. 1.—*a* = pressure in the pulmonary artery; *v* = pressure in the pulmonary veins. I. Normal pulmonary circulation. II. Pulmonary circulation with increased pressure in the pulmonary veins and correspondingly increased work of the right ventricle (e. g., in compensated mitral lesions), increase of pressure but no slowing of the blood current. III. Pulmonary circulation with weakness of the left ventricle without any corresponding increase of work of the right ventricle; increased pressure in the pulmonary veins with slowed circulation. IV. Pulmonary circulation with weakness of the right ventricle and normal lungs; diminished pressure but no slowing of the blood current. (Romberg.)

The condition in the lungs consequent upon insufficiency of the right ventricle may readily be deduced. The sinking of the pressure in the pulmonary artery is transmitted by virtue of the wide pulmonary capillaries

into the pulmonary veins, provided these latter are normal. The pulmonary vessels contract to accommodate themselves to the diminished amount of blood flowing through them, and the first result of this would be to establish again the normal difference in pressure between the pulmonary artery and pulmonary vein, and the rapidity of flow would remain the same. In many cases it is an increased resistance in the lungs such as, for example, obtains with emphysema, which has led to hypertrophy and subsequent insufficiency of the right ventricle. In these cases the resistance in the lung capillaries prevents the transmission of the decrease in pressure, and thus we have a lessened difference in pressure between pulmonary artery and pulmonary vein, with a consequent slowing of the stream, that is, stasis develops. The accompanying scheme from Romberg illustrates very clearly these different conditions.

The Blood Pressure.—In the enthusiasm engendered in recent years by the invention of instruments for the clinical study of the blood pressure there has been a strong tendency to overestimate the value of such determinations. Numerous attempts have been made to express numerically, by formulæ of one kind or another, the work of the circulation. It must be emphasized that, from the blood pressure alone, no conclusion may be drawn as to the functional integrity of the heart. As a matter of fact the mechanics of the circulation is an exceedingly complex affair. Beginning with the left ventricle, which delivers blood intermittently into the aorta, having a diameter of about two centimeters, the circulation is so arranged as to deliver a constant stream into the capillaries of the body with an average diameter of, let us say, 0.009.

Lateral Pressure and Velocity Pressure.—The *lateral pressure* is the pressure which the blood is constantly exerting on the walls of the

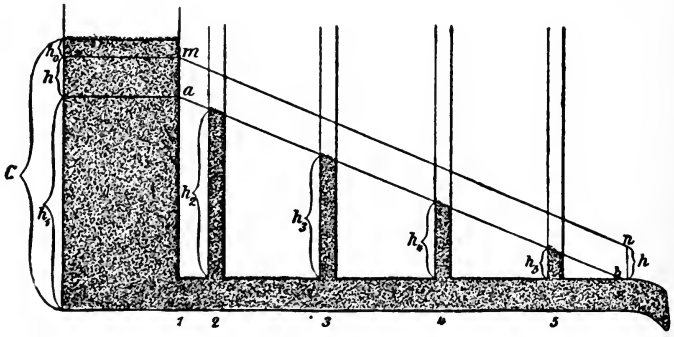


Fig. 2.—Flow of a Liquid in a Rigid System of Equal Caliber Throughout. (Tigerstedt.)

blood vessel in which it is to be measured. The *velocity pressure* is that pressure which is used in driving the blood along with a certain velocity. The lateral pressure, as shown in Tigerstedt's diagrams, is used up in overcoming the resistance which the blood encounters. Assuming the

original pressure to be a constant, the pressures in the side tubes are indicated by the height of the column of fluid supported. This represents the lateral pressure *at that point* because of the resistance of friction exerted by the walls of the rest of the apparatus between the point where the pres-

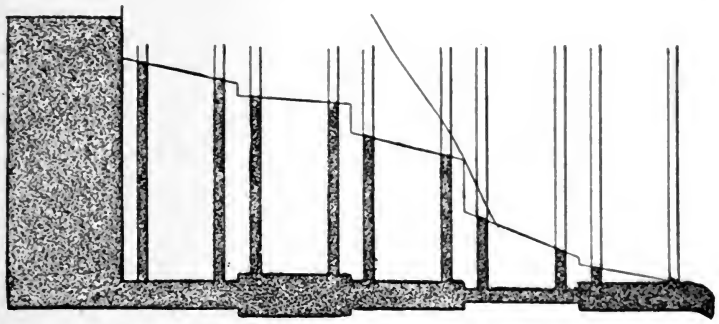


Fig. 3.—Flow of a Liquid in a Rigid System of Varying Caliber. (Tigerstedt.)

sure is to be measured and the exit of the stream. A perusal of the figures shows that the lateral pressure increases uniformly from the point of exit of the stream to the reservoir only so long as the caliber of the tube is the same. It further shows that only a part, but by far the larger part, of the pressure is used up in overcoming the resistance encountered in the course of the flow and arising from friction. The remainder of the pressure is used up in imparting velocity to the liquid.

The End Pressure.—The end pressure is the pressure exerted upon the column of blood in the direction in which it is flowing. It is equal to the lateral pressure plus the velocity head, but as this latter is small it differs by a very little from the lateral pressure. The lateral pressure in any vessel where a branch is given off from it equals the end pressure in the branch.

Such a scheme as that of Tigerstedt represents the basic principles of the circulation, but with two differences which are of the utmost importance in the distribution of the pressures. The first of these is that there is inserted between the arterial and venous sides of the circulation a set of tubes (capillaries) whose diameters are such that they prevent the free transmission of the pressure, i. e., they interpose a considerable resistance to the flow. The second difference, which is of equal importance, is that the tubes are elastic. The effect of the peripheral resistance, as that resistance offered by the arterioles and capillaries is usually called, is to raise the pressure on the arterial side very considerably, with a corresponding diminution of pressure on the venous side.

The effect of the elasticity of the arteries is to equalize the flow. If the blood vessels were rigid tubes each jet of blood projected by the left ventricle into the aorta would be followed by a similar jet from the cavæ

and the pressure would fall to zero during the diastolic period. With elastic arteries the blood projected into the aorta and its branches distends these, and the energy required to accomplish this is again liberated by the elastic recoil of the arteries. A little consideration shows that, with a sufficient rapidity of the discharges into the aorta, this arterial tension becomes such that it effects a continuous flow in the capillaries instead of the intermittent flow from the ventricle. The effect is precisely similar to the air chamber in a fire engine, where the intermittent discharge of the pump is converted into a continuous flow by virtue of the elasticity of the air contained in the air chamber.

It is evident from these considerations that the elastic pressure exerted by the arteries must be in equilibrium with the capillary flow. That is, if we conceive the circulation to be at a standstill, and the heart now commences to beat, blood is received into the aorta more rapidly than it can flow through the capillaries, and hence will accumulate in the arteries until the pressure there is such as to cause a flow through the capillaries into the veins just equal to that received into the aorta from the heart. Under these conditions only do we have a constant flow in the capillaries and veins. The side pressure increases then from the right side of the heart back to the capillaries.

Factors Influencing Blood Pressure and Blood Velocity.—Theoretically we may have the pressure and also the velocity influenced by four factors:

The rate and force of the ventricular contraction.

The elasticity of the blood vessels.

The peripheral resistance.

Total amount of blood to be moved in the circulation.

It is evident, with no further discussion, that, inasmuch as all the energy of the vascular system comes directly or indirectly from the force of the heart's contraction, this latter will, of course, influence the pressure and velocity directly, provided the other factors remain the same.

The elasticity of the arteries is in so far of importance that, if it were entirely done away with and the vessels were absolutely rigid, there would be a reversion to the conditions of the glass-model circulation, with an intermittent flow. There is probably never sufficient rigidity of the vessels in man to have much effect upon the capillary circulation as a whole. The peripheral resistance is affected by the dilatation or narrowing of the small arterioles (vasodilatation or vasoconstriction). This is a factor of the very utmost importance. Vasoconstriction causes (the other factors remaining constant) an increase in the arterial pressure, a diminution in the venous pressure, and a slowing in the velocity of the blood flow. With vasodilatation the lateral pressure falls on the arterial and rises on the venous side of the circulation.

The effect of differences in the total amount of blood is a very small

one, as this is rapidly compensated by changes in the contraction of the arterioles. The viscosity of the blood has an influence on the friction and hence on the rate of blood flow, but, under ordinary circumstances, these are probably of small moment, although under certain pathological conditions viscosity may be a factor of some importance.

In addition to these factors which affect the blood flow there must be reckoned the effect of simple hydrostatic pressure. In standing the arteries of the feet have the highest hydrostatic pressure to sustain since they support the weight of the entire column of blood above them. In the clinical determination of blood pressure this is a fact which must be taken into account. In changing from a long-continued recumbent position to the erect this is very manifest and gives rise to unpleasant symptoms of temporary dizziness and weakness until the circulation has had time to adjust itself to the new position.

While, as already stated, the essential motor of the circulation is the contracting heart, yet there are accessory factors outside the circulation which influence the flow of blood. These are, especially, respiration and muscular exercise. With each inspiration the intrathoracic pressure becomes less and hence the flow of blood to the heart is accelerated. In addition the intraabdominal pressure is increased by the descent of the diaphragm, and thus the flow in the cava inferior is further assisted. The veins being thin walled, and having a small internal pressure, are readily influenced, whereas the arteries are probably little or not at all affected.

Maximal and Minimal Pressure.—In the systole of the heart, as soon as the closure time has elapsed (0.07 to 0.09 second), the aortic valves open and the aorta receives its charge of blood. The aortic pressure soon reaches its maximum, and from this maximum it slowly declines until it reaches the lowest point just before the next systole, that is, at the end of diastole. This descent in pressure is due to the escape of the blood through the capillaries. The highest point is known as the maximal (systolic), the lowest as the minimal (diastolic) pressure.

Pulse Pressure.—The difference between the maximal and minimal pressures is known as the pulse pressure. The mean blood pressure cannot be regarded as the simple arithmetical mean of the maximal and minimal pressures since the pressure curve, that is, the pulse wave, is not uniform, and the descending limb is interrupted by smaller pressure waves. The mean pressure lies, in general, a little nearer to the minimal than to the maximal pressure. It must vary with the pulse curve.

The maximal pressure falls very quickly as the periphery is neared and approaches the minimal, so that in the arteries of the smallest size they are nearly identical. The minimal pressure, on the other hand, does not change much. It follows from this that the pressure in the arterioles approximates the minimal pressure in the aorta, being but a little less. Thus the peripheral resistance nearly represents the minimal aortic pres-

sure. The mean pressure is nearly constant. From these considerations it will be evident that the pulse pressure, i. e., the difference between the maximal and minimal pressures, represents the driving force of the blood. A number of factors have been shown to influence the blood pressure in the normal individual.

Physiological Variations in the Blood Pressure.—In sleep there is a fall in the minimal (diastolic) pressure, due to a general vasodilatation. On changing from the recumbent to the erect position the minimal pressure rises markedly and the pulse pressure is, in consequence, lessened. Erlanger and Hooker have shown that these changes are due to the influence of gravity. Exercise increases both the maximal pressure and the pulse pressure; the minimal pressure is increased, but only slightly. The circulation is accelerated, as is the pulse rate. If carried to exhaustion both blood pressure and rate fall below normal. Eating has approximately the same effect as mild exercise. Some of the more important as well as more frequently observed conditions associated with hypertension are the following:

Pathological Conditions Raising Blood Pressure (*Hypertension*).—*Nephritis.*—This is the paradigm of all the diseases associated with hypertension. The contracted kidney is associated with the greatest increase, a maximal pressure of 170 mm. to 210 mm. being common figures. The minimal pressure is also greatly increased, generally from 100 mm. to 150 mm. The highest maximal pressure which has ever come under the writer's personal observation was in a case of this kind (secondary contracted kidney with retinitis albuminurica), where the pulse could not be obliterated at a pressure of 300 mm., and when the pressure was raised so as to cause the mercury to flow out of the top of the instrument (a Stanton) at about 320 mm. the pulse beat was still palpable. Several partial convulsions had already occurred and the patient died on the following day.

Arteriosclerosis.—The results obtained by different investigators as to the frequency of hypertension in arteriosclerosis vary rather widely. Romberg and Hasenfeld have shown that increased tension occurs only when the splanchnic vessels are sclerotic. A failure to take into consideration the latent forms of contracted kidney probably accounts for the differences of opinion. Sawada found a moderate increase of the blood pressure only in about 12 per cent. of his cases. The increase of the maximal pressure may be 50 mm., that of the minimal 25 mm., so that the pulse-pressure increase may average 25 mm. In the highest grades of arteriosclerosis the condition becomes more like the inelastic model of the circulation, so that there is tendency to a high pressure in systole and to a low pressure in diastole. Corresponding to the different distributions of the sclerosis the pulse assumes the most varied forms, from markedly anacrotic to a pronounced collapsing type.

Hypertrophy of the heart from overwork, as in athletes and laborers who do heavy manual work, generally carries with it a hypertension.

Chronic plumbism is nearly always associated with some degree of hypertension. In this connection the relationship of lead intoxication to mesarteritis and to the contracted kidney should be borne in mind.

In angina pectoris the pressure may be increased considerably during the attack.

Basedow's disease is in many instances associated with hypertension, often with a hypertrophied ventricle.

The vascular crises of Pal, which he believes due to vasoconstriction paroxysms, have a consequent high blood pressure.

Cerebral Conditions.—Many of these, associated with a rise in intracranial pressure, produce an anemia of the vasomotor center with a great vasoconstriction. In consequence the blood pressure may rise to over 300 mm.

In polycythemia chronica there is frequently hypertension, probably due to the increased viscosity.

High pressure stasis (*Hochdruckstauung, Sahli*) is the name given by this author to certain forms of heart failure with high blood pressure and yet with broken compensation. This state of affairs, in which there is an apparent contradiction between the increase of blood pressure and a coexistent heart failure, is brought about in the following way: The slowing of the blood flow produces an overcharging of the blood with CO_2, and this produces, in turn, an asphyxia of the centers in the medulla, with a consequent vasoconstriction. The heart can only overcome this by greater effort, and by this effort raises the arterial pressure. When the point is reached where the heart empties itself incompletely, but against high pressure, the residual blood leads to cardiac dilatation and venous stasis. This further increases the asphyxia of the medullary centers and so a true vicious circle is set up.

Pathological Conditions Lowering Blood Pressure (*Hypotension*).—The commonest causes of a lowered blood pressure are the *acute infections.* The usual conception that this lowering of the blood pressure is due to a weakness of the heart muscle itself has been shown by Romberg and Pässler to be incorrect. These observers have clearly demonstrated that the principal effect of the bacterial toxic products arising in the infections is to produce a diminution of tonus of the vasomotor centers. The pressure falls because the peripheral resistance is low, i. e., there is vasodilatation, and if this vasodilatation be overcome artificially the cardiac strength is shown to be but little impaired. Typhoid fever, with its long, slow course, is the paradigm for this group, but the exanthemata, polyarthritis rheumatica, diphtheria, influenza, and many others show the same lowering in lesser degree.

Chronic Wasting Diseases.—Pulmonary tuberculosis is a classical ex-

ample. In carcinoma, secondary anemias, and gastrointestinal diseases associated with diarrheas the pressure is generally lower than normal.

Hemorrhage.—The drop in pressure is only pronounced when this is extensive, and especially when it is sudden.

In shock the conditions are almost identical with those which obtain in the acute infections. There is a loss of vasomotor tone, with consequent vasodilatation, the pressure falling as a result of the blood escaping too rapidly through the capillaries. Henderson believes that the primary condition is due to acapnia, a lessening of the CO_2 in the blood, as has been shown for mountain sickness. On this theory the CO_2 content of the blood acts as a "hormone," which adjusts the tonicity of the veins. With a lowering of the CO_2 content from hyperpnea there are a vasodilatation of the veins, lowered venous pressure with consequent diminished supply of blood to the right auricle, and, as an end result, diminished arterial tension with cerebral anemia.

In diseases accompanied with much *loss of fluid,* as in cholera, severe intestinal fluxes, or in long-continued vomiting, as in intestinal obstructions, the blood pressure is generally low.

Pleurisy and Pericarditis.—In these diseases the pressure is nearly always low, unless there should be a chronic endocardial complication.

Hyperpiesis.—A source of error which is commonly disregarded is the occurrence of periods of high blood pressure, which is temporary in character [Hyperpiesis (Allbutt)]. The writer has observed numerous cases in which patients complaining of migraine, constipation, dizziness, etc., were found to have maximal blood pressures ranging from 160 to 190 mm., or even more, whereas previous examinations, under identical conditions, had shown normal blood-pressure values. These would disappear in a few days, sometimes in a single day, with no other treatment than brisk purgation and restriction of diet. The possible relationship of such conditions of high blood pressure to states of intestinal putrefaction on the one hand, and to chronic nephritis and arteriosclerosis on the other, is of the utmost theoretical interest.

Clinical Determination of the Blood Pressure (*Arterial Tension*).—By clinical methods the pressure which is determined is the lateral pressure, that is, the pressure exerted by the blood on the vessel wall. This lateral pressure differs only very slightly, in the vessels accessible for measurement, from the end pressure, which is equal to the lateral pressure plus the pressure necessary to impart the given velocity to the blood.

The first to devise means for estimating the blood pressure in man was Marey, who, as far back as 1878, stated the fundamental principles on which our present clinical methods depend. He recognized that the maximal pressure was obtained at the point of disappearance of the pulsation in the artery, and also recognized that that pressure which corresponded to the greatest oscillations of the vessel walls equaled the minimal pres-

sure. Marey's methods did not, however, obtain a general introduction, and the instruments which came into subsequent widespread use, notably those of v. Basch and Potain, were useful only for determining the maximal pressure. The most important modification of the sphygmomanometer was that of Riva-Rocci, who introduced the use of the rubber arm-bag, compressing the brachial artery with air pressure from a pump apparatus.

Maximal Blood Pressure.—In this method, either with the original apparatus or with any of the large number of structural modifications of it, the fingers are placed upon the pulse, the pressure in the arm-bag then gradually raised so as to obliterate the pulse at the radial, and then the point noted at which, upon the gradual admission of air, the radial pulse reappears. This is taken as the maximal pressure. The only important advance which has been made upon the Riva-Rocci apparatus is in the use of a wide arm-band (12 cm.) instead of the original narrow one of 5 cm. in width.

Minimal Blood Pressure.—The method which is the most widely used is that of Masing and Strasburger, who determined the point at which the pulse wave showed its greatest amplitude to the palpating finger. It was only a step from this to the determination of the amplitude by means of the oscillation of the mercury in the manometer tube (Janeway). Of the structural modifications of the Riva-Rocci apparatus the instruments of Faught and Stanton have given the writer more satisfaction than some of the foreign instruments. The determination of the minimal pressure by means of the oscillation of the mercury column can rarely be made to yield more than an approximate estimation of the true minimal pressure. Where the pulse is small even this is impossible.

Probably the most accurate instrument yet devised is that of Erlanger. His apparatus employs a cuff, devised by v. Recklinghausen, connected, by means of a T tube, with a pressure bag, made of rubber, and inclosed within a glass case. The pressure changes, produced by the pulsation of the artery in the cuff, are transmitted to the rubber pressure bag, and these, in turn, are transmitted to the stratum of air surrounding the pressure bag, and within the glass case, and are recorded on an ordinary kymograph by means of a Marey tambour. Arrangement is made by means of a multiple stop-cock to admit air through capillary openings of various sizes, so that the pressure gradually falls. On the smoked paper small waves are seen, due to the pulsations of the compressed artery upon the distended bag at its upper edge. When the pressure is reduced to such a point that the first pulsation of the artery comes through there is a sudden increase in the amplitude of the waves. At this moment the height of the mercury column is noted, and this is just a very little below the maximal pressure. Continuing to admit air to the system of tubes the oscillations of the lever increase until they reach a maximum. The lowest point at

which this maximum size of the oscillations is noted corresponds accurately to the diastolic pressure.

The instrument most used in Germany for accurate work is the Sphygmotonometer of v. Recklinghausen. In this instrument the cuff is connected with an anaëroid, which indicates by means of a pointer the pressure, and the size of an oscillation communicated to the pointer by the brachial pulse. With this apparatus the maximal pressure is most accurately determined by palpation, the minimal pressure by noting the point at which the oscillations are greatest. The instrument may be arranged to record graphically the oscillations.

Normal Values.—With the Erlanger apparatus, in young adults, in a reclining position, the average blood pressures are: maximal, 110 mm., minimal, 65 mm., the pulse pressure being 45 mm. (Erlanger). In the average run of cases in private practice the writer's experience with the Erlanger apparatus gives for both maximal and minimal pressures values from 5 to 10 mm. higher.

Value of Blood-Pressure Determinations.—Notwithstanding the fact that it cannot be gainsaid that the estimation of blood pressure, and more particularly the determination of the pulse pressure, give us information which cannot be otherwise obtained in regard to the circulation, yet here, too, a considerable degree of reserve is indicated. As with all relatively new methods the value is apt to be overestimated, and at the present time there is a very strong tendency evident to overestimate the value of blood-pressure determinations. A single determination of the systolic pressure alone, under the ordinary conditions of private or clinic practice, is of little or no value, except when the value is very greatly different from the normal, as in cases of contracted kidney. A series of determinations are necessary to eliminate the psychical factor, as it is only when the procedure becomes a matter of indifference to the patient that the real value, independent of psychical influences, is obtained. Again, the determination of the minimal pressure, as has been already pointed out, is, when taken with the Riva-Rocci instrument or one of its modifications, little better than a very rough approximation to the true value. In such cases the writer relies exclusively upon the Erlanger instrument.

It cannot be too strongly emphasized that from a single or repeated observation of blood pressure no conclusion in regard to the functional capacity of the heart is allowable.

The determination of the pulse pressure, or amplitude, that is, the difference between the systolic and diastolic pressures, is of the very greatest value in determining the effects of digitalis therapy. As will be noted in the article on digitalis, the most delicate criterion of effective digitalis action is in the increase of the pulse pressure. This is especially important in the treatment of cases of high-pressure stasis.

The Pulse.—The expansion of the aorta as the blood is thrown into it from the left ventricle during systole and the importance of this in producing a continuous flow in the capillaries have been already referred to. This expansion, which is not of very great extent, even in the largest arteries, becomes smaller and smaller as the periphery is approached. In the radial artery, in which the pulse is almost always felt at the bedside, this expansion is exceedingly small, so small, indeed, as to be barely determinable by palpation. This can be best appreciated by laying the fingers with exceeding lightness on the artery, when it will readily be seen that the actual increase in size is practically a negligible quantity. Even in the abdominal aorta, if this be palpated with a minimal degree of pressure by the fingers, the increase in caliber is scarcely to be felt (Marey). Broadbent and, more recently, Mackenzie have emphasized the fact that there is a very general misapprehension as to what constitutes the pulse, as we palpate it clinically, the current idea being that it represents an expansion and contraction in the size of the vessel.

The fact is familiar to every one that to obtain the pulse at all a certain degree of pressure is necessary. The amplitude of the pulse becomes greater and greater as the pressure is increased until a certain maximum is reached, when, if the pressure be further increased, the amplitude becomes smaller and smaller, until, finally, the wave is entirely obliterated. That amount of pressure which makes the pulse wave appear greatest is exactly equal to the minimal (diastolic) pressure in the artery, i. e., the excursion of the wall of the artery is greatest when the pressure on the outside and that of the inside equal each other. Sahli calls attention to the fact that partial stasis, brought about by the finger, may modify this somewhat. Now this wave, which is felt only on compression of the artery, is in no sense to be regarded as an actual expansion and contraction of the artery, but as a simple variation in pressure. The pulse is felt to be largest when the finger is exerting upon the artery a pressure equal to the minimal pressure, because, under these conditions, there is the greatest increase in pressure following the next ventricular systole. The sudden increase in pressure in the artery, felt by the compressing fingers, is what we recognize clinically as the pulse.

Mackenzie has recognized the deceptive character of many of the phenomena visible in the arteries. The apparent expansion and contraction which may be so often observed in arteries like the carotid are, in reality, a process of displacement, that is, during systole the artery tightens and during diastole it becomes relaxed. In a tortuous artery such as is so often seen in the brachials, in arteriosclerotic patients, the bend in the artery is seen to be accentuated with the cardiac systole and lessened in diastole. If the carotid pulse were due to an actual expansion of the artery it would be the same on the sides as when the artery is directly compressed, whereas, as a matter of fact, the tracing from the side of the caro-

tid is the inverse of that taken with a receiver over it, compressing the vessel in the usual manner.

The two things which we are, in reality, most cognizant of in palpating the pulse are the minimal (diastolic) pressure, i. e., the "hardness" of the pulse, and, as has already been emphasized, the increment of pressure during ventricular systole, i. e., the pulse pressure. These considerations make it clear why it is that we may feel the pulse as "large" when the vessel is somewhat dilated, and as "small" when it is in a state of marked contraction.

The Pulse Curve.—The curve of the normal pulse is merely the record of the arterial pressure during the cycle of events caused by the heart's systole and diastole. The increase or decrease of the pressure in the artery depends upon the ratio of the inflow of blood from the heart to the outflow of blood into the capillaries at that particular moment of time. During the period when the intake exceeds the outflow the pulse curve rises. When the two are exactly equal the curve remains stationary (plateau), and when the outflow exceeds the intake the curve drops.

Normal Pulse Wave.—The principal (percussion) wave is moderately steep, and the summit sharp and well defined. The fall should be rapid and interrupted in its course by a tiny rebound (predicrotic) wave. Following this rebound the fall is somewhat more gradual and ends in a small negative wave (dicrotic notch) which indicates the closure of the semilunar valves and the end of ventricular systole. Following this notch is a positive (dicrotic) wave, and then the curve sinks more slowly during the rest of the diastole.

Catacrotic Waves.—As to the explanation of the catacrotic waves there is a lack of agreement. It is probable that the explanation which regards the dicrotic wave as due to a centrifugal wave is the correct one. Closure of the aortic valves occurs just before the ventricle dilates, and hence the valves are, as it were, supported by the taut muscle of the ventricle. When relaxation occurs a negative wave (dicrotic notch) is started, which is checked by the stretching of the aortic valves, the elasticity of which initiate a second positive, i. e., centrifugal wave—the dicrotic wave. It seems certain, however, that its form is modified by waves reflected from the periphery, and many of the catacrotic waves are due entirely to these. Thus we find that their number and form vary with the artery, depending on the reflection of waves from branches given off peripherally.

Influence of Peripheral Resistance.—The tonus existing in the peripheral arteries is of the greatest importance in modifying the form of the pulse curve. In general (Marey, Hirschfelder) three types of pulse occur, dependent on the degree of dilatation of the peripheral arteries.

1. Collapsing Pulse.—This occurs when the peripheral resistance is low and the arteries markedly dilated, as in shock, after large meals, in the infectious fevers, and in conditions associated with lability of the vaso-

motor system. In this form the rise and fall are both sudden and often there is a well-marked dicrotic wave, situated very near the baseline, i. e., the pulse wave is nearly spent before the aortic valves close (end of systole).

2. In the normal type, corresponding to a moderate degree of peripheral dilatation, the upstroke is a little more steep, the fall more gradual, the medium-sized dicrotic notch occurring near the middle of the catacrotic limb. Comparing the collapsing pulse with the normal it has apparently the more sudden rise. In reality, this is not the case, but owing to the sudden drop it gives that impression to the finger.

3. With well-marked peripheral constriction the outflow of blood is retarded. This gives rise to a pulse form in which the ascent is steep, the summit presenting a sustained plateau, which lasts to the end of systole, i. e., to the dicrotic notch, which is barely indicated or absent.

The Sphygmogram.—Clinically the pulse form is determined by the sphygmograph, the details for the use of which must be sought in the works on Clinical Diagnosis. Practically all of the instruments which have been extensively used clinically suffer from certain inherent defects. The most important of these are:

1. The inertia of the instrument, which leads to the curve being greatly distorted by the "fling" of the levers.

2. The fact that no accurate method of adjusting the pressure so that it just equals the minimal exists in most of them.

By merely varying the pressure with which the pelotte presses upon the artery curves of very different character may be obtained one after the other. Again, the curves which are obtained with different instruments vary considerably according to the "fling" of the lever systems. O. Frank has constructed a sphygmograph which is technically probably the most perfect existing form, but it has not found its way into clinical use to any considerable extent.

Inferences to Be Drawn from the Sphygmogram.—The sphygmograph has failed to accomplish what many conceive to be its chief purpose, i. e., to render easy the interpretation of the pulse. As a matter of fact, the sphygmographic curve requires an accurate knowledge not only of the various pulse forms, but of the inherent defects of the instrument, in order to render it of the least service. It serves to enable the trained observer to record his findings rather than to enable him to establish a diagnosis from the form of the curve alone. The only points of information which one may legitimately expect to obtain from the sphygmographic curve are:

1. Whether the upstroke is of the celer or tardus type.
2. Whether the catacrotic limb starts early or late in systole.
3. Whether the wave ends before the onset of diastole.

Perhaps, after all is said, the greatest practical use of the sphygmo-

graph is that it trains one to palpate more carefully if one habitually compares the results of digital palpation of the pulse with a carefully taken sphymogram. It is in the study of the arrhythmias alone that it is indispensable.

The Absolute Sphygmogram.—Aside from the defects in the sphygmogram produced by imperfect application, improperly adjusted pressure of the pelotte on the artery, etc., there is one inherent defect which lies in the nature of the method itself. That is that the sphygmogram, as ordinarily taken, presents in reality a pulse-pressure curve the ordinates of which are of unknown value. In order to transform the sphygmogram, as ordinarily obtained, into a curve in which the ordinates are of known value, Sahli has devised a method of obtaining the absolute sphygmogram. Sahli defines an absolute sphygmogram as one which is constructed in such a fashion that at every point of the curve the ordinates are proportional to the pressure. While it is possible to construct a sphygmogram every point of which shall fulfil the postulate that the ordinate of this point shall be proportionate to the pressure, yet in praxi the advantages gained from this procedure are scarcely commensurate with the work entailed by it. For the cases in which the sphygmogram is of real assistance, as a record of the pressure curve only, practically everything that is of real use can be obtained by the construction of what Sahli calls "the reduced absolute sphygmogram." In this procedure all that is determined is the rapidity of the rise and fall of the principal wave, neglecting entirely all the secondary elevations. In other words, the reduced absolute sphygmogram gives us exact information as to the height of the principal wave and the distance of its summit from the preceding and following valleys. [V. Sahli, Deutsch Arch. f. kl. Med., lxxxi, 493, for the method he has devised for constructing the absolute sphygmogram.—Editor.]

In order to obtain an absolute sphygmogram the following data are necessary: The sphygmogram of the radial artery is taken in the usual way by means of the Jacquet instrument, or one of its modifications, which must be provided with an accurate time-marker. The tracings should be taken, in part at least, with the fast speed. This permits of an accurate determination of the exact location of any given point of the curve. At the same time, the maximal and minimal blood pressures are determined. The difference between these two is, of course, the pulse pressure.

To construct the absolute sphygmogram the simplest manner is to use millimeter paper (coördinate or cross-section paper) ordinarily used by engineers and architects. This is simply paper with rulings at right angles one millimeter apart. An abscissa, *ab,* is first laid off on which each centimeter in a horizontal direction corresponds to the fifth second intervals of the Jacquet sphygmograph. Thus in a pulse of 60 per second, in which the length of pulse wave would be exactly one second, we should lay off, as the time abscissa, a length of 5 centimeters in the horizontal.

This constitutes the length of the absolute sphygmogram. At the beginning and end of this abscissa, at *a* and *b*, an ordinate is erected whose height in millimeters corresponds to the minimal pressure expressed in millimeters of mercury. Thus, if the minimal pressure was 90 mm. Hg, each of these ordinates, *ac* and *bd*, would be 90 millimeters in height.

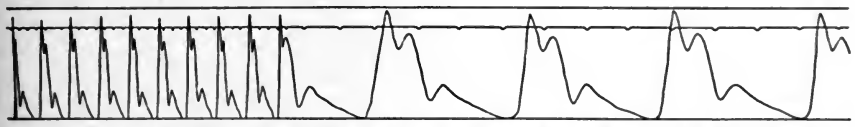


FIG. 4.—PULSE TRACING FROM A CASE OF CHRONIC HYPERTENSION. (The distortion due to instrumental defect is well shown; "fling of the lever")—Jacquet sphygmograph.

From the inspection of the sphygmogram the distance in time, i. e., horizontal distance, of the summit of the main wave from its beginning is measured, and this laid off from *a*, on *ab*, laying off one centimeter in horizontal distance for each one-fifth second in time. At the point thus obtained, *e*, an ordinate, *ef*, is erected whose height in millimeters is equal to the maximal pressure expressed in millimeters. The point *f* is now joined by straight lines to the points *c* and *d*. The curve *cfd* represents thus in its simplest form, neglecting all secondary waves, the pressure curve of the artery. It is evident that the height of the absolute sphygmogram, that is, the difference between the maximal and minimal pressures, is the pulse pressure.

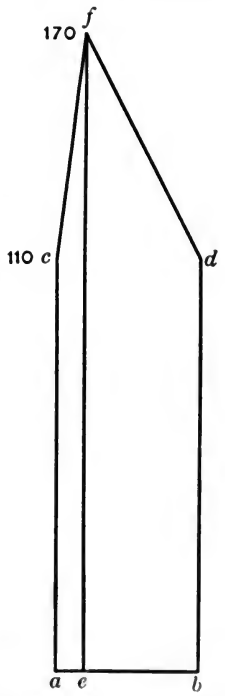


FIG. 5.—ABSOLUTE SPHYGMOGRAM CONSTRUCTED FROM TRACING IN FIG. 4. Maximal pressure 170 mm. Minimal pressure 110 mm.

This procedure can be repeated, estimating, for example, the pressure at the summit of the dicrotic wave by comparing the height of this with the height of the main wave, and then by obtaining its horizontal position in the same manner as was done for the main wave. The abscissa and ordinate of this point are laid off as before. In the same manner as many points as are desired can be laid off and these points connected by a curve similar to the tracing, being guided by the eye. These details have, however, no especial value and are quite time consuming.

If we compare the clinical significance of the absolute sphygmogram with that of the tracing obtained in the ordinary way we see that the former gives us a graphic account of the pressure curve in the artery, which is correct according to absolute standards. We have every reason to be-

lieve that the pulse pressure, that is, the height of the absolute sphygmogram, is not essentially different in the radial from what it is in the aorta. We may then regard, with a considerable approximation to accuracy, the absolute sphygmogram of the radial as being that of the aorta. In spite of the fact that the pressure curve thus obtained is correctly expressed in absolute standards, this does not permit any conclusion in respect to the work of the heart, or in respect to the systolic output. As Sahli correctly states, its principal practical value lies in the fact that by this means alone can we obtain an absolute judgment of the steepness of the ascent and descent; in other words, as to whether and to what degree we have a pulsus celer or a pulsus tardus. Every one with much experience with sphygmographic tracings is aware of the enormous errors due to the fling of the lever in cases where the blood pressure is high and the wave has the characters of the pulsus altus et celer. All these instrumental defects are eliminated by the construction of the absolute sphygmogram. It requires but a very few minutes' time to construct the reduced absolute sphygmogram and, especially in aortic lesions, the information obtained is of real utility. The far-reaching conclusions which many authors attempt to draw from the sphygmogram in its usual form, and which we have seen to be utterly unjustifiable, are equally so in this modification. Its field of usefulness is, and must remain, a very limited one.

Irregularities in the Cardiac Rhythm.—Three classes of these irregularities may be distinguished:

1. The arrhythmias, in which there is an irregularity, with no system or order in the succession of beats, to be made out.

2. The allorrhythmias (periodic irregularity), in which there is irregularity in the succession of beats, but in which the irregularity follows some system.

3. The pararrhythmias, in which there are two separate rhythms going on simultaneously (Wenckebach).

The greatest interest, clinically, attaches to the group of the allorrhythmias. A convenient classification of this group is that of Hering, modified by Hirschfelder, which is here followed.

ALLORRHYTHMIAS

A. OF EXTRACARDIAC ORIGIN.

I. *Neurogenic,* due to more or less rhythmic reflex stimuli, passing through the vagi and accelerators (toxic, reflex from various organs, respiratory reflexes from lungs).

a. Associated with the phases of respiration.

b. Not associated with respiration—Mackenzie's youthful type.

II. *Due to disturbances in the filling and emptying of the heart from traction upon the heart and great vessels*—dropping of beats without heart-block, pulsus paradoxus, and Riegel's pulse.

B. Of Intracardiac Origin.

I. *Due to disturbance in the conduction of normal impulses*—dropping of beats.

1. Auriculo- (atrio-) ventricular block.
2. Sinoauricular block.
3. Interventricular (?) block (hemisystole).

II. *Disturbance of contractility*—pulsus alternans, and failure to open the aortic valves.

III. *Occurrence of beats in response to abnormal stimuli or increased irritability.*

1. Extrasystoles, in which irregular beat is brought on by a single abnormal stimulus.
   a. Ventricular.
   b. Auricular.
   c. Auriculo- (atrio-) ventricular.
2. Permanently irregular heart.
3. Paroxysmal tachycardia (auricular fibrillation).

Associated with the phases of respiration we have the *pulsus irregularis respiratorius.* Clinically this is a pulse in which, during inspiration, the pulse beats are closer together than during expiration. This can be seen in normal individuals to a slight extent, and in neurasthenics the phenomenon is sometimes very pronounced.

Reflex Allorrhythmias.—It has been shown that arrhythmias of this kind may be produced reflexly by stimulation of various organs, especially the hollow viscera.

One of the most common forms of allorrhythmia of neurogenic origin is that described by Mackenzie as the "youthful type." We may assume that all the centers having to do with the regulation of the circulation are more susceptible to outside influences in the young and growing organism than in the adult. It will be remembered that there are constantly stimuli passing up the vagi, and in neurotic individuals, such stimuli, normally too small to produce visible effects upon the heart beat, become intensified to such an extent as to make themselves evident by the production of an arrhythmia.

In the same way, as there may be an irregularity from reflex causes, there is a *well-defined psychogenic allorrhythmia.* In these cases individuals, whose cardiac action has been known to be perfectly regular, may suddenly, under the stress of some psychical excitement, show a well-marked irregularity, which may subside almost immediately after the abnormal psychical condition has subsided. Several such cases have come under the writer's observation. In general, these allorrhythmias of reflex origin are of very variable character. Their rate may change rapidly and rhythmically, but they differ from the extrasystoles in that the contrac-

tions are of full strength and are not premature. Such allorrhythmias may be often caused to disappear by atropin.

Pulsus Paradoxus.—This is a form of pulse described first by Griesinger, and later by Kussmaul, in which the pulse is lessened and often a beat entirely missed during the phase of inspiration, as the result of adhesions in the posterior mediastinum. The same phenomenon occurring during expiration is known as Riegel's pulse. The mechanism in the pulsus paradoxus is that adhesions to the arch of the aorta exist of sufficient strength to produce a narrowing of its lumen during the descent of the diaphragm in inspiration, with a consequent diminution in size of the pulse. In the latter case a kinking of the cavæ may be at fault.

Allorrhythmias Due to Faulty Conduction of Impulses.—Heart Block.—*Auriculoventricular Heart Block.*—In this case the stimulus to contraction is generated in the normal manner, the auricles contract normally, but the impulse is arrested (blocked) at the auriculoventricular junction, as a result of the imperfect conductivity in the His bundle. Partial and complete blocks may be recognized, and these may be of either functional or organic origin. If the ventricle responds to the auricular contraction at every second, third, or even longer interval the condition is known as partial block. If the ventricle beats with a rhythm in no way corresponding to, and entirely independent of, the auricular rhythm we have complete block.

Sinoauricular Block.—In this form the stimulus is generated at the normal point of origin for the cardiac contraction, i. e., the sinus region, but is not carried over to the auricles.

Interventricular Block (*Hemisystole*).—The existence of this form has not been demonstrated with certainty as yet.

Pulsus Alternans.—This rare condition is to be found only in connection with cardiac weakness, generally in conditions of severe myocardial degenerations. It consists in the regular alternation of a normal contraction with a weaker one, the pause being of normal or increased length. This form of pulse must be clearly distinguished from the extrasystole. In the pulsus alternans the smaller beat never occurs prematurely, as in the bigeminal pulse. There is one source of difficulty, however, in that the small pulse of a true extrasystole is transmitted rather slowly to the periphery, and so may appear delayed at the radial and approximately in the middle of the interval between the previous beat and the one following it.

Allorrhythmia Due to Extrasystoles.—By extrasystole is meant a premature contraction (of either auricle or ventricle) in response to a single abnormal stimulus. At the same time the normal (sinus) rhythm of the heart goes on as usual.

At times the contraction of the ventricles may be very feeble so that the pulse wave may not be palpable in the radial artery. If, however, the

apex be auscultated it will be found that the heart contracted and the absence of pulse at the radial is due to a weak but not to an absent contraction. A neglect of this precaution may lead one to erroneously infer the existence of a heart block, or a bradycardia.

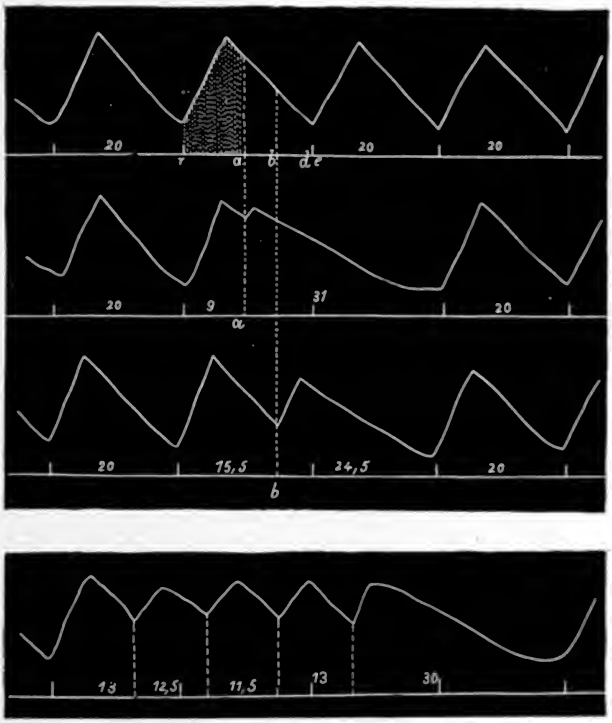


FIG. 6.—SCHEME TO ILLUSTRATE THE PRODUCTION OF VENTRICULAR EXTRASYSTOLES. (Hoffmann.)

It was shown by Marey that if a stimulus (electric shock) be given to the heart at any period of the cardiac cycle except the refractory period a contraction or premature systole (extrasystole) is the result.

The results, so far as the rhythm are concerned, are different according to the place of application of the stimulus. Three possibilities exist—the stimulus may be applied (a) to the ventricle, (b) to the auricle, and (c) to the auriculoventricular region (conduction system).

VENTRICULAR EXTRASYSTOLES.—The mechanism of the production of this, the most frequent type of extrasystole, is simple. The extra stimulus being applied to the ventricle, this chamber responds by a contraction which is premature, that is, it occurs before the next ventricular contraction with the normal rhythm would have occurred. Now this extrasystole has its refractory period, so that the next normal stimulus arriving from the auricles reaches the ventricle during the refractory period of the

extrasystole and, in consequence, there is no contraction. Thus a longer compensatory pause ensues, and with the arrival of the next stimulus from the auricles the heart picks up its normal rhythm again. The sequence of events is then: (1) a normal contraction; (2) the premature contraction (extrasystole); (3) the compensatory pause.

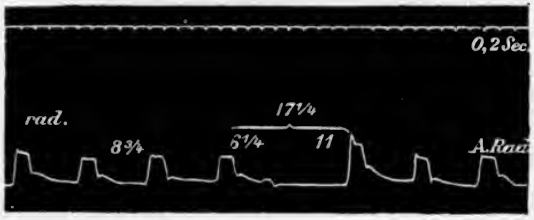


Fig. 7.—Ventricular Extrasystole. (Hoffmann.)

In the ventricular type of extrasystole the time occupied by the normal systole plus the extrasystole and the compensatory pause is exactly equal to two normal cardiac cycles. In very slow pulses it is said (Romberg, Mackenzie) that the extrasystole may sometimes occur so early that its refractory period may have passed when the next normal stimulus arrives and produces its contraction. In this case the extrasystole would be simply interpolated between two normal contractions.

Auricular Extrasystoles.—In this form of extrasystole the interpolated stimulus to contraction is applied to the auricles or sinus region. Clinically, on auscultation, the sounds do not differ from those produced in the ventricular type of extrasystole. The comparison of simultaneous tracings from the artery and the jugular vein is necessary to distinguish with certainty between the two types. In the auricular type the auricular wave in the jugular tracing can be made out preceding the ventricular wave. These two can be seen in the extrasystole as well. The tracing of the ventricular extrasystole shows a single large ventricular wave.

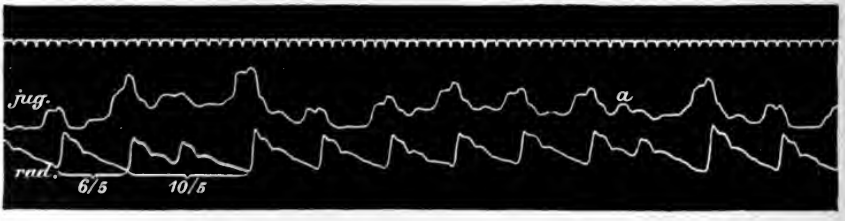


Fig. 8.—Auricular Extrasystole. (Hoffmann.)

If the extra contraction stimulus takes its origin at the place of origin of the normal stimuli then all the stored up material is used up by the extra stimulus, and an interval, exactly equal to the normal, must elapse

before the material has accumulated to such a degree as to permit a new contraction to be initiated. Thus the pause following an auricular extrasystole is of normal length, and not lengthened compensatorily as in the ventricular type or, in other words, the regular systole, plus extrasystole, plus pause, is less than the time of two normal contraction periods. The conditions are slightly altered if the contraction stimulus is applied at some other place than the normal. In this case the pause will be lengthened by the very short interval of time required for the propagation of the stimulus from the actual place of its application to the place of application of the normal stimulus to contraction. Even in this case, however, the length of the pause is shorter than in the case of the ventricular extrasystole.

Auriculoventricular Extrasystoles.—The characteristic feature of this type is that auricles and ventricles contract simultaneously and prematurely. This is evidenced by the auricular wave appearing simultaneously with the arterial pulse. This type is of extreme rarity.

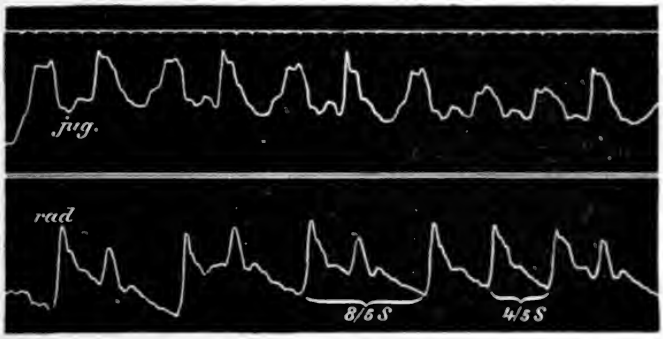


Fig. 9.—Atrioventricular Extrasystole. (Hoffmann.)

Clinical Significance of Extrasystoles.—In general, we may say that no rule can be laid down as to the significance of extrasystoles. Their importance must be determined in every case for itself. The opinions held by different authors as to their significance varies greatly. Some consider them always dependent on organic disease, others attach slight importance to them. It is probably not correct to assume that in every instance where they occur there is necessarily some pathological condition in the heart. Yet, in most instances, they should lead to a suspicion of cardiac disease. Knoll and others have shown that extrasystoles of the ventricular type may be produced by inducing artificial stenosis at the arterial ostia. This accords well with the general clinical experience that they are found with great frequency in conditions attended by hypertension.

The subjective symptoms accompanying extrasystoles vary. In some

instances there is palpitation, which may be looked upon as an evidence of cardiac hyperesthesia. Hering has shown that extrasystole cannot be produced by stimulation of nerves in animal experimentation, and that they must be regarded as an expression of an abnormal stimulus to the heart muscle itself; or, as Mackenzie expresses it, to an undue excitability of the remains of the primitive cardiac tube. In other instances the patient feels the extrasystole as an unpleasant "jump," and the pause as an intermission, or skipped beat. It is believed that, while these symptoms are not absolutely certain criteria of extrasystoles dependent on "functional" causes, yet they are seldom found in extrasystoles with an evident organic foundation. Here, as in many other instances, many cases referred to "nervous" or "functional" causes may be, in reality, the expression of beginning organic disease.

Pulsus Irregularis Perpetuus.—This type of arrhythmia is exceedingly common, forming the common persistent arrhythmia so well known in chronic endocarditis with valve lesions, and in the various chronic myocardial degenerations. This form of pulse is of much more serious import than the extrasystolic form, inasmuch as it invariably denotes an organic lesion. The normal rhythm can no longer be recognized, and the larger waves only may reach the periphery and be palpable at the wrist, so that a marked difference may exist between the rate, as determined at the heart and at the wrist. While this arrhythmia may improve greatly, it probably never completely disappears, a condition of affairs in sharp contradistinction to the extrasystoles, which at times disappear instantly and completely.

In this form of pulse the auricles are paralyzed and the auricular wave is lacking in the venous tracing. Originally believed to be due to tricuspid insufficiency (Hering), this has later been shown to be unnecessary. The explanation of this pulse type is probably best given by the assumption of a lesion of the Keith node, generally through chronic myocarditis, such as often is found in connection with valvular disease, or by coronary sclerosis. The contraction stimulus is assumed to originate in the Tawara node, and the auricles and ventricles to beat simultaneously (*nodal rhythm*—Mackenzie). This author states that "the nodal rhythm is present in the majority of cases of severe heart failure, and in a great many the immediate breakdown is directly attributable to the inception by the heart of this abnormal rhythm." This will be made plain by the following reflection: Any arrhythmia tends to slow the circulation, the longer pauses producing accumulation of blood in the veins and thus overdistending the heart and tending to further increase the arrhythmia. The auricles, being most readily responsive to changes in filling, lose their tonicity rapidly and may quickly become paralyzed.

GENERAL TREATMENT

Rest

Chief among all the means at our disposal in the treatment of cardiac insufficiency must be placed complete bodily rest. In our efforts to strengthen the heart muscle and to improve its tonicity we are only too apt to overlook the fact that in many, perhaps most, instances more may be accomplished by the removal of some of the work of the heart by complete rest than by all other therapeutic procedures taken together. Inasmuch as it is impossible to do more than reduce the work of the heart, by relieving it of all unnecessary strain, and since the work of the heart entailed by the normal metabolic processes can be lessened but very slightly, it is evident that, when we speak of complete rest for the heart, we are employing a relative term only. It is impossible to do more than estimate, in a rather rough way, to what extent the work of the heart is lessened by absolute rest in bed, but it can scarcely be doubted that it is materially less. This factor becomes, of course, a larger one in patients who habitually live a vigorous, active life, since the amount of work taken off the heart in these cases would be more than in those of very sedentary habit.

For practical purposes we may distinguish two degrees of rest: first, absolute rest; second, relative rest.

Absolute Rest.—The ideal to be sought for and worked toward is to have the patient observe the most complete repose of body possible, which is to be attained only by observing a strictly horizontal position, with a pillow only sufficiently high to keep the head in a line with the body, with every unnecessary movement carefully avoided, every exertion attendant upon urination and defecation reduced to a minimum, and, last but by no means least, free from the excitement of visitors, and the small worries of life. The value of this ideal rest is such as to make it imperative to consider minutely the details, the successful mastery of which alone can produce satisfactory results. The bed should be preferably a narrow one, in order that the nurse may more readily carry out the details of treatment, and at the same time move the patient as little as possible. The mattress should be firm, fairly hard, and, above all, not permitted to sink down in such a way that the patient lies in a hollow.

The most serious difficulty encountered is generally met with at the very beginning. The more severe cases of cardiac insufficiency, for whom this absolute rest is all-important, in many instances have a degree of dyspnea amounting to orthopnea. Under these circumstances they should not be made to assume a position so near the horizontal as to cause them actual distress. The utmost care, then, should be taken to place them

in a position in which they can breathe with comfort, and to retain them there by a suitable back-rest. Even so simple a matter as the adjustment of the patient in this position is a detail which should not be overlooked by the physician. If this is properly done there should be no difficulty with the patient slipping down in bed. If there should be a tendency toward this, it may be prevented by a suitable foot-rest. From the beginning the patient should be made to understand that the nearer horizontal he can lie the more rapidly will he improve. Day by day his back and head-rest should be lowered, the improvement warranting such, until the horizontal position is reached. A very common practice where the edema of the legs is marked is to raise the legs. This, for several reasons, is a bad practice, not only because it places the body and the thighs of the patient at an angle which is exceedingly uncomfortable, but also, if it does succeed in lessening the edema of the legs, it only tends to increase the edema about the trunk, that is, in a place where it is much less desirable, and productive of distinctly greater discomfort.

The patient should on no account be permitted to leave the bed to urinate or defecate, and both of these should be made as easy for him as possible. In the case of urination this is generally a simple matter. In the case of defecation the matter is again of sufficient importance to deserve a little consideration. With straining at stool there is a well defined rise in blood pressure, amounting sometimes to 40 or 50 millimeters and often more. Every effort should be made to regulate the bowels in such a way that there shall be one or two, and not more, soft stools in twenty-four hours. The common practice of purging patients freely is, in the writer's opinion, to be sharply condemned. The frequently repeated efforts produced by the act of defecation exhaust the patient to a much greater degree than would be offset by the very small amount of good which might be produced from the loss of fluid through the bowel. In case the gastrointestinal tract be overloaded at the beginning of treatment, a single brisk saline purge is in place. This being accomplished, some means must be taken to insure the one or two soft movements referred to. This is all the more important because the overwhelming majority of patients, placed in bed upon a restricted diet, are certain to suffer with constipation. The usual custom is the giving of enemata of various kinds, but this is not good practice in most instances. There is a certain amount of effort and excitement attendant upon the manipulations involved, and, hence, these are to be avoided whenever possible. [When enemata of large quantities of water are not well borne, glycerin or oil injections or rectal suppositories of glycerin may be employed. The introduction of very large quantities of water into the rectum of patients suffering from chronic myocardial insufficiency is connected with great risk to the patient. I have seen two patients die of it.—Editor.] A mild laxative, of which the cascara preparations are, on the whole, the most

satisfactory, especially if given in the favorite combination of cascara, aloin, and extract of belladonna, will be generally found best.

The diet must be arranged with the greatest care to avoid undernourishment on the one hand and overdistention of the stomach, with its attendant train of evils, on the other. For details consult the section on Diet.

In severe cases the visits of friends and relatives should be forbidden. Exceptions to this rule would be, perhaps, the occasional visit of a husband or wife, when it is evident that their exclusion brings about a degree of worry which would more than offset the effects of a short visit. It is only too common, in consultation practice, to find seated around the bedside of a dangerously ill patient, or in the next room, where the conversation may be frequently overheard, a half dozen semi-interested and semi-curious friends or relatives.

The admissibility of letters must depend upon circumstances. At all events, they should be reduced to a minimum.

A certain number of patients do badly under this strict limitation of movement. This is especially the case in old people, where there exists a strong tendency to bronchitis, and in the so-called hypostatic pneumonias. While complete rest should always be the ideal sought for, the fact must not be lost sight of that, if the condition is one which lasts a considerable time, the good effects of this régime may be offset, to a greater or less degree, by a weakening of the heart resulting from the long rest. While no rule applicable to every case can be laid down, we may say that the more acute the case is, and the shorter its probable duration, the more imperative is the indication for absolute rest.

The length of time which the patient with cardiac insufficiency must observe this condition of strict rest varies within tolerably wide limits. The guiding principle should be that no attempt to sit up or leave the bed should be made until all effusions into the serous cavities, if such have existed, have disappeared, until the edema of the dependent parts has entirely vanished, until the daily urinary output shall have regained its normal amount, taking into consideration the diet, and, lastly, until dyspnea shall no longer exist, at least while the patient is at rest. When all these conditions are fulfilled, the patient may be gradually prepared for getting up. This is, however, not the next step. During this period a few passive movements each day may be carried out with advantage. Indeed, in many instances they may be begun, if a thoroughly competent assistant be at hand, much earlier. The details as to what exercises shall be employed and when they shall be given are discussed in the article on Gymnastics. The important thing is that there shall be a slight increase each day in the amount of work given a patient's heart to do, and that this shall be well within the capacity of the heart. Periods of treatment at which there is, under ordinary circumstances, especial liability to

overexertion are the time when the patient is allowed to leave his bed and the time when he is allowed to resume his usual occupation. It is especially important that there should be a preparation for these two events by gradual training (see under Gymnastics and Occupation).

Relative Rest.—The patient who is convalescent from a severe attack of cardiac insufficiency, and who may be said, in a general way, to be ready to resume the more active duties of life, should have firmly impressed upon him the principle of relative rest. The average normal individual, not indulging in strenuous athletics, or severe manual labor, performs no work which is not well within the power of his heart to accomplish. The patient whose cardiac reserve power is diminished by forty or fifty per cent. must be made to clearly comprehend that, since the mountain cannot be made to come to Mahomet, Mahomet must needs go to the mountain. Since it is impossible for his normal cardiac reserve power to be restored, he must reduce the demands which he makes upon his heart in the same ratio that this reserve power is lessened. This is sometimes a matter of the greatest difficulty to carry out, and no small proportion of subsequent relapses are due to a failure on the part of the physician to impress this fact upon the patient's mind. The latter should have a clear conception of his exact status as regards the amount of work which he can safely do. If we reflect a moment, it is only natural that the patient should think his heart is as good as new. He is seen by the physician with an outspoken cardiac insufficiency, let us say from a previously compensated valvular lesion, and, after rest in bed, digitalis, etc., finds himself completely relieved from his edema, cyanosis, shortness of breath, and the other symptoms which led him to seek medical advice. Being able, as a result of this treatment, to walk about with no discomfort, what is more natural than that he should fancy himself the possessor of a heart as good as new, and should proceed to work and exercise in accordance with this idea? This is the time for frank explanations on the part of the medical attendant. The facts should be put before him precisely as they are, neither exaggerating them nor, on the other hand, minimizing their importance. This is a matter which must finally be entrusted to the intelligence of the patient to carry out, hence it is due him that the physician put him in possession of the exact facts of his case. It frequently requires much skill to strike just that sane middle ground, between chronic overexertion on the one hand and an injurious restriction on the other. This principle of relative rest is precisely the same as that which guides us in the selection of occupation for the cardiac patient. In a word, it is the duty of the physician to determine, as exactly as may be, just what is the reserve power of the patient's heart, and to see that the demands put upon it by the patient lie well within this.

Drug Treatment

Digitalis

Historical.—Although digitalis has been known since 1542, when it was mentioned by Fuchsius, who gave it its name in allusion to the German name Fingerhut, yet it has been entirely neglected, so far as its medicinal virtues were concerned, until the year 1775. In this year William Withering, physician to the General Hospital at Birmingham, had his attention called to the drug in the following manner. He says: "In the year 1775 my opinion was asked concerning a family receipt for the cure of the dropsy. I was told that it had long been kept a secret by an old woman in Shropshire, who had sometimes made cures after the more regular practitioners had failed. I was informed also that the effects produced were violent vomiting and purging; for the diuretic effects seem to have been overlooked. This medicine was composed of twenty or more different herbs; but it was not very difficult for one conversant in these subjects to perceive that the active herb could be no other than the foxglove."

Withering commenced to use the drug tentatively as a diuretic, and in an essay on Botanical Arrangement, published in the following spring, states that the digitalis purpurea "merited more attention than modern practice bestowed upon it."

About this time, however, a report reached him of the cure of a case which led him to pursue his investigations in regard to digitalis with increased vigor. "My truly valuable and respectable friend, Dr. Ash, informed me that Dr. Cawley, then principal of Brazen Nose College, Oxford, had been cured of a Hydrops pectoris by an empirical exhibition of the root of the Foxglove, after some of the first physicians of the age had declared that they could do no more for him. I was now determined to pursue my former ideas more vigorously than before, but was too well aware of the uncertainty which must attend upon the exhibition of a root of a biennial plant, therefore continued to use the leaves. These I had found to vary much as to dose at different seasons of the year; but I expected, if gathered always in one condition of the plant, viz., when it was in its flowering state, and carefully dried, that the dose might be ascertained as exactly as that of any other medicine; nor have I been disappointed in this expectation. The more I saw of the great powers of this plant the more it seemed necessary to bring the doses of it to the greatest possible accuracy."

Withering did not make public, except to his circle of friends, his discovery of the value of the digitalis until 1785, when he issued a work of some magnitude, entitled, "An Account of the Foxglove and Some of

Its Medical Uses: with Practical Remarks on Dropsy and Other Diseases." This, the great classic on digitalis, in which he reports a series of 166 cases of his own, a small number of hospital cases treated under his direction, and a number of cases treated by his friends, contains points of view which have really not been surpassed until Schmiedeberg laid the foundation of the modern pharmacology of the drug by his discovery of the active principles of the leaves. It is certainly remarkable that a drug, the efficacy of which was at once recognized, should have a relatively small clinical literature. Until comparatively recent years the series of cases reported by Withering was unrivaled. Many of them are written with a regard for exactness which, considering the state of medical knowledge at that day, is remarkable. He realized the importance of not selecting his cases to make his results appear more favorable, but recorded each and every case in which he used the drug. In 1785, as his book was about to go to press, he writes: "The cases which have occurred to me in the course of this year are numerous; but, as the events of some of them are not yet sufficiently ascertained, I think it better to withhold them at present." Not only this, but we learn from him that, after ten years of experience with the new drug, he did not publish his observations until repeatedly urged to do so by his friends, to whom the value of the drug was known.

In one respect Withering excelled all his followers, and was far in advance of general medical knowledge until the last two or three decades. He realized the absolute necessity of giving the drug to the point of producing its definite physiological effect upon diuresis, and, while in the beginning of his experience he encountered many cases in which he obtained toxic results, yet he has the incontestible merit of having used digitalis effectively. Many practitioners of the present day fail to derive the real benefits of the drug, in that they do not give it in effective doses. After ten years of experience his directions for the exhibition of the drug should be taken to heart by everyone: "Let the medicine, therefore, be given in doses and at the intervals mentioned above; let it be continued until either it acts on the kidneys, stomach, pulse, or the bowels; let it be stopped upon the first appearance of any one of these effects, and I will maintain that the patient will not suffer from its exhibition, nor the practitioner be disappointed in any reasonable expectation." Experience had taught him that his original massive doses were unnecessary, and that increased diuresis could be produced without the development of any unpleasant symptoms. His doses ranged from one to three grains of the powder twice a day to adults, or the corresponding amount of a freshly prepared infusion. He states that about thirty grains of the powder are necessary to produce a commencement of the nausea.

As is usually the case, for nearly a century after Withering's time digitalis was put to every conceivable use. Traube, with all his genius,

concerned himself vastly more with the "antiphlogistic" use of digitalis, drawing the erroneous deduction that, because of its action in slowing the pulse, it would have an especially beneficial effect in reducing fevers. In pneumonia he believed he could produce a favorable local effect. Because of these wanderings from the direction in which digitalis is really the sovereign remedy, Traube's extensive series of cases was unfruitful so far as the development of a definite system for the use of digitalis is concerned. The various textbooks of that time were of even less utility and richly merit the sharp criticisms given them by Schmiedeberg.

Pharmacology.—The modern pharmacology of digitalis dates back about thirty years, when Schmiedeberg produced the active principles. Following his epoch-making discoveries, much experimentation was carried out, both clinically and pharmacologically, with the active principles, although in many, perhaps most, instances these were of doubtful purity. The use of digitoxin, under the name of Digitaline Nativelle Crystalizée, became popularized in France by Huchard, and it is to this latter observer that we owe the development of an effective system of treatment with this active principle.

It gradually became evident, however, that, while digitoxin represented a most important active agent of the digitalis leaves, it did not represent the entire value of the latter. The German clinicians have, with very few exceptions, adhered to the use of the leaf or the infusion, and the perfection of the Galenical preparations is, at the present time, the task which is engrossing the attention of pharmacologists and clinicians. Recognizing the great differences which exist in the Galenical preparations, the present era of digitalis therapy, which is only just beginning, may be properly designated as the Era of Standardization.

The recently introduced method of intravenous injection of the digitalis bodies, especially in the form of strophanthin, is of the very highest importance. By this method it can relatively easily be determined exactly what effects the drug produces, as under these circumstances all the errors of absorption necessarily present when the drug is given by mouth can be eliminated. A glance at the newer series of cases shows that Traube's teachings in regard to the inapplicability of digitalis in renal cases is unjustifiable. Some of the very best symptomatic results of intravenous strophanthin therapy are to be found in the treatment of the cardiac weakness of the various forms of contracted kidney.

Digitalis Action.—Although Van Aubel had suggested as early as 1894 that digitalis bodies be used intravenously, his suggestion was not fruitful of results. His communication remained almost unnoticed until 1905, when Kottmann (under Naunyn) and Mendel revived the matter. Fraenkel considers the intravenous injection of strophanthin by far the best means of studying the complete action of the digitalis bodies. He describes its effects as follows: "Let us take a case in which a heart

muscle, competent up to this time, suddenly fails, and danger to life becomes imminent, even before any apparent disturbance in the distribution of the blood has shown itself, or, at all events, before any appreciable amount of edema has developed. The seriousness of the situation is shown in the collapsed look of the patient, the pale yet cyanotic skin, the cold extremities, the face covered with cold sweat, and in the great dyspnea. The radial pulse, if palpable at all, is small, usually rapid, and irregular. Bronchitic râles are audible over the lungs and pulmonary edema is imminent.

"If such a patient receives at the proper time a dose of strophanthin intravenously, in from five to ten minutes a great subjective improvement occurs, and the physician receives the impression that the danger has been overcome. If we determine simultaneously the systolic and diastolic blood pressures we can see at this time, and immediately after, the following physiological processes: Two or three minutes after the injection the pulse pressure (amplitude) increases, and this more because of the lowering of the diastolic than of the raising of the systolic pressure. After a few minutes more the radial artery is felt by the finger to become fuller, the pulse slower, and, if there has been a previous irregularity, more regular. But, in spite of a slowing of the rate, the product formed by the amplitude (pulse pressure) A, and frequency n, that is, A x n, increases, and this increase may amount to a doubling. This is at the height of the action. In the second stage of the action, after a successful compensation, the product A x n becomes smaller again, but, as a rule, not so small as before the injection. The relationship of the factors has changed as well. The pulse pressure remains larger, the frequency less, than before the injection. It is a prerequisite for such an optimal rapid 'digitalization' that the heart is one which will react to digitalis, that is, that the heart weakness is not absolute. A development of the basic pathological condition is not to be stopped by any form of digitalis therapy."

The same train of effects may be witnessed when a similar injection is given in a case of moderate intensity, the only difference being that in the latter case a period of two or three hours elapses before the symptoms show any marked improvement. Soon after this improvement occurs an increase in diuresis sets in.

When the drug is given by mouth the same chain of events occurs, except that these take place very much more slowly. They occur also with much less uniformity, as a result of the various contingencies of absorption.

The above record of events shows that an increase of the blood pressure is by no means a necessary concomitant of effectual digitalis action. To be sure, in most cases a more or less fugacious increase of the maximal pressure is observed, but this is of short duration, and by no means

is this a *sine qua non*. It should be emphasized that the full digitalis effect may be obtained with a stationary maximal pressure. Indeed, Sahli has shown that digitalis may exert its full action with a falling blood pressure. These are the cases of high pressure stasis (Hochdruckstauung), to which reference will be made later. In this group of cases, which are seen so frequently in the contracted kidney, the venous congestion of the centers of the medulla brings about a condition of vasoconstriction. This operates to further increase the blood pressure. If, now, this venous congestion be lessened as a result of the improvement of the heart's action produced by the digitalis, this element of medullary stasis is removed, and the blood pressure, in consequence, may fall.

In a highly instructive communication on the work of the heart under digitalis Gottlieb and Magnus have shown that the systolic output of each ventricle may be increased threefold. In a previous investigation the same authors have shown by means of plethysmographic experiments that the digitalis bodies really do have the much-discussed constricting effect upon the blood vessels, and that this is most marked in the splanchnic territory. These results were confirmed in 1907 by Carl Tigerstedt.

It must be regarded, then, as pretty definitely settled that the increased blood pressure after digitalis is not exclusively due to the increased heart action, but to the increased action of the blood vessels as well.

Gottlieb has further shown that the slowing of the pulse is not caused by the increased blood pressure, as has been hitherto proposed. In his experiment the slowing of the pulse was found to develop at a time when no increased blood pressure had yet occurred. If the experiment were arranged with an overflow manometer in such a way that there could be no increase in the blood pressure, the slowing still occurs, showing that this is a direct vagus action. It cannot be denied that the effect of digitalis in bringing about and regulating the changes of blood distribution in venous stasis may be in part dependent upon the action on the blood vessels. As a general rule, however, the cardiac action greatly predominates, so that Fraenkel's statement that "the improvement and increase in the volume per second is the characteristic chief action of the digitalis bodies in cardiac insufficiency" may be said to represent practically the very pith of our knowledge of digitalis action. In all cases there is an increase in the amplitude (pulse pressure) of from 20 or 30 per cent. up to 90 or 100 per cent., or even more. In strophanthin injections this increase in amplitude is the best objective criterion of the satisfactory action of the drug. When it does not occur we may rest assured that the therapeutic effect is not obtained. The same remark applies when the drug is given by mouth, except that under these conditions the increased amplitude occurs after a lapse of from 12 to 20 hours. It precedes, however, the development of increased diuresis.

The most certain effect of digitalis action is an increased diuresis.

Within so short a time as two or three hours after an intravenous strophanthin injection, or after the lapse of about 20 hours when the drug is given in efficient doses by mouth, increased diuresis invariably occurs. Of course, this presupposes that the case is one of real cardiac stasis, and one which is capable of being influenced by digitalis. Too great stress can hardly be laid upon the observation of the amount of urine passed in all cases where digitalis is being given, or likely to be given later. From the practical standpoint this is doubly important, as this is something which is very readily done, even with untrained assistance, and which requires no instruments of precision.

The third effect, and the least reliable criterion, is the slowing of the pulse. This is explicable when we remember that the slowing may occur from various causes. In most cases of myocardial insufficiency the accelerated pulse rate represents the endeavor of the heart, by pumping faster, to make up for what it has lost in the weakness of its contractions. As the strength of the contractions increases under digitalis, this element of increased pulse rate becomes unnecessary, and the heart slows up. The slowing due to direct vagus action occurs only with large therapeutic doses. While it has been shown that under the uniform conditions of animal experimentation the slowing may be a fair indicator of the degree of digitalis action, yet it is certain that in the case of man there are other factors, especially nervous influences, at work.

Clinical Indicators of Effective Digitalis Action.—Diuresis.—This is by all odds the most reliable and certain indicator of the beginning of effective digitalis action. Under all circumstances the quantity of urine should be measured with accuracy before the administration of the drug, so that it may be told by the first increase in the amount as to whether the drug is acting effectively. If the practitioner will take to heart this by no means new therapeutic caution, and measure the urine with the same fidelity and accuracy that he measures the temperature in typhoid, and, above all, study the results so obtained, he will find it of inestimable value.

Amplitude (*Pulse Pressure*).—The amplitude, or pulse pressure, representing the difference between the maximal and minimal blood pressures, or, in other words, the effective part of the blood pressure, is an even more delicate indicator. With the general use of the sphygmomanometer in clinical medicine, it is a matter of no great difficulty to determine this. As already explained, an increase in the amplitude is the characteristic action of digitalis in cardiac insufficiency. A very large proportion of the unsatisfactory results in the use of digitalis is due to inefficient dosage and the fear of the physician of the bugbear of cumulative action. The two indicators just given, namely, the increased diuresis and the increase in the pulse pressure, are the two criteria which should enable the physician, keeping in mind the points already given in regard

to the slowness of its action, to carry out a really effectual digitalis therapy.

Pulse Rate.—This indicator of the effect of digitalis is the one most frequently relied upon in routine practice, and yet it is unquestionably the least reliable. [This is not accepted by most authors, and time alone will tell whether further clinical experience will verify as a fact that pulse rate is the least reliable sign of digitalis effect.—Editor.]

It should be constantly kept in mind that no real digitalis action should be looked for in the absence of increased amplitude and increased diuresis.

Strumpell has emphasized, in common with many others, the absolute necessity of giving digitalis in effective doses. The writer can, from frequent clinical experience, abundantly testify to the fact that a great many instances occur in which, for example, the tincture or infusion of digitalis is given in accordance with a preconceived and often quite erroneous conception of proper dosage, and quite apart from any knowledge of the physiologic value of the preparation used, with, of course, the inevitable result that many cases which form ideal subjects for digitalis therapy fail to receive the enormous benefits which might accrue to them from the use of the drug. In such cases, because of the absence of a knowledge as to what constitute the criteria of effective digitalis action, the physician is apt to assume that the case is one which cannot be benefited by digitalis, whereas in reality it is his method of administration and the unreliability of his preparations which are at fault.

Fraenkel formulates the problem very neatly in a single sentence: "How can we induce full digitalis action without the appearance of accessory effects?"

Variation in Strength of Galenical Preparations.—Fraenkel found that the infusions which he obtained for analysis from the usual sources varied in strength in the proportion of 4 to 1. When we reflect that these are the preparations in most general use, it is readily to be seen that the assumption of any given amount being the proper dose leads to absolutely ineffectual therapy. This is because of the fact that there is little or no danger of the preparation being stronger than normal, but rather the reverse, as the preparations rapidly deteriorate.

Even in the case of the digitalis leaves it has been shown by Ziegenbein that there is a difference of from 100 to 200 per cent. in the strength of the leaves of the same crop, gathered in different parts of Germany. Focke found that digitalis leaves gathered during July and kept in hermetically sealed vessels, under the usual conditions, had lost a large portion of their strength in the course of the year. Kochmann examined five infusions of digitalis, the leaves of which had been obtained from different sources, and found that but two of these were capable of producing true digitalis action in dogs. Edmunds examined seventeen prep-

arations of tincture of digitalis and six of strophanthus. These showed very great variations. In one instance two supposedly standardized preparations prepared by the same manufacturer showed variations in strength of 100 per cent. Four preparations non-standardized, from the same manufacturer, varied 400 per cent. in strength.

Edmunds and Hale say: "In the one-hour method digitalone No. 2, in doses four times as large as were given of the weakest, and ten times as large as the strongest of the other (except digitalone) preparations, failed to call forth systolic arrest. Injected into rabbits, digitalone No. 1, instead of raising the blood pressure, lowered it 23 per cent., the curve resembling that given by the nitrite series." The conclusion which they draw is that digitalone is not invariably a permanent solution, and, when decomposed, is not only devoid of digitalis action, but distinctly harmful.

Standardization.—The whole fabric of successful digitalis therapy rests upon two factors. First, having a preparation of definitely known strength, meaning by this not simply a preparation which contains such and such an amount of digitalis leaves, themselves of unknown physiological strength, but a preparation of known strength in respect to its action upon the heart muscle, i. e., a physiologically standardized preparation of which the strength is definitely known. Second, upon giving this physiologically standardized digitalis to the point of securing definite digitalis action, as evidenced by the indicators referred to in a previous paragraph.

It is rather remarkable that in a drug which, in regard to its importance, is the undisputed queen of the pharmacopeia, and rivaled, if at all, only by opium and quinin, should have been prescribed for so long a time in so inaccurate a manner as has been the case. Fraenkel's gentle reproach is perhaps to be interpreted, by reading between the lines, as meaning that the art of prescribing digitalis judiciously and effectively is an art possessed by relatively few. It is one of those drugs, indeed, one might say the only drug, to which Osler's apt remark applies: "How he uses it may be taken as a sort of indication of the therapeutic intelligence of the practitioner." The method of standardization which is only now just beginning to come into wide use has varied considerably.

Methods of Standardization.—Within the scope of this sketch it is impossible to discuss the methods of pharmacological standardization in use. In a general way standardization has proven most satisfactory on the frog's heart. In the Heidelberg Institute the results are expressed in frog units, their frog unit being a purely arbitrary standard. Before standardized preparations can come into general use some agreement must be entered into between the manufacturers of the various preparations as to the absolute value of the frog unit, or else this unit must be determined by law. Efforts in the latter direction are being made in Germany. The Heidelberg frog unit is that amount of any digitalis preparation (powder, infusion, tincture, etc.) which, in a Rana Temporaria of 30 to

40 grams weight, produces arrest of the heart in systole with certainty inside a period of 30 minutes. If, for example, a given digitalis powder requires 0.02 gram to produce this systolic arrest, then 0.02 equals one frog unit, i. e., 1 gram of powder contains 50 frog units. They have found it convenient to express the number of units contained in one gram. According to investigations of Gottlieb, the average strength of a good commercial preparation should be at least 50 frog units. Digitalis powder derived from the Strassburg Hospital contained 100 frog units, and once even 120 frog units.

Focke, whose method has been used extensively, expresses his results somewhat differently. Instead of a time period of 30 minutes, he uses an average period of 10 minutes. He determines the value of the preparation from three factors, the weight, the dose, and the time. If in frogs weighing 30 grams 0.6 gram of an infusion produced systolic arrest of the heart in an average time of 10 minutes, then the toxic value $V=\frac{30}{0.6\times10}=5$. Some commercial preparations are on the German market with their toxic value expressed in terms of the amount of a standard infusion which, under certain specified conditions, is required to produce systolic arrest in 100 grams of frog.

Methods of standardization based on the chemical determination of the amount of digitoxin contained in a preparation have not been found satisfactory. In the German market a number of titrated tinctures and leaves have been obtainable for several years.

Loss of Susceptibility to Digitalis.—The fact that we have been accustomed to prescribe digitalis in preparations the strength of which varies so greatly is almost certainly responsible for the idea, which is widely prevalent, that after the continued use of the drug the heart fails to respond to its action. A little reflection will show how this conception may easily have arisen. A physician accustomed to draw his digitalis from a given source gradually evolves a dosage and a method of administration of his own. If, now, having occasion to treat heart cases which have previously responded promptly to digitalis with preparations derived from other sources, he applies the some dosage and method of administration and does not obtain the desired effect, he is quite likely to leave out of consideration the probability that in the latter case the preparation of digitalis was relatively inert, and so concludes that the case was one in which digitalis could produce no effect. The writer has seen this happen many times in cases where the so-called active principles have been administered, and yet the action of the drug was not manifest. The administration of powdered digitalis of known efficiency in adequate doses was promptly productive of the full action of the drug. As early as Niemeyer's time it was known that doses which were of just sufficient strength to produce the proper therapeutic effect, when administered in one part

of Germany, would show a distinct toxic effect when the same dose was given in another part of the country. The explanation was, of course, as is now well known, that the digitalis used in the two cases was derived from different sources, and in some cases was of twice the strength that it was in others.

Fraenkel has shown indisputably that even the long-continued use of the drug does not lessen its effect. Patients with chronic valve lesions, for example, who have taken small doses of the drug over long periods of time and then, because of a sudden attack of cardiac insufficiency, require more energetic treatment, are found to respond to the drug as satisfactorily as at first. This presupposes, as a matter of course, that the underlying pathologic process has not materially advanced in the meantime.

Toxic Action.—If excessive dosage be given, or if the individual doses be too close together, toxic action may set in. Speaking generally, toxic symptoms occur only when efficient doses are given in too close succession, so that the effect of the new dose is felt before that of the old has worn off. This so-called cumulative effect follows a definite law, and it should be emphasized that this same cumulation obtains in a greater or less degree for all the digitalis bodies. Fraenkel has shown that the therapeutic and toxic cumulation follow the same law. Slight differences occur of quantitative not qualitative value, depending in part upon the absorbability of different preparations. Probably a further cause of slight differences is that some of the bodies enter into more stable combinations in the heart than others. The greater or less cumulative action of a digitalis body depends probably more upon this latter factor, upon the stability of its chemical combination, than upon the rapidity of absorption and excretion. Digitoxin requires, when given subcutaneously, approximately 24 hours to produce its action. The after-effect of digitoxin is, however, the most lasting, and, in consequence, if really active doses of digitoxin are to be given, the interval between the dose must be most carefully measured. In this sense digitoxin exerts the greatest cumulative action. Strophanthin exerts its action more quickly, that is, within a few hours; its after-effect is, in consequence, much less than that of digitoxin, and hence it has a less cumulative effect than the latter. Digitalin ranks between the two.

From Fraenkel's experiments it is quite clear that a daily dose can be determined, which, when rigidly adhered to, is just sufficient to keep the action within the therapeutic stage. If the dose be increased toxic action arises, quite irrespective of the preparation used. The same author has shown that these statements are just as applicable to Cloetta's digalen, which was introduced with a statement that its action is not cumulative. The reason for thinking previously that digalen was non-cumulative was simply the fact that the doses which had been given were too small. Per-

haps the most important conclusion to be drawn from the investigations along this line is that, as Fraenkel puts it, *"A digitalis body without cumulative effect would not offer the necessary conditions for successful therapeutic action."* Schaeffer (quoted from Fraenkel), in an inaugural dissertation, from the Strassburg clinic, undertaken under the guidance of Fraenkel, has shown that the same thing applies to man. This author collected all the cases over a period of years which had been treated with digitalis (Alsatian digitalis having a strength of 100 frog units per gram), and found that toxic symptoms invariably resulted when certain doses were exceeded in a given period. He found that if

1.8 in 6 days
1.4 in 5 days
1.2 in 4 days
0.9 in 3 days
0.6 in 2 days

were given, toxic symptoms made their appearance with regularity. On the other hand, as much as 3.8 grams have been given without toxic symptoms, provided it was spread out over a longer period of time and the daily dose made a little smaller. He found one gram (100 units) in four days to stand just on the border line between the therapeutic and the toxic dose. In general, it may be stated that Schaeffer's results indicate that 0.2 gm. per diem (i. e., about 20 frog units) is about the largest amount which can be given with the certainty that toxic symptoms will not appear. These same results demonstrate that the cumulative action of digitalis in the human being, using the galenical preparations, follows the same law as the injection of the active principles in animal experiments.

In the case of intravenous injections the sudden change from the slowing of the pulse, which is the indication of its therapeutic action, to a sudden rapid pulse is the symptom most to be feared. In internal medication such a result is exceedingly unlikely ever to occur, as gastric and intestinal symptoms give ample warning in sufficient time to diminish the dosage. It can scarcely be doubted that, when one considers the large doses which are given by a few clinicians, who best understand the necessity of obtaining full action of the drug, as a *sine qua non* of successful therapy, that the great anxiety which is felt by so many physicians, and which has led in so many instances to a totally ineffectual method of treatment, is greatly exaggerated. The writer's experience would lead him to believe that our American physicians are accustomed, as a rule, to prescribe doses quite insignificant as compared with those used in the German clinics, and many instances have come to his notice where cases, supposedly refractory to digitalis, were in reality not so at all. The dosage had simply been too small to be effective.

A considerable number of the clinicians of the largest experience push digitalis therapy to the point of obtaining slight toxic symptoms, as evidenced by beginning gastrointestinal disturbances. This has been done with the idea uppermost that the improvement brought about by the drug will be more permanent when pushed to the point of incipient toxic action. This matter has been discussed pro and con by clinicians, but no very satisfactory results have been arrived at. In the compilation of Schaeffer cases which have been treated through a number of attacks of cardiac insufficiency were found to have experienced no shorter intervals between the succession of attacks when the preceding course of treatment had been carried to the point of slight toxic action. The matter is hardly yet ripe for definite settlement, but the probability would seem to be that the opinion just expressed is the correct one.

In determining the question as to whether the best course to pursue is to saturate the patient with digitalis just up to the point of beginning toxic action, or whether, on the other hand, it is better to give just such an amount as will suffice to produce definite action upon the indicators, it is well to bear in mind a point which Sahli has especially emphasized, which is: whatever may be the primary cause of the cardiac weakness, the ultimate cause is, in last analysis, defective nutrition of the myocardium. Since the coronary vessels have been shown (see introductory remarks) to be filled during systole in precisely the same way as the peripheral vessels, and since the circulation in them is greatly assisted by vigorous contractions of the heart muscle itself, it will be plain that the circulation in them suffers more in proportion than it does in the peripheral vessels, since in the latter the element of direct pressure by the heart muscle does not apply. It is probable that only a very moderate increase in the strength of contraction of the heart muscle is sufficient to bring about a greatly increased flow of blood in the coronary vessels, and in this way to increase the nutrition of the heart muscle. An insufficient coronary circulation leads to an impaired nutrition of the myocardium, which results in a further weakening of the coronary flow, which again further weakens the heart muscle. This is the true *circulus vitiosus* of the heart. The action of digitalis in increasing the coronary circulation breaks up this vicious circle by the rapid improvement of the nutrition of the heart muscle, which aids in the still further improvement in the coronary circulation.

Indications.—In general the indications for the use of digitalis are simple and precise. In all conditions of cardiac insufficiency where the heart is insufficient to carry on the circulation digitalis is indicated. In the more marked grades there can be absolutely no question as to the propriety of its immediate administration. In patients suffering from dyspnea, venous congestion of the liver, anasarca from this cause its exhibition is imperative. Considerable difference of opinion exists as to whether in cases of cardiac insufficiency of the light-

est grade digitalis should be used. The workers in the Leipzig school, who have done so much to increase our knowledge of heart muscle pathology, recommend its use even in the earliest degrees of insufficiency. It not infrequently happens that even in the initial stages of cardiac insufficiency attacks of angina pectoris or cardiac asthma may show themselves. Such symptoms increase the importance of restoring the normal coronary circulation at the earliest possible moment. That it should be used where other methods are not applicable or have failed is self-evident. Personally, this seems to the writer the only defensible position. Indeed, bearing in mind the influence of the coronary vessels on the circulation, it would seem as if digitalis is more imperatively demanded in this class of cases than in those where the cardiac insufficiency is more pronounced. We are probably justified in assuming that by keeping up as far as possible a normal coronary circulation we may prevent the beginning of the *circulus vitiosus* of the heart. Since the investigations of Fraenkel have shown so conclusively that the heart does not grow accustomed to digitalis, and that its effect on the heart is not diminished in any wise by its administration over considerable periods of time, it seems to the writer that the last prop has been taken from under the argument against its use in early cases of cardiac weakness. We may extend, therefore, the indication so as to read that cardiac insufficiency of whatsoever grade is an indication for the use of the drug.

The one question which might be still open to debate would be the following: In a first and very mild attack of cardiac insufficiency, with presumably fairly sound myocardium, where it is likely that with simple rest in bed the attack may subside, would digitalis be indicated? In cases of this sort, presenting no danger to life, it has been the writer's custom, after putting the patient to bed, to wait 24 hours before administering digitalis in any form. The reason for such delay is to be found in the desire to determine just how much improvement could be brought about by placing the heart, as far as possible, at rest. Only in some such way as this is it possible to determine just how much of the improvement is due to the rest given the heart, and how much to the drug itself. We must admit, however, that this is largely a question of personal preference. The propriety of administering it, if so desired, from the first hour cannot, we think, be questioned.

We began with the statement that cardiac insufficiency is the cardinal indication for the use of digitalis. This holds true in a general way, irrespective of the cause of the insufficiency. Sahli, in an address before the Nineteenth Congress of Internal Medicine, has expressed the indications, so far as the different forms of stasis are concerned, with great clearness. He distinguishes five varieties of stasis: first, cardiac; second, respiratory; third, high pressure stasis; fourth, vasomotor stasis; fifth, splanchnic stasis. Cardiac stasis rests, of course, upon the insufficient systolic output of the heart, dependent generally upon absolute diminution of the heart's force, or on a relative diminution of its force, in proportion to the resistances to be overcome.

Under respiratory stasis he includes those conditions of stasis which

result from diseases of the respiratory organs, such as that so commonly met with in emphysema, chronic bronchitis, asthma, cirrhotic processes in the lung, pleural exudates, kyphoscoliosis. All of these act mechanically in such a way as to produce a dilatation of the right heart, and are, as a matter of fact, neither more nor less than a subvariety of cardiac stasis.

High pressure stasis has been already sufficiently defined. Its importance lies in the fact that, because of the high blood pressure, the condition of cardiac insufficiency is apt to be overlooked.

By vasomotor stasis Sahli understands those conditions of impaired circulation in which, with normal cardiac power, the smallest vessels of the greater circulation are so dilated that the heart receives too little blood in diastole. While many of the symptoms are similar to those of cardiac stasis, the conditions are not identical.

In the condition known as splanchnic stasis the vessels of the abdomen are greatly dilated, a large part of the blood is retained in them, and as a result the patient, to use an old comparison, bleeds into his own portal system.

The important point to bear in mind is that in each and every one of these several varieties of stasis digitalis is indicated.

Contraindications.—We may say, in general, that digitalis is contraindicated if the nature of the lesion producing the cardiac insufficiency is such as to bring with it certain dangers which might be enhanced by the increased work of the heart, which would result from digitalis action. In conditions of high pressure stasis, with cerebral hemorrhages and cardiac insufficiency, we must weigh, for the particular case in question, the two dangers which confront us. If the cerebral hemorrhage seems the predominant condition, digitalis should not be given. In cases of thoracic aneurysm, associated with cardiac insufficiency, digitalis should not be given until all other means, such as rest in bed, appropriate diet, etc., have failed to remedy the insufficiency. A considerable number of similar cases arise, but in each and every one the question must be decided on the merits of the particular case. In conditions of high pressure stasis digitalis is indicated precisely as in similar cases with low pressure. As Sahli has shown, a part of the increased pressure is due to a venous congestion of the medullary centers, producing a vasoconstriction and further increase in peripheral blood pressure. In these cases digitalis often acts like a charm, and, as might be expected from the pathology of the condition, the blood pressure falls when its action becomes manifest.

In the cardiac insufficiency of the contracted kidney, which often occurs with a high blood pressure, digitalis is indicated. Some excellent therapeutic results have been obtained by the use of strophanthin in the contracted kidney. The argument against the use of digitalis in these

conditions has been that the increase of pressure produced by it would involve a danger of cerebral hemorrhage. When we reflect, however, that in the contracted kidney blood pressure has presumably been high for a considerable period of time before the cardiac insufficiency set in, and that it almost certainly became lower as the heart became weaker, we need have no hesitation in exhibiting a drug which, at most, would do no more than restore the blood pressure to its original height.

In arteriosclerosis, with insufficient heart, precisely the same reasoning holds good. The often postulated danger of cerebral hemorrhage is exceedingly unlikely. The utility of the drug, on the other hand, is unquestionable.

A much more difficult question to answer is as to whether digitalis should be given in the various degenerations of the myocardium. The confusion which exists in this respect has been due largely to a misunderstanding of just what can be accomplished by the use of digitalis. *Under no conditions can digitalis increase the absolute power of the heart. It merely enables it to use to better advantage the power which it has left.* In consequence, when a myocardium is so degenerated that there is not a sufficient number of normal fibers left to carry on the circulation, neither digitalis nor any other drug can produce much of an effect. As this is very frequently the case in advanced degrees of myodegeneration, we constantly meet cases which do not respond in the desired manner to the use of digitalis. The principle involved is absolutely no different from that involved in the treatment of a mitral insufficiency with intact heart muscle, except that in the latter case the chances of a successful result are much greater.

While we recognize that in the various forms of disease of the myocardium we will constantly meet cases in which, in spite of digitalis, the heart muscle cannot be restored to a degree of efficiency sufficient to maintain a normal circulation, yet this in no wise detracts from the fact that digitalis is indicated.

Aortic insufficiency has been considered by some a contraindication for the use of digitalis. While, for reasons which will be discussed under that caption, digitalis frequently fails to produce a satisfactory result, yet it is in no wise contraindicated in this affection. Romberg very properly calls attention to the fact that the lengthening of the diastole, which has been the principal argument against the use of the drug in insufficiency of the aortic valves, is not as great as in the case of the mitral lesions, in which latter every one is agreed that digitalis finds its proper place.

A question which must often be answered in practice relates to the propriety of administering digitalis when outspoken gastrointestinal symptoms are present. In the overwhelming majority of cases these are de-

pendent upon the venous stasis of the portal system; in other words, they are part and parcel of the picture of cardiac insufficiency. Digitalis is indicated here precisely as if the gastrointestinal symptoms were absent. If, however, gastrointestinal symptoms not dependent upon the state of compensation, as in certain cases of gastroenteritis, are present, then we have to decide in each individual case as to whether the absorption of digitalis will be satisfactory under these conditions, and whether, if absorbed, it is likely to increase intestinal irritation. While this question must be settled for the particular case, and may not be answered by any generalization, yet it may be said that, so far as possible, the administration by mouth should be avoided, and other methods of administration substituted. If the nature of the case is such as to preclude or render inadvisable the intravenous use of strophanthin, or perhaps digalen, rectal administration may be tried.

In the gastrointestinal symptoms, so often associated with a contracted kidney, and dependent, in part at least, on circulatory disturbances, digitalis is not contraindicated, but, on the other hand, these may be often improved by its judicious administration. A number of conditions in the heart are not uncommonly but erroneously treated with digitalis. We refer to such conditions as the various forms of arrhythmia, palpitation, slight anginoid attacks of neurotic origin, and the various forms of tachycardia. It cannot be too much emphasized that not a single one of these conditions affords a legitimate indication for the use of digitalis, unless there is at the same time some degree of cardiac insufficiency present, and in this latter event the cardiac insufficiency, and not the other conditions named, gives the indication. Many physicians fail to acquire a correct estimate of the value of digitalis from having constantly sinned in this respect, and having given the drug in this group of cases, to which it is, by virtue of its physiological action, wholly inapplicable. Failing to achieve success with the drug, their confidence in it is unjustifiably diminished.

Perhaps, of all the errors which can be made in connection with the administration of digitalis, the greatest is to prescribe the drug in a valve lesion which is perfectly compensated. The writer has many times seen the mere presence of a murmur in the heart regarded as sufficient indication for digitalis therapy. A perfectly compensated valve lesion is, in and of itself, never an indication for the use of the drug. It becomes so only when the compensation is disturbed. Fraenkel and Schwartz have shown that digitalis exerts no effect, at least in therapeutic doses, upon a normal heart. Neither the force of its contractions is increased, nor does its musculature become hypertrophic, even when it is administered over a long period of time. The heart muscle of a perfectly compensated valve lesion acts in both these respects in a precisely similar manner to a normal heart.

It should especially be noted that a perfectly compensated valve lesion cannot be improved by digitalis.

Results of Efficient Therapy.—In appropriate cases the results obtained by a properly carried out course of digitalis therapy are little short of marvelous. In an appropriate case, let us say one of primary cardiac weakness from a decompensated valve lesion, where the myocardium is still intact, with dyspnea, cyanosis, bronchitis from stasis, weak and rapid pulse, swollen and tender liver, and edema of the dependent portions, and, perhaps, fluid in the body cavities, the effect can generally be seen, when the drug is administered by mouth, in from 48 to 60 hours. By the beginning of the third day, or even a little sooner, the dyspnea becomes lessened, the blood pressure increases, the pulse is slower, fuller, and stronger, the diuresis becomes increased two or threefold, the tenderness over the liver becomes less, and the edema shows signs of lessening. The improvement increases rapidly, so that on the fourth or fifth day the patient has experienced a degree of relief which makes him feel like a totally different individual. In most instances the subjective symptoms are relieved before a very great impression is made upon the edema and transudates, if these be present. The dilatation of the heart rapidly subsides, and it is not an unusual thing to see a patient at the end of a week who feels as well as previous to the onset of his attack of decompensation. Stress should be laid upon the increase of diuresis, first, because it is the most certain evidence of digitalis action, and, secondly, because by means of this increased diuresis the edema and transudates are disposed of.

Causes of the Failure of Digitalis.—*The most prolific causes of failure lie in the physician and not in the drug.* As has already been emphasized, lack of care in obtaining an active preparation of the drug, insufficient dosage, and a failure to appreciate the criteria by which we may recognize the effects of digitalis are the most important of these. The fact must never be lost sight of that digitalis, howsoever given, does not increase in the slightest degree the absolute power of the heart, but merely enables it to use, to the best possible advantage, the power which it still possesses. A certain number of cases in which digitalis is properly and efficiently given, and which are suitable for the administration of the drug, still fail to derive any considerable benefit from it. An analysis of such cases readily shows us that the reason lies in the inherent nature of the cardiac lesion itself. Given a case, let us say, of insufficiency at one of the orifices which is steadily increasing in extent, in such a case the time arrives when the amount of blood regurgitated is so great that it is impossible, in spite of maximal contraction of the ventricles, for enough blood to be forced through the aorta to maintain the circulation.

In progressive lesions all that can be expected of digitalis is that it ward off this absolute incompetency of the heart as long as possible, by insuring the

maximal force of contraction of which the heart muscle is capable. When this is insufficient to maintain compensation the circulation must under any and all conditions fail.

Method of Administration.—The discoverer of digitalis declined to be led into the pitfalls laid by the use of many preparations. He says, in two sentences pregnant with wisdom, that should be taken to heart by every practitioner: *"The ingenuity of man has ever been fond of exerting itself to vary the forms and combinations of medicine. Hence, we have spirituous, vinous, and acetous tinctures; extracts hard and soft, syrups with sugar or honey, etc., but the more we multiply the forms of any medicine, the longer we shall be in ascertaining its real dose."*

Much has been written, and to comparatively little purpose, as to the particular form in which digitalis should be given. The tincture, the infusion, the powder, the various active principles, have all had their ardent advocates.

It may be laid down as a rule, with probably no exceptions, that all the galenical preparations produce essentially the same action when the preparations are physiologically standardized, the titer accurately known, and when the dosage is regulated to accurately correspond to the strength of the preparation used.

Using preparations of unknown physiological strength, it is impossible to advance beyond a mere cut and try therapy. Taking conditions as we find them in practice, at least here in America, and bearing in mind the rapidity with which both the tincture and infusion may, under average conditions, deteriorate, the writer confesses to a strong disinclination to the use of these two preparations. That it is frequently convenient to use them may be granted; that they are necessary cannot be granted. It has been shown, furthermore, that the infusion may be attacked by the gastric juice to a considerable degree, and that it is much more difficult and takes a longer time to produce the characteristic digitalis action with the infusion than with the drug itself. These facts must lead us to unqualifiedly indorse the statement of Fraenkel, that the infusion of digitalis is a preparation with which we could readily dispense. At its very best, it can have no possible advantage over the crude drug, and its disadvantages are so numerous that we, in our personal practice, have not used it for a number of years. That it may, when active and used in sufficient doses, produce good results is unquestioned; but these are obtained with greater certainty and uniformity by other preparations. Under all circumstances it must be absolutely freshly made, since it loses as much as fifty per cent. of its value within twenty-four hours (Fraenkel).

Tincture.—The tincture is a more eligible preparation, and yet some

of the remarks applicable to the infusion apply as well to the tincture. It does not, any more than the latter, represent the entire drug, and deteriorates more rapidly than the leaves, although it probably retains its strength much longer than the infusion. In regard to the ease of administration, the tincture is distinctly preferable to the infusion, because of the larger quantity of the latter and the difficulty, amounting to wellnigh impossibility, of disguising its nauseous taste. Romberg calls attention to the fact that toxic symptoms of a severe character have been reported with especial frequency from the use of the tincture. His recommendation that it would better not be used is to be strongly indorsed.

Powdered Leaves.—Infinitely superior to either of these are the powdered leaves themselves. One cogent reason is that there can be no question as to their containing all the active principles. In ease of administration it surpasses the infusion very greatly, and is infinitely less liable to produce those gastric disturbances due to the repellent taste of the infusion. It can be stated with positiveness that, so far as oral administration of the drug is concerned, the powder answers satisfactorily practically every legitimate demand which can be made upon it. In making this assertion it is assumed, of course, that its physiological titer is known. Focke has shown that the keeping qualities of the leaves are, under suitable conditions, fairly satisfactory, although here, too, control should be made from time to time. The powder may be administered either as such, or made up into pills containing as a convenient amount 0.05 gm. (1 grain) in each pill. The *time* of administration, we are inclined to think, has not been given the consideration which it deserves. It should not be given before meals, because of the increased liability to gastric irritation at that time. Nor should it be given at the height of digestion, since whatever effect the hydrochloric acid may have upon the drug would be most marked at this time. *During* or *immediately after the meal* is probably the best time. A considerable number of patients taking digitalis will not be given their regular meals, but will be kept upon a largely milk diet. In this event it would better be given simultaneously with the milk.

In regard to dosage, nothing is more disastrous to a proper treatment than to establish in one's mind a schedule of doses and to apply these to all cases. Each individual case requires a dose sufficient to produce effective action in that case and no more.

In a general way it may be stated that, if we assume the digitalis powder to have a physiological value such that one gram equals 50 frog units, we should give 0.1 gm. (1½ grains) three or four times a day for perhaps three days, and then reduce the dose to 0.1 gm. twice daily. Since in an ordinary powder 0.1 gm. contains five frog units, this is equivalent to giving from 15 to 20 frog units for the first three days, and then reducing the

dose to 10 frog units daily. If the case is unusually serious, one may give 0.1 gm. (1½ grains) every four hours for five or six doses, provided the case be under strict surveillance. At the end of this time the dose should be rapidly reduced to about five frog units in the twenty-four hours. Schaeffer's table, already given, showed that about 20 frog units per diem, i. e., 0.4 gm. of an average powder, is about the largest amount which can be given with assurance that toxic symptoms will not develop if the drug be continued over a considerable period of time. An average case may require from 1.5 gm. to 2.0 gm. (22 to 30 grains) of the powder in a time period of from five to seven days. The writer has for some years been accustomed to give several rather larger doses on the first day, dropping the dose to about half or less on the second and subsequent days. This insures the prompt action of the drug, and at the same time effectually prevents its cumulative effect. This is essentially the same plan as that of Fraenkel, and seems, on the whole, the method of choice, when digitalis has not been given in the previous twenty-four hours.

Rectal Administration.—If nausea and vomiting are present to such a degree as to make the oral administration of the drug difficult, it may frequently be given by rectum, in three or four ounces (100 to 125 c. c.) of physiological salt solution. The uncertainty of absorption makes it more difficult to obtain uniform action when administered in this manner. The writer has obtained brilliant results by rectal administration in several cases where digitalis had been given unsuccessfully by mouth. The necessity of the rectal method of administration will become probably less and less great as the ease and certainty of the intravenous method become better recognized. When given per rectum, the dose, in general, should be one-third to one-half greater than the dose by mouth.

Active Principles of Digitalis.—Of the various glucosides contained in digitalis, and originally isolated by Schmiedeberg, two have been the most widely used; these are digitoxin and digitalin.

Digitoxin.—This is the most toxic principle derived from digitalis. It is insoluble in water, but soluble in water containing a certain proportion of digitonin; soluble in alcohol. This preparation has been used rather widely, especially by French physicians. Digitoxin crystallisatum represents a pure active principle. Its administration by mouth is attended with considerable uncertainty, owing to its complete insolubility in water. Because of the uncertainty of absorption, doses which at one time produced only the desired therapeutic effect would at another time, when given under apparently the same conditions, produce severe toxic symptoms. In addition to this Fraenkel has shown that the lethal dose of a pure digitoxin does not greatly exceed the active therapeutic dose; hence the ease with which cumulative effects are obtained with digitoxin is greater than with other preparations. The writer can testify from considerable personal experience that it is exceedingly easy, even when given

in a weak alcoholic solution per rectum, to overstep the therapeutic stage and to bring about the development of tolerably severe toxic symptoms. Bearing these facts in mind, it must be regarded as a hazardous procedure to push the administration of digitoxin to the point of even the slightest toxic symptom, and, in the case of intravenous injection, the risk is so great as to be entirely unjustifiable.

Digitalin.—A number of the preparations which have been used have been impure. Nativelles' crystallized digalin is a mixture of several glucosides, principally digitoxin. The digitalinum verum (Boehringer) is a pure preparation, soluble with difficulty in water, more soluble in alcohol. This preparation has been extensively used in the form of deep intramuscular injections. The digitalins of all sorts have now scarcely more than a historical interest, as they are surpassed enormously in value by other preparations.

Digalen.—Very widely used in the last few years has been a preparation known as digalen (Cloetta). This was introduced as a pure soluble digitoxin. Kiliani has shown clearly that it cannot be regarded as a solution of digitoxin in a pure form. It probably contains digitalein in considerable amounts. According to other authorities, it contains digitonin; and to the presence of this latter is due its solubility. As it is prepared commercially, one cubic centimeter of the solution corresponds approximately to 0.1 gram of powdered digitalis. The absorption is rapid, but the testimony of most authors is that the after-effects are not of as long duration as with the galenical preparations. As already noted under the discussion of the cumulative effects of digitalis, digalen exerts a cumulative effect in precisely the same way as every other active digitalis body. Being a weak preparation, it is less likely to produce cumulation because of the small size of the doses commonly given. The advantages of digalen may be summed up as follows: It is a useful preparation, more especially because of the ease with which it may be given intravenously, and because it represents a titrated preparation of uniform strength. On the other hand, it is perfectly certain that digalen does not represent the full therapeutic effect of the crude digitalis, also that it has precisely the same effects as regards cumulation when given in really equivalent doses. In practice its principal use will be found in dangerous conditions of cardiac insufficiency, where it is desirable to bring about the digitalis effect with rapidity. It cannot, in any sense, be regarded as capable of replacing the crude drug in the majority of cases.

Physiologically Standardized Galenical Preparations.—There are several titrated tinctures and preparations of the powdered leaves on the German market, but they are with difficulty obtained in America. The so-called standardized preparations which have thus far been prepared and put on the market by American firms have been shown by Edmunds

and Hale to vary so widely in their physiological value as to render them utterly untrustworthy.

Digipuratum.—The most important advance made in digitalis therapy in recent years is the extractum digitalis depuratum introduced under the trade name digipuratum. This preparation was introduced at the suggestion of Gottlieb, and represents the full action of the crude drug. It is an extract made in such a way as to introduce as little treatment by chemicals as possible, and yet to free it in a large measure of the inert substances, and more especially of the products of decomposition. It is these latter which are largely responsible for the relatively rapid deterioration of the native leaves.

In brief, the method of its preparation, as given by Gottlieb, is as follows: The powdered leaves are extracted and exhausted with alcohol; then concentrated in vacuo; a number of by-products then precipitated out by ether, which treatment removes about 85 per cent. of the bodies which would be present in an ordinary extract. The sum total of the active substances (except a loss of five per cent.) remains in the alcohol-ether solution. This is evaporated to dryness in vacuo, and freed from chlorophyll by petroleum ether. The digitonin, together with other irritating bodies, is removed by the treatment with ether. Digipuratum is soluble in water made alkaline with soda to the extent of one pro mille. It contains all the digitoxin in the leaves. Digipuratum is, according to Gottlieb, a mixture of the combinations of the digitalis glucosides with tannic acid (digitoglucotannoids or digitotannoids). These digitotannoids are insoluble, or nearly so, in cold water and dilute acid, a little more soluble in warm water, but extraordinarily easy of solution in dilute alkali.

Gottlieb tested the activity of the preparation after the lapse of a year, and found it to be the same as when freshly prepared. It is important not only that the total physiological activity should remain the same, but that the relative proportions of the various active principles should remain constant, and to this end he determined the digitoxin content, and found it constant. In general, it may be stated that 50 to 55 per cent. of its action depends upon digitoxin, 45 to 50 per cent. on the other active principles (Gottlieb).

Digipuratum is marketed as a dry powder or in tablet form, physiologically standardized, and this standardization expressed in frog units (using the 30-minute period of systolic arrest). When dispensed as a *powder,* it comes of such strength, as a result of a dilution with sugar of milk, that 0.1 gram (1½ grains) contains about 8 frog units, which would be the equivalent of an equal weight of a normal digitalis powder, having the strength of 1 gram, equal to 80 frog units. When dispensed in *tablet* form, each *tablet* represents 8 frog units, the equivalent of 0.1 gm. (1½ grains) of normal digitalis powder.

In working with standardized preparations the physician should accustom himself to think in terms of frog units, as only in this way can he compare different standardized preparations.

Digipuratum has been given a searching examination by Leo Mueller in the clinic of Krehl of Heidelberg. This author found that the effects of digipuratum were in no wise different in regard to physiological activity from the action of digitalis powder. Its action was constant in all cases of cardiac insufficiency of marked degree, and in these cases the results could be predicted. Mueller studied his cases with careful reference to the effect upon the three indicators, namely, the diuresis, the amplitude (pulse pressure), and the pulse rate. The effects on all of these were precisely similar to those obtained with an active digitalis powder. The effect on the diuresis, which, as we have seen, is regarded by Fraenkel as the most reliable indicator, showed especially plainly. In regard to the quantity, he found, in a general way, that 12 tablets, equivalent to 96 frog units, were sufficient to produce effective digitalis action. In most cases a larger amount, 2.0 gm., occasionally even 2.5 gm., was used. This increases the strength of the digitalis action, and renders it especially lasting.

In the administration of digipuratum toxic symptoms may be obtained by overdosage. This is, and must necessarily be, the case with every active digitalis preparation. *These lie in the nature of the drug itself as a digitalis preparation.* These toxic symptoms may be readily avoided if we gage our doses correctly, and especially if, after a few large initial doses, the daily amount be considerably diminished. Mueller calls especial attention to the fact that the toxic symptoms which developed after the administration of the purified extract were slight in character, rapidly disappearing, and might have been, he thinks, entirely avoided had they recognized in the beginning that the full therapeutic effect may be readily obtained without the development of any toxic symptoms whatever. This, of course, is the ideal to be sought for.

By comparison with equivalent doses of the Vosges digitalis, it was found that toxic symptoms developed from the latter much more readily. Mueller sums up his work in this respect by saying: "Just this difference in the appearance, or rather non-appearance, of disturbing intestinal symptoms, using approximately the same physiological dose, points to a qualitative difference in digitalis leaves of different origin, and shows the advantages of a purified extract over an unpurified powder." Veiel in the Tübingen clinic treated 50 cases with titrated leaves, and 50 with digipuratum. He finds the general effect on the heart's action the same in each, but the digipuratum produced a diuresis nearly three times as great. The effects on the other indicators were the same in both, and he obtained toxic symptoms in both with the same frequency. Boos, Newburgh, and Marx report a series of 180 cases treated in the Massachusetts

General Hospital. Their results were especially favorable in the absence of disturbing gastrointestinal symptoms.

Method of Dosage.—Inasmuch as *digipuratum represents in its physiological value a normal, active digitalis powder* (80 frog units per gram), everything that has been said in regard to the method of administration of the latter applies verbatim to the use of the purified extract. If prompt and vigorous action be desired, about 30 frog units may be given the first day, equal to one tablet (0.1 gm. or 1½ grains) of the powdered digipuratum, that is, 8 frog units four times a day (total 32 units), and this reduced to 2/3 the dose on the second and third days, and perhaps half on the fourth day. In general, about 100 frog units, equal to 12½ tablets, are sufficient to bring about the full digitalis effect desired.

It must be emphasized here that such doses can only be taken to represent an average and that many cases may need less and others more to make the necessary impression on the indicators. In many cases 2 or even 2½ grams may be required.

The clinical results obtained by the use of digipuratum, as shown by the effects upon diuresis, amplitude (pulse pressure), and pulse rate, are well illustrated by the following cases from Leo Mueller:

Case 8			Pulse-Rate	Amplitude	Diuresis	
Mitral insufficiency. Severe decompensation.	General Stasis.	Digipuratum. 0.5 pro die.	108 82 (3d day) 70 (5th day)	46 60 (3d day) 82 (5th day)	500 3800 (4th day) 6400 (5th day)	Discharged fully compensated.
Mitral insufficiency. Severe decompensation.	General Stasis.	Ext. Digitalis depur. (powder) 0.4 pro die.	136 120 (2d day) 108 (4th day) 92 (5th day)	85 95 (2d day) 105 (3d day) 115 (5th day)	400 800 (2d day) 2300 (4th day) 6600 (5th day)	Well compensated.

Hypodermic and Intravenous Use of Digipuratum.—Digipuratum is also to be obtained in sterilized solution, hermetically sealed in ampoules, each containing 1 c. c., representing 0.1 gm. (gr. 1½) of the powder and equal to 8 frog units. This is suitable for both hypodermic and intravenous injection. These have been on the American market a little over a year, and in that time the writer has subjected them to rather critical clinical tests. Hypodermically, the dose is approximately the same as that by mouth, only a little less. This mode of administration is of especial value when, because of venous congestion of the stomach and liver, there is much nausea and consequently imperfect absorption from the bowel. In every case in which the writer has used the drug hypodermically he has succeeded in producing full digitalis action with promptness. Some patients complain of pain at the site of injection, but this is rarely of sufficient moment to be weighed against the unquestioned advantages of this method of administration. In a number of instances,

in spite of the fact that the patients had been receiving digipuratum by mouth, the condition of compensation showed no betterment. Substitution of the same doses hypodermically produced a definite improvement. This was without doubt attributable to the unfavorable conditions of absorption from the gastrointestinal tract.

Intravenously the use of digipuratum should be reserved for the severest cases of decompensation. The technique of its injection is the same as that for strophanthin. It should not be forgotten, in comparing these two substances, that the frog unit value of an ampoule of digipuratum is only about half that of an ampoule of strophanthin. In a few cases in which the writer has had opportunity to make use of digipuratum intravenously it has generally been necessary to administer the second ampoule within twenty-four hours or less time to produce the desired effect. When the immediate danger is over, recourse would better be had to hypodermic administration. The keeping qualities of the solution of digipuratum are to be regarded as still *sub judice*.

Continuous Administration of Digitalis.—In a considerable number of cases, after compensation has been restored by the use of digitalis to its full physiological effect, the heart little by little grows weaker again, so that from time to time digitalis has to be administered in order to keep the circulation up to the necessary level. Heretofore it has been the custom of most clinicians to give digitalis only at intervals, but since Fraenkel has conclusively shown that digitalis does not lose its effect under continuous administration it is greatly to be preferred to give the drug constantly in small doses. One may give 5 to 8 frog units daily for many months with the greatest advantage. The writer has seen many instances where patients who had received such doses for periods of two or three months, and remained during this time in a state of good compensation, would, if the drug were omitted for a week, at once show a decided impairment of compensation, which would be rectified after a few days' administration of the drug in the original dose.

Substitutes for Digitalis.—In spite of the large number of drugs which have been recommended as being efficient substitutes for digitalis, the universal testimony of the best clinicians is that there is no substitute for this drug. Strophanthin, as has already been pointed out, occupies a position of its own, and in that position is invaluable. Where digitalis fails the use of its substitutes may be dispensed with.

Strophanthus

This drug is included, as already stated, in the digitalis group, since its action is essentially the same as the latter. The purest "digitalis" action which it is possible to obtain is by the injection of strophanthin, the active principle of strophanthus, intravenously.

Strophanthus is absorbed more rapidly than digitalis, and at the same time its action lasts a much shorter time. Its full action is often manifested, in oral administration, within twenty-four or thirty-six hours. An energetic digitalis action may be obtained by its use, if sufficient doses of a reliable preparation be given. The rapidity of its excretion and the short duration of its action make it evident that there is much less danger of cumulation than is the case with digitalis.

The variations in the strength of the ordinary preparations of strophanthus are as great as, indeed probably greater than, those of similar preparations of digitalis. Precisely the same remarks apply, therefore, to the necessity of having physiologically standardized preparations of known titer.

The principal indications for the use of strophanthus are to be found in those cases where digitalis produces such unpleasant symptoms as to render it difficult to continue its use. It has been much used in attacks of acute heart failure because of the somewhat more rapid action than digitalis. Since the advent of digalen, and more especially of strophanthin, the indications for the use of strophanthus by mouth have, in the writer's opinion, diminished practically to the vanishing point.

Strophanthin.—This, the active principle of strophanthus, has been introduced in the form of an intravenous injection by Fraenkel. Strophanthin is obtained commercially, under the name of strophanthin (Boehringer), as a solution, in ampoules, each containing one milligram of the active principle. These are carefully sterilized and ready for intravenous injection. The full dose is one milligram, equal to 15 frog units. This dose should not be repeated within twenty-four hours. In most instances 0.75 milligram produces brilliant results. The detailed effects of such an injection have already been described under the physiological action of digitalis. Nowhere in the range of medication can more brilliant results be had almost instantaneously, and with a high degree of certainty, than with the intravenous injection of strophanthin in appropriate cases. The conditions which call for this method of administration are either severe acute heart failure or chronic cardiac conditions with an acute attack of decompensation, of such severity as to threaten life. Under such conditions the intravenous injection of strophanthin, followed, after the lapse of twenty-four hours, by the administration of digitalis, is perhaps the best plan.

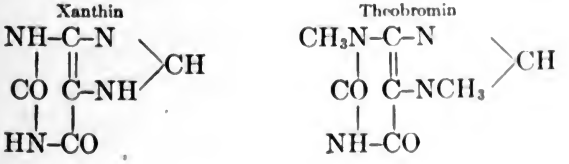
Fraenkel has obtained striking results in the cardiac insufficiency of the contracted kidney. He has given as many as twenty injections of strophanthin with two and three-day intervals. It must not be lost sight of, however, that the heart failure in contracted kidney usually marks the beginning of the end, not to be greatly deferred by any form of medication.

Technique of the Injection.—After careful sterilization of the site of

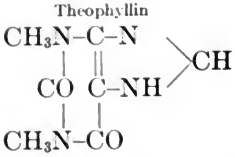
injection at the elbow, a rubber band is wrapped around the upper arm with just sufficient pressure to obstruct the venous flow, but not the arterial. The band should be held by an assistant or with a stout forceps in such a way that it may be loosened without disturbing the arm, as any manipulation might cause the needle point to penetrate elsewhere than the lumen of the vein. After cracking off the neck of the ampoule by a file scratch, the solution is taken up into a carefully sterilized, all-glass syringe, and care then taken to see that all air bubbles are expelled. The most prominent vein at the bend of the elbow is then selected, the needle thrust into the lumen, and the *piston then withdrawn until a drop or two of blood enters the syringe, to make sure that the needle is really in the vein.* This is highly important, since, *when the solution is injected into the cellular tissue surrounding the vein, it produces intense pain and occasionally thrombosis.* Having made certain that the needle is really in the lumen of the vein, the injection is made very slowly and cautiously. When we bear in mind that so large a quantity of a highly toxic active principle is injected directly into the heart, it is evident that the greatest precautions must be used in repeating the dose, and a strict twenty-four-hour interval must be observed. It is especially dangerous, in cases where digitalis has been given with apparently no effect, to then inject strophanthin. Several days, or, better, a week, should elapse after a course of digitalis has been given before an intravenous injection of strophanthin is administered. Chronic cases have been treated by repeated injections of strophanthin with rather long intervals between the injections. This method has little to recommend it. The internal administration of strophanthin has not been given a sufficient trial to enable any positive statements to be made with regard to it.

Caffein

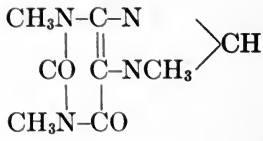
The drugs of this series have a double importance in respect to circulatory diseases, in that they are useful in the treatment of certain derangements of the heart and vessels, and for the reason that they are found widely distributed in a number of plants growing in different parts of the world, and are used extensively as beverages. The members of this group are three in number, namely, caffein, theobromin, and theophyllin. These three are xanthin compounds. The close relationship of these three substances may be readily seen from their structural formulæ:



Theophyllin



Caffein



Coffee is derived from the coffee berry and contains caffein; tea, from the tea plant, contains caffein with theophyllin. Thein, which was formerly supposed to be an active ingredient of tea, has been shown to be identical with caffein. Chocolate, cocoa (cacao), are derived from theobroma cacao, theobromin being the active substance. The kola nut, extensively used in central Africa, contains a mixture of caffein and theobromin. In the various South American countries beverages are habitually used in the same way as coffee in this country, and these all contain caffein and theobromin in various proportions.

Physiological Action.—This is very similar in all three, except that caffein has a more marked effect upon the central nervous system.

The most important action of caffein is upon the vasomotor centers. The vasomotor area in the medulla, as well as the rest of the central nervous system, is stimulated by it. This stimulation makes itself manifest in a contraction of the arterioles, which in turn produces a considerable rise in the blood pressure. It is this property of caffein which renders it of such signal service in the vasomotor failure of the acute infectious diseases (see Acute Vasomotor Paralysis). There is generally a diminution in the pulse rate in small doses, while larger doses produce an increase in the rate. Experiments are not conclusive as to whether there is a secondary action upon the heart itself, producing thus an increase in the force of the heart beat, but, in any case, this is of small moment as compared with its general vasoconstricting action. The effects of caffein in raising the blood pressure are due largely to the fact that the vasoconstriction is especially marked in the domain of the splanchnics. Some investigators have demonstrated a dilating effect upon the coronary vessels, but this is, in the case of caffein at least, not marked.

The respiration is rendered deeper and stronger by caffein, which is also due to its stimulating effects upon the medulla. Certain unpleasant symptoms occasionally attend the use of caffein, consisting principally of nausea, vomiting, sleeplessness, and palpitation. Dizziness may be complained of. These are at times productive of so much distress as to make the use of the drug very difficult. In many patients there is a distinct hypersensitiveness, especially in regard to sleeplessness, and not infrequently one or two therapeutic doses may be productive of so much loss of sleep as to more than offset the otherwise favorable action of the drug.

The action of caffein on the nervous system accounts for the widespread use of beverages containing caffein. In small quantity these seem to increase the capacity for intellectual work, and even the capacity for

physical exertion becomes greater. In larger quantities headache may be produced. There is a rather high degree of tolerance developed by the constant use of caffein. This is seen in the case of habitual drinkers of coffee, who may at times consume very large quantities without experiencing the slightest ill effects. Rarely this may reach the proportions of a severe addiction. The writer has observed several cases in which the patients would consume from four to seven cups of a very strong black coffee twice a day without experiencing any ill results.

Caffein-containing Beverages.—In view of the almost universal use of beverages containing some member of the caffein group, a consideration of its effects under these conditions is in place. The psychical functions are most affected by those doses of caffein which come into consideration in the quantity of tea or coffee usually employed as beverages. Ideation becomes clearer and the thought flow more rapid and free. When a person finds himself in that state of mind in which, as a result of exhaustion of the will, stimuli are transmitted to the muscles only with great effort, a small dose of caffein does away with the sensation of fatigue and drowsiness; the will responds by an increased stimulus and the muscles react to the stimulus more readily. This is further aided by the stimulation of the higher nervous centers and the muscles. With larger doses connected thought may become more difficult because of the rapidity with which the ideas follow each other. The reflex irritability is not increased.

The coffee bean contains about 0.66 per cent. of caffein, so that an average cup of coffee contains from 0.1 to 0.2 gram (1½ to 3 grains). In the case of tea, which contains from 1½ to 2 per cent. of caffein, we find a cup of average tea contains about the same amount of caffein as a cup of coffee, since the amount of tea used is considerably less than that of coffee. In addition to the caffein content, certain volatile substances are produced in the process of roasting which consist of about half furfur alcohol. Black tea, because of the increased temperature necessary to its manufacture, contains less volatile oil than does the green tea. Both sorts of tea contain considerable quantities of tannic acid (about 7 per cent.). This tannic acid goes into solution rather slowly. The acrid, bitter taste, so well known to everybody, which is found in tea which has steeped too long, is due to the tannic acid content of the tea passing into solution. The volatile oils probably have no other effect than that which is due to their local action upon the gastric mucosa. This may account for the feeling of *bien-être* produced by a cup of good coffee after a full meal.

The last word has not yet been spoken upon the effects of caffein-containing beverages on digestion. In general they may be said to retard it somewhat, but whether to a degree which may be regarded as pathological is still an open question. Properly prepared tea and coffee exert no effect upon intestinal peristalsis. In the case of tea which has steeped

too long, and which contains, therefore, a considerable amount of tannic acid, we find distinctly pathological phenomena in the stomach, in that the albumins and peptones are precipitated. Both physiological and clinical considerations make it clear that tea may thus be, and indeed not infrequently is, a prolific source of various dyspeptic conditions, especially those associated with constipation.

Chocolate contains from one half to one per cent. of theobromin in the place of caffein. Cacao butter is present to the amount of 30 to 50 per cent., besides some starch. The absence of the stimulant effect on the nervous system in theobromin permits chocolate to be drunk by such individuals as have an idiosyncrasy to tea or coffee. Many patients in whom a single cup of moderately strong coffee will produce a wakeful night may consume, with impunity, considerable quantities of chocolate with no ill effect. Cacao butter, while a fat which is somewhat difficult of absorption, is ultimately assimilated, as is also the starch. Chocolate is, therefore, a true food. The oil present is rather productive of gastric disturbances, so that chocolate is not infrequently prepared so as to be free from the greater part of the oil.

The action of caffein on the kidneys is second only in importance to its action on the vasomotor system. The diuretic effect of caffein has been long known, although its precise mode of action is still a matter of discussion. Von Schroeder first showed experimentally that the increased flow of urine resulting from caffein ingestion was due to changes in the kidney itself and not to changes in the general blood pressure. On the contrary, he succeeded in demonstrating that in cases where the vasoconstricting effect of caffein was very pronounced the increased diuresis was either diminished or entirely absent. If by means of chloral or paraldehyd the excitability of these centers was lessened the diuresis would attain its full proportions. Rost showed that the diuresis was proportional to the amount of caffein which was passed over into the urine. From this he concludes that the action of caffein is directly upon the parenchyma of the kidney. While these statements have not been controverted the explanation of the phenomenon is still *sub judice*. V. Schroeder explained the caffein diuresis by assuming that the drug stimulated the secreting cells of the kidney parenchyma to an increased activity. While this view is still probably the most widely accepted one, some of the most recent authors (Meyer and Gottlieb) have, after consideration of all the facts, adopted another explanation. The investigations of Loewi and Sobieranski have shown that caffein produces a dilatation of some of the vascular tracts in the kidney with a corresponding increase in the volume of the organ. The former author states that if this increase in volume be prevented by inclosing the kidney within a rigid capsule the increased flow of blood through the kidney is such that the outflowing venous blood assumes the arterial color. Furthermore he has shown that if the nerves of

the kidney were cut the effect remained the same. This increased flow of blood through the kidney explains without difficulty the increased diuresis.

Theobromin has practically no action upon the central nervous system at all, and, not affecting the vasomotor center, it does not produce an increased blood pressure. The action of theobromin on the kidneys is still more marked than that of caffein. Theobromin is generally employed in the form of diuretin, which is an easily soluble double salt of sodium theobromin and sodium salicylate.

Theophyllin has a more powerful influence than either of the above upon the diuresis. On the other hand, it is not so free from action on the central nervous system as is theobromin, hence it is not infrequently found after its ingestion that headache, sleeplessness, general restlessness, and nervous excitement may occur.

Therapeutic Action.—The principal indication for the use of caffein is to be derived from its action on the vasomotor system. It is especially useful in conditions of shock and collapse, in which the investigations of Romberg and his collaborators have shown it to be superior to either camphor or strychnia. It should be emphasized that in no respect can caffein be regarded as a substitute for digitalis. Caffein is best given hypodermically in the form of the sodium benzoate salt, in doses of from one to three grains (0.065 to 0.2 gm.), repeated several times a day. These doses are apt to produce unpleasant symptoms if they are continued for more than two or three days.

Where a pure diuretic effect is wanted, as in the removal of effusions and edema, theobromin or theophyllin, especially the latter, is preferable to caffein. Theobromin is best prescribed as the sodium benzoate salt, since the sodium salicylate is depressing to the heart. Theophyllin is best prescribed as the double salt of theophyllin and sodium acetate. Both theobromin and theophyllin have been used in angina pectoris, because of their action in dilating the coronary vessels. Their real value has not yet been sufficiently established. The former is prescribed in doses of from 8-15 grains (0.5-1 gm.). The latter in doses from 5-8 grains (0.3-0.5 gm.).

Nitroglycerin and the Nitrites

By far the best known and most widely used of these preparations is the glycerin trinitrate, usually known as nitroglycerin. This substance, which has the formula,

$$\begin{array}{l} CH_2ONO_2 \\ | \\ CHONO_2 \\ | \\ CH_2ONO_2 \end{array}$$

is official in the U. S. P. under the name of *spiritus glycerylis nitratis,* which is a one per cent. alcoholic solution of nitroglycerin (Liquor Trinitrini B. P.).

Sodii nitris, sodium nitrite, is a white fused mass ($NaNO_2$), very deliquescent. On exposure to the air it gradually oxidizes to the corresponding nitrate, thus becoming therapeutically inert.

Amyl nitrite is a yellowish diffusible liquid, very unstable, and with a highly penetrating odor. It has the formula

$$C_5H_{11}—O—NO.$$

It is soluble in alcohol and ether, but rapidly decomposed by water. It decomposes slowly on standing, and for therapeutic use should always be recently prepared. Commercially it is nearly always obtained in glass "pearls," thin glass capsules which are crushed when wanted for use and their contents inhaled. There is only one nonpharmacopeial nitrate which has attained any wide use, or which has any special value. This is *erythrol tetranitrate,* having the formula

$$CH_2ONO_2—CHONO_2—CHONO_2—CH_2ONO_2$$

Physiological Action.—The value of the nitrites in therapeutics depends almost exclusively upon their action upon the circulation. In animal experimentation they produce an intense vasodilatation, probably by depression of the nerve ends and muscles of the arterioles, which lessens the resistance to the blood flow. At the same time the heart is accelerated. Not only the arterioles, but the veins, are considerably dilated, those of the splanchnic area and the head more so than those of the extremities. The action of the various nitrites upon the coronary arteries has not been definitely settled.

The action of these different drugs upon the circulation is, in general, to produce a fall of the blood pressure. The manner and degree in which the different ones act vary greatly. Since these are most widely used in conditions associated with high blood pressure their therapeutic action is most readily seen in experiments with patients who have, to begin with, the blood pressure abnormally increased. The most instructive work which has been done in this connection is that of Matthew. A summary of his observations is as follows:

Nitroglycerin (*Liquor Trinitrini*).—The blood pressure begins to fall in from thirty to ninety seconds, with an average of one minute. The amount of fall produced varies from 20 to 35 mm., with an average of 28 mm. The full effect is obtained in from 3 to 8 minutes, with an average of 5, and remains at its reduced level for from 2 to 5 minutes, reaching its original level 20 to 28 minutes after ingestion.

Effect of Repeated Doses.—Nitroglycerin, given in doses three or four times a day, is not capable of producing any permanent reduction of the blood pressure, even when a single dose has previously affected the same patient favorably. Matthew could not observe such a permanent

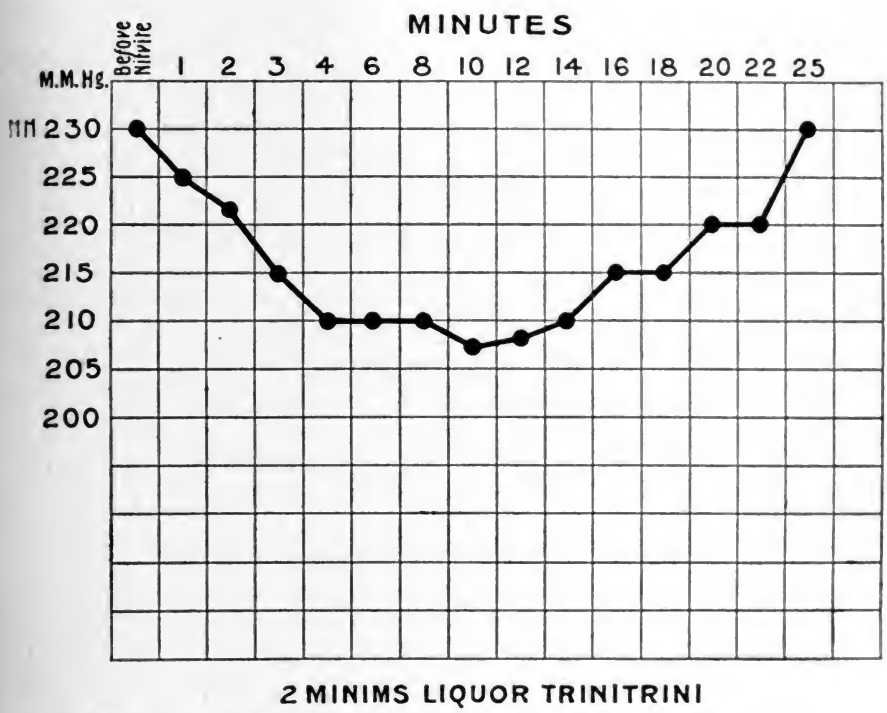


Fig. 10.—Effect of Nitroglycerin on Blood Pressure. (Matthew.)

reduction in any case, and states that even by giving the drug very frequently and in rapidly increasing doses this end is not capable of attainment. Not only this, but when, after an initial dose of 2 minims on the first day, he doubled the dose to 4 and then to 8 minims on succeeding days, the pressure, after a small drop on the first day, rose to a point considerably above the original pressure on subsequent days, with the development of headache and shortness of breath, which disappeared again on the cessation of the nitrite.

Sodium and Potassium Nitrites.—The action of these is identical. With the ordinary therapeutic dose the blood pressure begins to fall in from two to seven minutes, with an average of four minutes. The amount of fall varies from 20 to 50 mm., with an average of 32.5 mm. The fall reaches its maximum in from 8 to 40 minutes, with an average of 15.4 minutes, the fall being gradual and amounting to about 5 mm. every 2 minutes. The blood pressure remains at its lowest for from 16 to 65

minutes, and after a very slow rise reaches its original level in from 60 to 120 minutes.

Effect of Repeated Doses.—Matthew found that in cases which responded satisfactorily to a single dose of either potassium or sodium

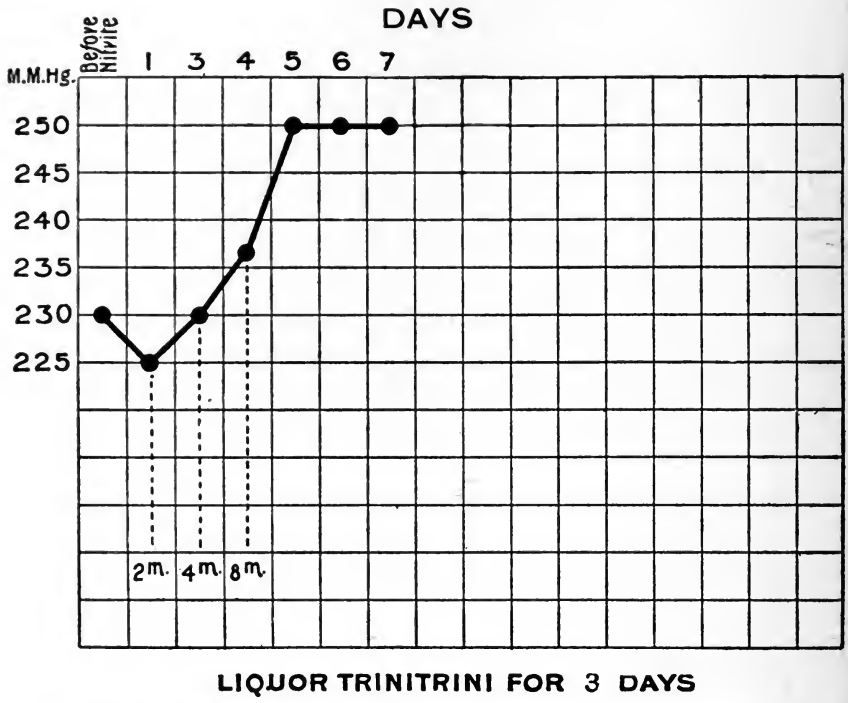


Fig. 11.—Effect of Repeated Doses of Nitroglycerin on Blood Pressure. (Matthew.)

nitrite he could administer the drug three times a day and thereby maintain a reduction in pressure for weeks at a time with no tendency to a tolerance developing. This reduction was not maintained at the lowest level of a single dose, but was still well marked. The pressure resumed its original level within twenty-four hours after the cessation of the drug.

Erythrol Tetranitrate.—The fall of pressure begins in from 4 to 8 minutes, with an average of about 6 minutes, a reduction of about 5 mm. every two minutes occurring. The total fall in pressure varies from 20 to 50 mm., with an average of 34. It reaches this maximum fall in from 14 to 20 minutes, with an average of 22 minutes. This maximum effect is maintained for from one to two hours, beginning to rise toward the end of this time, reaching the original level very slowly.

There is no tendency to the establishment of a tolerance with erythrol tetranitrate, but the drug is not so well borne as either the nitrites or nitroglycerin. A particularly unpleasant feature of it is that a marked sus-

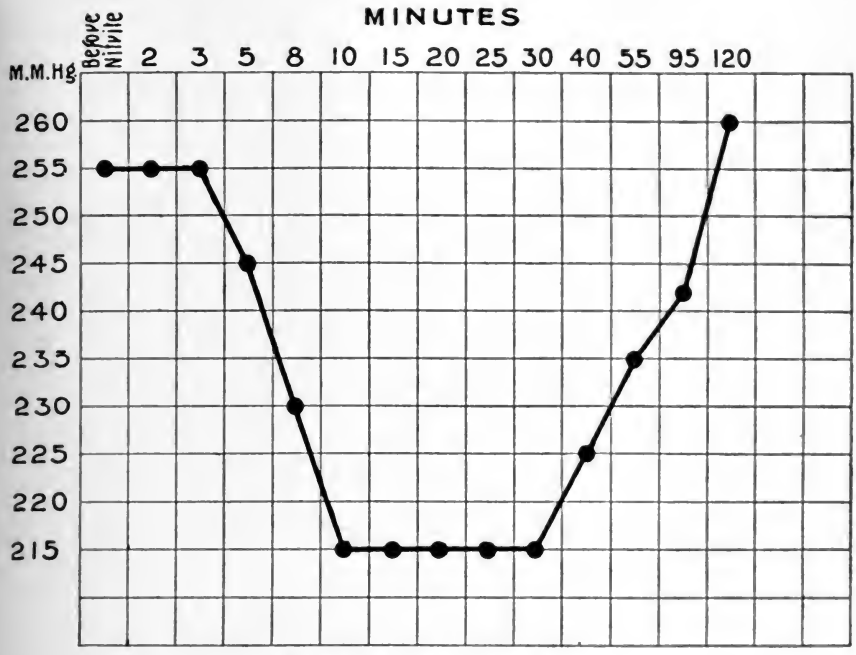


FIG. 12.—EFFECT OF SODIUM NITRITE ON BLOOD PRESSURE. (Matthew.)

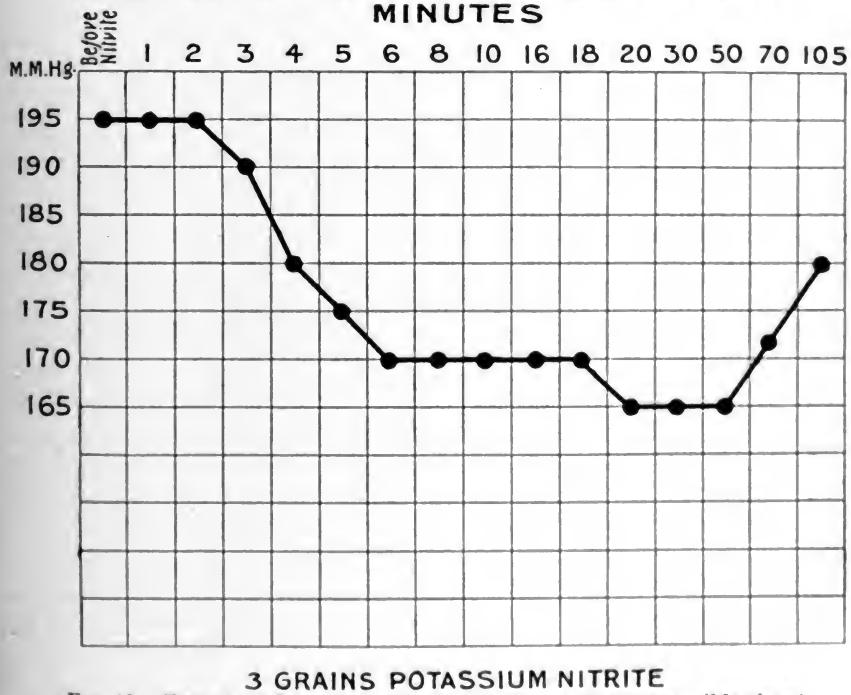


FIG. 13.—EFFECT OF POTASSIUM NITRITE ON BLOOD PRESSURE. (Matthew.)

ceptibility to its action exists in certain cases. With even the ordinary therapeutic dose of one grain (0.06 gm.) such degree of overaction occurred in one case as to produce dangerous collapse, lasting twelve hours.

Effect of Repeated Doses.—In a single dose the action of erythrol

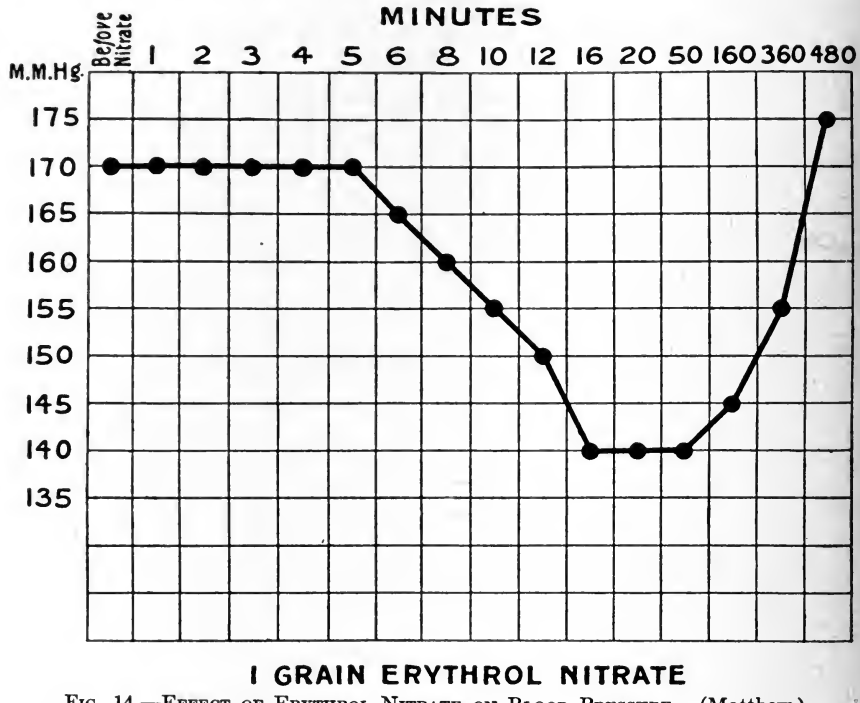


FIG. 14.—EFFECT OF ERYTHROL NITRATE ON BLOOD PRESSURE. (Matthew.)

tetranitrate lasts for about six hours, and when given in suitable doses three times a day a reduction in pressure is maintained. With doses of one-half to one grain (0.03-0.06 gm.) a reduction of about 30 mm. in mercury can be maintained, provided, of course, that the case responds satisfactorily to a single dose.

MANNITOL HEXANITRATE.—The action of this is almost identical with that of erythrol tetranitrate, but produces its maximum effect much more slowly than the latter.

The diagram taken from Bradbury indicates graphically the difference in action of the above-mentioned nitrites.

AMYL NITRITE.—The researches of Hewlett in man show that the action of this drug is decidedly more complex than has been hitherto supposed. Hewlett finds that in typical amyl nitrite action the maximum blood pressure drops rapidly immediately after the beginning of the inhalation and reaches a minimum in from 30 to 60 seconds. This primary fall varies considerably, the greatest drop being 40 mm. of mercury, the

average being 13 mm. The minimum pressure falls at the same time, but to a less extent, and the pulse rate is increased. Immediately following this primary fall there is rapid rise in the systolic pressure, which usually reaches a point considerably above the pressure at the beginning.

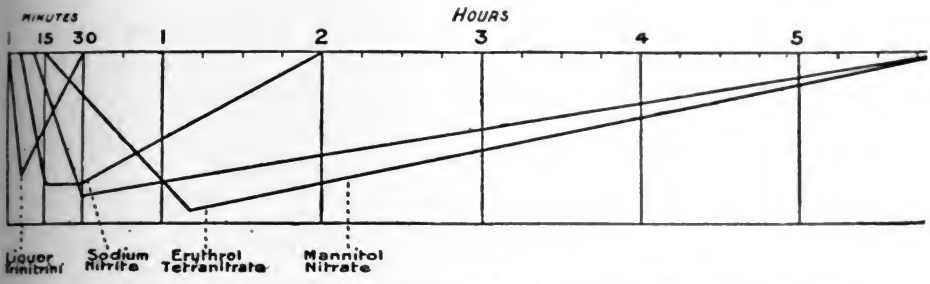


FIG. 15.—ACTION OF VARIOUS NITRITES ON BLOOD PRESSURE. (Bradbury.)

This secondary rise averages about 15 mm. of mercury, and its maximum generally occurs in from 1 to 3 minutes after the beginning of the inhalation. The diastolic pressure rises gradually to the normal, attaining this in from 2 to 3 minutes after the beginning of the inhalation. The pulse rate increases rapidly in typical cases for the first half minute, reaching its maximum, which may be nearly double the original rate, at the end of about 1 minute. From this it falls rapidly to reach the normal during the third minute.

From these results it is clear that the total output of blood is increased by amyl nitrite during both the primary fall of blood pressure and during its secondary rise. In the first of these stages the heightened output depends upon the increased rapidity of the heart's action; during the second stage it depends upon the increased amount of blood expelled from the ventricle at each systole.

Instead of the typical action of amyl nitrite being a dilatation of the peripheral arteries with a drop in the blood pressure it consists rather in a dilatation of the blood vessels, causing the heart to pump more blood with a resultant increased flow of blood in the arteries. In some of his patients there was obtained no primary fall of pressure, which is to be interpreted as indicating that the dilatation of the blood vessels was counterbalanced by the increased heart action. In only two instances was there no secondary rise of blood pressure, to be interpreted as indicating an absence of action on the heart.

As a result of these studies it is clear that amyl nitrite is an energetic cardiac stimulant with exceedingly rapid action, in addition to being a vasodilator. The vasodilatation, as determined by plethysmographic tracings, persisted throughout all of the experiments quite independently of the variations in the blood pressure. In elderly individuals the change in

the pulse rate was frequently very slight. All of the experiments were made with the usual therapeutic doses, from 3 to 5 minims of the drug being inhaled.

Therapeutic Dosage of the Various Nitrites.—In general, it may be stated that the most satisfactory therapeutic dose is one which produces a reduction of pressure of about 30 mm. This applies to the chronic cases where the blood pressure is high, and hence this criterion is not applicable to amyl nitrite. With a reduction of 30 mm. most of the symptoms which

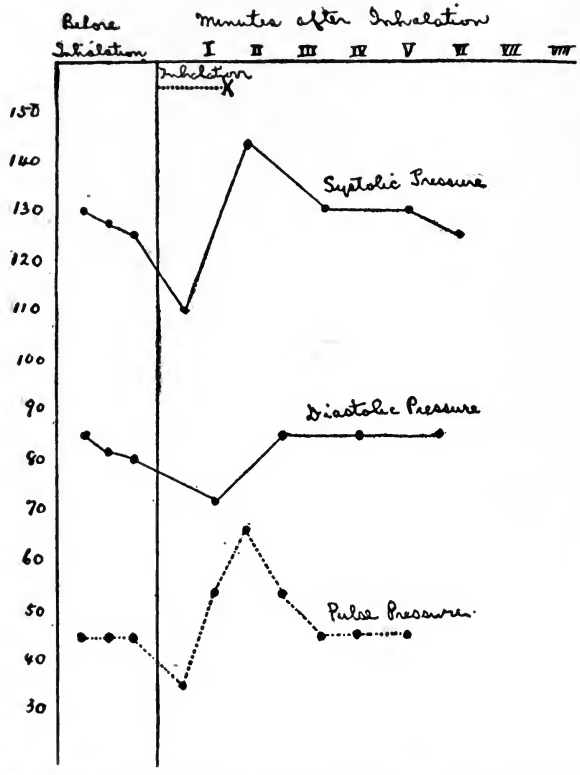


FIG. 16.—CURVES OF SYSTOLIC, DIASTOLIC, AND PULSE PRESSURES, SHOWING TYPICAL AMYL NITRITE EFFECT. (Hewlett.)

are due to high blood pressure *per se,* either disappear entirely or are greatly ameliorated. This is usually accomplished by a dose of 2 minims of nitroglycerin, repeated, if necessary, in a half hour. Permanent reduction in blood pressure cannot be obtained by the use of nitroglycerin administered three or four times a day. Increasing the dose and frequency of administration very greatly is, in the light of Matthew's work, inadvisable. A dose of sodium nitrite, about 2 grains (0.13 gm.), or of erythrol tetranitrate, from ½ to 1 grain (0.03 to 0.06 gm.), or of manni-

tol hexanitrate of 1 grain (0.06 gm.), given three or four times a day, is the average amount required to reduce the blood pressure the desired degree.

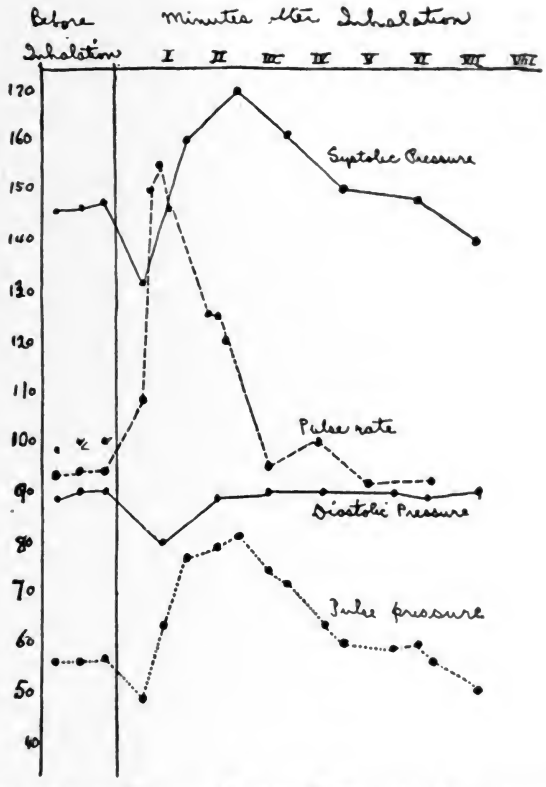
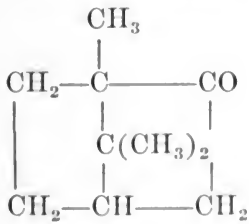


FIG. 17.—CURVES SHOWING TYPICAL MARKED EFFECT OF AMYL NITRITE. (Hewlett.)

Camphor

This body, the ordinary camphor of commerce, is a white substance with a peculiar fatty feel, derived from *cinnamomum camphora*, having the formula $C_{10}H_{16}O$, and having the following structural formula:



Although camphor is a powerful excitant of the central nervous system its therapeutic significance depends upon its power of stimulating the

vasomotor and respiratory centers (Gottlieb). The action of camphor upon the heart muscle itself has been proven directly on the frog's heart. If this has been arrested by means of muscarin, camphor applied in almost any form is capable of bringing back active pulsations. A heart arrested by chloral hydrate will frequently be made to contract again (Boehme). In rabbits in whom the blood pressure had sunk as low as 26 to 30 millimeters a rise to 60 or 65 millimeters could be produced by camphor.

The action of camphor in experimental animals is, according to Schmiedeberg, most irregular. This author states that intravenous injections of 0.08-0.10 gm. produce in dogs at first a diminution of the pulse rate and a considerable lowering of blood pressure. After a period of two or three minutes the blood pressure rises again to a point considerably above the original pressure. This procedure can be repeated several times and the same phenomena can be observed each time. In addition camphor increases the irritability of the heart muscle, thus increasing the frequency.

Camphor is excreted in the urine in combination with glycuronic acid as alpha- and beta-camphoglycuronic acid. If, as a result of severe disturbances of nutrition and lack of O_2, camphor does not enter into combination with glycuronic acid it may be retained in the organism and produce severe toxic action. Cases of hemorrhagic nephritis, probably the result of camphor intoxication, have been observed in isolated instances.

Therapeutic Use.—So far as the cardiovascular system is concerned the principal, if not the only, use of camphor is in conditions of acute cardiac failure, as we find it especially in infectious diseases. This is in reality quite as much an insufficiency of the vasomotor center (Pässler) as of the heart itself. In these conditions camphor is one of the best remedies.

Its administration by mouth is not to be recommended since the dose required to produce a given effect varies extraordinarily in different individuals. It is usually, and most conveniently, given in the form of camphorated oil (Linimentum Camphoræ U. S. P.). In European countries it is given commonly in solution with Ol. amygdal. and ether. It should be injected deeply in the muscles to overcome its irritable effects on the tissues.

Strychnin

This drug, the use of which in circulatory diseases is almost exclusively confined to English-speaking countries, is an alkaloid obtained from nux vomica.

The Pharmacological Action of Strychnin.—This, so far as it concerns the circulatory system, is really only a phenomenon of its general action on the central nervous system. It increases the excitability of the

vasomotor centers, thus producing vasoconstriction and increase of blood pressure. Most authorities consider that it has no effect upon the heart muscle, but recently Cameron, under Hirschfelder's direction, has determined an increase in tonicity of the heart, the maximal pressure remaining the same (Hirschfelder). Few drugs are used, in this country at least, with such a wholesale disregard for exact clinical indications as is strychnia. Clinical cases which have been recorded as showing a beneficial effect from strychnia are far from being conclusive. In many instances Cabot failed to improve a low blood pressure by its use. The investigations of Cook and Briggs are scarcely conclusive.

The action on the respiration is seen in its quickening and deepening. This action is especially pronounced if the respiratory center is in a state of depression as a result of a previous administration of a narcotic.

The indications for the use of strychnia are to be found in those conditions associated with failure of either the vasomotor or respiratory systems. The former occurs especially in the various acute infectious diseases, where it is an essential part of the cardiac failure which, under these circumstances, so frequently leads to death. In these cases strychnia may be administered, although the writer must state that he has never been able to obtain really satisfactory results from its employment. Its value is distinctly greater where cardiac weakness is associated with an abnormal degree of vasodilatation. In such a case strychnia may be given to produce a contraction of the peripheral vessels, and thus prevent the heart exhausting itself. Under these circumstances it is generally combined with digitalis.

In the various disturbances of respiration associated with severe heart disease, such as cardiac asthma, Cheyne-Stokes respiration, and slight degrees of asphyxia, strychnia finds its legitimate application, and under these circumstances is of a great deal of utility.

It is an error to assume that strychnia is in any way capable of taking the place of digitalis. When cardiac insufficiency has actually set in digitalis is the drug par excellence. Strychnia can only be of use under these circumstances by acting on the blood vessels (Meyer and Gottlieb).

In conditions of shock, associated with low blood pressure, strychnia is well-nigh universally employed in America. The investigations of Crile, however, prove that it has little value in this condition.

Strychnia is best employed in the form of the very soluble sulphate, which dissolves in three parts of water. Its average dose should be placed from 1-30 to 1-60 grain (0.002-0.001 gm.).

Hydrotherapy

By far the most important position under the hydrotherapeutic procedures is assumed by baths containing carbon dioxid. Scarcely any topic

in connection with the treatment of diseases of the cardiovascular system has given rise to more discussion than the subject of the value of the Nauheim bath, by which name these baths are generally known.

The Nauheim Baths.—The Nauheim bath was first recommended to the medical profession as influencing favorably certain circulatory conditions by Beneke in 1870. His recommendations did not succeed in popularizing this form of treatment, and it was not until after the work of A. Schott in 1880 that the Nauheim treatment can be said to have developed into a recognized system. Since the time of Schott these baths have undergone very much the same sort of evolution that most other forms of treatment have undergone. Originally designed for the treatment of certain forms of cardiovascular disease only, they in time have been used by many physicians as a method of treatment supposedly applicable to almost any and every form of disease of the cardiovascular system. As a result of the failure of so many physicians, not only in Germany, but in all countries of Europe, and even in America, to develop precise indications for the use of these baths, and to limit the cases sent to Nauheim to patients appropriately belonging there, Nauheim has come to be in the minds of both laymen and many physicians alike a word to conjure with. It cannot be denied that enormous numbers of cases utterly unsuited to treatment by baths of any kind have been sent to Nauheim and similar resorts. Patients with broken compensation of high degree have been made to incur great fatigue and expense to make the trip to one or other of these spas when they were utterly unfitted to be moved from their own homes. To such an extent has this highly regrettable condition of affairs developed that the Nauheim treatment has in the mind of many come to be looked upon as a sort of last resort to which any case may be appropriately subjected when it has failed to respond to every other form of treatment. The natural outcome of this state of affairs is, and must necessarily be, the equally one-sided condemnation of the whole method. To us, in America especially, it is only too familiar a fact that much of the charlatanism in connection with treatment centers about methods involving the uses of mineral waters, both internally and externally. Unfortunately, in spite of the favorable action of these baths in suitable cases, their precise method of physiological action was unknown, or imperfectly known, until within a decade, and so we find, what, under the circumstances, could only be expected, different groups of physicians holding radically different views as to the action and indications for their use.

So good a critic as Mackenzie, in the second edition (1910) of his work on the heart, writes as follows: "Though I enter into this matter reluctantly I conceive it none the less a duty to give my views on it, particularly as I am impressed with the injury done to individual patients through the unmerited reputation of the Nauheim baths among the medical profession. Institutes have been started for the financial exploitation

of the Nauheim waters, and I must confess to a feeling of shame for my profession when I consider the manner in which it has been imposed upon. One reads in sober English medical journals accounts of cures effected that seem like the puffs of an empiric remedy. One writer will tell how a patient obtained no benefit from his treatment, but was cured by a visit to Nauheim. Another describes how he watched the patients enter into the bathroom feeble, tottering, and livid, and how they came out upright and brisk, with the glow of health on their countenances. It is little wonder that the stay-at-home practitioner is impressed by all this dithyrambic praise." Further on he says: "I found these baths so modified as to be of different strengths, and it was stated that the different baths were given according to the nature of the complaint. But I could find no evidence of any rule being followed. I found that people with nothing the matter with their hearts were having the same baths as those who were suffering from severe heart affection. I also found patients with a weak and frequent pulse having the same baths as others with a slow, hard pulse."

In these words Mackenzie has unquestionably touched upon one of the sorest points connected with the spa treatment of diseases of the heart. There cannot be the slightest doubt that in many instances the wide advertisement given to the baths by the municipal authorities for commercial reasons has had a strong tendency to bring a method of treatment the indications for which should be founded on strict scientific principles down to the level of the advertising charlatan.

In spite of the sharp criticism of Mackenzie, who, Hirsch remarks, "seems unacquainted with the fundamental researches of Otfried Mueller," practically all authors who have studied the method and the indications for its use, with the same care that they have studied the pathology and diagnosis of the diseased conditions, are a unit in considering the Nauheim treatment or, more properly speaking, the use of CO_2 baths as a method of distinct value in appropriate cases. It cannot be too harshly condemned when interested individuals attempt to make of the treatment a cure-all for diseases of the heart. At most of the spas enjoying national and international reputation there will be found a considerable number of physicians whose practice is of a kind so roundly berated by Mackenzie, but, on the other hand, it cannot be gainsaid that in some of them at least physicians are to be found of the highest professional and ethical standing, with a specialized knowledge of the finesses of treatment, which it is only possible under exceptional circumstances for the general practitioner to acquire. A great many, perhaps most, of the so-called "Nauheim wrecks" are to be laid at the door of those who, in order to get rid of patients whom they have failed to benefit, send these poor unfortunates to a place like Nauheim. History is but repeating itself. The climatic treatment of tuberculosis had a similar evolution to pass through before it obtained a confirmed and definitely fixed status.

Physiological Action of Baths.—The first exact experiments which led to anything like satisfactory conclusions were those of Otfried Mueller, who, in a publication of the Leipzig medical clinic in 1902, investigated the action on the circulation of various hydriatic procedures. The conclusions at which Mueller arrives are as follows:

1. Baths with the water at a temperature below the indifferent zone (33-35° C.; 91.4-95.0° F.) produce an increased blood pressure, lasting throughout the bath, with a decrease in the pulse rate.

2. Baths with the water at a temperature above the indifferent zone to approximately 40° C. (104° F.) produce, after a short initial rise, a lowering of the blood pressure to or below the normal; this lowering is then followed by a second increase in the pressure. Below 37° C. (98.6° F.), in this group of baths, the pulse rate is lowered, above this point it is increased.

3. Baths over 40° C. (104.0° F.) produce an increase in pressure, lasting throughout the entire bath, with an increase of the pulse rate.

In the hot baths the increase of the blood pressure and bodily temperature occur simultaneously.

4. In the artificial Nauheim baths the increase in blood pressure is determined in greater degree by the temperature of the water than by the CO_2 content of the bath. These two factors play an approximately equal rôle in the production of the changes in the pulse rate.

The accompanying tables of curves from Mueller make detailed explanations unnecessary. It is perfectly apparent that a number of different factors may conceivably enter into the changes which occur in both blood pressure and pulse rate. Above all it must not be forgotten that the heart alone must not be taken into consideration, but the vessels as well, not only the arteries, but the veins, since in the changed distribution of blood is to be found the explanation of many such phenomena. The initial rise in blood pressure which occurs in all of the baths, irrespective of temperature, is probably to be explained by the simultaneous effect of the exertion necessary to get into the bath and the sensory stimulation of the skin, both mechanical and thermic.

In all of the charts there is either a relative or absolute lowering of the pressure following the initial rise. This Mueller believes to be due to the cessation of the skin stimulation which ceases almost in the instant when the patient becomes quiet in the bath and, in addition to this, through a regulation of the pressure by way of the splanchnics. In the case of the warm baths the dilatation of the peripheral vessels is probably responsible for the increased fall in pressure.

The second rise in pressure, forming the third part of the characteristic curve, depends upon different factors dependent upon whether the temperature of the water is above or below the indifferent zone. With cold baths, not only the superficial vessels are contracted but, as the dura-

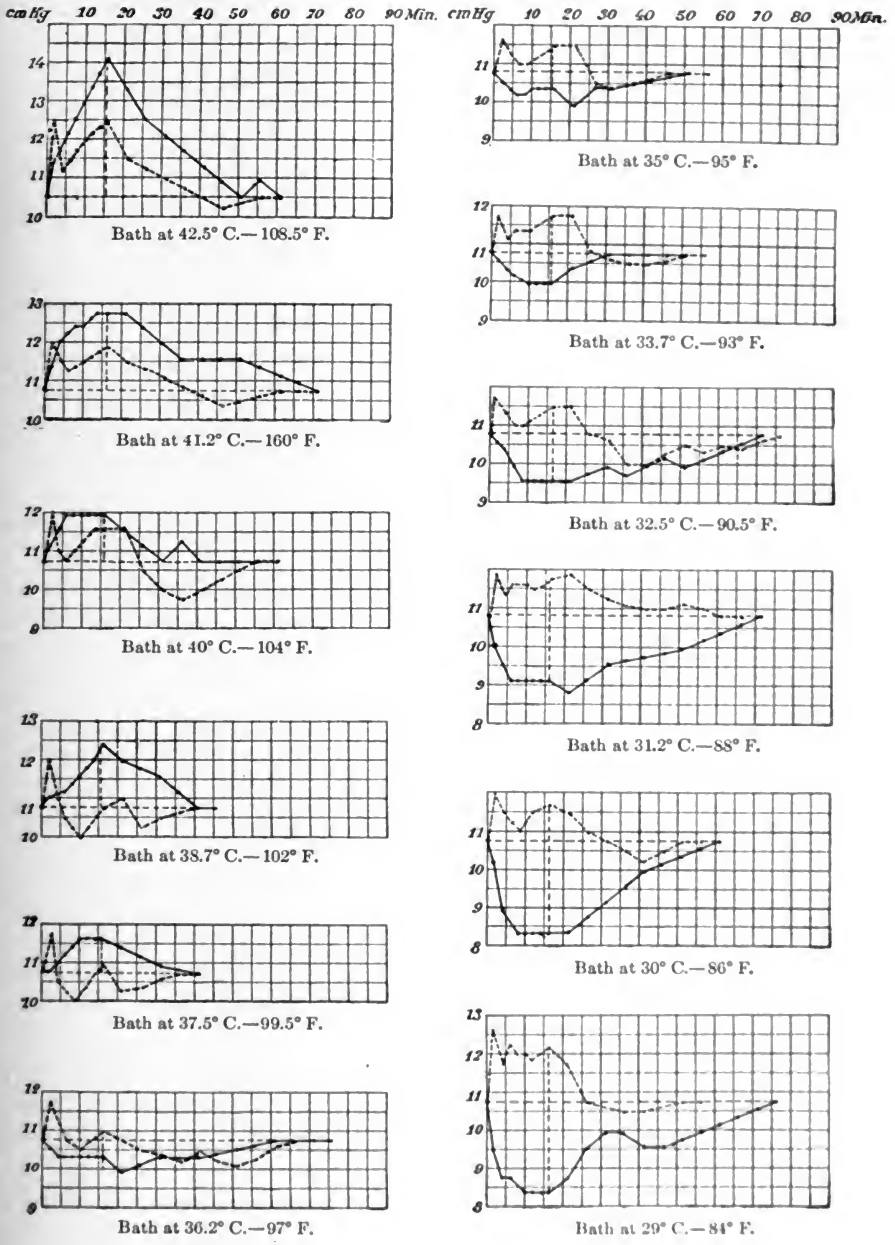
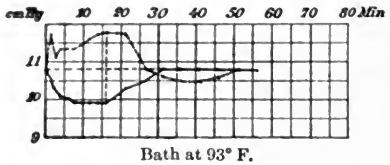
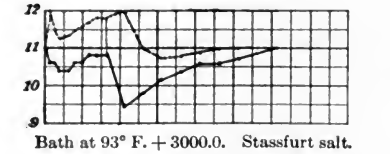


FIG. 18.—ACTION OF BATHS OF VARYING TEMPERATURES UPON BLOOD PRESSURE AND PULSE RATE OF A NORMAL MAN OF TWENTY-SIX. (After O. Müller.)

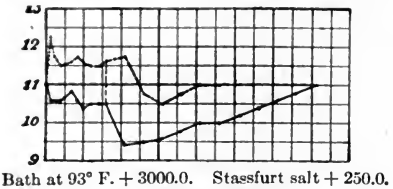
NOTE.—In both Figs. 18 and 19 the line ·· indicates the blood pressure; the line — the pulse rate. The vertical line ⁞ indicates the end of the bath; the horizontal line — the normal level of blood pressure and pulse rate. The vertical figures indicate 10 mm. Hg., or 10 pulse beats; the horizontal figures indicate minutes.



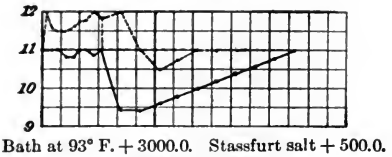
Bath at 93° F.



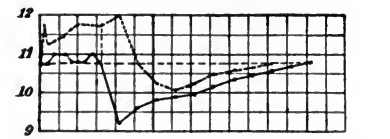
Bath at 93° F. + 3000.0. Stassfurt salt.



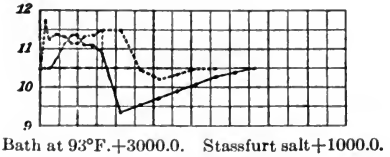
Bath at 93° F. + 3000.0. Stassfurt salt + 250.0. $NaHCO_3$ + HCl.



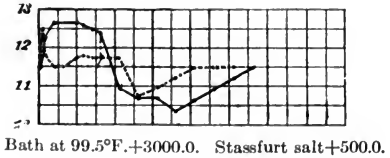
Bath at 93° F. + 3000.0. Stassfurt salt + 500.0. $NaHCO_3$ + HCl.



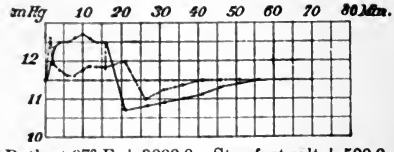
Bath at 93° F. + 3000.0. Stassfurt salt + 750.0. $NaHCO_3$ + HCl.



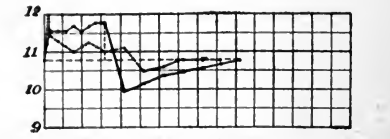
Bath at 93° F. + 3000.0. Stassfurt salt + 1000.0. $NaHCO_3$ + HCl.



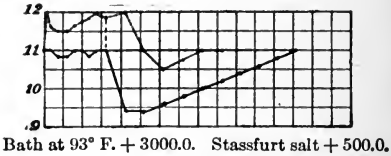
Bath at 99.5° F. + 3000.0. Stassfurt salt + 500.0. $NaHCO_3$ + HCl.



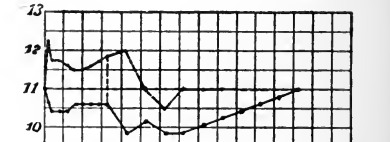
Bath at 97° F. + 3000.0. Stassfurt salt + 500.0. $NaHCO_3$ + HCl.



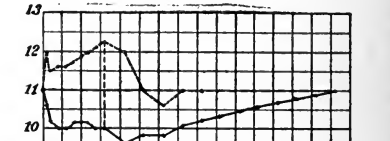
Bath at 95° F. + 3000.0. Stassfurt salt + 500.0. $NaHCO_3$ + HCl.



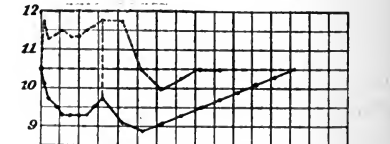
Bath at 93° F. + 3000.0. Stassfurt salt + 500.0. $NaHCO_3$ + HCl.



Bath at 90.5° F. + 3000.0. Stassfurt salt + 500.0. $NaHCO_3$ + HCl.



Bath at 88° F. + 3000.0. Stassfurt salt + 500.0. $NaHCO_3$ + HCl.



Bath at 86° F. + 3000.0. Stassfurt salt + 500.0. $NaHCO_3$ + HCl.

FIG. 19.—ACTION OF CO_2 BATHS OF VARYING TEMPERATURES AND CONCENTRATION UPON BLOOD PRESSURE AND PULSE RATE OF A NORMAL MAN OF TWENTY-SIX. (After O. Müller.)

tion of the bath is longer, the deeper vessels as well. The colder the bath the earlier and more pronounced the secondary rise in pressure and the less pronounced the drop which precedes it. In the baths with the water above the indifferent zone the peripheral vessels are continuously in a state of dilatation, and hence could not contribute directly to an increased pressure. The explanation of the secondary rise in pressure is probably to be sought in the following facts: First, there is at this time a considerably increased pulse rate. It has been shown, however, that the systolic output of the heart, that is, the amount of blood thrown into the aorta at each contraction, becomes lessened as the temperature increases, but at a relatively slow rate. Mueller suggests that in the case of warm baths this diminution in the systolic output occurs so slowly as to be more than compensated by the increased pulse rate, the net result being an increased output.

One might be tempted to think that inasmuch as the changes in pressure which occur with the baths are essentially the same, whether the Nauheim bath be used or plain water, that it would make little difference which of these was used. Mueller correctly concludes that such is not the case, since the changes in the pulse rate are dependent in equal measure upon the temperature and the composition of the bath, and changes in the pulse rate of necessity influence the work of the heart, the pressure remaining constant.

Further experiments by Liwschütz, under Mueller's direction, have shown that the work of the heart in the cold CO_2 bath is increased to a considerably greater degree than in a simple water bath of equal temperature. Liwschütz' tachograms show conclusively that, while the cool fresh water baths produced a very slight action upon the systolic output of the heart, the heart reacts to the carbon dioxid bath by a considerable increase in the volume of blood expelled with each systolic contraction. The vessels of the skin are in a state of contraction while those in the internal organs dilate. That this dilatation, which occurs especially in the abdominal and cerebral vessels, is not sufficient to compensate the contraction of the cutaneous vessels is evidenced by the increased blood pressure. In spite of the contraction of the peripheral blood vessels the skin takes on an active pinkish color. This pinkish color of the skin led originally to the erroneous assumption that the carbon dioxid baths produced general dilatation of the peripheral arteries and hence to a lessening of some of the work of the heart (Herzschonung). Wieland and Veiel, pupils of Otfried Mueller, have shown indisputably by means of exact plethysmographic investigations that there is always a diminution in caliber of the arteries of the extremities. Liwschütz has, moreover, shown through tachographic experiments that there is an increased rate of flow in the peripheral vessels. This corresponds to the condition of affairs which we find in a warm bath. Since, now, we have the work of the heart in the

cold CO_2 bath increased, even to a greater extent than in a simple water bath of the same temperature, and since, at the same time, there is an increased rate of flow in the peripheral vessels, we have, as Mueller states, to conceive of the action of the CO_2 bath upon the circulation as a complex one and having the same effects as a warm and cold bath simultaneously given, were such a thing possible. These facts would seem to explain satisfactorily why, in general, the cool baths are well borne and that, after a short immersion, the patient generally experiences a comfortable degree of warmth. The increase of the heart's work in the cool CO_2 bath has been shown by Groedel III to be a special action of the CO_2 content of the bath. Senator and Frankenhauser had already in 1904 emphasized this double effect of the CO_2 bath, calling attention to the fact that this gas is a much poorer conductor of heat than is air, and hence under similar conditions would give an impression of greater warmth than atmospheric air. In other words, as these authors put it, upon immersion in a CO_2 bath below 28° C. the cool water produces a stimulus due to cold. The areas of skin which are covered with bubbles of CO_2 and thus separated from the water are stimulated by the gas which is above the point of indifference and receive a stimulus of warmth, since the indifferent point for CO_2 gas is considerably lower than that of the air.

The depth of respiration increases considerably during the bath without there being any increase in frequency. In many of the earlier reports on the Nauheim baths remarkable diminutions in the size of the heart after a single bath were reported. Since exact orthodiagraphic investigations have been made on the subject it has been made very evident that many of these findings were strongly tinged with subjectivity. It is probable that the decrease in the size of the heart which occurs after a single bath is too small to be clinically determined. On the other hand, a series of baths, twenty or twenty-five, may produce a diminution in size up to two centimeters.

Indications and Contraindications for the Use of Carbon Dioxid Baths.—A perusal of the physiological action leads of necessity to the following conclusions: First, the indifferent baths, 33-35° C. (91.4-95° F.), act only by influencing the breathing, and to a very slight extent affecting the distribution of the blood. Since they increase the work of the heart little, if any, they are a therapeutic resource of small power. Second, baths below 33° C. (91.4° F.) increase the work of the heart, but do so under the most favorable conditions in that they produce a comfortable sensation of warmth, frequently a sensation of more or less relief, and, at the same time, bring about a favorable change in the distribution of the blood. These effects are increased in a more or less direct proportion as the temperature of the water is diminished and the carbon dioxid content of the bath increased.

The carbon dioxid baths are, therefore, in the words of August Schott,

gymnastic exercises for a weakened heart. Their particular advantage lies in the readiness and accuracy with which this action may be gaged, since we can construct a series of baths of gradually increasing strength by beginning with the temperature near the indifferent point 33° C. (91.4° F.) and with low CO_2 content, gradually diminishing the temperature and increasing the CO_2 to the point of saturation. A further great advantage is that the baths may be given over a period of many weeks. The relation which the Nauheim bath bears to the heart muscle should be looked at in precisely the same light as a relation existing between corporeal work and the skeletal muscles. A skeletal muscle which has been weakened by disuse or by disease may have its strength increased by judicious exercise, provided always that the exercise given is well within the power of the muscle to accomplish. The cardiac muscle may be strengthened in precisely the same way by a bath procedure which exercises it, provided always that the exercise given is well within the power of the heart to accomplish. This is, in its simplest possible expression, a legitimate function of the carbon dioxid bath.

The answer to the question, what cases are suitable for the Nauheim treatment? is but a paraphrase of the question, what cases have a myocardium of sufficient strength to justify a procedure which involves an increase of the heart's work?

No heart should ever be subjected to a course of Nauheim baths where the degree of cardiac insufficiency is other than a slight one.

Patients with moderate dyspnea on exercise, or even when at rest, and with the sensation of general lassitude which are the expressions of the early stages of the slightest degree of cardiac insufficiency, are, in general, the most appropriate cases for this treatment. On the other hand, slightly greater degrees of heart weakness, as evidenced by slight enlargement and tenderness of the liver and the earliest beginnings of edema of the feet, may be with propriety considered as being, in most cases at least, proper subjects for the baths. Under no circumstances should patients with higher degrees of edema, very marked enlargement, and tenderness of the liver and, still less, with effusions into the serous cavities, be subjected to any form of carbon dioxid baths, even the mildest. Such patients need rest in bed, digitalis, and means to take the work off the heart. The writer is of the opinion of Romberg, that it is a matter of indifference, as to the cause of the cardiac insufficiency, whether this be a valve lesion or a muscular degeneration, and whether the condition represent the beginning of a broken compensation which has not yet attained a high grade, or whether it represent a degree of broken compensation which has been of high grade, but which by proper therapy has been reduced to a low grade. No mere diagnosis of the existing pathological condition, still less the merely giving of the disease process a name, justifies one in deciding for

or against the administration of the bath treatment. In each case of cardiac insufficiency for itself, irrespective of the underlying pathological process, there must be a careful estimation of the power of the heart, which factor alone must determine whether the mode of treatment is a proper one in that case.

In cases where the signs of cardiac insufficiency are developing with rapidity, or where the cause is one which is presumably increasing, even though the momentary degree of insufficiency be not great, the method is inappropriate. Cases associated with angina pectoris demand the most careful reflection before deciding on bath treatment. While most authors agree that mild cases of angina may be submitted with safety to the baths, and while the writer himself has treated a moderate number of cases with, in most instances, the happiest results, yet he confesses to a feeling of considerable trepidation in each new instance. If one decides to make use of the baths in such cases the utmost care should be taken to progress very gradually frrom the milder to the stronger. It would seem as though it were hardly necessary to state that in cases of cerebral hemorrhage or aneurysm, or in cases of rather recent endocarditis, where the possibility of embolism must always be thought of, the baths are absolutely contraindicated. A more difficult question to decide is as to their propriety in cases of contracted kidney, and in arteriosclerosis with cardiac insufficiency. While this question is one which must invariably be tinged with a certain amount of subjectivity, and while opinions on the subject are widely divergent, the writer feels that their use in arteriosclerosis, especially in cases where the blood pressure is only moderately increased, is distinctly beneficial. In spite of the recommendations of some of the most experienced clinicians the writer has seen but little benefit accrue from their use in the cardiac insufficiency of nephritis. If used at all they should be limited to cases where the cardiovascular symptoms and the symptoms of cardiac insufficiency are the predominating elements in the disease picture. Cardiac asthma is, in and of itself, no contraindication, provided only that the degree of cardiac weakness be suitable.

Briefly, we must consider the use of the carbon dioxid bath as a therapeutic procedure of considerable value, and one which the physician who is properly appreciative of his therapeutic resources will use with a zeal tempered with much discretion. In a certain small number of cases patients will be found who seem, even after the most careful examination, to be proper cases for the Nauheim bath treatment, but who, when the series of baths have been given, are found not only not to do well, but to do badly in them. If more than a small number of such cases occur one should become suspicious of his accuracy in the estimation of the degree of cardiac insufficiency. It has, however, happened to the writer on several occasions that even after the most careful and painstaking investigation of the condition of the circulation, together with the application of exercise tests,

and such light as these are able to throw on the reserve power of the heart, the very first bath of moderately cool temperature showed plainly that the power remaining in the heart muscle was not sufficient to respond to the increased demands made upon it by the bath. Our guide as to whether the patient is reacting properly to the bath should be, in the first place, the blood pressure. Under no circumstances should the blood pressure in the bath fall below that which obtained under similar conditions just before entering the bath. Even a very slight diminution of the blood pressure indicates that the case is being injured, not benefited, and this is all the more so if the patient complains of a sense of oppression, palpitation, great nervousness, etc. The first baths should be regarded as trials, and no material change should be made in the frequency, temperature, or composition of the bath without a careful determination of the pulse pressure, as well as an examination of the patient on leaving the bath, due attention being paid to his subjective sensations.

Natural versus Artificial Baths.—A careful consideration of the results obtained in the various spas, in comparison with the results obtained by the use of similar baths artificially prepared, will show that each plan has both its advantages and disadvantages.

Taking, as an example, Nauheim, which is unquestionably, by virtue of the character of its different springs, its excellent accommodations for the treatment of cardiac patients, the considerable number of physicians who have had a highly specialized training in the treatment of these diseases, *facile princeps* among all the German spas, or, indeed, those of any country, we find the following advantages: First and foremost, the writer would place the psychical benefit which accrues to the patient of knowing that he is going to that place, which, of all others, he has come to regard as a sort of fountain of youth. Patients with cardiac diseases, feeling that the heart is, as they put it, the most vital organ, are apt to unduly exaggerate the importance of their symptoms, and generally it is the least important symptoms which are magnified by them. It is not at all uncommon, even in this country, when treating German patients in the better situated classes to find that with the first intimation that they are suffering from any sort of heart disease they at once ask whether they shall go to Nauheim. It can scarcely be doubted that the responsibility for the existence of such an absurd state of affairs must be laid very largely at the doors of the medical profession. Secondly, in patients who have sufficient means, and in the case of American patients who have sufficient familiarity with the conditions prevailing in Germany to feel thoroughly at home while there, it is a most attractive resort, and every effort is made to shield patients from the small annoyances of life. Last, and certainly not least, many people who will not give up the time, or subject themselves to the discipline necessary to produce favorable results at home, will be the very best of patients under the conditions which obtain in such places, where

every one they meet is devoting himself and all his energies to doing similar things.

To counterbalance these advantages we have many disadvantages, some of which have been so recently laid bare by Mackenzie. One of the most serious of these is the massing together of so large a number of cases who have so depressing an effect upon each other. Many patients who, at the cost of considerable financial sacrifice, a long journey involving physical exertion which they are unfitted to take, arrive at the spa expecting to find on every hand miraculous cures, are cast into the depths of despair by failing to find any such thing. They find, to be sure, patients with the various neuroses of the heart who, in many instances, feel that they have, and in reality have been, greatly benefited by their sojourn, but what they find is in such striking disproportion to what they expected to find that the result is disheartening. Finally, in some of the spas, at least, perhaps in all to a greater or less extent, the entire institution is regarded as a commercial asset of the inhabitants to be advertised in the usual flamboyant fashion, rather than as a scientific mode of treatment. In consequence the patient is frequently advised to do many things which tend to the pecuniary welfare of the place rather than to his benefit. That this, of course, does not apply to the really highly trained, conscientious, and skilful physicians who are to be found in greater or less number in most European spas at least is of course self-evident.

The advantages of the artificially prepared baths are, first, the ease of their preparation, the readiness with which they may be graduated in temperature and composition, their cheapness, and the fact that they may be given almost any place. It goes without saying that the physician who administers them must exercise exactly the same accurate supervision of them and must be as thoroughly familiar with the practical minutiæ of their administration as he would expect to find with the directing physician at a well-equipped spa. There has been a great deal too much ritual and ceremony thrown around the administration of procedures of this sort, and what is really not an especially complicated matter has been made to appear a matter of such consequence that it would be presumptuous for the average man to even undertake it. It must never be lost sight of that a large part of the success of the Nauheim bath is due to the fact that the patient goes to Nauheim in the confident expectation of being cured, having made many sacrifices, and being willing to make more, and to the fact that he is free from his business or household cares. In other words, much of the supposed success attendant upon the baths at Nauheim would be obtained at Nauheim without the baths.

Regarded from the standpoint of the American physician, of whose patients only a very small number could be induced to visit a European spa of sufficient renown to have the name mean much to him, the artificial Nauheim bath has proven of great use. The spa treatment in this country

has reached only a very insignificant development, as compared with Continental countries, and in consequence results of spa treatment in America are infinitely less satisfactory than abroad. The disadvantages of the artificially prepared bath lie principally in the fact that relatively few physicians have cared to give the amount of careful study which is necessary to carry out the bath treatment scientifically. The busy practitioner will say that he has neither time nor inclination to supervise accurately their administration, and without this little that is satisfactory can be accomplished.

The Natural Baths.—Nauheim possesses five principal springs, of which, at the present time, Springs Nos. 7, 12, and 14 are alone used in the preparation of the baths. The details of the arrangements cannot be gone into here; suffice it to say that the graduation of the baths is obtained by an admixture of the water from different springs in appropriate proportions. Some of the water is permitted to stand in reservoirs, so that it loses most of its carbon dioxid, and from this the weakest bath, the simple thermal bath, is prepared. In addition to this some of the water is obtained from lateral pipes taken directly from the main pipe of the spring. This, of course, still retains its entire CO_2 content, and is used for the sparkling baths (Sprudelbäder). By admixture of this water with water which has stood in reservoirs every conceivable modification may be had. The temperature may be, if necessary, lowered by the addition of ice.

For the purpose of retaining the CO_2 content of the water, and to keep the natural temperature as nearly as possible, subterranean reservoirs, built in such a way as to retain the temperature, have been provided for the three springs mentioned. This retention of the carbon dioxid gas keeps the calcium and iron salts in solution, producing a water which is clear and transparent. The water of those springs which is collected in open reservoirs loses its CO_2 in such a degree as to produce a precipitation of iron salts.

Still another bath is sometimes given here, the flowing Sprudel bath. In administering this bath the water is permitted to enter under some pressure, and during the entire duration of the bath is allowed to run through suitably constructed overflow pipes. This makes by far the greatest demands of any upon the heart, so that it should only be given to patients whose cardiac power can be brought up to a fairly high degree of efficiency.

ANALYSIS OF THE NAUHEIM WATERS

(Modified from Bezly Thorne)

Constituents	Spring No. 12 Friedrich Wilhelm's Quelle	Spring No. 7 Grosser Sprudel	New Sprudel No. 14
Chlorid of Sodium	29.2940	21.8245	24.0692
Chlorid of Lithium	0.0536	0.0492	.....
Chlorid of Potassium (Cæsium, Rubidium)	1.1194	0.4974	1.0825
Chlorid of Ammonium	0.0712	0.0550	0.0660
Chlorid of Calcium	3.3249	1.7000	1.6327
Chlorid of Magnesium	0.5255	0.4402	0.5634
Bromid of Magnesium	0.0083	0.0060	.....
Iodid of Magnesium	Trace	.....	.....
Sulphate of Calcium	0.0352	0.0347	0.0602
Sulphate of Strontium (with Baryta)	0.0499	0.0390	.....
Bicarbonate of Calcium	2.6012	2.3541	1.8423
Bicarbonate of Iron	0.0484	0.0383	0.0303
Bicarbonate of Manganese	0.0069	0.0065	.....
Bicarbonate of Zinc	0.0089	0.0104	.....
Earthy Matter	.....	.....	0.0044
Silicic Acid	0.0213	0.0325	0.0193
Arsenate of Iron	0.0002	0.00036	.....
Phosphate of Iron	0.0007	0.00046	.....
Organic Substances	Trace	Trace	.....
Amount of Solid Constituents	35.3573	26.3539	.....
Specific Gravity	1.02757	1.02088	.....
Carbonic Acid Gas, Retained	.....	.....	0.8221
Carbonic Acid Gas, Free	*1.0074	**3.1756	1.1905
Temperature (Fahrenheit) Celsius	(95.54) 35.3	(88.88) 31.6	(88.16) 31.2
Outflow in 24 hours (Normal)	1725	782	.....
In Cubic Meters (Valves half closed)	782	529	.....
Depth of Well in Meters	180	159.5	.....

*=578.93 c. c. **=1340.46 c. c.

Artificial Nauheim Baths.—It lay in the nature of things that a procedure so widely used as have been the Nauheim baths should be artificially imitated in many different forms. Into many of these a good deal of unnecessary complexity has been introduced, and in others, in the interest of supposed simplicity of administration, the most valuable feature of the baths, namely, the capacity of being graduated in their composition as well as in temperature, has been lost. To intelligently judge of the merits of different forms of artificial baths which are on the market, the following facts should be borne in mind: First, the most essential thing about the bath is the temperature. Second, the next most important thing is the amount of carbon dioxid which is held in solution in the bath water, together with an accurate means of measuring this amount. Third, the amount of the salts used is of minor importance. The temperature is, of course, independent of the chemicals used, and is regulated without difficulty. It is to the second point that especial attention must be paid in the use of the artificial baths. In many of these, as obtained commercially, the sodium bicarbonate and whatever acid salts may be used are put up in

packages in the proper relative proportion, but in such form as to make it difficult to use the amount necessary for a given concentration of CO_2 without reweighing the chemicals.

To use artificial baths which come in ready, prepared packages, and hence if used according to directions will always furnish a bath of one and the same concentration, is to renounce the valuable feature of progressive increase in the strength.

Composition.—The composition of a Nauheim bath consists essentially of sodium chlorid, calcium chlorid, and carbon dioxid. To produce the carbon dioxid artificially two methods may be made use of, both having this in common that the carbon dioxid is liberated from the sodium bicarbonate.

The original method, as suggested by Schott, is to decompose the sodium bicarbonate by means of concentrated hydrochloric acid, according to the formula, $NaHCO_3+HCl=NaCl+H_2O+CO_2$.

By simple substitution of the atomic weights it will be seen that sodium bicarbonate and hydrochloric acid combine in the proportions of 86 to 36.5 or as 100 to 42. The hydrochloric acid of the pharmacopeia contains 31.9 per cent. by weight of the gas HCl. It requires, therefore, about one and one-fourth parts by weight of the strong acid to one part by weight of the sodium bicarbonate. The specific gravity is about 1.16, so that for ordinary purposes of calculation the usual assumption that 100 grams of the crude acid will have a volume of about 75 cubic centimeters is sufficiently accurate. The proper proportions are then *as many cubic centimeters of crude acid as we take grams of sodium bicarbonate.* Since, of course, but a certain amount of CO_2 can be derived from a given weight of sodium bicarbonate it makes no difference if there should be a slight excess of hydrochloric acid.

The second method of generating CO_2 is by the action of acid potassium or sodium sulphate on sodium bicarbonate according to the formula:

$$NaHCO_3 + NaHSO_4 = Na_2SO_4 + H_2O + CO_2.$$

It will be seen by simple substitution of the atomic weights that sodium bicarbonate and sodium bisulphate combine in the proportion of 7 to 10. If the CO_2 be generated by this method for each 7 parts by weight of the bicarbonate 10 parts of sodium bisulphate should be added.

The two methods just described are the only ones which may be carried out anywhere without especial apparatus. There are advantages in each method. If sodium bisulphate be used the chemicals are easier to handle, and there is, perhaps, less danger of accidents such as might conceivably occur in the handling of strong hydrochloric acid. The disadvantages of this salt are that it is exceedingly hygroscopic; that it attacks the tub readily, so that it is necessary to use rubber sheeting to protect the latter, and,

finally, that the evolution of CO_2 does not go on so uniformly throughout the different portions of the bath. In addition to this the salt is not very easy to obtain in a satisfactory condition.

If hydrochloric acid be used the principal objection is that there is some difficulty in handling the acid because of the danger of breakage. The writer, after a fairly extensive use of both methods, has found the latter, under the conditions which obtain in our American cities, by far the most simple. It has the prime advantage that it is by far the easiest to graduate satisfactorily.

If this latter procedure be adopted the technique of giving a bath is as follows: The sodium chlorid is first dissolved in hot water, the calcium chlorid added and dissolved. It should be previously coarsely pulverized. The sodium bicarbonate is now added and dissolved. A precipitate of calcium carbonate is formed, noticeable in the turbidity of the water. The bath is now made up nearly to the full amount at the right temperature. Usually 50 gallons (200 liters) are required. The hydrochloric acid is now added in the following manner: The necessary amount is placed in an ordinary bottle, or, better, two, the stopper loosely inserted or the thumb placed over the mouth and the bottles quickly inverted in the water. Holding the bottles perpendicular, mouth down, they are moved about slowly close to the bottom of the tub, until by diffusion the water replaces the acid. This requires, as a rule, fully ten minutes, and in the strongest baths 15 or 20 minutes. As it is the CO_2 which remains dissolved in the water, and not that which escapes, which is the active agent, the importance of this will be clearly seen. Great care must be taken to prevent the ebullition of the carbon dioxid at a rate faster than it can be absorbed by the water. With the proper technique the water and acid mix in the lower strata of the water and the evolution of gas is not complete until a more thorough mixture of acid and water takes place as a result of the agitation produced by the patient getting into the bath.

A modification of this method consists in introducing the hydrochloric acid with the patient in the bath by means of a long flexible tube reaching to the bottom of the tub. The objection to this method is that it is somewhat difficult to introduce the acid without danger of having it come in contact with the patient's skin.

If the bath has been prepared as recommended the patient lets himself down into the water, taking care to produce as little agitation of it as possible, since violent stirring produces rapid ebullition and escape of gas.

While in the bath no unnecessary movement should be made, and under no circumstances should the patient rub himself or exert himself in any way whatsoever. In all excepting the milder baths the body will soon be seen to be covered with minute bubbles, which are, of course, the bubbles of CO_2, and which it is important to preserve, since it is to stimulation of these upon the skin that the baths owe their peculiar efficiency.

A large number of different devices for generating CO_2, more especially suited to the needs of hospitals and sanatoria, have been introduced. Some of these admit the CO_2 directly in the form of a gas which is liberated in the lower strata of the water. A slight experience with these has convinced the writer that they are unsatisfactory because of the large amount of gas that escapes. Other processes have arrangements for mixing CO_2 and water very intimately, and then the mixture is admitted to the bath. As all these devices are, because of their complexity and high price, suitable only for institutions, their advantages and disadvantages need not be discussed here.

General Rules for the Nauheim Baths.—The first bath should be in the nature of a trial, and care should be taken to have its temperature, salt, and CO_2 content well within the limits of the patient's tolerance. If there be any doubt as to this it is advisable to begin the course by omitting the CO_2 entirely, and with the temperature near the indifferent point. The first one or two baths, at least, must be under the physician's direct supervision or that of a trained assistant. If, after the first momentary shock of entering a cooler bath, a sensation of cold is still complained of the bath must at once be made warmer, and if it be very marked the bath must be discontinued. In this trial bath the blood pressure should be taken just before entering the bath, and again after a few minutes of immersion. On any evidence of a lowering of the pressure, and especially if this be associated with even slight cyanosis, dyspnea, or a sense of oppression, the bath should at once be discontinued. The patient should always be warned as to the necessity of entering the bath quietly, and especially against the very natural tendency to rub himself to overcome the initial chilliness. An important point is to avoid an unusual degree of warmth in the bath-room. A temperature of 63° to 65° F. (17-18° C.) should not be exceeded. Occasionally patients complain of headache or slight vertigo from inhalation of carbon dioxid gas. This is invariably an indication of faulty technique of administration. The simplest way of solving the difficulty is by fanning the patient diligently, which removes the CO_2 which has accumulated in a stratum on the surface of the water.

At the end of the bath the patient should be carefully dried, preferably while lying down. He should not be allowed to assist himself in any way, and should be put to bed for the following two or three hours. Under favorable conditions a strong desire to sleep manifests itself, and the patient generally has a long, refreshing nap, from which he awakes much invigorated.

In regard to the time of giving the bath, the writer strongly prefers the middle of the forenoon. It is highly undesirable to give them before breakfast on an empty stomach. Some have recommended giving them in the evening so that the patient may go to sleep immediately afterwards. As the patient is usually fatigued by the events of the day, this seems, on the whole, injudicious.

The frequency of the baths must vary with the individual case, and no schema should be set up as applicable to all cases. In a general sort of way they should not be given, except with especially robust patients, more than three times the first week, and four times during each of the two following weeks. The criterion should always be the result obtained in the previous bath. If this was satisfactory, if the patient felt refreshed, if the behavior of blood pressure and pulse rate were satisfactory the next bath may be proceeded with without any hesitation, its temperature a little decreased and the CO_2 content made a little greater.

The duration of the individual bath should be from five to ten minutes in the milder baths, increasing to twenty minutes for the strongest.

The total number of baths to be given must be prescribed strictly according to the necessities of the individual case. Little can be hoped for in the way of permanent results unless twenty-five to thirty-five baths are given. Any attempt to lay down a general scheme of either time, duration of treatment, temperature, or strength of the baths suitable for all cases must end in disaster. A common practice, and one which cannot be too severely condemned, is to send the patient to either some institution or a spa, provided beforehand with explicit directions as to the conduct of the baths. They should be given invariably under the absolute control of the attending physician, or else the treatment of a case should be temporarily placed in the hands of the physician who is to superintend the bath treatment.

When the baths are well tolerated, an endeavor should be made to increase the strength of the heart up to the point where the patient takes the strongest bath at the coolest temperature. The coolest usually given are 77° F. (25° C.). In the more severe cases 86° F. (30° C.) should be the minimum temperature.

The maximum strength of the bath is attained when a sodium bicarbonate content of 1,500 grams (3.3 lbs.) with 1,500 c. c. (50 fluid ounces) of HCl are used. The salt content is of much less importance than the other factors. In the weaker baths we may begin with 1 per cent. and increase to 3 or 3½ per cent. of sodium chlorid. This would be, calculated for 50 gallons of water (about 200 liters), 2 kilos (4.4 lbs.), increased to 6 kilos (13.2 lbs.). The $CaCl_2$ content should be 400 grams (14 ounces) to begin with, and this increased to 1,000 grams (2.2 lbs.) in the strongest baths.

A number of different schemes have been invented by different writers for the graduation of the artificial baths, the most usual of which is to divide them into three groups: weak, medium, and strong. The writer is strongly opposed to any such schematic arrangement, as it tends to produce, as do all similar schemes, a routine which is hard to break away from. Moreover, the thing above all others which is especially advantageous in the baths is the exact dosage which may be given, and this,

of course, is entirely lost if such a routine be employed. If the physician has the proper intelligent supervision over his patient, he should make such changes as he deems advisable in successive baths, or, at most, after each group of two or three baths. Much of the discredit which has been brought upon the use of the baths has been due to a lack of appreciation of the necessity of accurate attention to these details. The following record of a series of baths prescribed recently for a patient under the writer's care may serve as a guide: Each bath was given in approximately fifty gallons of water. The patient was seen after each bath and generally daily, and in the first four baths the blood pressure was noted at the beginning and end of each bath, with, as a matter of course, the frequency. It should be especially noted that the changes instituted were made from day to day, and not according to any preconceived arrangement:

No. of Bath	Day	Duration Minutes	Temp. Fahr.	Sodium Chlorid	Calcium Chlorid	Sodium Bicarb.	Hydrochloric Acid
1	1	5	92	5 lbs.	½ lb.	00	00
..	2	..	..	..	..	..	..
2	3	5	90	5	½	00	00
..	4	..	..	..	..	..	..
3	5	6	88	5	½	8 oz.	225 cc.
..	6	..	..	..	..	..	..
4	7	6	88	5	1	8	225
..	8	..	..	..	..	..	..
5	9	7	87	6	1	8	225
..	10	..	..	..	..	..	..
6	11	7	87	6	1	1 lb.	450
..	12	..	..	..	..	..	..
7	13	8	86	6	1½	1	450
8	14	8	86	7	1½	1	450
..	15	..	..	..	..	..	..
9	16	9	85	7	1½	1	450
..	17	..	..	..	..	..	..
10	18	10	85	8	2	1	450
11	19	10	84	8	2	1½	675
..	20	..	..	..	..	..	..
12	21	12	84	9	2	1½	675
13	22	12	83	9	2	1½	675
..	23	..	..	..	..	..	..
14	24	14	83	10	2	1½	675
15	25	14	82	10	2	1½	675
..	26	..	..	..	..	..	..
16	27	16	82	10	2	2	900
17	28	16	81	11	2	2	900
..	29	..	..	..	..	..	..
18	30	18	81	11	2½	2½	1125
19	31	18	80	12	2½	2½	1125
..	32	..	..	..	..	..	..
20	33	20	80	12	2½	3	1350
21	34	20	79	13	2½	3	1350
..	35	..	..	..	..	..	..

Four additional baths were given of the same strength as the last one in the table, with a day intervening after the second bath, making a total

of twenty-five baths, of which the last five were approximately of the same strength as the strongest of the natural baths.

A mistake which is commonly made is to permit a patient, after a course of treatment, to resume at once his ordinary vocation. The patient should work back gradually to the life he led previous to treatment. This is especially true in cases where the patient's vocation brings with it a fair amount of physical exertion.

Oxygen Baths.—The widespread use of carbon dioxid baths and the fact that part of their utility, at least, is due to the CO_2 content has led to the effort to replace the CO_2 by means of other gases. The best known of these are oxygen baths, introduced by Sarason, and to be obtained commercially under various trade names. In most of them the oxygen is obtained by means of the chemical reaction of salts dissolved in the bath water. Exact experiments in regard to the oxygen baths, of the same kind as those of Otfried Mueller for the CO_2 baths, have not been made, but it can scarcely be doubted that the action of the oxygen baths will differ but little from that of the CO_2 baths. A fair amount of experience with those forms which are commercially obtainable in America has led the writer to believe that they probably vary widely in composition, and, as they are distinctly less easy to control than the CO_2 baths, their use cannot be recommended.

Hydroelectric Baths.—The importance which hydroelectric procedures have assumed in the therapy of cardiac diseases is not great. In spite of the manifestly gross exaggerations of their utility which have characterized some of the reports, they have a distinct, though very limited, field of use. It is impossible, within the limits of an essay of this sort, to enter into the details of either theory or technique. Suffice it to say that the sinusoidal current is, in general, to be preferred to either the galvanic or the faradic current, because of its greatly lessened tendency to produce muscular contractions. Two methods of application are generally used in giving these baths: first, the full bath, and, second, the four-cell bath.

In the full bath the patient is immersed in water, at the indifferent temperature, and the current allowed to pass through the body by electrodes placed in suitable positions. In the four-cell bath the patient, with arms and legs bare, sits in a chair with each arm and leg immersed in receptacles of suitable size and shape. By means of large carbon electrodes contained in these receptacles the current is conducted into the water, and from this into the patient's body.

The physiological action of a hydroelectric bath, whether it be given in one manner or another, is the same. The hydroelectric bath is neither more nor less than a bath dependent for its effects upon peripheral stimulation. The current produces certain effects upon the sensory nerves which, in turn, act reflexly upon the heart and vessels. In general, the increase in the rapidity of the blood flow is proportional to the strength

of current. The peripheral vessels show a constriction more or less proportional to the current strength.

It should be strongly emphasized that there is no peculiar efficacy inherent in the use of electricity itself.

The most accurate investigations into the physiology of these baths have been made by Veiel, in the Romberg clinic. He comes to the following conclusions: The sinusoidal four-cell baths exercise the heart in the same way as the CO_2 baths. The greatest caution must be exercised with the dosage, which must never be schematized. The best criteria for the dosage are the subjective sensations of the patient. A distinct feeling of fatigue, which does not yield to a short rest, should lead to a weaker current with the next bath. We consider the sinusoidal four-cell bath an excellent supplement to the balneological treatment of cardiac diseases, which admits, without a full bath, of a distinct action upon the circulation in the sense of exercising the heart. On the other hand, we must emphasize that so strong an exercise cannot be obtained with them as with the CO_2 baths. The difference between the current strength which is useful to the circulation and that which brings about the reverse harmful effects is frequently a very slight one. The differences in susceptibility to them are much greater than in the case of the CO_2 baths, which stimulate the skin by means of the thermic stimuli. This variation in susceptibility is probably due to differences in conductivity of the skin. The electric four-cell baths are especially useful where we wish a mild balneologic excitation of the cardiac activity, and for any reason cannot apply the CO_2 baths.

These results and conclusions of Veiel should form the basis for the determination of the indications.

Indications.—The hydroelectric baths, precisely in the same manner as the CO_2 baths, *require a heart which is capable of responding to increased demands upon it.* These baths should never be used excepting in the milder degrees of relative cardiac insufficiency. The statements of some authors that even severe, almost absolute, cardiac insufficiency is benefited by them has no foundation, either in theory or experiment. Hydroelectric baths offer no advantages over the CO_2 baths, and no effects can be produced by the electric baths which may not be had more readily and more certainly by the use of the CO_2 baths. Since, as Veiel states, the difference between useful and harmful current strengths is a very slight one, there is distinctly greater liability of producing harm to the patient than is the case with the CO_2 baths. Nervous patients, in general, tolerate hydroelectric baths badly. The reported cases of marked diminution of cardiac dilatation after a single bath have no more foundation in fact than have the similar cases reported after a single CO_2 bath.

Gymnastics

The first important contribution, in modern times, to the use of gymnastics in circulatory diseases dates from Ling, a Swede, in the beginning of the 19th century. These methods were brought to the attention of wider circles of medical thought through the influence of Zander in Stockholm, and more especially Theodor Schott and Oertel in Germany. It may be said, indeed, that the influence of the latter two has been paramount in securing for gymnastic procedures a definite place in the treatment of cardiovascular diseases.

Physiological Action of Gymnastics.—Every actively working muscle requires, for the proper carrying out of its metabolic processes, an increased amount of oxygen. This increased amount of O_2 is brought to it by an increased blood supply, which presupposes dilated arterioles. The regulation of these is under the general direction of the vasomotor system, which again is affected by centripetal stimuli proceeding from the muscles themselves. This increased amount of blood to the muscles demands a proportionate increase of the heart's work. It may be laid down, therefore, as a general principle, that active muscular work brings with it an increased work of the heart, which latter, in general terms, is proportionate to the amount of muscular work done.

Another factor must, however, be taken into consideration, and that is the part which the brain plays in carrying out muscular contractions. Weber showed that in many instances the mere thought of work to be accomplished, i. e., the psychical processes involved in the conception of the work to be done, causes an increase in blood pressure. This fact, which has been already alluded to, is a matter of everyday experience to those accustomed to carry out exercise tests of the functional capacity of the heart. This increase in blood pressure is a direct result of increased cardiac action. When the exercise in question has been done so frequently, as a result of a course of training, that it is accomplished with a minimum of physical exertion, the blood pressure may fall, or at least rise, to a very slight degree. This is in part the explanation of the fact which has been repeatedly observed, that in well-trained athletes the blood pressure may fall, even after what, to an untrained individual, would be a considerable muscular exertion.

The effect, then, of applying increased resistances to the outflow of blood from the heart is to increase the tonus of the latter, provided always that the resistance is one which is capable of being overcome by the heart. This increase in tonicity gives rise to more forcible systoles, and has a tendency to lessen any residual blood which may be present. The converse of this statement is equally true, that an excessive strain which exhausts the heart muscle produces a weakening of its systoles, a lessened

tonicity, an increase in the residual blood, if there be any, and, hence, dilatation.

These are the fundamental facts upon which the application of gymnastics to the treatment of cardiovascular diseases is based. In this connection the interesting views of Hasebroek should be considered. This author regards the effect of gymnastics upon the circulatory system as confined largely, almost exclusively, to the peripheral circulation. The effects upon the heart he regards as entirely secondary. Indeed, he even goes to the extreme of considering that the peripheral circulation possesses a considerable degree of independence. It is certain that Hasebroek has gone too far in the latter assumption, and it is equally certain that we must regard the heart, arteries, capillaries, and veins as a unit in all considerations of the work done by the circulatory system. This author has, however, done a great service to the cause of gymnastics, in emphasizing its astonishing effects upon the peripheral circulation. It cannot be doubted that a very considerable part of the utility of all mechanical procedures upon the circulation is due to the increase of the flow of lymph, and of the increased metabolic processes in the muscles set in action by it. A factor of considerable importance, and one which has been hitherto taken into too little account, is the fact that through gymnastic exercises the skeletal muscles are increased in strength, and hence carry out the ordinary bodily movements with a lessened degree of exertion, and this in turn produces a lessening of the work of the heart. There must be added to this also the fact, already mentioned, that *the more a group of muscles becomes practiced in the carrying out of a given movement the less psychical exertion is required in the process.* As a result the usual increase in blood pressure and consequent increased work of the heart, attendant upon physical effort, do not occur. It would seem highly probable that this latter factor is, in some instances at least, to be accorded almost equal importance with the increase in strength of the muscles produced by the exercise.

The passive movements, i. e., those in which, without the patient bringing into contraction any muscles whatever, movements are carried out by a gymnast, or by appropriate machines, do not come under the head of the exercises just discussed. Their action may be regarded as a negligible quantity so far as any direct effect upon the heart itself is concerned. On the other hand, they exert a powerful influence in assisting the flow of blood not only in the muscles themselves, but in all the peripheral parts. Their effect upon the lymph stream is to accelerate its flow; hence these movements exert a considerable influence upon the metabolism.

Hasebroek considers that the slowing of the circulation is due, more especially, to the influence of the blood vessels and the muscles being lost. While recognizing the importance of these structures for the main-

tenance of a normal circulation, and while recognizing the fact that gymnastics exert the largest part of their action upon the periphery, yet Hasebroek unquestionably goes too far in regarding all the effects of gymnastics upon the heart as purely secondary. This is a matter of considerable importance, since, were Hasebroek's conclusions to be taken as literally correct, we should be compelled to believe that active exercises actually lessen the work of the heart instead of increasing it, as we have already seen to be the case. As previously stated, *passive exercises have no direct effect at all upon the heart,* and may, through their influence upon the peripheral circulation, actually lessen its work to a certain degree. *Active exercises, however, of whatsoever kind, bring with them an increased amount of work for the heart.*

Herz calls especial attention to the fact that the muscles are the most important structures for the development of energy, and for this reason it is of the very greatest importance whether muscles are active or inactive. In circulatory diseases the muscles are, as the result of the diminished blood supply, poorly nourished, and Herz considers that under these circumstances an increased supply of blood to the musculature would have a most important stimulating effect upon the metabolism, nervous system, etc., of the entire organism. While this author does not consider the stimulating effect of muscular work upon the heart and the entire organism as its most important effect, he does lay considerable stress upon the idea that the mechanicotherapeutic excitation of the heart is to be placed upon the same basis as the medicinal therapy, except that in the latter the material producing the excitation is introduced from without.

Indications and Contraindications.—In the case of the passive movements, which make no demands upon the heart, the indications are exceedingly simple. They may be used in all cases of chronic myocardial insufficiency from whatsoever cause. Their principal utility is in assisting the peripheral flow of blood and lymph, and in preparing the patient for a gradual transition to the various forms of active gymnastic movements. We must only expect such results from passive movements as proceed from an improvement in the peripheral circulation.

The indications for the use of active movements are derived from the consideration of two fundamental points: First, active movements produce an increase in the work performed by the heart. Second, the heart muscle, like the skeletal muscles, is capable of responding to work properly adapted to its strength by an increase in the force of its contractions. In the case of active movements, we are confronted with somewhat similar conditions to those which obtain with the Nauheim baths, since the exercises, like the baths, produce increased work for the heart.

The cardinal point to be considered in selecting cases for treatment by active movements is as to whether that particular heart possesses a degree of reserve power easily sufficient to carry out the movements in

question. In this respect the same conditions obtain as in the case of the Nauheim baths. Because of the great popularity which the gymnastic treatment of heart diseases has attained, this has been in only too many instances entirely lost sight of, and patients have been subjected to one or the other systems of active movements with little or no regard as to whether it was possible for the heart to master such movements. Since the heart must possess some degree of reserve power, in order to master any active movements, it is evident that absolute cardiac insufficiency is to be rigorously excluded. Not only this, but the more severe degrees of relative insufficiency are equally unsuitable. Cases with marked cyanosis and dyspnea, developing even while at rest, with marked swelling of the liver, considerable degrees of anasarca, and, still more, with serous effusions in the body cavities are to be rigorously excluded from treatment by gymnastics. Suitable cases are those attended by moderate dyspnea on exertion, with little or none while sitting still or lying down. Slight venous stasis of the liver, evidenced clinically by a little enlargement and tenderness, especially over the left lobe, should be considered as the most marked symptoms permissible in a case to be treated by active gymnastic movements. For the same reasons, aneurysms, or cases associated with aneurysmatic dilatation of the arch of the aorta, form contraindications. All forms of acute cardiac insufficiency are unsuitable, and, as a matter of course, acute endocarditic processes, whether these form the first attack or are a recrudescence superimposed upon a chronic endocarditis.

Cases of arteriosclerosis do not form an absolute contraindication, but, on the other hand, demand the very greatest possible care in the use of the method. It will be remembered that it is in just this group of cases, where compensation is already strained to its uttermost limit, or may, indeed, have already passed this limit, that we find the greatest increases in blood pressure on exercise. If there has been a tendency to cerebral hemorrhage, even though very slight, all active exercises would be better omitted.

When we reflect upon the fact that the exercises which can be appropriately employed are of very small moment as compared with those which a vigorous man of the laboring class, in the ordinary pursuit of his vocation, would carry out, an additional fact becomes self-evident. We may expect no improvement from gymnastics in cases where the patients have been accustomed to even a moderate amount of physical exercise in the daily routine of their lives, and certainly none where they have been accustomed to severe manual labor. These patients have already a myocardium which has hypertrophied in direct proportion to the development of their skeletal musculature, and yet, in spite of this physiologic hypertrophy of the heart, the myocardium has proven insufficient to compensate the disease process. In hearts such as these the insignificant amount of exercise for the heart muscle represented by such gymnastics

as the Schott or Herz movements is of very small moment as compared to the amount of exercise to which these hearts have been accustomed. Hence, little can be expected in this group of cases from such movements. A failure to take into consideration this fundamental fact has resulted in many patients being subjected to a course of gymnastics, whose myocardium was already hypertrophied as a result of hard manual labor, and yet which, in spite of this hypertrophy, had proven insufficient. Under these circumstances not only do the gymnastics do no good, but, if persisted in, are exceedingly likely to work actual harm through overexertion.

The converse of what has just been said is equally self-evident. The best results are obtained from gymnastics in patients who have lived a sedentary life, with a minimum of physical exertion, and with feebly developed skeletal musculature, such as is commonly seen in the ordinary degrees of obesity. In this group of patients the heart, as the result of the small demands made upon it by the mode of life of the patient, is feebly developed; gymnastics, therefore, cause such hearts to put forth a considerable degree of exertion, and hence, when properly applied, are an important aid in producing the desired hypertrophy.

Just because the heart in these cases has not been accustomed to the demands made by vigorous physical exertion, extraordinary care must be taken with the dosage of the exercises. In the beginning the lightest movements must be carried out only for a very short space of time at each séance, and an increase in time and severity of the exercises should be undertaken only when the heart has shown itself competent to meet the demands of the milder exercises.

One of the most important uses of gymnastics is as an after-treatment in cases where, by other means, hearts with varying degrees of myocardial insufficiency have regained, in great measure, their lost compensation. To further develop the strength of the heart, gymnastics are of the greatest use. Especial care should be taken not to prescribe active gymnastics in cases where other measures which tax the heart are being used at the same time. This is a common error, and not infrequently the combination of CO_2 baths and active gymnastics proves sufficient to overstrain a myocardium which would be strong enough to master either by itself.

Methods and Technique.—In general, we may distinguish between two great groups: first, those exercises carried out by the aid of machines, mechanogymnastics; second, those exercises which are carried out without mechanical aid.

Mechanogymnastics.—In this system the exercises are carried out by means of elaborate machines, and are largely passive in character. These machines, which are capable of producing almost every variety of motion, were first introduced by Zander of Stockholm, in whose hands the method reached a considerable degree of perfection. There can be little doubt of the usefulness of this method, provided, always, that the physician himself have exact supervision of the exercises, or, at the very least, that the

direction of them be under the care of some one who is carefully trained in the method and in the dosage of the exercises. On the other hand, the method carries with it the very great danger of overstepping the limits of the patient's cardiac reserve power. All such methods, which in their essence are absolutely mechanical, and involve the expenditure of considerable sums of money for apparatus and maintenance, must, in the very nature of things, be carried on in institutions where it is well-nigh impossible for the physician to have an accurate supervision of his patient.

The writer's somewhat limited experience with the Zander methods leads him to the following conclusions: Under ideal conditions, with strict individualization, under the direct guidance of the physician, who must of necessity be more or less trained in the application of the method, the Zander methods produce as good, but no better, results than similar exercises carried out manually. Under any but ideal conditions there is infinitely greater danger of the patient overexerting himself in the mechanical than in the manual systems.

In addition to the Zander apparatus, an exceedingly ingenious series of apparatus on the same general principle has been elaborated by Max Herz of Vienna. Judging from his descriptions and the care with which the details of construction have been attended to, they should prove fully the equal of, or even superior to, the Zander apparatus. The writer has had no practical experience in their use.

Systems of Exercises.—Of the large number of systems of exercises which have been recommended for cardiac conditions, but three have attained any lasting claim to permanency. These are, in the order of their development, the Schott method, the Oertel's Terrain-Kur, and the method of Max Herz. The latter method is, in reality, a combination of various systems. Herz, in an exceedingly carefully thought out analysis, has shown that many of the points in which the different systems were supposed to be in direct opposition to one another were, in reality, upon a more correct analysis, points of similarity. The Herz system must be regarded as the most accurately analyzed, carefully worked out, and most scientifically founded system of gymnastics at present existing.

The Schott Exercises.—Resistive Exercises.—Schott lays down certain fundamental points which should be observed in carrying out these exercises:

1. The patient should be always warned to carry out the movements so slowly that there shall not be the slightest sensation of effort. Schott was accustomed to tell his patients that while carrying out the movements they should always have breath enough to carry on a conversation with comfort simultaneously.

2. The movements should be carried out at a uniform rate from beginning to end.

3. A pause should be made after each movement.

4. The movements should be made in such an order that new muscle groups are brought into action successively. Only after all the skeletal musculature has been brought into play should the cycle of movements, if the patient be fresh enough, be repeated.

5. This latter condition may be complied with by simple consideration of the geometric conditions of the various joints, and their musculature.

6. The gymnast must learn to apply the resistance which he opposes to the movement at a point nearer to, or farther from, the fulcrum, according to the relationship existing between his own strength and that of the patient. As the patient's strength increases the resistance is to be made at a point farther removed from the fulcrum.

7. The gymnast must always exercise care to apply the resistance to that side of the limb which is in advance; thus, if the arms are being approximated in a horizontal direction, the resistance should be applied to the volar side. If the arms are being separated, resistance should be applied to the dorsal side. In the case of trunk flexion, the resistances should be made over the manubrium sterni and over the lumbar spine. In the case of extension of the trunk, the resistances should be made over the neck and the xiphoid process. In rotations of the trunk one hand is placed upon each shoulder.

8. The gymnast should never encircle the limb, else he is apt unconsciously to aid, instead of to resist, the motion. He should always begin as if he intended to force the carrying out of a movement just the opposite of the one to be made, and then gradually yield to the patient's effort.

9. The resistance should be so gaged by the gymnast that, while the movement shall ensue slowly and with equal rapidity at all stages, the resistance must never be strong enough to suppress the motion entirely. If the movements are very slow, considerable resistance may be used without danger of overexertion, for the symptoms of which the gymnast should be constantly on his guard. These are, especially, dilatation of the alæ nasi, slight cyanosis of the cheeks or lips, palpitation, yawning, precordial distress.

The importance of these latter admonitions of Schott is especially to be borne in mind, since most of the ill results which have followed the injudicious use of these exercises have been due either to the use of too great resistance by the gymnast, to their too frequent repetition, or to neglecting to keep a watchful eye for the development of the signals of distress.

Before proceeding to a study of the exercises employed in this method it should be emphasized that it is not so much the choice of the particular movements which renders the system of value as it is the discretion and good judgment of the physician and gymnast.

In Germany the physician himself not infrequently carries out these movements, and, while that is not customary in this country, the physician should see, under all circumstances, that the person who acts as gymnast should have absolute command of the details. Schott himself makes the statement that any person of fair intelligence may be taught to carry out these movements with an amply sufficient degree of accuracy, provided his schooling in the movements be superintended the first few times by the physician. With this statement the writer is in perfect accord. He has treated a very considerable number of cases, especially among the better classes, in this way, and in many instances has found an intelligent member of the family to make a most acceptable operator. Where a professional operator is available, of whom the physician knows to a certainty that he may be trusted to carry out the movements with proper attention to dosage, it is perhaps preferable to make use of his services. It is unfortunately the case that a large number of those purporting to be trained operators in this line of work have but little claim to be considered as such. If in doubt, it is far wiser for the physician to expend the extra time necessary to properly school an intelligent nurse or member of the family.

Arm Movements.—1. At the shoulder joint. The patient stands with arms hanging down by the sides. The arms are raised slowly in parallel planes in a sagittal direction until they are horizontal, and then back again. The operator's hand must be applied to the forearm and wrist in such a way that the part of the arm in advance is antagonized by the fork formed by the thumb and first finger of the operator.

2. Standing, the arms at the sides. The arms are then raised outward until the hands are on a level with the temples, and back again. Resistance as before.

3. Standing, with the arms extended in front, palms together. The gymnast's hands rest upon the backs of the patient's wrists. The arms are carried backward in a horizontal direction to the line of the shoulders, against the resistance of the gymnast's hands; the latter then allows his hands to glide around so as to make pressure against the palmar surfaces of the patient's hands, and the arms are gradually brought back to the starting point. It is sometimes recommended in the first movements to carry the arms up over the head to the vertical position, but, because of the unfavorable hydrostatic conditions thus brought about, it is best not to raise the arms above the level of the head.

4. Arms stretched out in front, horizontally, and parallel to each other. They are then rotated about their axis as far as possible in each direction, a motion which includes both pronation and supination, the resistance being made by the operator at the wrist.

Movements at the Elbow Joint.—1. From the nature of the joint, the movements at the elbow are limited to simple flexion and extension. These

may be carried out either standing, the upper arms being supported by the operator with one hand, while he makes resistance to the movement with the other, or, better still, the patient sitting down, with the elbows suitably supported, the operator making the resistances and exercising both arms simultaneously.

Movements at the Wrist Joint.—1. At the wrist joint flexions, extensions, radial and ulnar abductions are made in precisely the same way (rotations, i. e., pronation and supination, are carried out with the last arm movement).

Movements at the Finger Joints.—These are flexions and extensions, radial and ulnar abductions. The resistances are made in precisely the same way as at the other joints.

Movements of the Trunk.—1. Standing, with the arms by the side, the trunk is flexed at the hip joint, the knees being kept rigid. The reverse movement is then made and the trunk bent backward as far as possible.

2. The trunk is flexed laterally, first to the right and then to the left. In resisting this movement one hand of the gymnast is placed in the axilla of the side toward which the patient is making the movement, the other hand being placed over the crest of the ilium of the opposite side.

3. Standing, with the hands by the sides, the vertebral column is twisted about its long axis, first in one direction and then in the other. In making the resistance the operator's hands are placed upon the shoulders. In all trunk movements the writer greatly prefers the astride-sitting position, with arms akimbo.

Movements at the Hip Joint.—1. With the knee held straight, the leg is raised forward in a sagittal direction to the height of about one foot from the ground, the operator making the resistance at the ankle.

2. Starting from the position attained at the end of the last motion, the leg is brought back again to the vertical, the operator slipping his hand around in such a way as to make the resistance against the heel.

3. In a precisely similar way the leg is abducted against resistance made over the outer malleolus, and from that position adducted again against resistance made over the inner malleolus.

4. With the knee rigid, the leg is extended backward until the foot is about twelve inches off the floor, resistance being applied against the heel, and from this position is brought back again to the vertical against resistance applied to the front of the ankle.

Movements at the Knee.—1. These are, from the nature of the joint, limited to simple flexion and extension. In this exercise, as in all those of the lower extremities, the patient stands supporting himself with one hand placed upon the back of a chair.

Movements at the Ankle Joint.—1. At the ankle joint simple flexion and extension are carried out in the same manner as at the knee. The

resistances in both of these are made in precisely the same manner as in the corresponding movements at the elbow and wrist.

Whenever possible, the writer prefers the half-reclining position for leg and thigh movements. In flexion of the legs, and particularly of the thighs, care should be taken to exhale simultaneously.

In carrying out these exercises it is much better to do them in cycles, that is, to carry out each movement described once, and then, if thought advisable, to repeat the cycle, than to do each exercise a number of times before passing on to the next. Great attention should be paid to the breathing, especially since the inability to breathe through the nose is an early symptom of cardiac insufficiency. Even in the absence of other symptoms of overexertion, the inability of the patient to breathe through the nose should be a signal for immediate cessation of the exercises.

All of these exercises may be grouped together under the general name of resistive exercises, since the essence of them is that they are made against the resistance of the gymnast's hand. Schott has devised a series of movements in which the resistance supplied by the operator is dispensed with, the patient supplying his own resistance. To this group of movements Schott gave the name of

Self-resistive Movements (*Selbsthemmungsbewegung*).—These will be described in detail under the system of movements devised by Herz.

Oertel's Terrain Cure.—Oertel's "Terrain Kur" was primarily designed for the treatment of the cardiac insufficiency of the obese, but subsequently Oertel applied the method to the treatment of widely different cardiac conditions, having that point in common that they all suffered from a greater or less degree of cardiac insufficiency. Oertel observed that in mild degrees of cardiac insufficiency long walks, especially climbing mild grades, proved exceedingly beneficial.

The principle of Oertel's system differs in reality but little from that underlying other systems of active movements. He begins with directing the patients to walk for certain distances at a given rate, on the level, and then gradually passes to paths having a slight ascent, continuing with steeper grades, until finally the treatment ends with tolerably steep ascents.

Under the advantages of Oertel's method may be named the absolute soundness of the principle involved. As a matter of fact, this principle had been recognized previous to Oertel's time by Stokes, who applied a similar method in the treatment of the cardiac insufficiency of the obese.

Stokes, in his treatise on the heart, published in 1854, pages 357 et seq., says: "We must train the patient gradually but steadily to the giving up of all luxurious habits. He must adopt early hours, and pursue a system of graduated muscular exercise; and it will often happen that, after perseverance in this system, the patient will be enabled to take an

amount of exercise with pleasure and advantage, which at first was totally impossible, owing to the difficulty of breathing which followed exertion. This treatment by muscular exercise is obviously more proper in young persons than in those advanced in life. The symptoms of debility of the heart are often removable by a well-regulated course of gymnastics, or by pedestrian exercise, even in mountainous districts, such as Switzerland, or the highlands of Scotland or Ireland. We may often observe in such persons the occurrence of what is commonly known as 'getting the second wind,' that is to say, during the first period of the day the patient suffers from dyspnea and palpitation to an extreme degree, but by persevering, without overexertion, or after a short rest, he can finish the day's work, and even ascend high mountains with facility. In those advanced in life, however, as has been remarked, the frequent complication with atheromatous disease of the aorta and affections of the liver and lungs must make us more cautious in recommending the course now specified.

"We should advise the use of such a regimen as will tend to nourish without increasing the bulk of the system, and especially the growth of fat. The patient may use fresh meat of any kind freely, but should avoid taking an overquantity at any particular meal. He should abstain from all articles of food which are oleaginous, and probably also the white meat. He must be forbidden the use of soup or of much milk, and should partake of vegetables sparingly. His use of fluids should also be as sparing as possible. The best drink would be water, with or without a little brandy or wine; but soda water or any alkaline drinks must be inhibited, and he should accustom himself to the daily use of the cold shower bath, followed by strong friction over the whole body.

"We can do little in this disease by mere medicines; but great attention should be paid to preserve a free state of the bowels, etc., etc."

In addition to this unquestioned correctness of principle, this method permits the patient to be out of doors, and, if the treatment be carried out in a properly chosen resort, he may derive the benefits accruing from charming surroundings.

The disadvantages are, however, of a rather serious nature. All of the work is done by a comparatively small number of muscle groups, instead of being distributed equally over the entire skeletal musculature. It is much more difficult to correctly estimate the amount of work that the patient is actually performing, and hence it is exceedingly difficult to avoid overexertion. It has happened to the writer, on several occasions, that, in spite of strict personal supervision, rather serious overexertion has occurred, which, of course, nullified much of the good which had been accomplished. For these reasons there is a growing agreement among writers on the subject that, in all cases where cardiac insufficiency has developed to anything beyond the very slightest degrees, the "Terrain

Cure" brings with it risks incommensurate with the good to be obtained from its employment. Suitable cases are generally to be found among obese patients under middle age.

Indications and Contraindications.—With these facts in mind, we may consider that the principal indication for the application of the "Terrain Cure" is to be found in young patients suffering from obesity, in whom the skeletal musculature is weak, and in whom the heart strength is disproportionate to the body weight. In such patients, before the beginnings of cardiac insufficiency set in, this treatment is the method par excellence to be employed. Under these circumstances the climbing not only is of aid in strengthening the heart, but in strengthening the skeletal musculature and reducing the obesity as well.

Equally useful is the Terrain Cure as an after-treatment for patients who have passed through debilitating diseases of an acute or subacute nature, and in whom the indication to strengthen the heart muscle exists. The same thing may be said of patients who have had conditions of cardiac insufficiency and have overcome them by means of rest in bed, digitalis, CO_2 baths, etc. In these cases, when a fair measure of cardiac strength has been restored, the Terrain Cure finds a useful application.

Technique.—As a result of the general popularity of Oertel's Terrain Cure, the roads in a considerable number of resorts have been laid out according to the plans suggested by Oertel. These roads are divided into sections designated by signs, each section representing the distance to be covered in fifteen minutes. In addition, the various roads are classified according to the steepness of their grades into four classes:

Class 1. Approximately horizontal paths with occasional rises up to five degrees (a rise of 9 feet in 100).

Class 2. Paths with slight rise up to 10 degrees (18 feet rise in 100).

Class 3. Paths with steeper rises up to 15 degrees (27 feet in 100).

Class 4. Very steep paths with a rise up to 20 degrees (36 feet rise in 100).

These various grades are designated by different colors, and in most European resorts Terrain cards are to be obtained indicating the meaning of these different signs. The great majority of heart cases should not be subjected to a steeper grade than No. 2, rarely number 3. Grade number 4 represents really pretty steep climbing, which taxes somewhat the average normal individual. One of the very regrettable features of the widespread knowledge of this "cure," especially in Germany, is the fact that a large number of patients with heart disease go to the various resorts, and, guided by the cards everywhere obtainable, undertake these climbing exercises with no medical supervision. It need hardly be stated that infinitely more harm than good must come from any procedure carried out in this way.

The Herz System.—Herz' system is in reality a combination of numerous other methods worked over into a homogeneous, progressive, and carefully thought out method. Herz distinguishes five fundamentally different classes of movements.

Passive Movements.—A movement may be regarded as passive when the part to be exercised is yielded, with no muscular resistance, to the force impressed upon it by a second person. As a matter of fact, an absolutely passive movement is, in practice, almost an impossibility, since more or less active movements are exceedingly apt to be made involuntarily, especially in the effort to fix the trunk. The simplest passive movements are flexions and extensions at the wrist joint, rotations of the wrist, pronation and supination of the hand, flexion and extension at the elbow joint, flexion, extension, and circumduction at the ankle joint, flexion and extension at the knee joint. To these may be added in some cases flexion, extension, abduction, adduction, and circumduction at the hip joint.

Inertia Movements (*Pendulum*).—These may be defined as strictly rhythmical movements, without any external resistance of consequence, but which are regulated by a pendulum-like weight. The salient feature of the inertia movements lies in the fact that, when they have once been initiated by the patient, they may be kept up with regularity with practically no further effort. In other words, the patient initiates a movement which then becomes almost completely automatic, for it requires little or no attention, and in this point is the exact antithesis of the self-resistive movements. The former are influenced but very little by stimuli from the cortical centers, whereas the self-resistive movements demand the maximum of concentration and are disturbed by anything which diverts the patient's attention, such as engaging him in conversation.

Herz describes two forms of these movements, those which are carried out in the manner of a pendulum, and those which are carried out in circles. In circulatory diseases associated with cardiac insufficiency these movements are of great utility, especially the rolling motions, by means of which the contents of the veins of the extremities are assisted in their centripetal flow. The frequent repetition of these may actually assist the circulation. These movements are especially applicable in circulatory conditions, because their rhythmic character, whether of swinging, rocking, turning, or circling, makes it possible for the patient to carry out a considerable number of the movements with little or no danger of overexertion. Herz lays especial stress upon the fact that flexions and extensions of the joint carried out in this manner (i. e., with a pendulum-like weight) produce a distinctly quieting effect upon the nervous system as well as upon the circulation. He regards the fact that the excitability is diminished as an important attribute of this entire group of movements. This diminution of excitability is most pronounced

in respect to the peripheral circulation, and by means of these rhythmic, automatic movements the marked and labile reaction of the peripheral vessels toward stimuli of various kinds is diminished.

By the employment of the various forms of machines introduced by Herz a large number of these movements may be carried out, but, as they are in general inaccessible to American physicians, they will not be described here. Full details are given in Herz' work. A number of these may be easily carried out with such apparatus only as may be constructed very cheaply and simply. In a pamphlet on the subject of the "Home Treatment of Cardiac Diseases" Herz gives illustrative diagrams, which are here reproduced, and which show the method of application of this principle to some of the simpler movements.

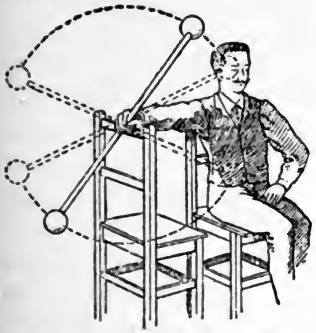


FIG. 20.—ROTATION OF THE HAND AND ARM.

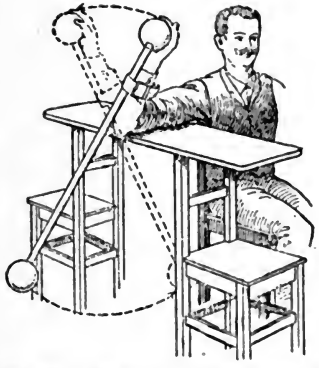


FIG. 21.—FLEXION AND EXTENSION AT THE ELBOW JOINT.

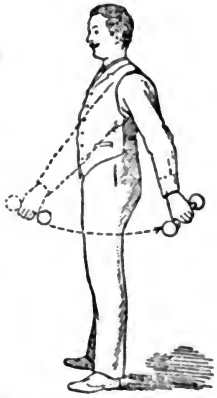


FIG. 22.—SWINGING OF THE ARMS.

These movements occupy an intermediate place between the passive and active movements, that is, they make slightly more demands upon the heart than do the passive movements, but, of course, less than do the active, or the self-resistive, movements. The apparatus shown in the illustration consists merely of a simple stiff wooden rod about 75 cm. in length, on the ends of which are fastened firmly two wooden balls of from 12 to 20 cm. in diameter. A croquet ball answers fairly well. The rod is supplied with straps by means of which the apparatus is fastened to the arm in the manner illustrated in the diagram. For the arm-swinging movements a simple dumbbell answers every purpose. A stirrup iron forms a convenient means of fastening the weight to the feet. Care should be taken in the leg-swinging exercises to have the body properly supported. In this respect Herz' diagrams are faulty. A useful piece of apparatus, which, in one form or another, is to be found occasionally already installed, is a stationary bicycle. In order to make this applicable for this kind of movement all that is necessary is to provide it with a fly-wheel of moderate weight.

It must not be lost sight of that walking on a level surface is, in reality, a movement of this sort. It is practically a pendulum motion or, at most, a pendulum motion with slight weight. The act of walking is practically automatic, demanding no attention. Properly executed it is rhythmic, the pendulum-bob being represented by the weight of the body alternately

FIG. 23.—ROTATION OF THE UPPER ARM.

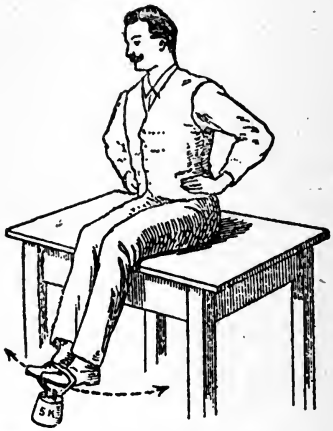


FIG. 24.—FLEXION AND EXTENSION AT THE KNEE JOINTS.

placed in front of and back of the point of support. The duration of these movements should be in most cases from one half to two minutes, seldom over three minutes for each movement.

These two classes of movements, the passive and the inertia movements, make such slight demands upon the heart that they may be used in almost every case for which gymnastics of any kind are suitable.

SELF-RESISTIVE MOVEMENTS.—These may be defined as movements which are carried out with the most intense mental concentration possible, with a rapidity much less than would be employed in carrying out the movements under normal circumstances, and with either no resistance at all or an insignificant one. These movements form an integral part of the Schott system of gymnastics. Herz has, however, carried them to a much greater degree of perfection. The principles upon which the efficacy of these movements depends are the following: If one carries out a movement with an ordinary degree of rapidity he is constantly orientated as to the position, etc., of the limb by means of the sensory impressions from the periphery; or, more specifically stated, from the sensory impressions which arise from the moving joint surfaces and from the muscles which are called into action. In the case of the self-resistive movements, because of the very great slowness with which these are executed, these sensory impressions are lacking or, at least, are present in such a way as to be of no utility for the correct execution of the movement. The maxi-

mum concentration of attention must be given to the effort in order that it may be carried out slowly without halts or unsought for increase in rapidity, and to prevent the development of atactic subsidiary movements. What the patient actually does is to contract the muscles necessary to carry out the movement, and at the same time to voluntarily contract the antagonists in a slightly less degree, so that, as an end result, the movement is carried out with great slowness and evenness. It soon becomes very evident that a considerable degree of weariness ensues after these have been carried out for a short while, which is, of course, due to the intense mental concentration.

Emphasis should be laid upon choosing, for the self-resistive exercises, such movements as the patient is accustomed to carry out in everyday life, whereas, in the inertia movements, rhythmicity is the guiding principle. In a majority of people the movements are carried out more easily and exactly with the right side of the body; hence, for the purposes of self-resistive movements, right-sided exercises are preferable. The self-resistive movements produce an increase in blood pressure and, in many instances, a slowing of the pulse rate. There can be no doubt but that there is an increased work thrown upon the heart, albeit this is of no great moment. If desired a very slight resistance may be made to the movements by a second person, the intention being rather to regulate the speed at which they are carried out than to convert them into actively resisted movements.

The more important movements which are suitable for carrying out the principle of self-resistance are:

1. Flexion of the wrist joint.
2. Extension of the wrist joint.
3. Forearm pronation.
4. Forearm supination.
5. Forearm flexion.
6. Forearm extension.
7. Upper arm raising and lowering.
8. Circumduction of the arms.
9. Flexion and extension at the hip joint.
10. Flexion and extension at the knee joint.

These exercises are, of course, to be graduated, in the same manner as all gymnastic movements, by beginning with one or two and gradually increasing their number and frequency. While machines may be used in carrying out these movements they are quite unnecessary, and hence we prefer to follow the suggestion, originally made by Schott, that they be carried out with no other resistance than that of the opposing muscle groups (so-called "free" movements).

Remembering the very considerable degree of fatigue produced by these movements, it is well to interpolate rather longer periods of rest between them than is usually the case. Each of the series mentioned should be done not more than two or three times, or, if no resistance be used, the maximum may be five times. Herz recommends following each group of self-resistive movements by a number of inertia movements.

Resisted Inertia Movements.—These differ from the inertia movements proper only in that the automatic pendulum action is made slightly more difficult by the application of a light resistance. This group of movements forms a natural bridge between the self-resistive movements, on the one hand, and the actively resisted movements, on the other.

Actively Resisted Movements.—An actively resisted movement is defined by Herz as a primary isodynamic muscular action carried out against an external resistance, which latter varies according to physiological principles, and which may be accurately regulated as to its strength. The most important consideration in these movements is that the amount of resistance shall be accurately proportioned to the strength of the muscular contraction at any given moment. In other words, the movement should be made isodynamically. Numerous forms of apparatus have been devised, by means of which a measured amount of resistance may be made to each particular movement. Those of Herz are exceedingly ingenious and apparently admit of a very accurate graduation of the resistance. A trained gymnast is, however, infinitely preferable, and any intelligent individual may be taught to carry out these movements successfully, if not skillfully. It is self-evident that *their primary aim is to give the heart a certain amount of extra work to do,* in contrast with the self-resistive movements, where the work given the heart is, so to speak, accidental and not a purpose of the movement. The resisted movements make distinctly greater demands upon the heart than the previously described exercises, hence it is all-important that the physician should be very sure that the heart is capable of compassing the extra work thus thrown upon it. These movements should never be pushed to the point of even commencing dyspnea, for this is invariably the indication that the exercise has been injudiciously applied. As was remarked apropos of the Schott movements, the good judgment and careful discrimination of the physician in charge are of infinitely greater importance than the precise movement employed. A number of the simplest movements are shown in the following illustrations.[1] In all cases the opposite movement is made by reversing the position of the operator's hands.

Attention is again called to the great importance of the resistances being directly proportional to the strength of the muscular contraction at

[1] My acknowledgments are due to Mr. Hugo Ad. Oldenborg for his kindness in posing this series of illustrations.—C. S. W.

FIG. 25.—FLEXION AT WRIST JOINT.

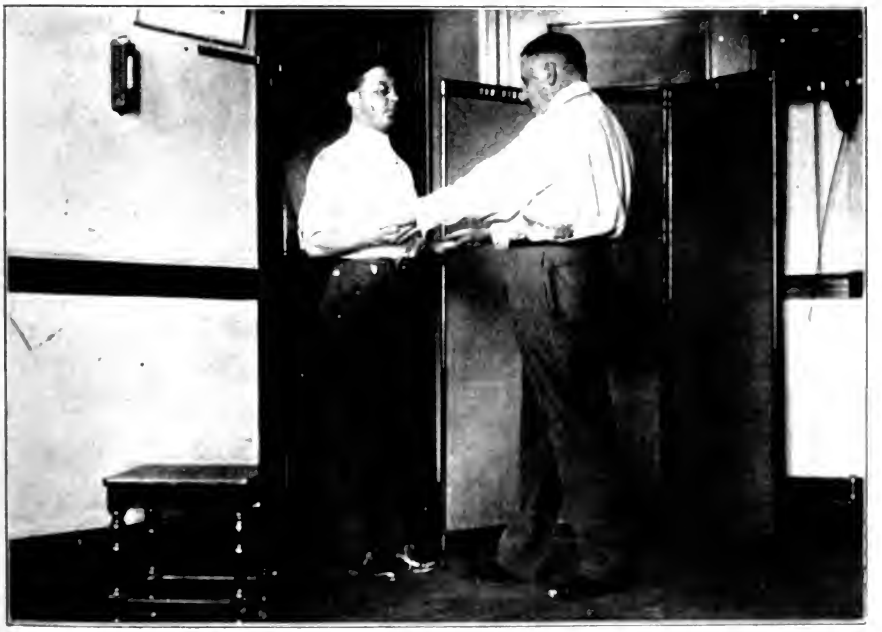


FIG. 26.—FLEXION OF ELBOW JOINT.

FIG. 27.—RAISING OF ARMS.

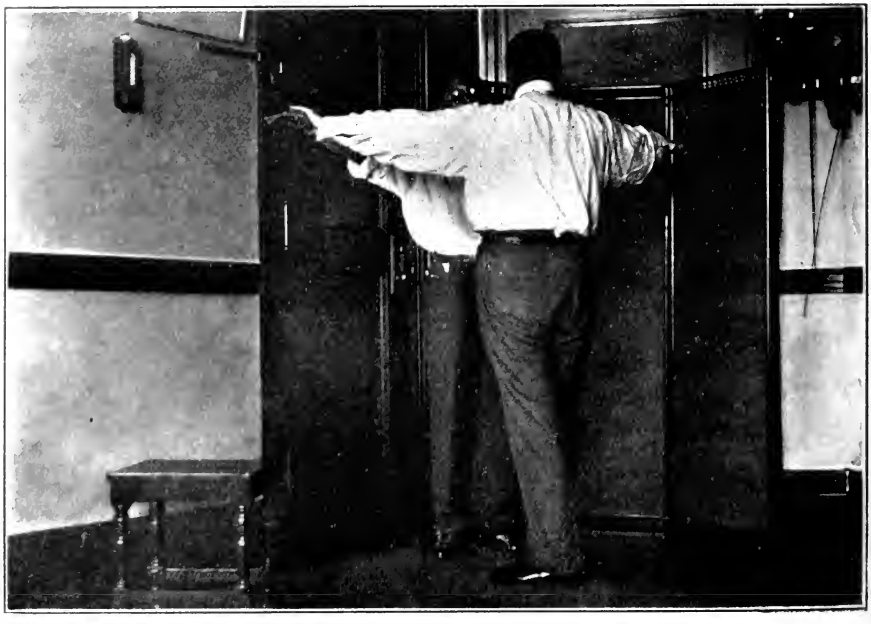


FIG. 28.—ABDUCTION OF ARMS IN PLANE OF THE SHOULDERS.

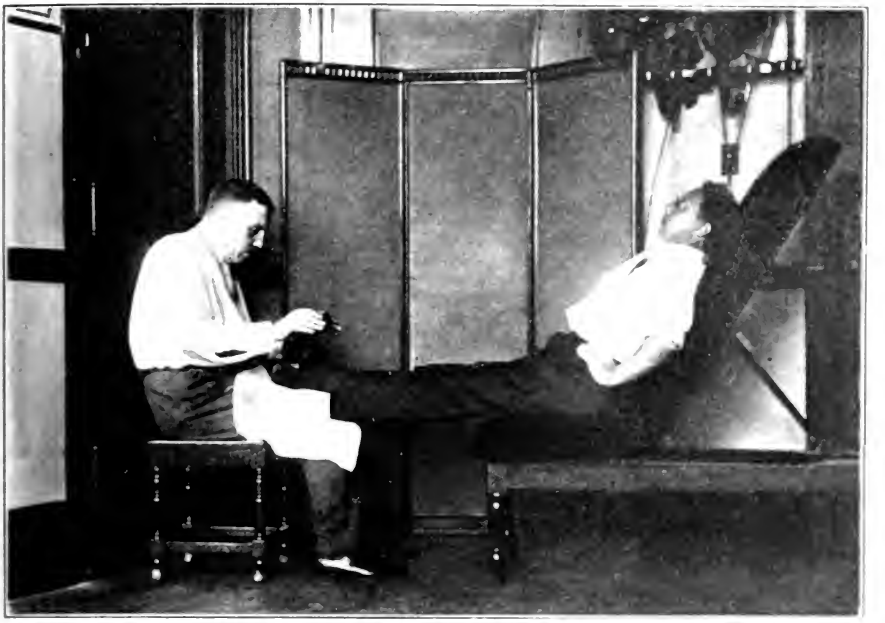


FIG. 29.—PLANTAR FLEXION AT ANKLE JOINTS.

FIG. 30.—EXTENSION OF KNEE JOINT.

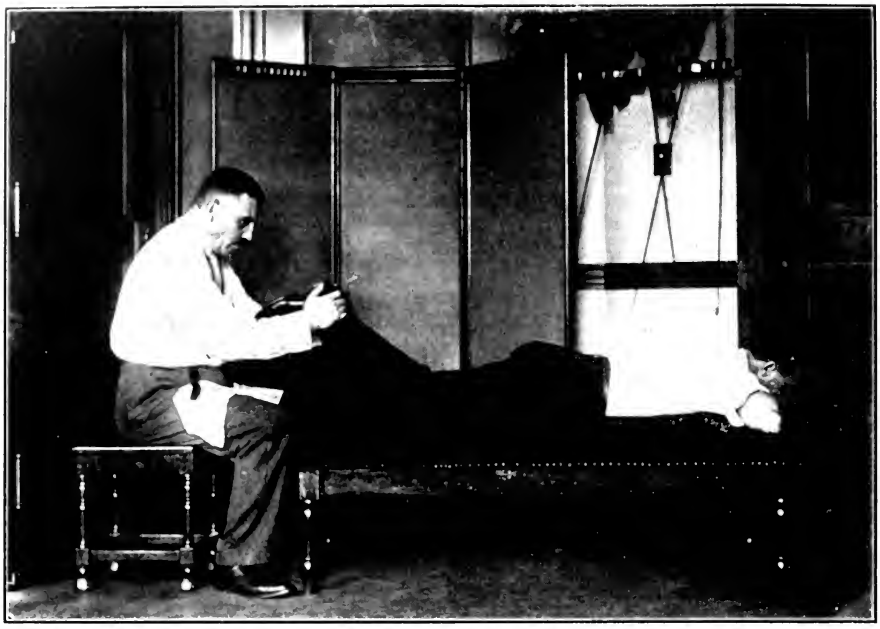


FIG. 31.—FLEXION OF KNEE-JOINTS.

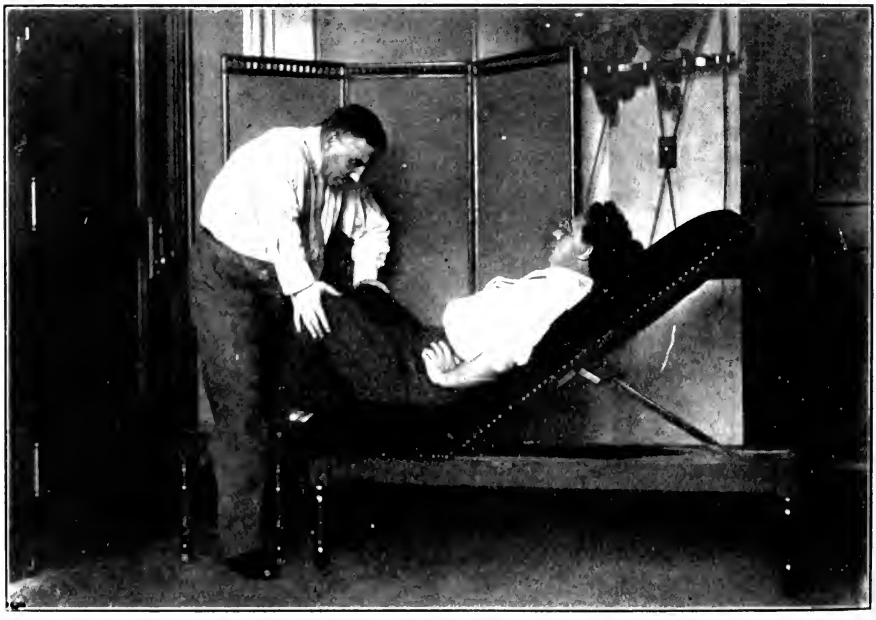


FIG. 32.—ABDUCTION AT THE HIP-JOINTS.

FIG. 33.—FLEXION AT HIP-JOINTS. Patient exhales as the thighs come up.

FIG. 34.—FORCED EXTENSION AT HIP-JOINT, THE PATIENT RESISTING.

FIG. 35.—RAISING OF BACK FROM THE STOOPING POSITION.

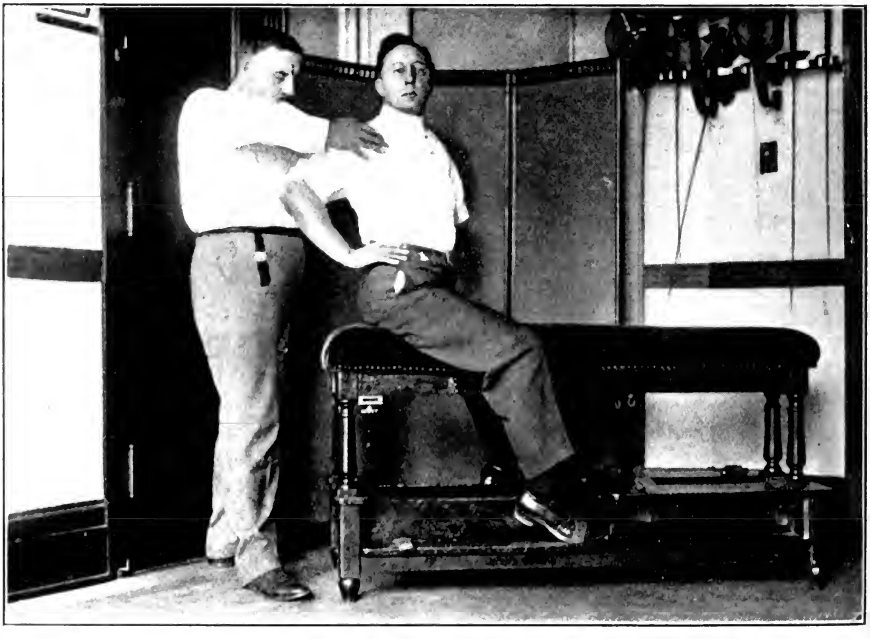


FIG. 36.—ROTATION OF TRUNK. Hips fixed by the stride-sitting position.

any given moment. It is probable that this can be done after a moderate degree of practice with greater accuracy manually than by means of a machine.

Respiratory Gymnastics.—Respiratory exercises have been recommended by a considerable number of authors, and the simpler breathing exercises deserve, as a matter of fact, a more important place in the gymnastic armamentarium than they have hitherto received. They have a very decided advantage in that they may be applied at a time when sitting up or walking is impossible for the patient. Indeed, they may be most advantageously applied while the patient is still in bed, the more so as

FIG. 37.—ROTATION OF TRUNK. Hips Fixed by Operator's Knees.

they make very small demands upon the heart strength. It is a matter of general knowledge that the excursions of the diaphragm produce a lowering of pressure within the thoracic cavity, and hence are of material assistance in favoring the flow of venous blood. The respiratory movements aid, therefore, during inspiration, the diastolic filling of the heart and, during expiration, the systolic emptying of the ventricles. Furthermore, inspiration assists because of the increased volume of the lungs the outflow of blood from the right heart into the latter. While inspiration, theoretically, retards the flow from the left ventricle this is probably a factor of small moment when we take into consideration the great strength of the latter.

These respiratory influences are of relatively subordinate value to the normal individual. On the other hand, they attain a position of such importance under pathological conditions that Herz very justly regards a powerful acting diaphragm as a sort of accessory heart.

These exercises are best carried out by beginning with as deep an inspiration as possible and expiring forcibly in a staccato fashion, that is, in two periods, the latter of which is especially vigorous. An old, but a good, plan is by means of compression with the hands on the lower part of the thorax to assist in the movement of expiration. That is, as deep an inspiration as possible is taken, with the hands resting lightly on the sides of the thorax. The expiration then follows in two forcible efforts with a pause between, and simultaneously with each expiratory effort pressure is made upon the thorax by the hand. This pressure on the thorax may, of course, be made equally well, and in severe cases would better be made, by a second person. Rumpf recommends doing this hourly, later every half or even every quarter of an hour, making but a few deep respirations at a time. He begins with these, increasing gradually in number and frequency, and then, when all evidences of stasis have disappeared, he proceeds to other forms of gymnastics.

Forced Breathing (*Herz*).—This consists of a very long inspiration followed by an expiration, during which the glottis is partially closed, so that a stronger effort on the part of the expiratory muscles is required to force out the air. Herz considers that the blood in the pulmonary vessels is, by means of this forced breathing, pressed out of the lungs into the left heart. For this reason he recommends this procedure in stenosis of the mitral orifice. The correctness of this assumption has not been proven, and, indeed, the entire subject of respiratory gymnastics, except in relation to the simple exercises above mentioned, is in such a chaotic state that we may agree, in general, with Sittmann's dictum that "it is advisable to refrain from making any attempt toward influencing the breathing for therapeutic purposes," at least, as regards forced breathing.

Vibration.—Numerous observers have reported excellent results by means of vibrations of the thorax according to the Zunder method, and by various manipulations of the back in the form of short chopping strokes (tapotement) on the muscles. Despite a fairly general agreement that diminutions in the pulse rate and increase in the blood pressure may be brought about by such manipulations, these have failed to receive a sufficient experimental foundation to make it possible to lay down even approximately accurate indications for their employment. In view, therefore, of the chaotic state of our knowledge, or rather of our lack of knowledge in regard to these vibratory methods, their employment can hardly be recommended.

Choice of Exercises.—It will be clearly evident from the description of the various systems of gymnastics which has preceded that it is quite

impossible to lay down hard and fast rules as to precisely what exercises should be used in a given case. Because of this, however, it is important to bear in mind the following general principles which should govern the application of all gymnastic exercises:

1. Gymnastics of any sort should not be employed until the patient has been under observation for a certain time to enable the physician to obtain an accurate estimate of the condition of the heart in respect to its sufficiency or insufficiency.

2. If the degree of cardiac insufficiency be severe, so that rest in bed and digitalis are being prescribed, and especially if considerable degrees of edema or effusions in the body cavities are present, it is wisest to refrain from gymnastics of all sorts. While the analysis of the action of passive movements shows clearly that they have no direct action on the heart itself, but on the contrary exert a distinctly favorable effect upon the distribution of blood and lymph in the peripheral parts of the body, yet the danger of going just a little too far, and thereby throwing additional work upon the heart, is so great that the writer has never felt justified in prescribing them as a routine in these severe cases. If, on the other hand, under the influence of digitalis, rest, etc., the condition begins to mend somewhat, the edema and dyspnea lessening, the effusions becoming smaller, indicating in this manner that the reserve power of the heart is still sufficient to become master of the situation, then, under these circumstances, the passive movements, as carried out by Herz, are eminently appropriate. They may be carried out, at first, only one or two at a time, with the patient still in a recumbent position, in which position they are, of course, less apt to produce undesired effects than if the patient be made to sit up. For some years the writer has made it a routine practice to make use of some such exercises before the patient is allowed to get up.

3. A properly conservative plan of treatment will impose no further gymnastics upon the patient until he has been up for several days. In the management of heart cases it is frequently not taken into sufficient account how great a strain, in reality, it is to hold the body erect in a sitting or standing position. Now is the proper time to begin with inertia movements. These having been carried out for a period of time, varying according to the severity of the case, the patient may be regarded as sufficiently prepared to take up the self-resistive movements. An absolutely necessary condition for each additional exercise is that the previous exercise shall have been accomplished with absolutely no untoward symptoms and that the patient shall feel refreshed after them.

4. Walking may be permitted by the time the patient has shown that his heart is capable of responding to the inertia movements. As Herz has shown, walking itself is, in reality, largely an inertia movement as long as it is carried out on a horizontal plane.

5. Following the self-resistive movements, during which inertia move-

ments should be continued, we may proceed to the application of the inertia movements with graduated resistance. These progressing satisfactorily, the ordinary resistive movements may be begun, care being taken to carry them out isodynamically.

6. Herz suggests that at each séance those exercises which are most difficult of execution should be undertaken first, and then, after appropriate intervals of rest, the less active movements, especially the inertia movements, should follow. Indeed, the inertia movements may be given directly following more active movements, with a subsequent pause.

7. Further refinement of gymnastics, in the sense that certain ones are especially appropriate in, for example, a given valvular lesion, is highly undesirable and practically impossible since, in most instances, several factors are at work in producing the cardiac insufficiency.

8. It cannot be too often repeated that the all-important part in gymnastic therapy depends not so much upon the individual movements, as in their adaptation to the particular degree of cardiac insufficiency present, i. e., to the dosage. Only by pursuing this strictly individualized method will we be enabled to heed the old admonition, primum non nocere.

Resumption of Vocation.—A very important consideration, especially among the working classes, is as to the time when the patient may resume his vocation. This assumes, of course, that the patient has recovered, or is in a fair way to recover, such a measure of cardiac reserve power as will enable him to resume it at all. In hospital practice, especially, it must be evident to every observer that this question is given by far too little consideration. The patient who is able to be up and about the ward, and perhaps climb a few steps without distress, is only too often allowed to leave the hospital with no further admonition than to "take things easy for a while." The patient, wholly ignorant of the physiology of his circulation, is only too apt to receive the impression that, his symptoms having subsided, he is as good as new, and hence he sees no reason why he should not jump into the midst of what is, perhaps, an exceedingly strenuous occupation. If the physician is to do his full duty to his patient this must form a very important part of his advice and treatment, and one which is only too often omitted altogether.

It is perfectly obvious that no rule can be laid down in this connection which has more than a general bearing on the matter. It is also perfectly obvious that it is a matter of a great deal of importance as to whether the occupation which the patient wishes to resume is that involving, let us say, clerical or office work only, with duties which are, perhaps, semimechanical; or whether, on the other hand, the resumption of the former occupation brings with it a considerable degree of physical exertion or, perhaps, even this, coupled with severe mental strain, as is only too often the case with professional men. Nothing, perhaps, in the entire domain of prognosis will tax the physician's powers of judgment to a greater ex-

tent than the weighing of the pros and cons as to just how much may be attempted by the patient, and to what extent his occupation must be modified. In the majority of instances the man who has a clerk's work to do has a clerk's heart to do it with, that is, a myocardium which has not been developed by muscular effort. The possibilities for strengthening the myocardium of such a patient are, therefore, considerable. On the other hand, the blacksmith has a blacksmith's heart, in which the myocardium has already presumably hypertrophied to its limit, so that little or nothing more in the way of compensatory hypertrophy may be expected from him. His occupation must be modified in such a way that he shall habitually place less strain upon his heart. The clerk may, with proper preparation, be permitted to resume his work, and sometimes with the lapse of time a somewhat more active life may prove beneficial.

It must not be lost sight of, however, that if the blacksmith be directed to lead a wholly inactive life his myocardium rapidly becomes weaker, and instead of such admonition proving useful to him it may, indeed often does, work distinct harm. Probably no one has carried out this idea more carefully than da Costa during the War of the Rebellion, and his admonitions and practice are as sound to-day as they were then. It is the imperative duty of the physician, from the time the patient is up and able to be about, to so graduate the work which he is permitted or required to do that there shall be a slowly and steadily progressive increase in the strain placed upon the heart. There must be no sudden increase of strain, as these bring with them imminent danger of heart failure. The patient may be allowed, when the physician deems the cardiac reserve power sufficient, to resume his work for at first an hour or two daily, increasing by degrees only so long as no untoward symptoms supervene. At no time in the history of a cardiovascular case are accurate observation and supervision by the physician of more importance for the ultimate welfare of the patient than during this stage of his disease. It may not be superfluous to suggest that, with an intelligent patient, at least, a perfectly frank exposition of the subject as it relates to his particular case is eminently desirable.

Sleep

It might seem almost superfluous to state that there is no degree of cardiac insufficiency, from the lightest to the gravest, in which abundant sleep is not an important therapeutic measure. Not only this, but, what is equally important, abundant sleep is one of the most important prophylactic measures, in a perfectly compensated heart, to guard against the development of insufficiency. The reasons for this are sufficiently evident. Every act which we perform during our waking hours requires an expenditure of a certain amount of energy, which involves, in the same

proportion, an increase of the heart's work. Whether it be sitting up, standing, walking, talking, eating, reading, nay, even thinking—every one of these and the thousand and one other activities of ordinary life all consume energy, and all of these are absent during sleep. The body is horizontal, hence the hydraulic conditions under which the heart operates are the best possible; the heart's work is reduced to the very lowest conceivable minimum. Regarded in this light it is literally correct to look upon every additional hour of sleep as the best prophylactic or therapeutic measure. It is not only that "which knits up the raveled sleeve of care," but that which performs a still greater service in *putting the heart as nearly as possible in a state of physiological rest.* The patient whose heart is in fairly good compensation should have eight, and preferably nine, hours' sleep. Much can be accomplished by the cultivation of the habit of sleep, and even in elderly people, who are often proverbially bad sleepers, complete repose, if not actual sleep, for eight or nine hours is of the greatest assistance.

During the milder attacks of cardiac insufficiency this becomes even more imperatively necessary. If the general discomfort of the patient, his nervous apprehension and general restlessness preclude a satisfactory amount of sleep, no time should be lost in securing this for him by proper therapeutic measures. In the mildest cases a cup of hot fluid with a cracker and the addition of a small dose of veronal are frequently productive of admirable results. A warm sponge bath of four or five minutes' duration, if not otherwise contraindicated, aids materially. In cases where the sleeplessness is due more to general restlessness moderate doses of bromids are generally productive of good results. In the severer cases of cardiac insufficiency these measures will probably fail, and recourse must be had to codeia, or even morphia. The latter drug is insufficiently appreciated under these conditions, and to a patient whose thoughts are haunted with terror at the prospect of a sleepless night, with a struggle for breath, morphin is indeed a *magnum donum Dei.* The good to be derived from half a dozen hours of quiet sleep under these circumstances many times outweighs the disadvantages of its administration. The more acute the condition is, and the shorter its prospective duration, the more freely can morphin be used.

Especial care must be taken in cardiac patients to avoid such hypnotics as tend, in effective doses, to produce a greater or less degree of collapse. For this reason chloralamid, trional, and sulphonal are better avoided.

In conditions of great excitation, in which the use of bromids fails to give prompt relief, the hydrobromate of hyoscin, hypodermically, in doses of gr. 1-300 (0.0002 gm.) usually acts sufficiently.

Travel

With patients in the better situated classes of society, and with the ever-increasing number of men whose business requires them to travel extensively, this becomes an important question.

In regard to travel undertaken for pleasure the guiding principle should be that the patient is to be *sent away only when in satisfactory condition,* and when he will presumably improve still more. Only too often the physician yields to the entreaties of the patient's family, or mayhap the patient himself, to be permitted to undertake a trip to some resort when his condition is not improving or, perhaps, growing worse. This desire should not be acceded to. Many patients with cardiac disease have the feeling, which is only too common with patients with other ailments, that somewhere, if they only go far enough, must be found the ideal place for their treatment. These patients go to make up the great class who object strenuously to carrying out relatively simple measures at home, but would be perfectly willing to cross the ocean to Nauheim or Timbuctoo if so ordered.

On the other hand, a patient whose means and tastes permit him to travel with comfort and pleasure, especially if he be of an introspective turn of mind, may be greatly benefited by a sojourn at some suitable resort. In this country the winter resorts on the south Atlantic and Gulf coast, or in southern California, are admirably adapted to this purpose. In the warm weather the resorts of Michigan and northern Wisconsin or along the St. Lawrence River are equally suitable. The mountains should be avoided, excepting such places as do not exceed a thousand or twelve hundred feet in altitude. Above all, care should be taken to seek places which are reasonably sheltered, and where the charm of the surroundings, the opportunities for harmless recreation and agreeable, yet not taxing, social conditions relieve the patient of his cares and worries.

A modifying condition, especially in this country of magnificent distances, is that of the length of railroad journey necessary to reach the place in question. While, with the increasing comfort and even luxury of American travel, a patient can take relatively long journeys with less exertion than in some of the European countries, where the traveler is subjected to innumerable petty annoyances, yet the fact remains that long railway journeys, even under the most ideal conditions, are very undesirable. The fatigue of such a journey may be considerably lessened by the patient remaining recumbent in bed during its progress or, if this be impossible, by stopping over at night. Many patients, as well as many normal people, find much difficulty in sleeping on trains, and for them it is strongly advisable to interrupt the journey early in the evening, thus securing a good night's rest and proceeding with the journey the following day.

In many cases the physician is called upon to decide the question as to whether a patient with cardiac disease may take a trip to some resort, but in many others the patient feels himself perfectly competent to settle this matter for himself, and then the physician learns of it simply as an accomplished fact. The principle on which a judgment should be based in this matter, if the physician should be consulted, has already been stated—the patient may be permitted to go away when he is doing satisfactorily, and when, presumably, he will improve still more. A change of scene and environment is especially useful for patients who have had relatively slight degrees of cardiac insufficiency and who have recovered sufficiently to be permitted to take part in the milder activities of some quiet resort. Many of these patients, of a neurasthenic temperament, do themselves much harm by too great a degree of introspection, and a change of scene, meeting new people, a change of diet and air will often work wonders in "taking them out of themselves." No class of patients are more apt to develop neurasthenia on the basis of a real pathological condition than are patients with heart disease, hence every effort should be made to prevent this by suitable occupation and diversion.

Motoring.—Closely related to the question of travel and recreation comes that of motoring. With the almost inconceivable increase in the use of the automobile as a means of recreation the physician is often called upon to decide to what extent a patient with heart disease may indulge in motoring. The guiding principle is precisely the same as in railroad travel. Patients with even the slightest degrees of cardiac insufficiency should be prohibited from motoring in any form, excepting a very quiet ride through a park on a perfectly smooth road. There are two elements which enter into the question of motoring, entirely aside from the physical exertion involved in driving the machine. One of these is the incessant jolting which, under the ordinary conditions of travel, is quite marked; the other is the nervous tension involved which, of course, is directly proportional to the speed, the amount of traffic, the difficulties of the road, and the familiarity of the patient with this pastime. Both of these factors are insufficiently appreciated in their effects upon patients. The writer has more than once known physicians to permit, indeed, even advise, patients recovering from considerable degrees of cardiac insufficiency to take rides of forty or fifty miles and more at a fairly high rate of speed for the purpose of "taking the air," and invariably the results have been anything but beneficial. Motoring at high speed becomes with many a passion, to be followed at whatever cost to nerves and body. A quiet stroll, or a slow drive behind a placid horse, would accomplish the wished-for purpose, that of being out in the fresh air with a very slight degree of exertion.

It may be said, then, that in patients with heart lesions which are perfectly compensated the utmost discretion must be used as to whether the

use of an automobile may be permitted at all. The intelligence of the patient, the territory in which he drives his machine, and his willingness to pursue his pastime with great moderation, in addition to the condition of his heart, should be the guiding factors for the medical attendant.

Venesection

Probably no single therapeutic procedure in the entire domain of medicine has been more widely practiced or can boast of a greater antiquity than venesection. Its beginning dates back to remote antiquity and one hundred years ago had reached such a height that it was said of one of its disciples that he had shed more blood than the French Revolution. It lay in the nature of things that a reaction against a practice carried to such extremes should set in. This countermovement was initiated largely through the Viennese school and reached its height about the middle and latter part of the nineteenth century. Jürgensen, writing in 1880 in a monograph on the subject, says: "I, myself, have never undertaken venesection of my own accord for therapeutic purposes." Since Jürgensen wrote these lines it seems as if our ideas in regard to venesection were changing again. Few experienced clinicians at the present time could make the statement which Jürgensen made thirty years ago. It would seem that the present tendency is to accord venesection a very distinct place among our therapeutic resources, but one which is applicable in a relatively small number of cases.

Physiological Action of Venesection.—It would seem that in so simple a procedure the physiological action and the influence upon pathological conditions could be determined with the greatest ease. Such has, nevertheless, not been the case. The immediate result of venesection, which affects both the liquid and cellular elements in like proportion, is, so far as the blood itself is concerned, manifested in the amount and not in the composition. A blood count immediately afterward may show normal hemoglobin value and a normal number of corpuscles. A diminution in both hemoglobin and the erythrocytes occurs very soon, but does not reach its low point for several days, rarely before forty-eight hours, and sometimes as late as ten days. It is probable that two processes are at work here. The first of these is purely mechanical and depends upon the rapid absorption by the capillaries of fluid from the tissues so that the blood rapidly becomes greatly diluted. This transfer of fluid begins very quickly, and it is highly probable that within a few hours after the removal of the blood the original total volume has been again reached. The farther reduction in hemoglobin and red corpuscles is more difficult of explanation, but depends probably upon the entrance into the blood of numerous immature red corpuscles, having feeble resisting powers, and which, therefore, undergo rapid destruction. Later on, when the bone

marrow becomes able to produce red corpuscles having greater resistance, the blood count commences to rise.

It has been determined by Lyon that, after small losses of blood, the number of corpuscles reaches the normal again in from two to five days. In hemorrhages which amount to from one to three per cent. of the body weight (which he reckons as hemorrhages of medium size) he found the period of regeneration to lie between five and fourteen days. Large hemorrhages, amounting to about four per cent. of the estimated total volume of blood, require from fourteen to thirty days for complete recovery. The following curve, taken from Buntzen, illustrates the effect of a venesection on a healthy dog:

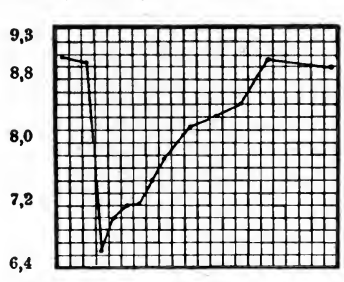


FIG. 38.—VENESECTION (DOG). AMOUNT ABSTRACTED, 31 PER CENT. OF THE PRESUMABLE TOTAL AMOUNT. The vertical lines represent the number of dogs after the venesection. Gumprecht (after Buntzen).

The main interest in connection with diseases of the cardiovascular apparatus centers in the effects of venesection upon the circulation. The relief which is afforded to an overdistended right auricle by means of venesection has been frequently noted in animal experimentation. The viscosity of the blood, which Heubner has shown to be largely due to the corpuscles, must of necessity be diminished, and hence there is a reduction of blood pressure from this source as well as from the partial emptying of the vascular system. This latter factor, the diminution in volume of the blood, is probably of very temporary duration, since the volume is restored again to the normal within a few hours.

The conditions of absorption must be very different, however, in patients with a high degree of venous stasis, who come properly within the range of venesection, and in normal experimental animals. It is conceivable that under these pathological conditions reabsorption of fluid might go on at a very much slower rate.

A number of authors consider that the fall in blood pressure is too small to be of moment, or does not exist at all. On the other hand, it seems clear, even without exact experimental evidence, that the venous pressure must be considerably lowered, and hence the difference in pressure between arteries and veins (pressure-head) increased. The one thing which seems perfectly clear is that the main effect of venesection,

from the standpoint of the circulation, consists in an unburdening of an overdistended right auricle.

Indications.—Irrespective of causation venesection is indicated in those conditions of the circulatory apparatus associated with intense dyspnea, cyanosis, and overdistention of the right auricle, as indicated by the increase of cardiac dullness to the right. The more acute the condition is the greater are the probabilities of relief from venesection. In conditions of pulmonary edema, with dissociation of the two ventricles, venesection sometimes works admirably.

Contraindications.—The presence of a severe anemia is, in most cases, an absolute contraindication, and as a general rule venesection should not be performed in patients having less than 70 or 75 per cent. of hemoglobin. Nor should venesections be repeated in close succession. With proper technique the failure of venesection to relieve, at least temporarily, the condition indicates that the case is one unlikely to be benefited by further abstraction of blood. Under all circumstances no attempt should be made to reduce a high arterial blood pressure, if such exist, by means of venesection, but the latter should only be carried just far enough to reduce the venous stasis and the distention of the right heart.

Effects.—Favorable results from venesection are manifested at once. The dyspnea lessens, cyanosis is replaced by pinkish color of the lips and ears, this latter change being the all-important one. When venesection is carried out slowly, as it should be, this change can almost invariably be seen while the blood is yet flowing, and is the signal that sufficient blood has been abstracted. Beyond this point, when clearly and definitely reached, the physician should not go, since the mechanical effects from the relief of distention of the right heart have been obtained, and any further loss of blood quickly results in so much anemia.

Technique.—The classical venesection is performed at the bend of the elbow. After preliminary disinfection by scrubbing with soap, rinsing with warm water, scrubbing with alcohol, followed by a bichlorid solution 1-1,000, a bandage is placed around the upper arm with just sufficient pressure to obstruct completely the flow of blood through the vein without affecting the arterial flow. The vein selected is a matter of indifference, and one generally takes the one which stands out most prominently. The median cephalic is the one generally selected because, when making use of this vein, there is no liability of injury to the brachial artery. The median basilic is equally advantageous, since the danger of injury to the artery is more theoretical than real. The incision may be made in two ways, either with a double pointed lancet, which should be very sharp, pushing the point directly through the skin and opening the vein preferably in a diagonal manner; or a curved bistoury may be used, a short incision made one side of and parallel to the vein, through which the bistoury is slipped underneath the vein and an incision made against the skin, cut-

ting through the vessel about halfway. With proper technique the blood spurts out sometimes under such force as to reach a distance of several feet, and there is usually but little difficulty in obtaining a sufficient quantity of blood. Should the flow cease it may generally be started again by alternately clenching and opening the hand.

Some authors, with the intention of relieving the congestion in the ascending cava, select one of the veins on the dorsum of the foot. This method has little to recommend it. Whatever vessel be selected a number of minor difficulties may be encountered. With either lancet or bistoury there may be some difficulty in incising the vein if the instrument be not very sharp. The remedy is clear. Again, the bandage may be applied with such force as to entirely compress the artery as well as the vein. This is a common error among those who have had but little practice in this procedure. When the flow of blood stops, with no apparent cause, this should be always sought for. Sometimes portions of the subcutaneous fatty tissue may occlude the wound. In this case, when it is pushed to one side, the flow recommences. Thrombosis is very exceptional, and with fairly good technique should be very rare. Quite frequently considerable collections of blood accumulate in the subcutaneous cellular tissue. A simple bandage with firm pressure will cause its absorption very rapidly. Infection should be unheard of, and even in the days prior to asepsis was very rare. Accidental injury of the artery can only occur as a result of absolute lack of knowledge of the anatomical relations, and even then could only be produced by great carelessness. A common event is to have the patient faint at the sight of the blood. This should lead to a cessation of the procedure, but carries with it no danger.

It is quite difficult, even for one who has a thorough command of the technique, to avoid besmirching the patient and himself with blood. The latter has a propensity for running in every direction excepting the one wished for, and it is frequently more or less difficult to estimate the amount of blood withdrawn. To the patient the whole procedure seems a very unsurgical one, and to his untrained eyes the amount of blood withdrawn seems prodigious, and is the real cause for the syncope which so often ensues. For all these reasons the writer, for some years, has ceased to employ venesection, but instead uses the puncture of the vein.

Technique of Vein Puncture.—All that is necessary to carry out the puncture of a vein is an ordinary hollow needle, well sharpened, with a diameter of about 2 mm. (1-12 inch), and a length of 5 or 6 cm. (2 or 2½ inches). After the usual disinfection this short, stubby needle is thrust through the skin and into the lumen of the vein at as acute an angle as possible. The blood comes out in a cleanly defined stream, and may be caught in a suitable receptacle. If desired a short bit of rubber tubing may be slipped over the end of the needle for greater convenience in collecting the blood. If care is taken in the application of the bandage so as

to produce the greatest possible amount of distention of the vein, this is a matter of great simplicity. It has the great advantage of cleanliness and of being a much more workmanlike procedure. In addition to this the patient sees no blood at all (as that in the vessel may be readily kept from his sight), and the danger of syncope from nervous apprehension is practically eliminated. With the short, thick needle used there is much less difficulty in keeping up the flow of blood than with the ordinary incision. Should this difficulty arise a very thin coating of sterile liquid petrolatum might be applied to the lumen. This, however, the writer has never found necessary.

Whichever method is used a small dressing should be applied to the wound for twenty-four hours subsequently. If the vein be punctured the bandage should be taken off before the needle is withdrawn. Frequently a little collodion will answer all the purposes of a dressing.

Amount of Blood Withdrawn.—No general rule can be laid down beyond that already stated, namely, that the flow should be stopped when the cyanotic color gives place to the pink tint of health. If this fails to occur it will seldom be found necessary to remove more than 400-500 c. c. (13.5-17 oz.). Occasionally, with the most extreme degree of distention of the right heart, as much as 1,000 c. c. (34 oz.) may be removed with great benefit. With these larger quantities at least 15 or 20 minutes should be taken in removing the blood.

The amount of blood which may be lost with recovery of the patient depends upon a number of factors. In addition to the age and sex and general vitality of the patient the rapidity of the blood loss is of the greatest importance. The usual statement made is that a loss of fifty per cent. of the total volume of blood results fatally. On the other hand, Hayem states that even after a loss of blood as great as 1-18 of the total body weight of the patient recovery is possible. In support of this statement he has recorded a diminution in the number of red corpuscles as low as 11 per cent. of the normal with the recovery of the patient. Laache has recorded cases where the blood count was less than fifty per cent. of the normal, so that the usual statement does not invariably hold good.

These comparisons are cited to show what great losses of blood patients may endure, and to show how groundless the fear is that by removing ten or twelve ounces of blood untoward results may develop. It has come to the author's observation on a number of occasions that venesection has failed utterly of its purpose because the amount of blood abstracted was insufficient. This is especially likely to be the case where the blood is not accurately measured.

Treatment of General Anasarca and Serous Effusions

The dropsy of cardiac insufficiency, when of high grade, demands treatment addressed especially to it for two reasons. In the first place, a considerable degree of general anasarca causes the patient much discomfort; secondly, if effusions in the body cavities reach a considerable size they interfere materially with respiration and so indirectly with the heart's action. At first the degree of dropsy present is only the very slightest, i. e., that amount of edema of the ankles which is just plainly noticeable at night and disappears in the morning (edema subcutaneum fugax). At the other extreme we find the entire body deformed by the enormous swelling of the legs, abdomen, and subcutaneous tissue. The legs may develop such a degree of swelling that elephantiac conditions set in, and often the skin cracks open, and the fluid exudes slowly of its own accord. So long, however, as the fluid does not collect in the various serous cavities the interference with the respiration is not marked. In most cases soon after the legs become markedly swollen the abdomen shows evidences of ascites, and then fluid begins to make itself manifest in the pleural and pericardial cavities. With the development of these serous effusions the respiration becomes steadily more and more embarrassed. The active furtherance of the circulation, produced normally by the act of inspiration, becomes less and less; the pericardial effusion may be large enough to interfere with the diastole of the heart, and this further interferes with the circulation.

It frequently requires some study and good judgment to know in just what degree these effusions are impeding the circulation. The dilatation of the right heart which produces them produces at the same time dyspnea, rapid, weak pulse, cyanosis, etc., and these symptoms are only intensified, not changed, when the respiration and heart become further embarrassed by the existence of effusions. It should be borne in mind that quite considerable amounts of fluid can accumulate in the peritoneal cavity without producing more than a slight impediment to respiration. This is probably because of the yielding nature of the abdominal walls. In the pleuræ much less fluid produces a great increase in the dyspnea. Indeed, it would seem that in some cases pleural effusions produce a severity of symptoms out of all proportion to their size. It is a matter of small moment as to just how high up an effusion must reach before it should be aspirated, since the indication for puncture is given not by the size of the fluid transudate, but by its effects on the breathing and on the pulse. It should be made a rule that when in doubt it is far better to aspirate the fluid than to wait for it to collect farther. It is by far preferable to aspirate too early, even at the risk of an unnecessary puncture wound, than to endanger the heart by waiting too long.

The localization of the serous effusions by no means always follows the course above mentioned, nor does it always develop symmetrically. Indeed, it may be stated that at times the localization of an effusion seems almost freakish, and in many instances the reasons are exceedingly difficult to understand. The utmost attention should be given to this distribution of fluid collections, since they are of considerable importance in respect to the indications for removal. Thus it is exceedingly common, with only a very moderate edema of the lower extremities, for an ascites of rather high grade to develop. This is due, in many instances, to the coexistence of atrophic changes in the liver, which by itself was not capable of producing ascites, but which, with the superadded stasis due to cardiac insufficiency, is sufficient to determine an especially abundant localization of fluid in the abdominal cavity. Nor is the importance of the cirrhotic changes, due to long-continued venous congestion of the liver, to be overlooked, although this latter is many times less frequent than is the combination of cardiac insufficiency and the simple atrophic cirrhosis. Indeed, the localization of fluid in the abdomen is at times so pronounced, and the difficulty in examination of the heart, due to the associated high position of the diaphragm, with consequent dislocation of the heart upward and outward, is so great that unless especial care be taken the cardiac component may be entirely overlooked, and in consequence the treatment may be addressed to a wrong condition.

The fluid in hydrothorax being a transudate, and its accumulation being due to mechanical reasons, it would seem, *a priori*, as if it should be invariably bilaterally symmetrical. As a matter of fact, this is by no means always the case. A unilateral hydrothorax is by no means uncommon, and of these unilateral cases effusions on the right side predominate in considerable measure. Many reasons have been assigned for a unilateral occurrence. It is probable in most of them a small amount of fluid is present, but escapes diagnosis because of the predominance of the physical signs on one side, and because of the difficulties of examination. Again, many patients find it exceedingly difficult to lie upon the left side, especially where much dyspnea exists, and the continued position on the right side may be sufficient to produce a localization of the fluid on that side. Another explanation assumes that when this factor of position is not operative, and yet a hydrothorax exists limited to the right side, its cause is to be sought in the coexistence of a low-grade pleuritis. A more satisfactory explanation than any of these has been offered by Stengel and Steele. They have shown that the peculiar location of the vena azygos major, which drains the intercostal spaces and the pleura, is such that it may be readily pressed upon by a dilated right heart or dilated cavæ. Hirschfelder notes that the mouth of the vein is not as distensible as the walls of the vein above it, and considers that this may offer some obstruction to the flow of blood, since, in experiments in animals dying

with heart failure, the vena azygos may be found dilated above the point where it empties into the cava.

The importance of a careful consideration of these unilateral cases is that if Stengel's explanation be correct there is, in a certain sense, a *circulus vitiosus* set up. The dilated right heart produces pressure upon the vena azygos, which in turn gives rise to hydrothorax on that side, and which again increases the degree of cardiac insufficiency, etc. With a unilateral hydrothorax, therefore, we should perform paracentesis somewhat earlier than when it is bilateral, the dyspnea in the two cases being equal. While, as already stated, the indications for paracentesis must primarily be sought in the degree of embarrassment of the circulation as evidenced by the dyspnea, yet it must not be lost sight of that even moderate amounts of fluid produce distinct obstruction to the flow of blood from the right heart. For this reason, in the writer's judgment, paracentesis of the pleura should be carried out much more frequently than is at present the custom. The foreign text-books on this subject usually state that the circulation becomes seriously embarrassed when the effusion reaches as high as the third or fourth rib. This statement must be taken with some qualification, since serious symptoms, necessitating mechanical removal of the fluid, are often found with much smaller amounts.

Bearing all these facts in mind, the practitioner will do well to make it a general rule when the symptoms are tolerably severe and the case not improving under other means of treatment, even when only moderate amounts of fluid exist, to perform paracentesis promptly.

With proper precautions paracentesis may be done with such a degree of safety as to make it the proper procedure in cases of doubt.

Paracentesis Thoracis.—Technique.—This is discussed in detail under Diseases of the Pleura, to which article the reader is referred.

Paracentesis Abdominis.—In the absence of hepatic complications the amount of fluid which collects in the abdomen, even in the highest grades of cardiac insufficiency, is not excessive. The physician is, therefore, called upon much less frequently to perform paracentesis of the abdominal than of the thoracic cavity. Furthermore, the good effects from removal of ascitic fluid are much less pronounced than is the case from the removal of the fluid in hydrothorax.

Removal of Edema.—A highly useful therapeutic resource, and one which by many practitioners is insufficiently appreciated, is the removal of fluid from the extremities by incision or puncture. While, as has been already stated, collections of fluid in the subcutaneous tissue do not have the same injurious effects upon the respiration or the heart, yet for all that they are not entirely without influence. It is not sufficiently recognized how much obstruction to the venous flow may be caused by pressure on the cutaneous veins due to the presence of a high-grade anasarca. The clini-

cal observation has been made many times that in cases where digitalis utterly failed to produce its characteristic effect upon the heart these effects appeared promptly after the mechanical removal of the fluid from the subcutaneous tissue. For this reason, as well as because of the great annoyance produced by the swollen limbs and body, it is highly desirable that the accumulated fluid should be mechanically removed. This is especially important when digitalis has been given, and in spite of the improvement in the heart's action has failed to accomplish any considerable diminution in the edema. Again, the failure of digitalis to bring about any improvement in the heart's action should always be considered as an indication for the mechanical removal of an edema, if this be of any considerable degree; since, as already mentioned, it not infrequently happens that, after the removal in this way of a certain amount of fluid, the heart promptly responds to the drug.

The amount of fluid which, in suitable cases, may be drawn off from the subcutaneous tissue is almost incredible. It is quite common for a half gallon to a gallon (2-4 liters) to be removed in the first day. The following table, taken from Eichhorst, gives the amounts which were obtained with the Southey tubes from a case of mitral insufficiency:

Date	Position of Puncture	Amount of fluid removed in 24 hrs. expressed in c c.	Albumin (per cent.)	Albumin (absolute amount in grams)
3–2–86	Right thigh	1,550	0.431	6.7
	Right leg	2,660	0.401	10.4
	Left thigh	2,650	0.431	11.4
	Left leg	2,800	0.326	10.1
	Total	9,600	.....	38.6
10–2–86	Right thigh	2,900	0.468	13.6
	Right leg	1,300	0.459	6.0
	Left thigh	900	0.621	5.6
	Left leg	2,100	0.380	8.0
	Total	7,200	.....	33.2

It is perfectly evident that where such quantities of fluid can be removed in a comparatively short time the procedure cannot fail to bring with it great relief. While in the vast majority of cases it is perfectly harmless and carries with it no other source of danger than that of possible infection of the skin, yet this is not invariably the case. Syncope, vomiting, and collapse symptoms have been observed during the procedure, and Eichhorst had one patient in whom rapid death from collapse ensued. As will be seen from the table, there is a very distinct loss of albumin with the fluid, but this is of too small an amount to be considered as being in any sense a contraindication.

Technique of Puncture of the Skin.—The simplest of all methods consists in making multiple small incisions of from one half to one inch in length through the skin. The most careful disinfection should be carried out and the limbs enveloped in a large quantity of sterile absorbent cotton, which serves not only to prevent infection, but to absorb the fluid as well. If rigid asepsis is practiced the sterile cotton dressings liberally applied, and changed only by the physician himself or by a competent nurse, the danger of infection is not great. This procedure has the advantage of simplicity and of requiring no especial apparatus.

Puncture with Trocar.—The classical method of skin puncture is that by means of Southey's trocars. These consist of very small cannulæ with a slight enlargement at the head. To introduce them a tiny trocar is fitted into them and the two together pushed through the skin up to the head, whereupon the trocar is withdrawn, leaving the cannula in place. A rubber tube of appropriate size is slipped over the head of the cannula and the other end led into a suitable vessel. The usual plan is to introduce one trocar into each thigh and another into each leg. The most scrupulous asepsis should be observed throughout the entire procedure. Scrubbing with green soap and water, rinsing with sterilized water, then washing with alcohol, and finally the application of tincture of iodin to the area immediately about the site of puncture is the writer's procedure. The whole is covered with sterilized dressings.

The advantages of the puncture by trocar are the somewhat lessened danger of infection and the greater ease of keeping the patient clean. There is sometimes difficulty in maintaining the patency of the cannula, as it may become plugged by small clots. This is not, as a rule, a difficulty of much moment. Nevertheless, this difficulty has led to the invention of cannulæ of larger dimensions and constructed with numerous side openings. The best known of these are those devised by Curschmann. These are flat with a similarly shaped trocar having a knife-like point, with double edge. The cannula has a number of side openings to permit of a freer flow, and to obviate the danger of plugging.

Methods for Increasing Diuresis.—That digitalis properly given is the diuretic *par excellence* in cardiac insufficiency has already been sufficiently emphasized under the discussion of the action of that drug. There are in addition a number of chemical compounds which act directly upon the tubular epithelium of the kidney and stimulate this to increased action without exerting any effect upon the heart and, in many cases, with none upon the blood pressure. Any increased rapidity of flow in the renal vessels is due to a local action upon them.

The diuretics in this group, which have proven themselves most reliable, are derivatives of theobromin and theophyllin. Of these, diuretin (salicylate of sodium theobromin) has been most extensively used. This is a salt readily soluble in water and containing about 50 per cent. theo-

bromin. It is given in doses of 0.5-1.0 gm. (7½-15 gr.) every four or five hours, in capsules or in some flavored water. It has the disadvantage of rather easily producing unpleasant disturbances of the stomach, occasionally vomiting, sleeplessness, and severe headache. Because of these unpleasant effects, and because of the somewhat depressing effect of the sodium salicylate upon the heart, the use of theobromin in combination with some other salt is to be preferred.

The writer's preference is for the theobromin and sodium benzoate (containing 47 per cent. theobromin) in the same doses as diuretin. The theobromin and sodium acetate salt (agurin) has been much used. It may be given in the same doses as diuretin.

The most powerful diuresis is excited by theophyllin and its salts. This is somewhat more irritating to the stomach than theobromin, producing, if used in too large doses, quite severe nausea and vomiting. Because of this it is well to begin with rather small doses, increasing them daily if they are well borne. The most useful salt is theophyllin and sodium acetate, of which the usual dose is 0.3 to 0.5 gm. (5-7½ gr.). It is well to begin with half the smaller dose, thrice daily, and increase gradually to that dose which produces effective diuresis, not exceeding the larger dose above given. Having elicited the minimum effective dose, this may be continued over a considerable period of time.

The ethylendiamin salt of theophyllin has been introduced under the name of euphyllin, and is said to have as vigorous action as the salts previously mentioned. In addition it has one advantage which is of real moment, that of being very soluble and nonirritating, so that it may be given by intramuscular injection. It may be obtained in ampullæ, each containing 2 c. c. (0.48 gm.) euphyllin.

Calomel.—This, one of the oldest diuretics now employed, is commonly used in combination with opium to avoid its laxative effect. The combination of digitalis, calomel, and opium is an old one, but as usually prescribed owes most of its efficiency to digitalis. That it does at times act very efficiently may not be gainsaid; on the other hand, it fails in a considerable number of cases. In the writer's hands it has produced on several occasions severe mercurial enteritis and, in a number of cases, equally severe stomatitis. This is especially the case with patients having nephritis. For all these reasons calomel, as a diuretic, is a drug which may readily be dispensed with.

[In my experience calomel is the best diuretic in heart diseases. Given in doses of 0.20-0.25 gm. (gr. iii-iv) four times daily for three days it causes diuresis when no other drug will. In a number of cases no bad results have followed its administration in this way. But, notwithstanding all precautions, toxic effects may follow its administration.—Editor.]

It would serve no useful purpose to discuss the long list of diuretics

which have been used and recommended. None of them compare in efficiency with those which have been named, and are to be regarded, in a general way, as superfluous.

Removal of Fluid by the Intestine.—One of the very commonest methods of procedure, in this country at least, is to endeavor to bring about the absorption of an edema by inducing free catharsis with salines. If one merely takes the trouble to have the total quantity of the stool measured it will be found that the fluid which is eliminated by means of the bowel amounts to but little and is therapeutically of small value as compared with the weakness induced by this procedure. The writer has for some years made no farther attempt to eliminate fluid through the bowel, but simply secures a free, soft movement once daily, at most twice, by means of any mild laxative.

Elimination Through the Skin.—This may be accomplished either by the use of pilocarpin or by the employment of various hydriatic procedures. In spite of numerous attempts carefully and conscientiously carried out to make use of pilocarpin the writer has had a number of cases of severe collapse from its use, so that it has long ceased to be a part of his therapeutic resources.

The hot-air bath, the hot full-bath, hot packs of various kinds all act, at least in some instances, in a very satisfactory manner, so far as initiating the diuresis is concerned. After one case in which the patient died in collapse shortly after removal from a hot-air bath of moderate intensity the writer has not felt justified in making use of it except as a last resort. At best sweating procedures of all sorts accomplish but little, and the depression caused by them is considerable. Their use should be limited much more strictly than has hitherto been the case.

Occupation

The question of a suitable occupation for individuals who have different forms of heart disease is one to which the physician should give his most careful attention. This is all the more the case since it is very difficult to lay down hard and fast rules. It is necessary, rather, to formulate the leading principles which should govern the physician in giving advice to the patient on this subject.

The indispensable prerequisite for advice of any kind is as accurate and complete a knowledge of the functional capacity of the heart as can be attained. To this end all the information possible should be obtained from exercise tests, a study of the pulse, blood pressure, and size of the heart under different conditions of work, and the results of these should be taken as a basis of an estimate as to how much the heart is capable of doing without injury to itself. The next factor which should be carefully considered is as to the probable future progress of the disease. Thus, a valve lesion, the result of endocarditis following pneumonia, which has

come to a standstill would offer, other things being equal, a better prognosis, and the patient could be permitted a wider latitude in the selection of an occupation, than in precisely the same lesion following rheumatic endocarditis, where the patient had had several attacks. This, of course, because of the probability of a return of the rheumatic condition and a lighting up of the endocarditis. The third factor, in regard to the patient, is the temperament and intelligence of the individual himself. One patient, with a high degree of intelligence, is capable of comprehending his exact position if it be frankly explained to him, and possesses, perhaps, the necessary decision of character to carry out the suggestions of the physician in the spirit as well as in the letter. Another, guided by what he is pleased to term his "common sense," feels himself superior to advice of this sort, and either makes no attempt at all to follow it or else, after a short period of time, gradually comes to neglect it.

In respect to the occupation itself the physician must do more than to have a merely general knowledge of what is required of his patient. Not only must he be thoroughly acquainted with exactly the demands which the occupation imposes on him under ordinary circumstances, but also with the strain to which he may be subjected under extraordinary conditions. In this connection the writer has in mind especially such clerical occupations as exist in our large cities in great numbers, in which, under ordinary conditions, nothing but office work is required; during the "rush" season the same individual would be required to assist in loading or unloading goods, or at least to help in taking stock or in handling goods—all of which requires an amount of physical exertion which must be taken into the most careful consideration. A mail carrier under certain conditions may have little to do but walk on level ground and carry a relatively light load; under other conditions he may have, in the course of a day, to climb an enormous number of steps and carry a heavy load. The servant who works in an apartment may have little hard physical work to do, while another in a three or four-story city house may have to do an amount of stair climbing utterly incompatible with a serious heart condition; and so examples might be multiplied indefinitely.

Nor must it be lost sight of that many occupations bring with them the necessity for an intense mental concentration and, more especially, of nervous expectancy and hope deferred. The ever-growing contingent of men engaged in more or less speculative enterprises whose occupation carries with it one day the prospect of great wealth, the next, perhaps, of impoverishment, forms a population to which it would be bad judgment to add patients with serious cardiac or arterial disease.

Occasionally the surroundings in which a man is placed while pursuing his vocation are of as great, if not greater, importance than the occupation itself. An important practical application of this is in connection with chronic alcoholism. While it would be absurd to say that any

vocation carries with it the necessity for habitual indulgence in liquor, yet every one familiar with mercantile life knows that the temptations to this are, in many lines of business, difficult to withstand, or at least are difficult to withstand for men of such caliber as are usually found filling these positions. Changes in occupation can, under these conditions, sometimes be made which will eliminate this factor. It is in just these matters that a little ingenuity and real interest in the patient are productive of great good.

Residence

Closely connected with the subject of occupation is the question of residence. In this country of geographical extremes this becomes a question of some importance. The writer has had abundant opportunity in private practice of noting the changes brought about in cardiac patients in moving their residence, even for a few months, to higher altitudes. Many patients who do well at an altitude of but a few hundred feet will develop cardiac insufficiency on attempting to spend a summer vacation at an altitude of six or seven thousand feet. One patient, in particular, has come under the writer's observation who, traveling from his home in California to Chicago, in stopping off for a few days at an altitude of approximately six thousand feet, developed severe cardiac insufficiency on each occasion, whereas at a low altitude his heart had sufficient reserve power to enable him to carry on his ordinary business, which was largely advisory in character. In general terms it may be stated that about three thousand or three thousand five hundred feet above sea level is about the limit of altitude which can safely be recommended to patients with any degree of cardiac insufficiency. It is probable that differences exist, dependent upon whether the patient has been accustomed from childhood to a higher altitude. At least it would seem, *a priori,* probable that such is the case. The writer has no personal evidence to offer in respect to this point.

A more important point, because one of every-day application, is the question of the number of flights of stairs which must be climbed each day. A little simple calculation will make it clear that a woman whose household work makes it necessary for her to climb two or three flights of stairs eight or ten times a day is in reality performing a considerable number of foot pounds of work. It is a matter which can be verified by most physicians that the elimination of this work, by moving the bedroom to the first floor or by living in a first-floor apartment, is of itself frequently sufficient to lessen the degree of cardiac insufficiency.

Marriage

Many factors enter into the question of the marriage of patients with heart disease. The most important factor is as to whether it is the man

or the woman to whom we are giving the advice. From the man's standpoint the thing to be most dreaded are the sexual excesses which are not uncommonly the accompaniments of the first years of married life. An important practical factor is one in regard to which the physician may not be always the most competent advisor. Reference is made here to the purely economic side of marriage. A young man, earning just enough to provide himself with the ordinary comforts of life, and whose occupation is such that his income will increase presumably very slowly, may find that the greatly increased exertions necessary to support wife and family, together with the sacrifices he must make in so doing, may make marriage for him inadvisable. On the other hand, a young man who is busily engaged in sowing his wild oats with its excesses in every direction, all of which are fraught with the greatest danger to a damaged heart, may find that the steadying down which he experiences from a happy marriage may prove the very best thing for him. It need hardly be stated that, while theoretically the physician should be called upon as counsellor in such cases, the greater number of young men contemplating marriage will be far more apt to be governed by motives other than those of pure reason, the dictates of which are apt to be unpalatable.

In the case of the woman two additional important factors enter into the question, namely, the strain which pregnancy and parturition throw upon the damaged heart, and, secondly, the infinitude of small troubles which the rearing and education of a family bring with them. Among the poorer classes the additional work imposed upon the wife in the care of a family, which is proverbially large among this class, may prove an exceedingly serious menace to the preservation of compensation. In general terms, we may say that only when the cardiac muscle is in a state of perfect compensation, and when the underlying pathologic process is not of a progressive nature, should marriage be sanctioned for either party. The woman should be fully informed as to the danger which parturition brings with it. The writer's experience is that, however docile and obedient patients may be in other respects, in this one matter the physician's advice falls on deaf ears. In the relatively small number of cases in which he has been called upon, in all seriousness, to give advice in this regard he has contented himself with explaining to the interested parties all the factors which enter into the question and then leaving them to form their decision, with just a hint, perhaps, on his part, as to what he considers the part of wisdom. The writer feels very strongly that in such matters as these the physician is a little apt to overstep his boundary. He can only regard the question from the standpoint of one to whom the prolongation of life represents almost the greatest good to be achieved. To the patient the chances of a few years more or less of life may be of much less moment than the matter of his happiness and, in the last analysis, this is a matter in which the patient should be the final arbiter.

Recreation

It should be made a cardinal principle to disturb the patient as little as may be in the enjoyment of his accustomed recreations, provided always that these have been of such a character as are unlikely to produce cardiac overstrain. The physician should not fall into the error of indiscriminately forbidding the patient to do this or that unless the pathological condition of the heart warrants such prohibition. Under no circumstances should the patient be condemned to a life of complete inactivity, so long as he is capable of taking exercise without injury. The question of the relationship existing between exercise and cardiac overstrain is discussed under the caption of Prophylaxis in the cardiac insufficiency of overstimulation.

Such forms of recreation as are not accompanied by physical exertion may, in general, be freely permitted, and are of distinct service in helping the patient to get his mind away from himself. Such forms of recreation as involve a high degree of mental excitement are best avoided.

Certain forms of recreation, indulged in especially by older boys and girls, are, while apparently harmless, frequently carried to great excess. Chief among these is dancing. It is no very uncommon thing for a girl of from sixteen to twenty, in whom the love of dancing at times amounts to a passion, to attend an evening gathering where dancing will be indulged in from perhaps half past eight or nine in the evening until three or four o'clock in the morning. An attractive young girl, not lacking for partners, may actually dance a third to a half of that time. The amount of physical exertion is vastly greater than one would imagine who is not thoroughly familiar with all the conditions. The keen quest of pleasure, the more or less artificial excitement, the overheated ballroom, all conspire to render this a peculiarly injurious pastime for cardiac patients. In the lighter grades of cardiac weakness, such as a well-compensated valve lesion, very moderate dancing may be conditionally allowed. A useful plan is to permit four or five round dances in an evening, separated by perhaps half-hour intervals, and not exceeding four or five minutes at a time.

In little children a particularly vicious exercise, because of the almost invariable tendency to carry it to a great excess, is skipping the rope. This should be absolutely forbidden, since the children who indulge in it are rarely of sufficient age to exercise any discretion.

Horseback riding as a recreation is very frequently prescribed by physicians in the idea that it is a gentle and mild form of exercise which takes the patient out in the open air and, at the same time, involves, as one of the writer's colleagues put it, "No work for anybody but the horse." This is, to one who is practically familiar with riding in all its aspects, abso-

lutely incorrect, or, more properly speaking, only conditionally correct. A patient, especially if of mature years, puts forth rather strenuous exertion in first learning to ride. This is all the more the case if, as is generally the custom, he rides an English saddle and a trotting horse. On the other hand, one who has previously acquired the art, for art it is, can ride with relatively little expenditure of energy. To ride a horse possessed of any of the so-called saddle gaits, such as are generally natural to our Western and Southern horses, involves only a very slight expenditure of energy, especially if a saddle with high pommel and cantle be used. The writer, after considerable experience in these matters, can unqualifiedly recommend riding, under these latter conditions, as one of the very best forms of exercise, and one in which there is but little danger of overexertion, the latter point being, of course, all-important to patients with cardiac disease. Many men well along toward the threescore and ten bestride a well-mannered, quiet, saddle-bred animal for an hour every day with great advantage and little fatigue.

On the other hand, the amount of exertion necessary to ride a well-bred and fairly strong-stepping trotting horse is very great unless the rider have been really well schooled. This latter is so rarely the case in America, where the general public neither takes any interest in riding as an art nor, indeed, is even aware of the fact that there is anything more to be learned than simply to bestride the animal and start him off, that we may assume it never to exist. The physician, then, should use great caution in recommending, especially to obese and generally clumsy adults, the pursuit of riding as a suitable exercise. In any event, he should see to it that careful instruction is given by competent individuals before permitting any patient with heart disease to even attempt riding. One factor which can unfortunately never be eliminated is the possibility of the horse "playing up." In these days, where an automobile, a road roller, or a fire engine may come upon one unawares, it must indeed be a horse of good nerves and quiet disposition that can always be depended upon under such conditions.

In a word, horseback riding may be either a perfectly proper exercise for patients with even tolerably well-marked cardiac conditions when well compensated, or, on the other hand, it may be made a very strenuous exercise, and one which no patient should be allowed to undertake without careful supervision and preliminary instruction and training.

Diet

It is impossible to lay down a specific diet which can be regarded as appropriate for the generality of cardiac cases. In this sense there is no diet for the stage of compensation, but, on the other hand, there are certain general principles which should be applied in the selection of the dietary for individual cases.

If the patient be already in a state of proper nutrition, his weight being correct for his general build and musculature, we should then seek to keep him at this weight and at the same time give him the smallest amount of food which is just sufficient to accomplish this purpose. In other words, the dietary should consist of just that amount of food which will suffice to keep his weight stationary. The reason for this is the principle of protective therapy, and its application in this case is that all food over and above the exact amount required to keep the weight at the norm simply taxes the circulation by that much more. Aside from this it can hardly be said that definite indications exist for any special diet list excepting those which apply to the question of diet in general. The amount of proteids given should be well above the minimum amount necessary to maintain the nitrogenous balance, say from 90-100 grams per day. A fair amount of the green vegetables should be taken and fruits in abundance, that by these means constipation may be avoided. In general, as simple a diet as will fulfil these conditions is to be preferred, since in this way difficulties of digestion are best avoided.

In this place may be conveniently discussed the question of *constipation,* a question which is, in patients with heart disease, of more than usual importance. Bearing in mind the fact that during defecation, when constipation exists, there may be a rise in blood pressure of over 50 mm., it will be seen that the existence of this complication is by no means a matter of indifference to the patient. Every effort should be made, therefore, preferably by dietetic means, to see that the patient has a large, soft movement daily. Since the patients in this class are generally unable to take such exercises as involve considerable vigorous action on the part of the abdominal muscles, it is all the more necessary that dietetic measures should be the mainstay. In many instances the addition of agar agar, which is strongly hygroscopic, exceedingly bulky, and relatively incapable of absorption, may be found very serviceable. The writer has used it somewhat extensively, and in cases where the constipation is due to a lack of bulk in the diet, or to too great rapidity of absorption, extremely good results have been had with its use. It should be borne in mind that it is in no sense a laxative, but that it acts in a purely mechanical manner, producing by its affinity for water soft, bulky stools. Most patients ingest it with little repugnance, provided that care is taken to use only the very best qualities of it. The writer customarily directs that it be taken in the following manner: The agar is cut up into small bits after the fashion of a flaked breakfast food, put into a bowl and covered with just enough hot water to thoroughly soften it and then eaten with the addition of cream and sugar. A half ounce morning and evening generally suffices to insure one large, soft evacuation daily. The further details of treatment of constipation, should this exist, may be sought for in the article on that topic, and form a matter of no small moment.

The habitual use of salines, which is so commonly practiced in patients in this group, is to be strongly deprecated.

Even more important is the question of diet in patients who, for any reason, may be below par in their nutrition. If we regard it as axiomatic that the state of the general musculature in regard to its nutrition is an index of the nutrition of the myocardium it will be sufficiently obvious that no stone should be left unturned to place the patient in the best possible state of nutrition. To this end additional food should be given so that the patient may take on weight slowly but steadily until he has reached that point where it is judged that the weight attained represents the optimum for him. Having arrived at this point, the diet should be diminished again to the minimum necessary to keep the weight stationary.

In patients who are above weight a very guarded attempt may be made at slow reduction. The proper course to pursue in these cases has been given in detail under the Prophylaxis and Preservation of Compensation in the Cardiac Insufficiency in Obesity.

Care should be taken, in whichever of these groups the patient may fall, to see that the food is taken in fairly equal amounts and at least three times daily. The habit, which is becoming in our large cities increasingly frequent, of taking little else for breakfast but a cup of coffee and a bit of toast, followed by a light luncheon at noon, with a heavy course dinner at six-thirty or seven in the evening, cannot be too strongly condemned. While it is not within the province of this article to discuss the desirability of this method of living in normal individuals, it must be again emphasized that the ingestion of so large a quantity of food at one time may lead to distinctly unpleasant results. Not alone is the overdistention of the stomach and the consequent pushing up of the diaphragm and displacement of the heart prejudicial, but also the great demand made upon the heart by the processes of digestion and assimilation of so large a quantity of food at one time. Especially should the avoidance of a heavy dinner, with the addition of wine and perhaps cigars, be enjoined. Some of the German authors recommend that the food be given in from five to six small meals daily. Under the conditions as they obtain in German-speaking countries this is perfectly feasible, since the normal individual takes in addition to his three principal meals generally two smaller ones. Under the conditions as they obtain in America this becomes eminently impracticable. Bearing in mind that the diet chosen will probably have to be adhered to for many years, if not for the rest of the patient's life, it is sufficiently obvious that the patient will, in all likelihood, chafe under the restrictions, if these be difficult of fulfilment, and ultimately fail to carry them out. It is quite practicable to have the patient take, perhaps, a glass of milk in between the other meals and so distribute the food ingested. Even this is not ordinarily necessary if the patient be made to take approximately equal amounts of food with each of the three meals.

The *limitation of fluids* is a subject which has been much discussed in recent years, and in some hands has been carried to extremes. In patients with good compensation all that is necessary is to see that they do not exceed a fair average amount daily. Many people, under the impression that drinking large quantities of water is in some way beneficial, consume a number of liters daily. This, of course, should be promptly prohibited, and the patient permitted to drink only such quantities as are really necessary to quench the thirst. Limitation of fluids beyond this point subserves no useful purpose and is unquestionably a great deprivation for the patient.

The use of tea and coffee, when these are consumed in unusually large quantities, or drunk very strong, should unquestionably be prohibited. On the other hand, most individuals carry out the processes of digestion with more satisfaction to themselves, and possibly, if the concentration be slight, with actually greater ease, when taking a cup of tea or coffee with their meals. To prohibit both of these as a routine measure would be to deprive the patient of a certain amount of pleasure, with little or nothing gained in so doing. By limiting the amount taken to a single cup of either weak tea or coffee once or twice daily practically all objections are eliminated. The writer has had much satisfaction, especially in patients who develop insomnia very readily after the use of coffee, by prescribing the use of caffein-free coffee. The most available preparation in the American market known to the writer is that which is marketed under the trade name of "Dekofa" and contains something less than ten per cent. of the original amount of caffein present. It is to be had in the bean, which is ground and prepared in the ordinary manner. Most patients are unable to detect its use or to distinguish it from ordinary coffee. The writer has repeatedly found that patients who have been accustomed to drinking several cups of black coffee for breakfast complain that "there is no strength" in this new coffee. This is natural enough since they are obtaining less than ten per cent. of the amount of caffein to which they have been accustomed. These are patients who take coffee for the sake of the stimulation rather than for the sake of the agreeable flavor or because they like a warm drink with their meals. The majority of people, on the contrary, drink coffee largely for the sake of having a pleasant-tasting, warm beverage, and the stimulation is entirely a matter of indifference. The indication for the cessation of coffee is the more imperative in proportion to the amount the patient has been accustomed to take and to the development of abstinence symptoms on its cessation.

In principle there is no difference between the use of tea and coffee as beverages if due allowance be made for the strength of each (see under Caffein). Many laymen imagine that tea may be drunk in practically unlimited quantities without any untoward results, whereas, in fact, it has all the advantages and disadvantages of coffee. In addition, tea which has

steeped for some time contains a considerable quantity of tannic acid, which is productive of digestive disturbances. Since the proper making of tea is by no means a widely known art this should be explained to the patient, together with the reasons why. Boiling hot water should be put into a cup and the proper amount of tea inclosed in a little tea ball, dipped into the water, which should always be freshly boiled, for from 20 to 40 seconds. In this short space of time the quantities of tannic acid which go into solution are too small to be of moment.

Use of Alcohol

The principal factors involved in the use of alcoholic drinks are, first, the effect of the alcohol itself; second, the ingestion of large quantities of fluid, when the alcohol is taken in the form of beer or similar drinks, and, third, the caloric value involved.

In any considerable quantity, and in the form of concentrated liquors, alcohol should be absolutely prohibited in cardiac patients. In those who are already hard drinkers it may not always be wise to attempt to bring about the cessation of the habit at one stroke. Each case of this kind will have to be decided with due regard to the severity of the heart lesion, the degree of alcoholism, and the intelligence and moral stamina of the patient. Patients who are accustomed to drink small quantities of light wine with their meals, especially patients well along in years, should be permitted to continue in their custom. In such patients, especially where the physician is in a position to know at first hand that the bounds of moderation are never exceeded, it is pretty certain that the withdrawal of alcohol would do more harm than good. On the other hand, the habit of taking two or three drinks of a strong liquor before meals is to be strongly condemned. The idea which many patients have, that it gives them an appetite, is too frequently merely the excuse of a chronic drinker, who seeks to justify a bad habit. The heavier wines, and especially the sparkling wines, should not be permitted, particularly the latter, because of the CO_2 contained in them. The principle of extreme moderation, rather than arbitrary prohibition, should be the dominating idea in giving advice in this matter. In those who have not been accustomed to alcohol, but who have, of their own initiative, begun its use with the idea uppermost that alcohol is "strengthening," it had better be entirely prohibited. This also applies to patients in whom the use of alcoholic drinks produces palpitation, a feeling of fullness in the head, or similar symptoms.

In beer drinkers the question of excessive ingestion of fluid is of great importance. It is astonishing to what extent the beer drinker will go in his consumption of his favorite beverage, when he has once really acquired the habit. While this factor is not so important with our native Americans as with, for example, many of our citizens of foreign birth,

yet it is sufficiently important to be inquired into carefully in a given patient.

In patients accustomed to its use with their meals the ingestion of one or two half bottles daily is probably of no moment, and the writer, especially with his German patients, is accustomed to permit this amount to be taken.

It is self-evident that, if the heart lesion in question had been produced entirely or in large measure by the use of alcohol, even this had better be omitted. If excessive obesity, or a strong tendency toward this, exist, the caloric value not only of the alcohol, but of the carbohydrates, must be taken into consideration. Bavarian export beer contains 4.5-5.5 per cent., the light Rhenish beers 2½ to 3 per cent., and Pilsener beer 3½ per cent. carbohydrates (Zuelzer), and the composition of American beers in this respect is probably not very different. In general, the caloric values of the strongest cognac, brandies, and similar drinks varies from 400-500; sherry, port, and Marsala, 100-120; champagne, 90-130; Rhine wine, Burgundies, Bordeaux, 68-80; beer, from 40-60. All of these are calculated for 100 c. c., and represent the middle value from von Noorden's tables. It will be readily seen from these figures how great a factor the ingestion of four or five glasses of whiskey *per diem* is in the production of obesity.

While, as a matter of course, the chronic overindulgence in alcohol is a vastly more important factor in heart disease than are occasional sprees, yet the importance of these latter, too, must not be underestimated. This is especially important in America, where the habitual spreer is perhaps quite as common as the chronic tippler. It cannot be doubted that a single fairly prolonged drinking bout, with a consumption of such quantities of concentrated liquors as usually occurs under such circumstances, may produce by itself well marked decompensation. This is the more likely to be the case when the patient has not been previously accustomed to liquor, as in the case of university students, whose excesses in this respect are sometimes fraught with rather disastrous consequences.

The Use of Tobacco

Our lack of knowledge in respect to the effect of tobacco upon the heart is such that it is exceedingly difficult to frame an accurate judgment as to just what are its potentialities for evil. The subject is discussed at some length under the treatment of arteriosclerosis. A large number of men smoke purely for the sake of the companionship and because their associates are smoking. Others, again, smoke because either their business or their pleasures bring them in contact with others who are smoking, and the disagreeable odor of smoke is obviated to a certain degree if

they themselves smoke. In such patients as these the cessation of smoking is in no sense a hardship. An absolute abstinence from tobacco should be enjoined upon them. The very much larger group of moderate smokers, who smoke from three to four or five mild cigars a day, find it a considerable deprivation to give up the habit. Perhaps the wisest plan to pursue with them is to gradually reduce the number of cigars allowed to one small, mild cigar after dinner and supper. The writer's experience is that this is about the minimum which is capable of affording any pleasure to patients in this group. If general arteriosclerosis, and particularly coronary sclerosis, exist, every effort should be made to eliminate even this small indulgence.

With the confirmed smoker the problem is distinctly harder. Few habits, aside from the severer forms of drug habits, take hold of a man with greater tenacity than this. Many of these men are possessed of great bodily and physical vigor, and stoutly maintain that they neither experience the slightest ill effect, nor do they believe that any bad results can accrue from it. It is rare, indeed, to find a patient of this kind who, however great his confidence in his medical adviser may be, does not feel that in such matters his own opinion is far more reliable and unbiased. The writer has in mind a recent patient, a man of great bodily and mental vigor, who purchases cigars in lots of one thousand, at intervals of from three to four weeks, and of these practically all are consumed by the patient himself. As the patient expressed it, "From the time I wake up and look at my watch and at the same time take a cigar, I am practically never without one until I retire at night." In patients of this kind the very greatest difficulty arises even when an attempt is made to reduce the number of cigars consumed. For all that, the attempt must be made and made seriously, since, in the long run, such overindulgence is almost certain to result disastrously. Nothing is gained by changing the form in which tobacco is smoked, as, for example, from cigarettes to cigars. Of all the various devices which have been recommended in the endeavor to do away with the habit the writer cannot speak in favorable terms. The question is really one of moral stamina on the patient's part, with intelligent interest and coöperation on the part of his physician. If the patient can be induced to gradually reduce the number of cigars, and to use only very mild ones, the way is opened for a still further reduction later on, and possibly an ultimate complete withdrawal. A little point which may occasionally be useful is to induce the patient to agree to limit himself to the same number of cigars, but to throw each one away when two-thirds consumed, and later when half consumed. This has, perhaps, a slight advantage, in that in this way there may be less absorption of the volatile products of combustion.

Cigarettes should be completely prohibited, and old, strong pipes likewise. The long clay pipe, which can be thrown away and new ones ob-

tained at short intervals, is less harmful. On the other hand, it is difficult to get patients to carry this out.

The use of chewing tobacco, because of the digestive disturbances to which this so frequently gives rise, should be absolutely interdicted.

CHRONIC MYOCARDIAL INSUFFICIENCY

In the therapy of cardiac diseases the interest focuses sharply upon the treatment of chronic myocardial insufficiency with its many causes. It thus assumes paramount importance, and hence will be considered as forming a basis for the discussion of the treatment.

Definition.—By chronic myocardial insufficiency is meant a condition of chronic weakness of the cardiac muscle, due to various pathological conditions of the myocardium itself (weakened heart, cardiac insufficiency, debilitas cordis, insufficientia myocardii).

Under this heading is included a considerable number of conditions which have this in common, that in all of them the clinical course is dependent upon the fact that there is a weakening of the cardiac muscle, a true insufficiency of function. In some the primary cause may lie outside of the heart. It may not be always possible to establish the diagnosis with sufficient exactness to recognize the individual forms of myocardial disease, and, in many instances, the various forms are combined or overlap, but every effort should be made to determine it with as much precision as the individual case may admit. In spite of the variety of causes which lead to myocardial insufficiency, there are in the clinical course a large number of symptoms and signs common to all, the sum of which may be regarded as forming the clinical picture.

The valvular lesions will be discussed under the present caption, since, as Krehl and Romberg have shown, the course of valvular lesions is determined to a much greater extent by the condition of the heart muscle than by the extent of the lesion of the valve. Especially from the standpoint of therapy is this classification justifiable, since the cardiac insufficiency due to valve lesions is treated along precisely the same lines as that produced by any of the other causes enumerated below.

Clinical Forms of Chronic Myocardial Insufficiency.—The conditions grouped together under this head are:

1. Cardiac insufficiency from overstimulation.
2. Cardiac insufficiency from disturbances of the general metabolism (malnutrition).
3. Cardiac insufficiency from long-continued rest.
4. Cardiac insufficiency of the obese.
5. Cardiac insufficiency from general and local (i. e., coronary) arteriosclerosis.

6. Cardiac insufficiency from chronic myocarditis.
7. Cardiac insufficiency from alcohol (beer heart).
8. Cardiac insufficiency from syphilis of the myocardium.
9. Cardiac insufficiency from concretio pericardii.
10. Cardiac insufficiency in chronic nephritis.
11. Cardiac insufficiency in pulmonary conditions (emphysema, chronic indurative conditions in lungs, asthma, chronic bronchitis).
12. Cardiac insufficiency in kyphoscoliosis.
13. Cardiac insufficiency in the valvular lesions.

Functional Diagnosis—The Recognition of the Functionally Insufficient Myocardium.—It lies entirely without the scope of this article to enter upon the symptomatology of the above conditions, but it should be remembered that, functionally, they all have this in common, that the myocardial insufficiency, that which the clinician is generally called on to treat, exhibits the same symptoms irrespective of its causation. To the picture of myocardial insufficiency may be superadded the symptoms peculiar to each of these conditions, when such exist. It is sufficiently evident that, irrespective of the underlying pathological condition, the prognosis, so far as the circulation is concerned, depends almost exclusively upon the condition of the myocardium, upon its sufficiency or insufficiency, upon its reserve power. The most important problem which confronts the physician, and often the most difficult, is to determine just what condition the heart muscle is in; in other words, to determine its functional value, its capacity for work. This is all the more important, from the standpoint of treatment, in that most of our therapeutic measures are directed toward the restoration and maintenance of the functional integrity of the heart muscle.

Results of Insufficient Myocardium.—In general, it is convenient to recognize early and late stages. In the first, or initial, stage the symptoms are generally relatively slight. Probably the most frequent symptom at the onset is dyspnea. At first this appears only after some unwonted exertion—a short run, climbing stairs, etc. Again, it may appear after an unusually heavy dinner, a meal acting, as has already been noted, in precisely the same way as physical exercise, so far as the heart is concerned. At first it disappears when the exciting cause has passed, but later may become permanent. Dyspnea is especially apt to appear in patients in the laboring classes, whose work involves considerable muscular effort. It is not uncommon to have patients in whom dyspnea is perfectly evident make no complaint, and even assure one that their breathing is "all right." Catarrhal conditions in the bronchi and larynx are quite common, and recur with no apparent exciting cause, or as a result of causes too slight to affect a person in robust health. Microscopically the "Herzfehlerzellen" and occasionally a few red blood corpuscles may

be found, although these are seldom present until the condition has existed for some time. Cough is common as a result of the catarrhal conditions just referred to.

In patients of sedentary habits gastrointestinal conditions are more frequently noted first. These are loss of appetite, meteorism, slight disturbance of digestion, a sense of weight and fullness in the epigastrium, eructations of gas, irregularities of the bowels. Soon there is added to these a tenderness in the epigastrium, at first slight, later more marked. Women frequently have their attention drawn to it by an unpleasant sensation on wearing their corset. These symptoms are due to the venous congestion of the abdominal vessels, producing catarrhal processes in the mucous membranes and engorgement of the liver. The latter increases in size and becomes tender, owing to the stretching of its capsule, with resultant pressure on the nerve endings. It is important to note, however, that under two conditions this tenderness may be occasionally absent: in old people, in whom there are already senile changes in the liver, with resultant atrophy, and in cases where the venous congestion of the liver has lasted a long time, the nerves seem to become obtunded, and the tenderness may gradually become less and disappear. Vomiting is uncommon, and is generally of grave import.

In a smaller number of cases subjective sensations on the part of the heart itself are complained of, but even in these, oddly enough, the symptoms on the part of the heart are relatively few. At best, these cases are not numerous. Discomfort in the precordia, a sense of tightness or fullness, or palpitation may develop after relatively slight exertion, less frequently after mental excitement. In a more advanced stage these may develop while at rest. Anginal attacks, generally of a mild type, may initiate the picture, as may also attacks of cardiac asthma. In these latter the patient is suddenly seized, usually at night, with an intense degree of dyspnea, with a rapid, feeble, often irregular pulse, cyanosis, and great suffering. Anginoid and asthmatic attacks are not very infrequently combined.

With these more or less localized symptoms, general symptoms are often present. The most important of these are weakness, listlessness, loss of weight, cold sweats, pallor of the skin, vertigo, headache, and attacks of syncope.

The objective examination of the heart discloses a dilatation, generally slight at first, often not to be made out with any degree of certainty. The sounds may be normal, or there may be a systolic murmur following the first sound, loudest at the apex. There may be an accentuated second pulmonary sound, indicating a mitral muscular insufficiency. It must be borne in mind that outspoken symptoms of myocardial insufficiency may be, and often are, present with no changes evident in the physical examination of the precordia.

The pulse is generally small and soft, unless the cause of the cardiac weakness lies in a contracted kidney, in which case the pressure may be high. While not often much accelerated while at rest, it is generally markedly labile, contrary to former belief. Arrhythmia is absent in most cases.

The urine shows a distinct diminution in volume, if the case is one of any severity, with increase in specific gravity (above that which existed before the onset of the attack).

Edema of the dependent portions of the body may develop. This, in the writer's experience, is invariably a later symptom than those on the part of the liver and gastrointestinal tract.

These symptoms, which go to make up the picture of the initial stage of cardiac insufficiency, progress, as a rule, slowly, so that the duration of this stage may vary from a few weeks to many years. A year might be considered a fair average.

The second stage is characterized by severe dyspnea, outspoken enlargement of the liver, greatly lessened quantity of urine, edema of the extremities, later transudates in the body cavities, albuminuria, etc. These lie outside of the scope of our consideration.

Functional Tests.—In the past decade the ever-increasing importance of having some means to recognize the slighter degrees of functional weakness of the heart has been more clearly recognized. As a result numerous investigators have endeavored to devise means by which the reserve force could be determined. While these researches have not led to any absolutely conclusive results, yet they have disclosed many facts of great importance for the clinician, and, while we are still far from having an exact functional test applicable to all cases, we have learned enough to be of distinct aid in some cases.

Principles Involved.—The earlier methods sought to learn from the behavior of the pulse alone, under varying conditions, just what effort the heart was capable of putting forth.

Mendelsohn-Gräupner Method.—These authors caused the heart to be subjected to mechanical work, in a manner which permitted of quantitative determination, noting the pulse rate before and after, and then determined the time which the heart required to come back again to the normal frequency. This time, which may be called recuperation time, forms the basis for the conclusions. The longer the time required for the heart to regain its normal rate the less is its functional power.

It has been determined by others that other factors than the reserve power are set in play in any method depending on this principle, so that it has been given up even by the authors themselves.

Herz' "Selbst Hemmung" Method (*Self-antagonizing Method*).—A second method (M. Herz) employs the following procedure: The patient, *applying his entire attention to the matter in hand*, very slowly

bends his forearm in such a way as to contract simultaneously both flexor and extensor groups of muscles. This is regarded as being a physical exercise of strain. The author states that normal hearts invariably show either no change in rate or a slight increase in rapidity, whereas functionally damaged hearts showed an invariable slowing. This method has been reinvestigated by several authors (Aug. Hoffmann), who have not been able to confirm his results. Another method makes use of the pulse rate in a still different way. The patient is made to take the recumbent position and the rate determined. This is done again standing, and it was found that, in normal individuals, the acceleration was never more than twenty, on the average seven. Several factors impair the accuracy of this test; one is the length of time the patient has been in the recumbent position, and another the psychical condition, which plays here an important rôle.

Methods Dependent on Blood-pressure Changes.—After it had been demonstrated, two decades previously, by Marey, that compression of the large peripheral arteries simultaneously induced a rise of the blood pressure, this fact was used in the endeavor to develop a method of functional testing.

Katzenstein's Method.—This observer found that, after causing the heart to perform an increased amount of work by compression of both femoral arteries, for from two and a half to five minutes, a normal patient reacted with an increased blood pressure. He found the following conditions to obtain:

A. In normal hearts with competent myocardium a rise in pressure of from five to fifteen mm., the pulse rate remaining the same or becoming less.

B. In hypertrophic hearts, with competent myocardium, a rise in pressure of fifteen to forty mm., the pulse rate being the same or less.

C. In hearts with slight degree of insufficiency the pressure did not rise, the pulse rate remained the same or increased.

D. In hearts with severe degrees of insufficiency the pressure fell and the pulse rate increased.

This method has been found to be unreliable, because of the pain caused in some instances, and also because of the psychical factor, as well as dangerous to use in very severe cases.

Gräupner's Method.—After his first communication Gräupner started with a somewhat different principle. He gives the heart an amount of work to do which can be accurately measured, and from the behavior of the blood pressure draws his deductions. He found that in normal hearts a rise of pressure was caused by mild exercise, but a fall in weakened hearts. This test is open to a number of theoretical objections. It does not and cannot take into consideration the effect of the peripheral vessels in the blood pressure. It is usually correct to assume that the

increased pressure noted in normal hearts goes, *pari passu,* with an increased systolic output of the heart, but conditions can be imagined where the rise of pressure might be due to medullary stasis, and in this event would have an exactly opposite significance. It has been found by others that the blood pressure falls in the case of a trained athlete, instead of rising, giving Gräupner's pathological reaction. It had previously been shown that in elderly patients, who often show with this test a very great increase in the pressure, and who, therefore, should have good hearts, the heart is, as a matter of fact, brought near to a point of serious insufficiency by the exercise, as is evident by the accompanying severe general symptoms. A secondary stimulation of the vasoconstrictor center may be in play here, the stimulus to constriction being given by an excess of CO_2 as a result of stasis in the medulla oblongata, in the sense of high pressure stasis (Hochdruckstauung) of Sahli. Under these circumstances such a rise in pressure would be unfavorable. Cabot and Bruce, who have worked with this method, believe that, in spite of its defects, it is of use in helping to judge of the heart's reserve power. The writer, after considerable experience with the above tests, and after several years' pretty constant use of the Gräupner test, has arrived at the following conclusions: The test has all the inherent fallacies of any method dependent upon the behavior of the blood pressure alone. The psychical influence may be allowed for, or eliminated by repeated tests. It is not difficult to decide, in a heart which shows a drop in pressure, whether its possessor is a sound, trained athlete, or has a badly damaged heart. Making all these allowances, and judging only from outspoken changes in the pressure, the method has a limited field of usefulness. Hoffmann finds that, just in the cases where it is most needed, in the differential diagnosis between cardiac neuroses and beginning myocardial weakness, the method fails entirely. To this opinion the writer can subscribe in part.

Hirschfelder makes the appropriate remark that, in nearly all the tests, if they are to be really decisive, they must be pushed to an extent where the concomitant symptoms and signs are in themselves sufficiently characteristic. With the present state of our knowledge on the subject we may say that all patients in whom there is doubt as to the competency of the myocardium should be subjected to some form of exercise test, but this must not be taken as the sole criterion.

The Relation of the Maximal and Minimal Pressures (*Amplitude—Pulse Pressure*).—From the height of the blood pressure and the rate, and from the presence or absence of the usual attendant symptoms of an overtaxed heart, from the rapidity of recovery from the exertion, and from an examination during the following twenty-four hours to see if after-signs of cardiac exhaustion have set in, from all of these, rather than from the numerical values obtained at the time of exercise, should the final estimate be drawn.

It must be emphasized that, in determining the amount of exercise that the patient is to be permitted to take, the test should be made with exercises familiar to him and which he must do in his everyday life. It is highly important that the exercises should be such that the patient can do them easily, as in unaccustomed exercises, especially if awkwardly done, the actual outlay of energy far exceeds that necessary to be expended when the patient has acquired the address necessary to do them easily and skillfully. This is equally important in treatment, and was taken cognizance of in the original method followed by da Costa during the War of the Rebellion.

The psychical factor must never be left out of consideration, whatever the form of exercise we may use. Weber has shown that the increase in blood pressure is due, in a measure at least, to the fact that the cortex is concerned in the carrying out of the muscular contractions. As a result of this, a patient about to be subjected to any of these tests may, as a result of the mere psychical concept of the work to be done, react with an increased blood pressure. This factor, so familiar to everyone in testing the pulse rate for the first time, may be eliminated by repeating the test when the patient has overcome the nervousness incident to the novel procedure.

Plethysmographic Method of A. Müller.—This author attempts to measure, by means of the plethysmographic curve taken from the forearm, as to the systolic output of the heart, and to deduce from this the work done by this organ. Aside from the technical difficulties involved, which would render the method one of considerable difficulty, the method has the inherent error derived from endeavoring to generalize as to the condition of the entire circulatory system from the results obtained from one artery.

Method of Plesch.—Plesch has published a method for determining the systolic output of the heart, based upon entirely different considerations. The principle of the method is as follows: If the gaseous content of the blood in both the right and left sides of the heart be known, and if one determine in addition (by the Zuntz method) the O_2 intake per minute, then from these data the amount of blood which has passed the lungs during this time may be calculated. If this amount be divided by the number of heart beats in the same time, we obtain the systolic output of the heart for each beat.

Inasmuch as the analysis of the heart's blood cannot be made in man, some other than the direct method must be devised. The details of the method cannot be given here, but essentially Plesch determines:

A. The amount of O_2 which is used per minute by the organism.

B. The percentage of O_2 contained in the venous blood, when, after having satisfied the tissue needs, it returns to the lungs; that is, the percentage of O_2 in the right heart or pulmonary artery.

C. The percentage of O_2 present in the arterialized blood; that is,

the percentage change in O_2 which the blood has undergone after it has been changed to arterial blood in the lungs.

Plesch gives as an example: If the volume per cent. in O_2 of arterial blood be 20, and that of venous blood 13, then per 100 c. c. blood there will be necessary 20—13=7 c. c. of O_2 for arterialization. This is furnished by the respiration.

Assuming in this case the O_2 consumption to be 210 c. c. per minute, then the amount of blood per minute necessary to carry this amount of oxygen would be as many times 100 c. c. as 7 is contained in 210. If X be the "minute volume" of the blood, then $X=\frac{100 \times 210}{7}=3{,}000$. If 3,000 c. c. are required per minute, assuming a pulse rate of 70, then the systolic output is equal to 3,000 (minute volume) divided by 70 (rate per minute). Systolic output $=\frac{3000}{70}=43$ c. c.

Theoretically interesting as this method is, it seems doubtful whether it is destined to attain clinical importance. At best it could not be used excepting under exceptionally favorable conditions.

Röntgen Method of Moritz and Dietlen.—These observers determined a diminution after exercises in the size of the heart measured by the orthodiagraphic method. Their investigations have been partially confirmed. They draw the conclusion that the reaction of the normal heart to stress placed upon it is in a diminution of its size. More explicitly, a strain which is within the power of the heart to overcome produces not a temporary dilatation, as has often been assumed, but an actual diminution in size and volume. This has been explained by the incomplete venous filling as a result of the shortened diastole associated with a more frequent pulse. This interpretation has not been allowed to remain without some contradiction. Kraus denies that muscular work as such produces a diminution in the size of the heart. He considers that the distinction between the trained and untrained heart is that in general the trained heart produces more work by increasing its systolic output with little or no increase in rate, the untrained by increasing its frequency. The cause of the diminution in size is, according to Kraus, the more complete emptying of the heart. In general, it may be stated that, while there is agreement that the normal heart is smaller following exercise (i. e., increased tonicity), yet it is very doubtful if this alone furnishes a reliable measure of the heart's strength.

Value of Functional Tests in General.—The above résumé of the more important methods of testing the functional power of the heart shows that, in spite of the desirability of some such mathematical procedure of determining the heart's functional power, we must say that at present no one of these methods answers the requirements. *We possess at present no means of estimating in terms of a simple proportion the heart's functional capacity.* The physician, brought face to face with a case in

which it is necessary to estimate just what the reserve power of the heart muscle is, must rely on close and accurate observation. As already stated, exercise tests should always be given, but not according to any fixed scheme. In one case a half dozen quick turns around the room, in another merely sitting up in bed, in yet another climbing a flight or two of stairs, may be the appropriate dosage of exercise. A careful study of the pulse rate and quality, of any changes in the blood pressure, the development of cough, dyspnea, of discomfort in the precordia, of giddiness, of a feeling of anxiety—all these, together with the patient's general condition, must be carefully observed and the conclusions based on the analysis of all of them. Special stress should be laid on an examination some hours after, or even the next day, so that the rapidity of recovery from the test may be observed. In addition, the physician will again look for the evidences of disturbed circulation above enumerated. It is self-evident that in many cases where the patients show definite signs of weakened heart function, such as swollen and tender liver, slight edema of the feet, such tests are often entirely superfluous.

The Prophylaxis of Myocardial Insufficiency

(*Preservation of Compensation*)

The question of prophylactic treatment is probably most frequently considered by the physician under those conditions where he is treating cases which, according to experience, are particularly prone to be complicated by endo- or myocarditis. These are, of course, the infectious diseases, such as acute articular rheumatism, scarlet fever, pneumonia, typhoid, follicular tonsillitis, chorea, and others of a similar nature. The prophylactic treatment of the cardiac complications of such infections is so closely associated with the treatment of acute endocarditis in general that it will be discussed under that caption.

Much more difficult to estimate, and yet equally, if not more, important, is the prophylaxis of the chronic forms of myocardial insufficiency. As we have seen, these chronic forms of cardiac insufficiency owe their origin to a number of different causes, and our prophylactic measures must first and foremost take cognizance of these.

Cardiac Insufficiency from Overstimulation.—Practically these cases fall almost entirely into the group of hypertrophies from excessive work. We have already seen that it is almost impossible, in a concrete case, to state that a particular heart is hypertrophied as a result of overwork alone, since in so many cases the effects of alcoholism, syphilis, and sexual excesses are contributing factors. With a heart before us which is commencing to show some of the effects of excessive work, as expressed

in an accentuation of the second aortic sound, and a beginning hypertrophy of the left ventricle, the question arises as to the advice which we shall give the patient. The first point about which we must be absolutely clear is as to whether the conditions which present themselves are, in reality, pathological. In other words, we must not attempt to force every strongly beating heart in a man whose work is of the heaviest manual character into the diagnosis of hypertrophy. It should be our endeavor first, by repeated examinations of the individual, to determine whether or not the work which he is called upon to do is actually within the physiological capacity of his heart. This is frequently a matter of the most difficult nature. Bearing in mind the great difficulties and many fallacies which are incident to the determination of slight variations in the size of the heart by the classical methods of physical examination, we should be exceedingly conservative in the interpretation of slight apparent increase in size after work. More reliance is to be placed upon the orthodiagraphic examination. Above all, the physician should apply the various exercise tests previously discussed, not once, but repeatedly, and these, taken in conjunction with the accurate determination of the maximal and minimal pressures before and after work, give us, perhaps, our best insight into the effectiveness with which the heart is working. If we find the heart, as shown by the fluoroscopic examination, to have diminished in size (increase of tonicity), and the exercises to have been accomplished with none of the subjective symptoms of cardiac overstrain showing themselves, with the size of the heart showing no greater changes to percussion than fall within the limits of error of the method, we may assume that the heart is thoroughly competent to master the particular work which it has been called upon to do. If the converse of these conditions are found, we are equally justified in assuming that the work which is being done is producing cardiac overstrain, and it then becomes the imperative duty of the physician to advise the patient to modify his mode of life and his employment, if necessary, so as to bring down the work to a point at which the heart can readily master it.

Childhood Sports.—In these days when athletic sports, many of them of the most strenuous kind, have become the rule, especially with lads between the ages of fourteen and twenty, an exceedingly important question is the prophylaxis of cardiac overstrain from this source.

It is very difficult to distinguish between those exercises which might be termed "normal" for a growing lad and those which involve a pathological degree of heart strain in their accomplishment. It must be borne in mind that the differences, after all, are quantitative rather than qualitative. A very simple example suffices to render this perfectly clear. Running for short distances may be looked upon as a perfectly normal exercise for almost any healthy boy or girl, even of rather delicate mold, whereas long distance running, the so-called Marathon runs, which are in recent

years becoming popular, even for untrained boys, represent a degree of effort which is almost invariably pathological.

It is convenient to classify exercises into various groups, one of the simplest classifications being that adopted by McCurdy. He recognizes:

Exercises of Speed.—The classical exercise of this group is running. The essence of the exercise of speed lies in the fact that the individual movements making up the exercise require but a very small amount of muscular effort, but the rapidity with which the repetitions of each movement are made is so great that there is a summation of effort and consequent summation of strain.

Exercises of Endurance.—The most important of these are long distance walking, long distance running (in which the rate of speed is not great), etc. The essence of these lies in the number of repetitions of the individual movement, the strain element beginning at the point where fatigue sets in. In the exercises of endurance the individual movement is one which requires neither particular dexterity nor especial effort to carry out.

Exercises of Strength.—These are typified by weight lifting, wrestling, and those gymnastic feats involving the holding up of heavy weights. The essential point in these is that the movements are carried out neither very frequently nor with especial rapidity, but the amount of strain involved in the individual movement is excessive.

It should be borne in mind that athletics involving any of these three groups of exercises may produce cardiac overstrain. It is hardly possible from a perusal of the literature to form an accurate estimate of the frequency with which these various groups of exercises are concerned in the production of overstrain of the heart, the variety of cases reported by individual observers depending, to a very large extent, upon their sphere of professional activity.

Competitive Athletics.—Obviously the tendency to overexertion will be greatest where there are strong reasons for persisting in the exercise, and this in practical life occurs especially in competitive athletics. One of the most serious defects of sports, as carried out at present in the United States, is the tendency, which has been so well emphasized by various foreign writers, to win at any cost. The conception of sport has come to mean, in only too many instances, not only in our universities and colleges, but, which is vastly more important, in our preparatory schools as well, that a small number engage in highly specialized athletics. Some forms of athletics which arouse the highest pitch of enthusiasm, such as football, are participated in only by a very small proportion of the school, and then only for a short time and season, the participation of the overwhelming majority being limited to the cheering. Athletics of this type must in their present exaggerated form be regarded as far from being beneficial to the great body of students. The athletic spirit which

should be fostered is that which cultivates athletics of a type in which all students may have a part. In a preparatory school, for example, encouraging the students to play a set or two of tennis every day in the season, to walk, skate, and indulge in similar outdoor sports for a limited period of time each day, must be regarded as a goal not to be worked toward in any merely desultory way, but systematically, carefully, and, above all, with due observance to what may be termed the "dosage." The psychical factor in this connection is most important. A wholesome rivalry is absolutely essential to a proper interest in any sport, at least during the formative years. A careful mean must be sought for between the extremes of a senseless mollycoddling, on the one hand, and competitive athletics, only suitable for the trained athlete, on the other hand. Nothing is farther from the writer's intention than to attempt to discourage any rational form of outdoor sports or indoor exercises, but it can hardly be questioned that, as they are at present carried on, they are neither productive of the greatest good to the greatest number, nor are they rationally or systematically directed. Too much has been left to chance or to the discretion of those who have not reached years of discretion. From the standpoint of the physician, a single case of badly damaged heart as the result of competitive athletics goes a very long way toward neutralizing the good which is brought about by athletics in general. These being matters which can only be changed to any very considerable degree by the always slow process of education, we may content ourselves for the present with the following suggestions:

The duty of the family physician is to insist that every child under his care be encouraged in every possible way to gradually strengthen his heart by systematic daily exercise, always by preference in the open air. The father of a family can do much, with both his boys and girls, to encourage long tramps, riding, skating, hockey, outdoor basketball, baseball, and the long list of similar sports. Swimming should hardly be regarded in the light of a sport, but rather as a necessary component of every child's education.

In the case of children who are ill nourished or poorly developed, and the capacity of whose hearts for exertion may be open to some suspicion, the physician should make examinations of the child after various exercises of a vigorous nature, and these should be his guide in recommending or prohibiting a given sport. In the present state of our knowledge in regard to the functional tests of the heart, more precise rules cannot be laid down.

Especial care should be taken to avoid indulgence to excess in such sports as lead readily, by their very nature, to overexertion, particularly where these are associated with a faulty bodily posture. This is especially true of bicycle riding.

Care should be taken to insure a sufficient variety in these sports to

develop all of the muscles approximately equally. This is especially important for girls, whose sports, in the very nature of things, are more limited than is the case with boys.

Cardiac Insufficiency from Disturbances of the General Metabolism.—(*Malnutrition*).—The prophylaxis in cases coming in this category must of necessity vary widely in its application to different individuals, on account of the large variety of causes which are capable of bringing about severe malnutrition, with consequent myocardial weakness. In the great majority of cases these act only as predisposing causes, actual cardiac insufficiency being delayed until some other factor is superimposed. We find among the commoner causes of malnutrition tuberculosis, chronic gastrointestinal diseases, especially those associated with diarrhea, diabetes, the essential anemias, gout, and especially injudicious attempts at the rapid reduction of obesity.

In tuberculosis several factors coincide to bring about cardiac weakness. If the case is a progressive one, in spite of adequate therapy little can be done, nor would it be of great consequence in any event. In many cases which are progressing satisfactorily, so far as the lung condition is concerned, cardiac insufficiency sets in as a simple result of the anemia, lack of exercise, and, in many instances, toxic degenerations of the heart muscle itself. Bearing in mind the possibility of cardiac insufficiency due to this cause, it is desirable to allow patients suffering from the early stages of tuberculosis somewhat more freedom as regards exercise than is commonly the case, provided always that the temperature and general condition of the patient admit of this being done with propriety. The anemia and loss of strength which result from injudicious and too rapid loss of weight in the treatment of obesity is one of the most prolific causes of cardiac insufficiency falling in this group. This will be referred to in detail under the heart of the obese.

The prophylactic treatment of the cardiac insufficiency from the other causes named is essentially identical with the treatment of those conditions.

Cardiac Insufficiency from Long-continued Rest.—In the same way that the heart responds to increased work by the development of increased strength, so a heart which has for a considerable period of time had very slight demands made upon it responds by a steadily increasing degree of weakness. We see these cases especially after such conditions as typhoid, long-continued gastroenteritis, or, indeed, in a convalescence of any condition which has led to a strict sojourn in bed for a considerable period of time. This can be clearly seen in elderly people whose hearts have already a lessened functional power, and in whom, when they have been confined to bed for many weeks or months with, for example, a fracture, cardiac insufficiency is very prone to develop. This group of cases offers a very satisfactory field for prophylactic treatment. In the majority of

conditions necessitating a long sojourn in bed gymnastics may be carried out with the greatest possible benefit. Few cases are so sick that, when the severity of the disease has passed, they cannot be advantageously treated by passive exercises to begin with, and, a little later, by very light active movements. In a rather wide variety of cases, the severity of which has been such as to bring with it a well grounded fear of the development of cardiac insufficiency, the writer has been accustomed to use the lightest forms of active and resistive movements, the details of which are discussed in the appropriate place. Aside from the value such exercises have in forestalling the development of cardiac weakness, they have, in addition, the very manifest advantage that they shorten up the stay in bed somewhat, and, since they can be given for some time before the patient is strong enough to leave his bed, they form a gradual transition to the effort involved in getting up.

Cardiac Insufficiency of the Obese.—In scarcely any other class of cases can the physician who has the proper conception of the relationship which exists between obesity and cardiac insufficiency, and who has the proper control of his patients, accomplish more than in this group. A relatively small number of cases excepted, obesity is due to a disproportion between the food intake and the energy output. After all proper allowances have been made for the effects of heredity, etc., in the production of obesity, the fact still remains that the disproportion between the amount which the patient eats and the amount of physical work done by him—both factors which may be readily controlled—is practically the sole cause of his excess of fat. We now know that the heart itself in these cases may be, and often is, perfectly normal, but, on the other hand, a heart which is perfectly capable of carrying on the circulation in a patient of 160 pounds weight may be utterly unable to do so if the weight of this patient be increased to 200 pounds. The second factor which must be taken into careful consideration is that, with increasing corpulence, the patients develop a decided antipathy to muscular exertion. As a result of this their skeletal muscles lose their tone and strength and, in addition, the heart itself may even grow weaker from insufficient exercise. Patients of this class are exceedingly common among prosperous business and professional men in our larger cities, and in women of middle age in almost all classes of society. One can trace every possible gradation in these patients, from the slight puffing on climbing stairs to the outspoken picture of cardiac breakdown. The cases are easy of recognition, and a few simple exercise tests will indicate sufficiently that the reserve power is becoming lessened.

The indications for prophylactic treatment in such cases are perfectly clear and distinct. The disproportion between the amount of food ingested and the energy expended must be righted. To this end we begin by a very gradual restriction of the quantity of food, according to the gen-

eral plan discussed under the treatment of the heart of the obese. Simultaneously the amount of work which the patient does must be increased in the same slow, steady, progressive manner. Nothing is more disastrous or courts serious results with greater certainty than the too energetic application of this method. The work given the patient to do should be carefully graduated, and in patients of this sort we find the ideal indication for the application of Oertel's Terrain Cure. The restriction of water is of minor importance, the all-important matters being the very gradual reduction of the food and the equally gradual increase in the amount of work which the patient is required to do. The chief obstacle to the success of such treatment lies in the unwillingness of the patient to subject himself absolutely to the régime laid down for him.

Practically the writer is accustomed to set about this treatment in the following manner: Instead of depending upon general statements, as to how much the patient consumes of various foods in a day, the patient is directed to continue his usual diet for a period of three days, weighing the food as accurately as possible on a small postal scale. While such a method can make no claim to a very high degree of scientific accuracy, it is abundantly so for clinical work, since the accuracy of the weighing in the hands of ordinarily intelligent people is at least as great as that of the tables from which we have to figure the caloric value. This is, of course, because of the great variations which necessarily must exist between different meats, vegetables, and cereals, depending on the manner in which they are cooked. With this as a basis, the patient having been at the same time instructed to keep an accurate record of the amount of exercise he takes during the same three-day period, we have the two factors which enable us to proceed in an intelligent manner. Inasmuch as the cases now under discussion are those in which no outspoken symptoms of cardiac insufficiency have shown themselves, the condition is one which can by no means be regarded as serious, unless the degree of obesity be of an extreme grade. The writer has found an exceedingly simple and yet perfectly practical procedure to consist in the reduction of the food to the extent of ten per cent. of its caloric value. A careful perusal of the list of foods which the patient has taken during his trial period indicates with perfect certainty whether the patient is overeating in respect to all classes of food, or whether, as our own experience finds to be usually the case, overeating in respect to one or two foods only. In the latter case the ten per cent. reduction is best made by taking away the proper amount of this particular food. A simple example will illustrate the importance of careful scrutiny in these matters. A patient under the writer's care who, after having had a carefully calculated diet given him, still failed to lose weight satisfactorily, was found, through a misunderstanding on his part, to be taking with each dinner a very large bowl of thick soup made of peas, beans, or lentils. Merely substituting

for this a similar quantity of clear broth (bouillon) at once caused a reduction of weight more than that really desired.

Equally important is the increase in the exercise taken. The writer invariably makes it his business to have a confidential talk with the patient, explaining to him that the only possible solution of his problem lies in the diminution of his food and the increase of his exercise, to such an extent that a slow loss of weight ensues, and when the desired point has been reached the food can be again slightly increased, so that the patient remains with his weight stationary. The patient must be made to understand that in this matter there is no royal road to success, and that overindulgence in eating, with general bodily indolence, or the confinement which so frequently results from sedentary occupations, must inevitably lead to increase of weight with the resultant deterioration of cardiac strength. It is exceedingly difficult to lay down rules for exercise which are anything more than merely suggestive. No hard and fast schema should ever be permitted to fasten itself upon the physician's mind in this respect, but instead he should bear in mind the two fundamental principles, the observance of which alone leads to successful results:

First, the exercise taken must be systematically increased. Second, the form of exercise taken should be such that it is agreeable to the patient and, if possible, one from which he can derive real pleasure.

The first of these is self-evident. The second of these is by no means equally so, and yet, in our judgment, it is the keynote of all successful treatment in these conditions. To induce a patient to subject himself to a course of gymnastics in some institution, or to carry out work in some gymnasium which is excessively repugnant to him, is to invite almost certain failure. The patient will carry out these measures for a length of time dependent upon his momentary enthusiasm and desire to improve, but to every physician who has the proper understanding of the human element involved it will be perfectly clear that, after a short time, the enthusiasm wanes and physician and method alike become discredited. There are few people with reasonable intelligence who may not be made, by careful instruction on the part of the physician, to grasp the situation thoroughly. Every endeavor should be made to interest the patient in some sport. The professional recluse may take kindly to walking or riding; he may take a daily spin on a bicycle into the country, if the conditions admit of this; he may induce a neighbor or a half-grown son or daughter to play a set of tennis with him daily; he may, if convenient to a gymnasium, interest himself in handball or one of the similar games of this kind; or, if worst come to worst, he may be induced to walk a few miles a day in the course of his professional duties. The clerk or business man whose hours, in our large cities at least, are regulated by laws as inflexible as those of the Medes and Persians, is harder to deal

with. Yet, if either of these have been sitting at a desk for eight or ten hours a day, an hour's brisk exercise in the morning or evening, or, in some instances, during a somewhat prolonged lunch hour, will go a very long way toward the solution of the problem. The middle-aged woman who has her household cares, or mayhap her church and club duties, as she calls them, can readily be made to see that a couple of hours each day given up to some exercise is to expend time to much greater advantage. For women of this type, whose exercise has been limited to household duties involving much standing but little real exercise, simple walking at a brisk pace, especially if gentle inclines are included, is eminently satisfactory. Above all, it should be impressed upon the patient that playing golf or taking a long walk once a week, however keenly these may be enjoyed, accomplishes little or nothing. On the contrary, the man who takes no exercise all the week, and then, in a burst of enthusiasm, exercises rather violently for half a day on Saturday or Sunday, is not only doing himself no good, but running the chance of doing harm. A decent amount of interest on the part of the physician, coupled with a little ingenuity, will almost invariably, after a little experimentation, discover some exercise in which the patient can be interested, and which, by virtue of this interest, he can be made to keep up. Ordinary gymnasium work, of the type of the German "Turnen," should be the very last resort, unless, indeed, the patient be a *rara avis* who really enjoys that sort of thing.

A point commonly overlooked is the influence of alcohol on obesity. The business and professional men of our large cities who habitually take a half dozen highballs or cocktails a day, or the laboring man who drinks a couple of quarts of beer daily, seldom realize that these have a considerable food value, and, in many instances, are an important contributory factor in the production of their obesity. A visit to a country club near any large city will show that a pretty large number of men who take a half day off weekly to play golf for the sake of the exercise, in an endeavor to lose weight, nullify the effects of their exercise by the amount of alcohol which they drink for the sake of good fellowship. Reference will be made to this point under the treatment of the heart in obesity.

There is little real danger in these cases of the patient injuring himself through overexertion, if he has been correctly instructed. On the other hand, it is not very infrequently the case that in our larger cities a business man will consult some professional gymnast whose picture he has seen in some magazine, as a model of what exercise will do in the development of the biceps, and the unlucky victim is then and there put through a course of severe gymnastics, the only result of which is to produce a cardiac overstrain. Nor is it very uncommon to find patients who, of their own initiative, have taken up the lifting of heavy dumbbells or the swinging of heavy Indian clubs, or exercises with heavy chest weights. It need hardly be stated that these are all to be condemned.

Cardiac Insufficiency from General and Local (*i. e., Coronary*) **Arteriosclerosis.**—The prophylaxis of the cardiac insufficiency in arteriosclerosis does not differ from the prophylaxis of arteriosclerosis in general, and will be discussed, therefore, under that head.

Cardiac Insufficiency from Chronic Myocarditis.—It is distinctly exceptional for the physician to be placed in a position where he can really be said to be carrying out the prophylactic treatment of a cardiac insufficiency from this cause. The researches of Köster, Rühle, and Krehl were the first to show that true chronic inflammatory changes in the myocardium, apart from the focal degenerations associated with arteriosclerosis, are not uncommon. As clinical entities they occur in connection with the various infections. In a considerable number of cases it follows those infections notoriously prone to produce acute myocarditis, such as diphtheria, scarlet fever, the various forms of sepsis, and variola. It seems certain also that cases occur without endocarditis as a result of acute articular rheumatism.

The greater number of cases, however, begin insidiously, and the great majority of these cannot be diagnosticated until the beginning of cardiac insufficiency sets in. Even under these circumstances the diagnosis is generally one of extreme difficulty. In view of these facts, therefore, a discussion of the prophylaxis is really superfluous. In those cases in which, during the course of one of the acute infections, which, as a matter of experience, we know to be followed by myocardial changes with especial frequency, particular care should be taken to observe the heart closely for a considerable period of time after the convalescence has set in. Should there, under these circumstances, be adequate reason for the rational diagnosis of chronic myocarditis, which will be only very exceptionally the case, appropriate measures should be taken for the avoidance of overstrain, and for the development of the reserve power of the heart. The measures to be taken are identical with those discussed in the prevention of cardiac insufficiency under the head of Arteriosclerosis.

Cardiac Insufficiency from Alcohol (*Beer Heart*).—Cases under this rubric are rarely ever observed in a pure form, since it is almost impossible to exclude the effects of hard work, syphilis, sexual excesses, and overeating. Indeed, it is not known with certainty just how far the ingestion of the large quantities of fluid and the very considerable amount of food value consumed with the alcohol, when taken in the form of beer, may come into consideration in the production of the cardiovascular changes. Given a case of hypertrophy of the heart in which it can be established with reasonable certainty that the drinking of excessive amounts of beer is the principal, if not the only, cause of the heart changes, the prophylaxis against the development of cardiac insufficiency resolves itself into two things: First, the removal of the cause. In the very nature of things, the abolition of the habit of drinking alcohol to excess,

a habit which already is of many years' duration, is a matter of extreme difficulty. In spite of this, the only really rational prophylaxis consists in just this point. Second, if the results of physical examination and exercise tests show that the heart has lost much of its reserve power, and is perhaps on the verge of cardiac insufficiency, the attention should be turned in the direction of increasing this reserve power. The appropriate measures to be pursued are identical with those discussed under cardiac insufficiency due to excessive work, with which condition, as has already been said, it is most frequently associated.

Cardiac Insufficiency from Syphilis of the Myocardium.—These cases belong to the rarities, so far as pure syphilitic changes are concerned, although the latter disease plays a very important rôle in the development of general arteriosclerosis and of coronary sclerosis associated with syphilitic aortitis. In every case where there is even a reasonable likelihood of syphilis being a factor, an energetic antisyphilitic treatment should be at once instituted. It must be borne in mind that old cases in which the syphilis has influenced the myocardium through the medium of the coronary vessels are, in reality, essentially the same, as regards end results, as an ordinary coronary sclerosis. The degree of improvement which can be rationally expected under antisyphilitic treatment is not great. In a moderate number of cases of this sort, which the writer has had under his care, and in which the diagnosis could be established with a fair approximation to certainty, but slight improvement was noted after appropriate treatment. In one or two cases where the improvement was quite striking the results obtained were merely temporary. It should be noted that it is only legitimate to regard cases of cardiac insufficiency as being of luetic origin, when it is reasonably certain that no previous organic heart disease existed, and when simultaneously with the cardiac affection other unquestioned syphilomata are present, as, for example, cutaneous or osseous gummata. Practically the physician will not be called upon to institute prophylactic treatment for the cardiac insufficiency due to lues, except in those cases where, after having treated a case of syphilis, symptoms arise which point to an involvement of the heart.

Cardiac Insufficiency from Concretio Pericardii.—It can hardly be said that a prophylactic treatment of the cardiac insufficiency due to this cause really exists, either theoretically or practically. If pericardial adhesions of sufficient grade and mediastinitis coexist to such a degree as to seriously influence the heart, there is in reality nothing which can be done to arrest the progressive weakening of the myocardium, excepting those general measures, already noted, which tend to strengthen and develop the heart muscle. If the cases have been seen during the attack of acute pericarditis, aspiration should be performed early and repeatedly if the fluid accumulation be great. For the surgical measures which have been suggested reference is made to the treatment of pericarditis.

Cardiac Insufficiency in Chronic Nephritis.—The patients generally come under observation in one of two conditions: either they show the outspoken picture of a chronic nephritis, generally the contracted kidney, or they show nothing but an unusually high blood pressure. In the first group of cases the relationship existing between the renal changes and the hypertrophy of the left ventricle is perfectly evident, but in the latter group of cases the connection is by no means so obvious, and, indeed, it is still not definitely settled as to whether all cases of persistent very high blood pressure take their origin in the kidney. The writer has had the opportunity of observing a number of cases, all but one in men in the forties, in whom a very high blood pressure, ranging from 160 to 200, existed for years, in one case as long as 6 years, before albumin could be detected in the urine. In one of these cases, the only one occurring in a woman, the average blood pressure ranged from 140 to 150 mm. At intervals of several months there would be a rise to 200 or 210 mm., and during this rise a small amount of albumin was invariably present. Free catharsis would invariably bring the blood pressure down to what it was before the attack. Whether these be regarded as cases of contracted kidney from the beginning, in which no other sign existed for years but the high blood pressure, or whether they be regarded as cases of so-called hypertension seems more or less immaterial, and, as the writer's cases are all still living, he is not in a position to make any statements as to post-mortem findings, based on his own experience.

The important fact to be borne in mind is that in all of these cases the effects upon the heart are brought about through the medium of the high blood pressure. The prophylaxis of the cardiac insufficiency of chronic nephritis is practically identical with the treatment of that disease (see Chronic Nephritis).

Cardiac Insufficiency in Pulmonary Conditions.—The cardiac disturbances which arise in the course of various pathological pulmonary processes occupy a peculiar position in that they affect the right ventricle only. The conditions in the lung which come into consideration are especially emphysema, extensive pleuritic adhesions, cirrhotic processes in the lung, and long-continued cases of chronic bronchitis; the severer forms of asthma, when sufficiently prolonged, and, in exceptional cases, diseases associated with prolonged attacks of severe coughing. Under the latter head the writer has seen severe cardiac insufficiency result from an unusually long pertussis. Exceptionally tumors compressing the trachea, especially large and hard goiters, may lead to such a degree of stenosis as to eventually produce cardiac breakdown.

The group of conditions just mentioned, by virtue of the fact that they impair the respiratory capacity, produce, at least when they are of more than low grade, a certain amount of dyspnea. This dyspnea is, as a rule, rather moderate, and, in most instances, is not manifest if the patient

is sitting. With moderate exertion, however, the dyspnea is usually plainly manifest. If other complications arise in the lungs the resultant dyspnea and cyanosis are of much higher degree than would otherwise be the case. This is especially seen when, in the course of an emphysema, an acute infectious bronchitis, such as that often associated with influenza, develops. It is important to bear in mind the fact that, under ordinary circumstances, the dyspnea associated with these chronic processes in the lungs is of so mild a nature as to be only seen on slight exertion. A very common error is to mistake the earliest symptoms of cardiac insufficiency for the symptoms of the underlying process in the lungs. If the right ventricle dilates under the strain imposed upon it by the obstruction in the lungs, the latter become insufficiently supplied with blood, and, as a result, we almost invariably find a great increase in the severity of the bronchitis, if any exist; or, if none have existed up to this time, it now develops. The temptation to interpret this as an aggravation of the primary pathologic process rather than as due to the cardiac weakness is very great.

Wanner states that the sputum in a simple case of chronic bronchitis contains practically no albumin. If the cardiac component is marked the sputum may be found to give a distinct albumin reaction. Wanner recommends for this purpose shaking a measured amount of sputum with 3 per cent. acetic acid until the mucin is dissolved. The mixture is then filtered. In the filtrate albumin may be demonstrated either by the addition of potassium ferrocyanid to the strongly acid filtrate, or after the addition of caustic soda, until only a slight acid reaction remains, by the addition of sodium chlorid solution and boiling. In some cases it is simpler to make a smear of the sputum and stain with a half saturated solution of safranin (Zenoni), after previous fixation fifteen minutes in absolute alcohol. Albumin is stained red, mucin yellow. The importance of these methods is more than a merely theoretical one, since they enable us to determine how much of a bronchitis is due to the cardiac weakness. Just this condition of affairs is exceedingly common, and in many instances the decision is not easy. The writer has repeatedly seen cases of chronic bronchitis with no outspoken symptoms of cardiac insufficiency, such as swelling of the liver, etc., which had failed to yield to the ordinary therapeutic procedures in such cases, disappear rapidly under rest and digitalis.

The careful diagnosis and treatment of these forms of bronchitis is perhaps the most important prophylactic problem which confronts the physician, in the endeavor to ward off cardiac insufficiency in severe cases of chronic pulmonary affections. It is not to be wondered at that they are commonly somewhat neglected, since the severity of the primary condition would seem at first sight to be inadequate to produce severe secondary cardiac changes. When, however, we reflect that these conditions in

the lungs are permanent and rarely susceptible of more than a moderate degree of improvement, it will be seen that they are really a determining factor.

The prophylaxis must necessarily vary with the nature of the lung process. In the case of emphysema, it will be found that in most instances the patient's condition is reasonably satisfactory during the warm months of the year. As cold weather sets in, especially if this be changeable, as is the case with many of our central and north central states, the patient's condition becomes much worse. This is in part due to the fact that the impaired vitality of the lung is not sufficient to resist the exposure incident to the changes in temperature, hence chronic bronchitis from this cause is apt to develop which, in its turn, reacts unfavorably upon the right ventricle.

Bearing in mind the fact that emphysema is a wholly incurable malady, every effort should be made to carry out effectual prophylactic treatment in respect to the heart from the very beginning. It must be frankly admitted that drug treatment is entirely unsatisfactory. It would serve no useful purpose to give a list of the various cough mixtures and sedatives with which these patients are usually deluged. By far the most satisfactory treatment is that derived from change of climate. The patient in easy financial circumstances should, at the approach of the cold and wet months of the year, change his residence to a warm, equable climate, free from sudden changes and free from high winds. The altitude should be moderate or low. In America the climate of southern California or the Gulf coast is often highly satisfactory. Other cases do well in an arid climate. In Europe the Riviera and portions of Egypt form a perfect Mecca for large numbers of such patients. With less fortunately situated patients, who, for various reasons, cannot do this, every effort should be made to have them expose themselves as little as possible during the cold and wet months. It is a common experience to have a patient, usually well along in years, remain in excellent condition during the greater part of the winter, and then, as a result of a single indiscreet exposure, develop a superadded bronchitis which leads only too frequently to insufficiency of the right heart. These patients should wear warm underwear, preferably of silk and wool.

A large number of different mechanical appliances have been devised with the idea of aiding expiration. The vast majority of these, perhaps all, are practically useless because of the relatively short period of time during which it is possible to employ them. At best they have little more than symptomatic value.

For many years various applications of pneumotherapy have been used, and, in general, these have some rational basis. The essence of all of them consists in the fact that the patient inspires air under increased pressure and expires under rarefied air. The value of all such procedures,

as usually carried out, is probably very slight, and not a little of it due to suggestion.

A number of hydrotherapeutic applications have been recommended in achieving useful results in emphysema, but it is exceedingly doubtful if these are of any especial value. Simple cold ablutions, sheet rubs, salt rubs, have an unquestioned value in that they make the patient somewhat less susceptible to the effects of exposure.

The above remarks in respect to emphysema may be applied verbatim to the more serious cases of chronic bronchitis without emphysema, and to the rarer cases of bronchiectasis.

In the various forms of indurative processes in the lungs, such as those which result from a pleuropneumonia, the condition is apt to be stationary, hence the danger of ultimate cardiac failure is less than in those conditions which are essentially progressive in nature. While the majority of such conditions are permanent, some degree of improvement may usually be brought about by systematic respiratory exercises. These at first may be passive, and later active. The writer has seen excellent results from these, even after the onset of disturbances in compensation.

Since in all the cases discussed in this group the right ventricle alone is involved, the measures ordinarily taken to increase the strength of the heart, and which act primarily on the left ventricle, are probably of little use. In regard to occupation it is important that all patients affected with chronic pulmonary processes of the above-mentioned types should not carry on any vocation which brings with it the necessity of severe physical strain.

Cardiac Insufficiency in Kyphoscoliosis.—Cardiac insufficiency from this source, especially when of high grade, is so common that it is the cause of death in considerably over half the cases (Bollinger). Romberg noted in thirty-eight cases of kyphoscoliosis that death resulted twenty-six times from cardiac insufficiency. The importance of prophylaxis may be judged from these figures. For the appropriate orthopedic measures to be taken under these circumstances, reference should be made to the textbooks on that subject.

Cardiac Insufficiency in the Valvular Lesions.—The preservation of compensation in the various valvular lesions gives the physician, in many respects, the opportunity to make of prophylaxis of decompensation something more than an enumeration of things which are theoretically desirable, but rarely carried out. The reasons for this are evident. The valvular lesions are, in comparison with most of the other causes of cardiac insufficiency, easy of diagnosis. The physician is generally on the lookout in the various infections for the development of a murmur, hence the diagnosis is, as a rule, made early. An equally important reason is the fact that the majority of writers, even at the present time, give to the valvular lesions an importance far beyond their due, relatively ignoring

the vastly more frequent and important forms of cardiac insufficiency unassociated with pathological changes in the valves. The mind of the public, which reflects to a certain extent the opinion of the general practitioner, is firmly imbued with the idea that, so long as the valves of the heart are normal, there cannot be much the matter with that organ. How frequent it is that we hear, when called in consultation, and have made, let us say, a diagnosis of cardiac insufficiency from myodegeneration, to have the patient, seconded more or less by his medical attendant, say: "Oh, I am so glad it is nothing organic." The consciousness of the medical world has been exceedingly slow to grasp the fact that the valvular lesions constitute neither the most frequent nor even the most important of the various causes of cardiac insufficiency, and so it has come about that the term "organic" is almost identified with valvular lesions.

In most instances, then, the practitioner is in possession of the fact that a valve lesion exists while it is yet comparatively recent. In those infections, therefore, which are notoriously prone to be followed by endocarditis the most important prophylactic measure consists in enjoining a sufficiently long period of rest, in order that the damage to the valves may be minimized, since it cannot be, by any means at our disposal, absolutely prevented. These points are made the subject of further discussion under acute endocarditis.

The acute stage being passed, and the valvular lesion having reached its height, and assuming the compensation to be perfect, the question then presents itself as to what measures may be employed for the preservation of its compensation. The accumulated experiences of recent years having shown so conclusively the great importance of the nose, throat, and tonsils as portals of entry for the infectious processes leading to endocarditis, these are first of all to be examined with the utmost thoroughness. Where the tonsils are chronically enlarged or adherent to the pillars, or if, even without much enlargement, there have been attacks of tonsillitis, the tonsils should be at once thoroughly and completely extirpated. The same remarks apply to the question of adenoid vegetations. Both these and the tonsils should be removed with the greatest thoroughness by some one who has had the necessary training to do the operation in a thoroughly workmanlike manner. Many of the tonsil operations which have come under the writer's observation have been little more than the removal of the protruding part, a procedure which is, in his judgment, something worse than useless. The writer has seen thorough removal of tonsils and adenoids put an end to recurrent attacks of rheumatism and endocarditis so many times, that he has come to regard it as the first prophylactic measure to be undertaken. In a less degree this holds true of pathological nasal conditions. In the event of a recurrence of a rheumatism, chorea, etc., the indication is imperative to have the patient remain in bed a longer time than would be the case if no valvular lesion existed, and especial

care should be taken during convalescence to see that overexertion of every kind be carefully avoided.

Minor special indications are to be found in the seat of the valve lesion. The mitral lesions, especially mitral stenosis, are compensated by the hypertrophy of the right ventricle, and an integral part of the mechanism of their compensation consists in an increase of the blood pressure in the lungs. While a perfectly compensated mitral lesion (meaning by this one in which the mean blood pressure and rate of flow in the systolic circulation equal the normal) causes no dyspnea while at rest, exercise produces, in these patients, at least when the lesion is of any considerable grade, a more severe dyspnea than in a normal individual. This is because of the mechanical effects of the increased pulmonary blood pressure, hence in patients having mitral lesions a more than usual degree of care should be bestowed upon such intercurrent diseases as affect the lungs, such as chronic bronchitis, asthma, etc. Lesions at the aortic orifice are compensated by the left ventricle alone, hence, so long as compensation remains perfect, the pulmonary circulation is not touched. The degree of compensation which may be maintained frequently over a long period of years is nothing short of marvelous. Romberg has shown that in experimental valve lesions the heart has at its disposal an amount of reserve power little, if any, inferior to that possessed by the normal heart. The writer cannot subscribe to the belief held by some that a heart with a valvular lesion perfectly compensated by hypertrophy of one or both ventricles is as efficient as a normal heart, since many other factors, such as the condition of the myocardium and the likelihood of progressive disturbances of nutrition existing, must be taken into consideration. Indeed, in last analysis, it is the condition of the myocardium, rather than the nature of the valve lesion itself, which determines the future course of compensation.

The remarks already made under previous captions in regard to the effects of exercise and sport, overeating and overdrinking, etc., apply, of course, with equal force to the valvular lesions. It should be borne in mind that with a stationary lesion at one of the valvular openings which is in a condition of perfect compensation no attempt should be made to further increase the existing hypertrophy with the idea of still farther adding to the reserve power.

Treatment

(*Restoration of Compensation*)

For purposes of illustration it will be convenient to divide the cases of myocardial insufficiency into three groups: First, the mildest cases with relatively slight symptoms of decompensation, such as moderate dysp-

nea and very slight venous congestion of the liver; second, cases of medium severity with considerable dyspnea, perhaps amounting to orthopnea, well-marked enlargement of the liver, a fair degree of edema of the dependent portions, and somewhat diminished urine; third, those cases in which cardiac insufficiency is so great as to involve distinct and immediate danger to life, associated with extreme dyspnea, great congestion of the liver, anasarca of high grade, and effusions into the serous cavities, with marked diminution of the quantity of the urine and frequently a stasis albuminuria.

Mild Cases.—In these mild cases the first question to be answered is, shall the patient be placed at complete rest in bed? This must be answered according to the circumstances of the patient. The writer's preference is very strongly for absolute rest in bed, if only for a few days, in the beginning of every case of cardiac insufficiency, even of the very mildest grade. While this would probably be regarded by the majority of clinicians as going somewhat to extremes, the writer has found so much difficulty in these mild cases in convincing patients of the necessity of curtailing very greatly the work of the heart, that he prefers to take the rather radical step of putting the patient in bed where he is under better control, and where the heart's work can be reduced to a minimum.

It has happened, literally scores of times in ambulatory clinic practice, that hearts of this kind which failed utterly to respond satisfactorily to digitalis, even though the patients were presumably curtailing their physical work, would show very definite and marked improvement after twenty-four hours' rest in bed. The writer is accustomed, in teaching, to express this by the statement that a case of cardiac insufficiency which is sick enough to need digitalis is sick enough to go to bed. Of course this does not refer to those cases where, to preserve the compensation, digitalis is administered over long periods of time, the patient being up and about.

On going to bed the patient's bowels should be thoroughly opened, an ice bag placed over the precordium, and the patient placed on simple, light diet during his stay in bed. In these very mild cases great limitation of fluid is neither necessary nor desirable, but the patient should be restrained from drinking more than average amounts, perhaps one and a half to two liters daily. In many instances the response to this rest in bed is so prompt that digitalis would seem almost superfluous. The writer is in the habit of waiting twenty-four hours before administering digitalis so as to obtain an idea of how much may be accomplished merely by rest. These mild cases require relatively small doses of digitalis, such as pulvus digitalis, 0.05 gm. (gr. ¾), t. i. d., assuming the digitalis powder always to have a value of 80 frog units per gram. The dose of digipuratum is the same, since this is standardized so that 1.0 gm. represents 80 frog units. If unstandardized preparations are used the dose is practically guesswork. This digitalis may be kept up in the above dosage for three or

four days, and then continued in half the dose for perhaps a week longer. In these mild cases the use of gymnastic therapy or the carbon dioxid baths is perfectly appropriate, since the heart has plenty of reserve power to admit of their application. Indeed, it may be said that they find their best field of activity just in this group, and, the means and intelligence of the patient permitting, they may be employed according to the detailed rules laid down under those captions. Practically it may seem to the patient that it is a case of "much ado about nothing." Under no circumstances should such procedures be used in a slovenly or haphazard way, and, if the physician is uncertain as to his being able to have them carried out in a correct and skillful manner, they would far better be omitted entirely. The use of digitalis for a long period of time is hardly advisable. When compensation has been perfectly restored, as evidenced by the complete disappearance of swelling and tenderness over the liver and the cessation of all dyspnea, the patient may be allowed to get up. This is the time to have a frank understanding with the patient, in which it must be made clear to him that the maintenance of good compensation depends upon his willingness to diminish the work which he has hitherto thrown upon his heart. Gentle exercise in the open air, increasing very gradually, and, when possible, including gentle grades somewhat after the fashion of a Terrain cure, are now indicated.

If the patient has an indifferently developed musculature, quite a little can be accomplished by exercises designed to strengthen this, and yet of sufficient mildness to run no risk of overtaxing the heart. They should only be taken under the supervision of the physician. The special measures to be instituted in the different varieties of cardiac insufficiency are discussed under those heads.

Moderately Severe Cases.—In these cases of moderate severity there should be no question as to the propriety of promptly putting the patient at absolute rest. Immediately the diagnosis is made, the individual should be put to bed with an ice bag to the precordium. For the first few days, at least, a strict milk diet, not over one and a half liters (three pints) in twenty-four hours. Only a very small quantity of water should be given in addition. From the very beginning the quantity of urine in each twenty-four hour period is to be accurately measured to control the effects of digitalis. While there can be no possible objection to giving digitalis at once, and indeed this is the best plan if there be much subjective discomfort, the writer, even in these cases, prefers to wait for twenty-four hours so as to determine the quantity of urine which is being passed and to ascertain the effects of rest alone. During this first twenty-four hours the bowels should be well opened, but the patient should not be unduly purged in the hope of relieving the edema in this way. In the writer's opinion much more harm is done by the production of great weakness through purging than is offset by the small amount of good accomplished by the removal of relatively small quantities of fluid. Whether digitalis be given at once or at the end of twenty-four hours, it should be given in effective doses in the manner described under the caption Digitalis. Powdered digitalis of the standard strength of

80 units, or correspondingly larger doses if the leaves are of weaker titer, should be given in doses of 0.1 gm. (gr. 1½) about four times the first day, reducing the dose to half this quantity on the second and subsequent days. The dose of digipuratum is the same. Each tablet corresponds to 0.1 gm. of standard digitalis leaves and each tablet represents this dose, equal to 8 frog units. Thus, four tablets may be given on the first day and two on subsequent days. It must be understood that these doses represent averages, and many patients will respond to less and a few may require more. Above all, the practitioner should remember that digitalis effect is determined first and foremost by the increase in diuresis, secondly by the increase in the pulse pressure, and that the slowing of the pulse rate is by no means so accurate or reliable an indicator as these two. If the heart is one which is capable of responding to digitalis at all; in other words, if there are enough normal fibers remaining in the myocardium to be affected by the drug, and if the underlying pathological process be not of too severe a grade, the beneficial effects of digitalis are generally manifested by the end of the second day. The books of fluid intake and fluid output should be as carefully kept as the ledger in a counting house. If any considerable amount of edema exist, and this does not show signs of yielding in three or four days, its mechanical removal is indicated by means of one of the methods described under that head. This is much too frequently omitted, and it will be often found that where digitalis fails to act before its removal prompt results may be had from its use after the drainage of the subcutaneous tissue. This applies with equal force to transudates in the pleural cavities.

The disappearance of the objective signs of cardiac insufficiency usually occurs in the inverse order of their development, the serous effusions first, the anasarca next, then the enlargement and tenderness of the liver, and lastly the dyspnea. The physician is urged to pay particular attention to the liver, since it is an extremely delicate indicator of the degree of venous congestion. Digitalis should be continued in doses of about 8 frog units (0.1 gm. or gr. 1½) of powdered digitalis or digipuratum daily, as long as there is the slightest indication of insufficiency of the heart. When perfect compensation has been restored, the patient should be in bed for a week longer. During this week passive exercises should be given, if possible, as indicated in the discussion of that subject. It is a great mistake to allow the patient to get up as soon as compensation is restored, but with no preliminary training of the heart.

Carbon dioxid baths should never be used in this group of cases until the patient has regained a good degree of compensation, and until the physician feels that the myocardium is capable of responding to the increased work thrown upon it by the baths. They should not be used in cases where the patients are of a highly excitable disposition. Care should always be taken to begin with the very mildest baths with the temperature in the indifferent zone.

Especial care should be taken to avoid the use of baths and exercises simultaneously, in a schematic manner, as is so often done, forgetful that each of these makes demands upon the heart. This organ may frequently have plenty of reserve power to master the demands of one, but

too little to master those of both. In other words, the strictest individualization is necessary, and not the mere routine application of methods, however much vaunted these may be. After perhaps a week's application of passive exercises, the patient may gradually be allowed to get up, the physician not forgetting the frank understanding to be had with him. It is hardly necessary to say that in this group of somewhat more severe cases it is still more necessary that the patient limit his physical activity to that amount which is well within the reserve power of his heart. On the other hand, the mistake of condemning him to total inactivity should not be made. The physician should see the patient frequently after he is up, and no increase in work should be made without his sanction.

After the first few days of strict milk diet, and as soon as a distinct improvement is seen, semisolid food may be added which is easy of digestion, care being taken to avoid "slops." Full diet may be given after the patient has been about for a few days.

Except to fulfil some special indication, other medication is in general superfluous. When digitalis or strophanthus, appropriately given, fails to act, nothing can be expected from their very much inferior substitutes. The patient may be well spared the strychnia which is so universally used in this country.

Severe Cases.—With the danger to life postulated in this group of cases, prompt and energetic action must be taken. The question of the propriety of putting these patients to bed does not come into consideration, since the patients have generally been there for some time, and, when the symptoms have reached the postulated severity, the dyspnea is almost invariably so severe as to amount to orthopnea of the highest grade, so that the patients are usually found propped up in bed, or, perhaps quite as frequently, sitting up in an armchair. The theoretical indication is, of course, to have the patient assume, as nearly as possible, the horizontal position, yet this is manifestly impossible. No attempt should be made, therefore, to have the patient take any position which causes him increased dyspnea, since the increase of this would much more than counterbalance the small amount of good which would accrue from a more horizontal position. One of two things should be done with the least possible delay, and in some instances both may be necessary. These are either a free venesection or an intravenous injection of an adequate dose of one of the digitalis bodies, the three coming under consideration being strophanthin (Boehringer) (which is always referred to when strophanthin unqualifiedly is used), digipuratum, or digalen. With no further ado, whichever of these measures has been decided upon should be carried out. If the patient be in otherwise satisfactory condition, that is, not greatly anemic and reduced in vitality, the venesection would be generally given the preference, for the important practical reason that it may be carried out under almost any conditions at once, and because, after a venesection,

digitalis quite often works with greatly heightened effect. After quick disinfection of the arm at the elbow the vein is opened, according to one of the methods described under the head Venesection, care being taken to abstract a sufficient quantity, since the failures of venesection, the indications for it having been properly established, are generally due to the failure to abstract a sufficient quantity of blood. The quantity abstracted should be carefully measured, since a little blood spread around over bedding, dressings, etc., generally conveys the impression of a much larger amount.

The relief afforded by the venesection should be almost instantaneous. If the improvement following venesection be sufficiently great, the question may then be debated as to whether digitalis would better be given internally or intravenously. If the patient has not had digitalis previously, it should by all means be given intravenously and at once; if, on the other hand, the patient has had digitalis (or strophanthus, which terms we use interchangeably when speaking of the digitalis bodies as a group) recently, great caution must be exercised in the injection of full doses of strophanthin, digipuratum, or digalen to avoid serious cumulative action. It should be remembered, as discussed under the head Digitalis, that these bodies are not to be injected as last resorts after their administration in other ways has failed. Strophanthin comes in ampoules, each containing 1 c. c. (16 minims) with a physiological strength of 15 frog units, the full intravenous dose. These ampoules, which are exceedingly convenient for emergency use, are already sterilized and require no further preparation. The fluid is drawn up through the needle of a carefully sterilized syringe (the writer much prefers the all-glass syringes of English manufacture), and, after a quick disinfection of the skin, is injected into one of the large veins at the elbow. The utmost care should be taken to assure oneself that the needle is actually in the lumen of the vein, by first aspirating a drop or two of blood and then injecting very slowly. Even though the veins be prominent, it is generally best to make sure of this by the application of an elastic bandage about the arm. As a rule, the full dose of strophanthin would better be given, but excellent results are obtained with three-quarters of this dose.

Digipuratum is marketed in ampoules (for intravenous and hypodermic use). The tablets should not be used for this purpose. Each ampoule contains 8 frog units, and the intravenous dose is 1 ampoule, which may be repeated once in the 24 hours.

Digalen is marketed in bottles containing an ounce, a measuring pipette accompanying each bottle. The intravenous dose is 1 c. c. (16 minims). Its effect should be equally as rapid as that of strophanthin, and improvement in the pulse pressure and subjective symptoms is generally manifest in a very short time. *In the case of both strophanthin and digalen these doses must on no account be repeated within twenty-four*

hours. Serious, possibly fatal, results may follow a disregard of this injunction, especially with strophanthin. At the end of twenty-hour hours, if the patient be improved as a result of these measures, the oral administration of powdered digitalis may be proceeded with in the ordinary way, in doses of approximately 0.2 gm. (gr. 3), equal to 16 frog units, if the powder be active (80 frog units per gram). Since digipuratum is arbitrarily standardized to this value, the same doses of it should be employed. If difficulty of absorption is to be apprehended, digipuratum may be continued hypodermically.

In these extraordinarily severe cases the writer is of the opinion that, while in many, if not in most, instances the anasarca and serous effusions will be absorbed of their own accord, if the cardiac power be improved, yet it is not expedient to wait for this. For the reasons analyzed under the special treatment of these conditions, these dropsical effusions are not a matter of indifference, but throw additional strain upon the heart. Because of this their mechanical removal would better be undertaken at once. A nice question to decide arises just at this point, if there happen to be, as is usually the case, effusions into the serous sacs, especially the pleuræ. Shall these serous effusions be removed by puncture? While the puncture of one or both pleuræ is, with the patient in good condition, a matter attended with a small amount of shock, it must be borne in mind that these patients are about in the worst possible condition imaginable to withstand even the slightest degrees of shock. In addition to this, the necessary sterilization and manipulation of the patient are fraught with danger, so that, unless the pleural effusions be of high grade, the writer strongly advocates, under such conditions are we are now postulating, leaving them alone. Fluid in the abdomen rarely reaches such a degree as to warrant a puncture while the patient is in so grave a condition. On the other hand, the introduction of Southey's trocars into the legs and thighs, or incision of the skin, can be done with the minimum of pain and shock, and with an orthopneic patient, and the legs in a dependent position, the removal of fluid is generally exceedingly rapid. The results obtained by the employment of a free venesection, the intravenous administration of a digitalis body, with simultaneous evacuation of fluid from the legs, are in many instances, as the writer can testify, brilliant beyond expectation. Assuming that the underlying pathological process is one that is not hopelessly beyond redemption, the rapidity with which a patient gasping for breath, unable to sleep, and literally water-logged is transformed into an individual capable of enjoying a very fair degree of health is so great, and the results so apparent to both the patient and his environment, as to make these cases conspicuous examples of the therapeutic resources of the internist.

For the first day or two sleep is almost impossible. The hypodermic use of morphia or its derivatives is to be looked upon as something more

than symptomatic treatment, since a good night's sleep adds greatly to the recuperative powers.

Until the patient shows marked improvement, at least, the diet would better be limited to milk. The fluid intake should be sharply restricted, the total fluids ingested not exceeding a liter and a half to two liters daily (three to four pints), this amount to be increased only as the conditions warrant, up to a normal number of calories.

It need hardly be said that the strictest accounting should be kept of the urinary output, as well as of the fluid intake, since this affords us the surest evidence of satisfactory digitalis action. In like manner, accurate account must be kept of the amount of fluid removed mechanically from the subcutaneous tissue.

For the first few days, with severe orthopnea, it is frequently best not to put the patient to bed at all if a large, high-backed, comfortable chair can be obtained. As the dyspnea grows less the position assumed by the patient should approximate more the horizontal, but this should not, under any circumstances, be brought about too rapidly, or so as to cause the patient any distress. Indeed, the ease with which the patient can assume a more horizontal position is, in and of itself, a very good criterion of the progress he is making. With the patient in bed, the legs should never be raised with the intention of causing the fluid to disappear in this manner. All that happens under these circumstances is that the fluid drains from the legs to the trunk, where it is productive of infinitely greater embarrassment. On the contrary, the legs should be rather kept low, especially if the Southey's trocars or similar contrivances are being used.

Carbon dioxid baths and gymnastics of any kind are absolutely contraindicated during all this time. Gentle massage of the extremities may occasionally be useful, and perhaps helpful, in that it aids slightly in promoting the absorption of fluid. When the patient is able to lie down with comfort, very mild passive exercises may be instituted, but *until perfect compensation has been restored* and, in addition, a certain amount of reserve power established, no thought of even the mildest forms of active exercises should be entertained, and then only in strict accord with the principles and methods laid down under that caption. The same remarks apply to the administration of the CO_2 baths, and in these severe cases, in spite of numerous recommendations to the contrary, it is probably never justifiable to employ both baths and exercises simultaneously.

Care should be taken to keep the bowels moderately active, but, although it is a time-honored custom with many clinicians to prescribe the administration of vigorous doses of salines as a routine measure, the writer cannot subscribe to the advisability of this procedure. The weakening of the patient more than offsets the small amount of fluid lost in this way. The same remarks may be made of sweating procedures, but

with more force, since in these very severe cases there is serious danger of collapse from their employment.

With the great development of fluid accumulations which exists in these cases, the question as to the use of other diuretics is of importance. They should certainly not be ordered as a matter of routine. Digitalis is, after all, the great diuretic in these cardiac affections, and at the outset, at least, it is far wiser to employ digitalis alone, as only by so doing can we obtain a correct estimate as to the efficacy of its action. In case of its failure, and where, for some reason or other, the Southey's trocars do not work satisfactorily, and the edema is of high grade, the addition of one of the theobromin or theophyllin compounds would be in place. Too much, however, must not be expected from them.

The favorable outcome, above described, for so high a grade of cardiac insufficiency is, of course, only possible where the cardiac musculature still has a fair degree of power remaining in it, and especially where the cardiac failure is a result of excessively great demands suddenly placed upon the heart. Such a combination of affairs is frequently met with in young patients with valvular lesions, with a fairly intact myocardium, and where as a result of excessive physical exertion a severe grade of decompensation has set in. Under these circumstances, especially if the attack of decompensation be the first, the above-sketched brilliant results may be legitimately hoped for. If, on the contrary, it be due to the final giving out of an arteriosclerotic, senile heart, or the final stage of a contracted kidney, but little can be hoped for from any method of treatment. The point which the writer wishes to urge is that many cases are lost through a want of appreciation as to what constitutes really efficient treatment. By this is meant the giving of a few small doses of a digitalis preparation of more than questionable activity, the prescribing of some refrigerant diuretic, the administration of a daily purge—all of these constituting, of course, a mere *"Schein-therapie"* (imaginary treatment), as the Germans call such "playing-at" treatment.

Treatment of Cases with Doubtful Diagnosis.—It not infrequently happens that in the exigencies of practice the practitioner may be confronted with a case presenting most of the symptoms just described under the third group of cases, i. e., those with symptoms of such severity that there is immediate danger to life, and where manifestly there is a considerable degree of cardiac insufficiency, but where the presence of albumin in the urine in fair amounts makes it a matter of doubt, in the beginning at least, as to whether the condition is a primary kidney disease and the heart involvement entirely secondary, or whether the albumin present is due entirely to stasis. While this differential diagnosis is not one of extraordinary difficulty on paper, it is, at the bedside, and especially when an accurate history is unattainable, not infrequently impossible.

In all such cases the proper course to pursue is for the practitioner to assure himself definitely as to one central fact, namely, as to whether or not there is actually cardiac insufficiency existing. If he can with certainty diagnosticate the existence of this the case should be treated as a pure cardiac one quite independent of the existence of a renal complication. Indeed, most clinicians have seen, in cases which they felt certain had both cardiac and renal components, under the measures just described, the albumin disappear and the case so shape itself as to make it perfectly clear that after all there was no pathological condition in the kidney except a severe stasis. As discussed at considerable length under "Digitalis," cardiac insufficiency from whatsoever source is appropriately treated by digitalis. The results must manifestly be good or indifferent or entirely absent according to the nature of the underlying pathologic process.

Treatment of the Clinical Forms of Chronic Myocardial Insufficiency

While, as we have seen, the essential points in the treatment of chronic myocardial insufficiency are the same, irrespective of its causation, yet the underlying pathological conditions which produce it afford us certain special indications, in addition to those already treated of under the general plan of treatment. It must be understood that no endeavor will be made to outline a special course of treatment for each of these clinical groups, but only to emphasize the few individual points in which the therapy in each of these groups may differ from that laid down in the general plan.

Cardiac Insufficiency from Overstimulation.—Since in these cases the insufficiency has been due to overexertion in one form or another the most important point is absolute and complete bodily and mental rest. This complete bed rest may be required even for weeks, and in this group of cases all such measures as baths and gymnastics should be administered only with the *greatest possible caution.*

The same remarks apply verbatim when the overstimulation is due to nervous impulses, as in Basedow's disease. It may be doubted if masturbation, in and of itself, is ever productive of cardiac insufficiency, yet in those cases in which it is a factor an attempt must be made to overcome the habit by appropriate measures. All sources of artificial stimulation such as alcohol and tobacco should be strictly frowned upon. Cool baths just before retiring are useful. The diet should be rather scanty than otherwise, and the bowels should be kept well opened.

Cardiac Insufficiency from Metabolic Disturbances.—In the heterogeneous group of cases coming under this caption almost no general rules can be laid down. The most important point to be enjoined is that in cases of cardiac insufficiency of obscure origin, especially in patients under forty, in whom no histories of the infections may be obtained, the likelihood of the heart's weakness being due to secondary anemia and to the products of an altered metabolism is very great. Since the causal therapy

is of the utmost importance, these cases, though not common, need careful study. Thus in one of the writer's cases the cardiac insufficiency could be traced to a high grade anemia, which ultimately was shown to have had its origin in the presence of intestinal parasites. A similar case was shown to be due to repeated small hemorrhages from gastric ulcer. In severe chlorosis, where these cases of myocardial insufficiency are not infrequent, it is likely that other causes coöperate with the anemia. The writer has, on several occasions, seen light but well-defined symptoms of cardiac insufficiency develop in patients with severe chlorosis, who had acted literally upon the advice to "take plenty of outdoor exercise." The particular measures to be employed will suggest themselves when the underlying cause has been determined. Bearing in mind the baneful influence of even moderate degrees of anemia as a contributory factor the writer would urge *careful determination of the hemoglobin in every such case,* and its correction, if found to be deficient, according to the methods already laid down.

Cardiac Insufficiency from Long-continued Rest.—The diagnosis of the cause of the functional weakness of the heart suggests its own remedy. A systematic endeavor must be made to train the heart muscle by exercising it according to the principles which have already been discussed. Carbon dioxid baths and, if these are well borne, the addition, somewhat later, of gymnastics along the lines laid down by Herz, later perhaps graduated active exercises and walking up mild grades—all of these undertaken, of course, under the direct supervision of the physician, are the measures to be employed.

Cardiac Insufficiency of the Obese.—The patients in this group who present well-marked symptoms of cardiac insufficiency must be regarded in a very different light from simple obese individuals who have presented no symptoms of this nature. Otherwise expressed, an obese individual who has shown no symptoms on the part of the heart, except the dyspnea which results from the disproportion between the weight of the body to be moved and the power of the motor which has to move it, is, so far as his heart is concerned, a relatively normal individual. If his excess fat be removed the heart will, under most circumstances, carry on its work as well as ever. This presupposes that the obesity has not been of too long a duration and that the skeletal musculature is normally developed. On the other hand, the patients in the group now under consideration are patients affected primarily with cardiac insufficiency, and the treatment of the obesity, if undertaken at all, is undertaken merely because it is the excess in weight which has led to the cardiac breakdown. The first of these groups of patients, normal individuals, except for a degree of obesity which, in our judgment, might prove likely to develop cardiac weakness, has been abundantly discussed under the Prophylactic Treatment of the Heart of the Obese. It might seem entirely superfluous to make statements which, in

general, are so self-evident were it not for the fact that it is one of the commonest occurrences to see patients with outspoken symptoms of cardiac breakdown, due to obesity, subjected not only to severe régimes of diet, but made to exercise in a manner which, all too frequently, is productive of great harm. The layman himself feels quite competent to treat a condition to which he refers rather lightly as "nothing but too much fat." In our larger cities there is quite a contingent of patients of this kind whose hearts have been seriously damaged by their taking up this or that diet fad and by consulting some advertising gymnastic quack.

The first question to be answered is—after having determined that the patient has a cardiac insufficiency, and that this is due to obesity—shall the patient be subjected to a régime of restricted diet for the purpose of reducing the amount of fat? In the beginning, "No." It is infinitely safer and, in the majority of instances, will lead to satisfactory results more quickly, to first endeavor to increase the strength of the heart by digitalis, graduated exercises, etc., and to abstain from all dietetic reductions until these measures have either proven insufficient or the heart is again restored to a condition of good compensation. In this connection it is well to remind ourselves again that an even more important rôle than is played by the excess of fat is played, in most instances, by the weakness of the skeletal muscles. The patients who generally come under observation for cardiac breakdown and suffering with obesity are usually not the active, powerfully built, muscular individuals, but the indolent, soft-muscled, flabby kind, prone to the excesses of the table and, not infrequently, beer drinkers as well. We may conveniently distinguish the same three grades of cardiac insufficiency as were noted under the General Plan of Treatment.

In the lightest cases, with slight dyspnea, with some swelling and tenderness due to the congestion of the liver, the first indication is to place the patient, if not at absolute, at least at relative, rest. In other words, in spite of the fact that the obesity originally may have been due to a lack of exercise, the condition of the heart is now such as to imperatively demand that the individual limit his physical work to a point which is well within the power of the heart to accomplish. Romberg lays particular stress upon thoroughgoing rest, especially in cases where the patients have been overdoing in both body and mind. As this author, who has had a rich experience with this class of cases, states, this is a matter in which the obese patient with weak heart is frequently sinned against.

On the other hand, the other extreme must not be adopted. In no group of cases is the application of systematic gymnastics of greater utility. Beginning with the passive and inertia movements, as described under the head Gymnastics, little by little we proceed to resistive movements in the same proportion as the strength of the heart warrants. In spite of the prejudice of many against digitalis in such cases, it may be

employed with precisely the same beneficial results as in any other variety of cardiac insufficiency of equal grade. The writer has had many notably good results in this group of cases by judicious limitation of work, the administration of digitalis and graduated exercises, the diet remaining the same and, in most instances, the weight not changing materially until the strength of the patient's heart became such that he could take much more exercise than he had been accustomed to.

The writer's experience with the Terrain Cure has been, because of the geographical conditions which obtain in his field of practice, and the difficulty of securing suitable Terrain paths near home, somewhat limited. And yet, even with this limited experience, the results obtained by this method have been more than unsatisfactory. The difficulty arises in the almost absolute impossibility of controlling the exact amount of work done by the patient, in consequence of which overexertion is prone to occur with, of course, disastrous results.

The carbon dioxid baths, if carried out with the precautions and under the limitations noted under that caption, are admirably adapted for the treatment of this group of cases.

A successful result in the treatment of a case of this kind should aim rather at the gradual improvement in the functional capacity of the heart and at the development of the skeletal musculature than at the mere removal of a given amount of adipose tissue. In cases where the cardiac insufficiency has reached the second grade, the more pronounced dyspnea and swelling of the liver, together with edema of the feet, the above precautions should be especially taken to heart. A still greater degree of rest should be strictly enjoined. Digitalis should be given according to the usual principles and, in the beginning, at least, no attempt should be made toward the reduction of the body fat. In the milder cases coming in this category the passive and inertia movements are properly applicable, especially if the case shows a tendency to improve. If, after persistent and conscientious endeavors to increase the strength of the heart, carried out over a period of two or three weeks, no improvement be noted a very careful reduction cure may be instituted. Under no conditions should this ever be carried out rapidly, the loss being not more than ½ to 1¼ lbs. a week. It does not lie within the province of this article to discuss in detail the technique of the method for the dietetic treatment of obesity, since this is abundantly treated of in the discussion of that subject. There is no especial diet suitable for the reduction of obesity in heart cases as distinct from that suitable for its reduction in any other class of cases. The only points to be observed are, first, that the proteids should not be materially reduced; second, that the green vegetables and fruits should be freely given, and, third, that the fats and carbohydrates should be restricted to such a degree as is necessary to bring the caloric value of the diet down to that desired. Especially should no preconceived notion as to what

constitutes the patient's "proper weight" be allowed to influence the judgment as to how far the reduction should be carried. *This is to be governed solely by the condition of the patient's heart.* When the reduction has reached that point at which the proportion between the patient's weight and the strength of his heart is such that the action of the latter becomes satisfactory the loss of weight has gone far enough.

In this connection particular emphasis should be laid upon the rôle of alcohol in the production of obesity. If the patient has taken a sufficient quantity of alcohol to make the caloric value of this a factor to be reckoned with in the production of obesity this should be promptly prohibited, or at least reduced to a minimum. Frequently this alone, the diet remaining otherwise unchanged, is sufficient to bring with it a not inconsiderable loss of weight.

Recently Moritz and others have recommended an exclusive milk diet in the reduction of obesity. While it is undeniable that good results may be obtained in this way the writer's experience in attempting to carry out a diet of this kind is that the monotony of it becomes almost unendurable. It is self-evident that the employment of a strictly milk diet, for a period of perhaps a week or ten days, because of the existence of a cardiac insufficiency of a severe grade, is based on entirely different principles from that of the milk diet which contemplates only a reduction in fat as its end result.

Much unnecessary discomfort is inflicted upon obese patients, especially those with cardiac ailments, by a senseless schematic limitation of fluids. To state that an obese patient, irrespective of his cardiac condition, should limit his fluids arbitrarily to a given amount is to proceed in a manner which is justified neither theoretically nor practically. While an excessive indulgence in fluids should be forbidden, the limitation of them much below the normal brings with it no results commensurate with the hardship imposed.

This applies to patients without edema. In patients with greater or less degrees of edema the fluid may be very properly limited, to a considerable degree, until this has disappeared, but it should be carefully noted that the indication for the diminution of fluid is to be found in the presence of the edema and not in the existence of the obesity.

A great deal of harm is frequently done obese patients with cardiac insufficiencies of the milder grades by sending them to various spas and health resorts, especially those which have a certain reputation in the treatment of obesity. In most of these the patients are purged to an unconscionable degree, and after a few weeks' sojourn return home weak and anemic with their cardiac condition far worse than in the beginning. While it is not our purpose to discuss the question of obesity in general we doubt if reduction cures attended by strong purgation ever constitute the most judicious form of treatment for obese patients, even when their hearts are normal, but with the slightest degree of cardiac weakness pres-

ent such a mode of treatment is most baneful. Such evil results are especially to be feared in patients over fifty, in whom the combination of obesity with arteriosclerosis and myodegeneration is exceedingly common.

An error which is frequently made is to attribute the loss of weight, which occurs in patients with cardiac insufficiency and considerable edema, to a loss of the adipose tissue, leaving out of consideration the fact that the disappearance of the edema itself may be largely responsible for it.

Cardiac Insufficiency from General and Local (*i. e., Coronary*) **Arteriosclerosis.**—Especial points in the management of these cases are discussed under the treatment of arteriosclerosis in general.

Cardiac Insufficiency from Chronic Myocarditis.—The physician is but seldom placed in a position where the diagnosis of a pure chronic myocarditis can be made with sufficient accuracy to justify him in taking especial measures toward its treatment, apart from those directed toward the cardiac weakness. Occasionally one encounters cases following the various infections, such as polyarthritis, or the other acute infections which are the common causes of myocardial inflammations, in which it seems clear that a sudden exacerbation of the cardiac insufficiency is due to this cause. Since we have no therapeutic measures which are capable of influencing in any way the inflammatory processes in the myocardium, all that a rational therapy can do is to exercise the greatest care in insisting upon long-continued rest in bed for these patients. In the writer's experience it happens much more frequently that a valvular lesion following, let us say, acute articular rheumatism remains perfectly compensated for a long period of time, and then, after a second attack of rheumatism, the heart becomes suddenly insufficient, without any new changes having developed in the endocardium. It can scarcely be doubted, keeping in mind the investigations of the Leipzig school, that the cause of this is in the development of an acute or subacute myocarditis. Such cases should be treated with extreme care, and confined to bed for an adequate period of time to permit of the acute changes in the myocardium subsiding.

Cardiac Insufficiency from Alcohol.—This group of cases, which is by no means so common in this country as in the south of Germany, should be treated along the same general lines as the cardiac failure from obesity. The question of the greatest importance to be answered is—shall the physician, when possible, prohibit the use of alcohol entirely? In the prophylactic treatment of this group this was not only advised, but urged, as the only rational procedure. The heart having developed symptoms of insufficiency the problem becomes an entirely different one, exactly in the same manner as in the case of the heart of the obese, with which group, as already stated, it is closely allied. The alcoholic who drinks beer to such an extent and over such a long period of time as to lead to the hypertrophy of the heart and its subsequent breakdown is a patient of whom it

may be almost said that his beer is both meat and drink to him. Especially when the beer consumed is rich in carbohydrates, the caloric values ingested with the beer, representing both that of the alcohol and the carbohydrate, is very great. The patient comes to rely on this as a very important part of his food supply, and to withdraw it entirely is to put the patient under very much the same conditions as the patient afflicted with simple obesity with cardiac insufficiency if we should order him a very severe reduction cure. Furthermore, the human side of the question should not be disregarded. These patients, accustomed for most of their life to consume often prodigious quantities of beer, are very unlikely to be able to renounce this habit entirely, especially in the weakened condition in which they now find themselves. Taking all these facts into consideration, it seems to the writer distinctly undesirable to do more than try to keep the consumption of beer within reasonable bounds, at the same time seeing to it carefully that the total caloric value of the diet given is ample, without being too great. In a few such cases it has happened to the writer that the patients had accustomed themselves to beer to such a degree that when, during severe cardiac breakdown, their beer supply was cut off entirely their appetites failed to such a degree that the weakness resulting from this became so great as to make it necessary to permit the ingestion of beer in at least moderate quantities. This plan is pursued by some of the German writers whose experience in treating this class of cases is unrivaled.

In the heart of the alcoholic, as in the heart of the obese, the same somewhat paradoxical advice is in place. So long as the heart is in good condition with no evidence of insufficiency the withdrawal of alcohol or the institution of a reduction cure is in place, since, so far as the cardiac component is concerned, the patients are practically normal; in both groups when once insufficiency has set in the removal of the causes, i. e., the alcohol, and the excessive ingestion of food, is to be undertaken, if at all, only with the greatest caution.

Cardiac Insufficiency from Syphilis of the Myocardium.—Cases of pure syphilis of the myocardium are extremely rare. Under these cases should be grouped only such as show unquestioned syphilomata, such as osseous or cutaneous gummata, along with the myocardial changes, and when the physician can be reasonably sure that no previous organic heart disease existed. It is quite probable that many of the cases classed as such clinically, and reported in the literature, were in reality instances of other affections.

In that vastly larger group of cases where syphilis is simply one of several contributory causes, producing its effects largely through the production of coronary sclerosis, we have, as already stated under prophylaxis, essentially the same cases, as regards end results, as in the ordinary forms of coronary sclerosis. In this latter group but little improvement can be reasonably looked for under antiluetic treatment.

We may say, then, that when syphilis, as the exclusive or predominating cause of a cardiac insufficiency, can be diagnosticated with a fair approximation to certainty energetic antisyphilitic treatment should be at once instituted. Striking results should be looked for only in the first extremely small class of cases, where the syphilis is the only cause for the myocardial incompetency, in which case other syphilomata are practically invariably present. An energetic course of inunctions, with iodids in rapidly ascending doses, would probably be the most satisfactory line of procedure. With Ehrlich's salvarsan in these cases the writer has had no experience, but from the nature of the drug and its mode of application would hesitate very greatly to use it.

Cardiac Insufficiency from Concretio Pericardii.—These cases are to be treated along precisely the same lines as those developing from chronic myocarditis. The cases of true Concretio Percardii, which are, in any event, not common, are rarely diagnosticated before the onset of the first symptoms of cardiac insufficiency. In view of the impotency of our therapy to remove the cause, and in view of the fact that many of the patients are young, and in many instances the heart muscle still has a very fair degree of power remaining, it seems to the writer as if the surgical treatment of these cases by resection of the overlying ribs (cardiolysis of Brauer) might with advantage be given a somewhat wider scope. A small number of cases are on record where the results obtained were quite satisfactory. Under medical treatment alone the cases go steadily on from bad to worse.

Cardiac Insufficiency from Chronic Nephritis.—This is an exceedingly frequent group of cases, and one in which the therapeutic indications of the underlying cause and those of the resultant cardiac incompetency are sometimes reconcilable with great difficulty. The general point of view, however, is clear. The patient is suffering, for the time being, at least, from the cardiac affection, and not directly from the kidney. We are now presupposing that the kidney condition in question is, as is generally the case, the contracted kidney. Again, it should not be forgotten that the kidney lesion is already a very old one, and that, in a certain sense, the development of cardiac insufficiency marks the beginning of the end. In the beginning, at least, the diet would better consist exclusively of milk, or milk with the addition of cream, and cereals. The salts should be reduced to as small a quantity as feasible, particularly if edema be present. In view of the high blood pressure which generally exists in such cases, digitalis would better be used in rather small doses. Fraenkel has obtained excellent results in some cases by repeated intravenous injections of strophanthin. The use of theobromin or theophyllin preparations, in the manner and doses described under those captions, is of the greatest utility in producing satisfactory diuresis. The hypertrophy of the heart which already exists, and the high blood pressure,

render the use of carbon dioxid baths or active gymnastics hazardous, if not absolutely contraindicated.

Where the cardiac insufficiency, after treatment by rest, digitalis, etc., shows no signs of yielding, and it becomes evident that the heart no longer has sufficient reserve power to compensate the high peripheral resistance, the physician should no longer make the life of the patient a burden in the endeavor to accomplish an impossibility, but should attempt to render the remaining days of the patient's life as comfortable as possible, restricting him as little as possible in his appetites, and resorting to morphia and similar drugs as the indications arise.

It is not desired to convey the impression that every case of contracted kidney that shows signs of cardiac insufficiency is thereby irretrievably lost, as regards regaining compensation. On the contrary, many cases of contracted kidney, especially in private practice, recover from repeated attacks of slight cardiac failure and live for rather long periods of time afterward. Nevertheless, the statement that the development of cardiac breakdown in a cirrhotic kidney marks the beginning of the end is to this extent true, that it marks the beginning of the time when compensation is with difficulty maintained, when the patient's reserve power is practically used up in overcoming the high peripheral resistance, and when there is no reserve left to meet the ordinary exigencies of life, however much he may try to limit these.

Cardiac Insufficiency in Pulmonary Conditions.—This group of cases offers a much larger field in the way of prophylaxis than in the way of treatment after the conditions have become firmly established. In emphysema, with chronic bronchitis, which is perhaps, in our climate, the commonest condition of the respiratory organs leading to cardiac insufficiency, the emphysema itself is, of course, absolutely incurable. The disappearance of the elastic tissue in the lungs cannot be made good by any means at our disposal. There is, therefore, a certain amount of obstruction to the right heart due to the resistance of the obliterated capillaries, and below this resistance we cannot go. Our object must be, then, to prevent its further development, and to maintain the integrity of the heart to such a point that it may suffice to overcome this resistance. Since the obstruction is to the right heart it is in this class of cases that we find the most extreme engorgement and distention of the right auricle. *In this class of cases, and under these circumstances, a copious venesection may be directly life-saving.* The cough produced by the bronchitis may be exceedingly exhausting, not only to the patient as a whole, but to the right heart, so that every effort should be made by means of small doses of codein, heroin, or morphia, combined, if necessary, with small doses of apomorphia, to allay this source of irritation. Every effort should be made to have the patient seek a warm and equable climate during the cold and wet months of the year, as in no other way can so satisfactory a result be ob-

tained as by this change of climate. These patients should wear wool or part wool underwear during the greater part of the year.

If pleuritic adhesions be the cause of the insufficiency what can be accomplished depends largely upon the age of the patient. In young individuals brilliant results can sometimes be obtained by pulmonary gymnastics, combined with the measures, already discussed, directed toward strengthening the heart muscle. In one of the writer's cases of this kind, a young lady with the severest cardiac insufficiency due to old pleuritic adhesions, the patient not only recovered perfect compensation, but in the six or seven years which have elapsed since that period she has regained such an amount of reserve power as to enable her to take fair degrees of exercise with comparative comfort. Even in these, at first sight apparently hopeless, cases there is no room for the absolute therapeutic nihilism which is too often the attitude of the physician toward such cases.

Cardiac Insufficiency in Kyphoscoliosis.—The outlook for therapy in these cases is most unsatisfactory when once cardiac insufficiency has set in. In the milder grades, in young people, with the cardiac symptoms not very pronounced, recoveries occur and the patients may live for long periods of time with a fair degree of comfort if they are kept under proper supervision. In the high grades of kyphoscoliosis, as already mentioned, death from overdistention of the right heart is so frequent that it may well be termed the normal mode of death for the kyphoscoliotic. Since these cases are of such long standing as to make, in most instances, orthopedic treatment unsatisfactory, but little can be accomplished in this line. Everything possible should be done to take off the strain from the heart by enjoining upon the patient as much rest as is possible, by the use of digitalis, etc., without attempting too much toward the relief of the underlying condition.

Cardiac Insufficiency in the Valvular Lesions.—The favorable position in which the physician is placed in regard to prophylactic treatment (i. e., the preservation of compensation) has already been referred to under that caption. When the patient is first seen during an attack of decompensation the treatment of this should be proceeded with along precisely the same lines as in cardiac insufficiency due to any other cause. Nor, so far as the application of our therapeutic resources is concerned, is it of material difference which valves are affected, or whether, as so frequently obtains, more than one valve is affected, or the same valve with a double lesion. The one thing to be determined is whether or not there is decompensation. Again, too much time should not be spent in the endeavor to make a precise diagnosis of which valves are affected, and how. The experienced clinician is only too well aware of the fact that it is rarely possible to make a complete and accurate diagnosis of the details of valvular involvement during this stage of severe decompensation. Only

too frequently do we see time which is precious for the therapy wasted in the endeavor to work out the refinements of physical diagnosis, forgetting that after all the quickest way to arrive at a final diagnosis of these details is to get the heart into a condition of good compensation, after which the diagnosis is relatively easy. What the writer wishes to emphasize is that, having made the diagnosis of a valvular lesion, no delay should be had in instituting prompt treatment, especially if the degree of decompensation be great. It is justifiable neither from the humanitarian nor from the scientific aspect to putter indefinitely with placebos, under the excuse of waiting to attain a more precise diagnosis. A great deal has been written in regard to the application of digitalis in the different valve lesions. Especially does this apply to the question as to whether digitalis is applicable in aortic lesions. *The practitioner will do well if he takes to heart the principle that digitalis is equally indicated in every valve lesion and in every combination of valve lesions when decompensated. Per contra, it is indicated in no valve lesion nor in any combination of them, when compensation is perfect, irrespective of the subjective symptoms or rate of the pulse.* There is no difference of opinion as to the utility of digitalis in the mitral lesions. The only question which arises is as to its applicability in aortic lesions, particularly in aortic insufficiency. The prolongation of the diastole by digitalis has been theoretically considered to favor the overdistention of the left ventricle. As a matter of fact, this is of very trifling moment, and a circumstance which may be utterly neglected as compared with the increase in tonicity brought about by the use of digitalis. The current fear of using digitalis in aortic insufficiency lies in the nature of this lesion itself and the mode of action of digitalis. Aortic insufficiency is the valve lesion *par excellence* which may be well compensated for long periods of time. Quite high grades of it may exist without the patient being aware that he is a sufferer from heart disease, since neither dyspnea, congested liver, nor edema develop until very late. This is for the reason that aortic insufficiency is compensated by the left ventricle alone, the strongest chamber of the heart, and one which may undergo enormous hypertrophy and dilatation in compensating this valvular leak. Just in the same proportion that symptoms of decompensation are absent for so long a time, so, for the same reason, when they finally occur, they develop with great rapidity and severity. The left ventricle has used up its entire available strength; it can hypertrophy no more, and when once it is exhausted the rapid development of decompensation and resultant asystole is not to be checked. If it be kept in mind that digitalis does not increase the absolute strength of the heart, but only enables it to use that which it is already possessed of to greater advantage, it will be clear that, under these conditions, digitalis can be rarely of great service. To those unfamiliar with these facts it may well seem that patients with aortic insufficiency are actually hastened to their end

by the use of digitalis. In moderate degrees of this lesion, where the left ventricle still has a tolerable amount of reserve power, precisely the same good results are obtained by the use of digitalis as in mitral lesions, and the same statement applies to combined mitral and aortic lesions.

Another reason for the more frequent failure of digitalis in aortic than in mitral lesions is because of the more frequent involvement of the coronary arteries in the former. We may say, therefore, that digitalis is equally indicated in aortic and mitral lesions, but that, when the former are of high grade, the results will not be so good as in mitral lesions of similar grade.

Use is to be made of carbon dioxid baths in valvular lesions along the same general lines as were laid down in the discussion of this procedure. Especial care should be taken to avoid their use if fresh endocardial changes should be present.

Gymnastics are applicable only in such cases if the patient's skeletal muscles are weak and illy developed, and where, because of this, an improvement may be looked for by increasing their strength, and so lessening the exertion required to carry out a given amount of work. Thus, in able-bodied muscular patients in the working classes the light, active exercises which could be employed would be of no service whatever; whereas, in weak, over-fed, and undertrained patients, pursuing sedentary occupations, they may, when properly employed, be of the greatest utility.

A feature of especial danger in old valvular lesions is the frequency with which recurrent attacks of acute endocarditis develop. Because of this the most stringent precautions should be taken in the treatment of the patient during intercurrent affections. A tonsillitis, polyarthritis, chorea, or other similar acute infection should lead to the most painstaking and repeated examinations of the heart, not only during its existence, but during convalescence. Even should no recurrent endocarditis set in the patient should be made to remain in bed for a longer period of time than would ordinarily be necessary for the same infection. Foci of infection, such as the tonsils, adenoid vegetations, antrum infections, nasal polypi, should be carefully sought for and radically treated when found. Especially should the so-called "submerged tonsil" be sought for and carefully extirpated when diseased.

The use of salicylates in attacks of polyarthritis or tonsillitis is not to be entirely dispensed with, but, on the other hand, they are to be used promptly, but with somewhat more caution, than if the valvular lesion did not exist.

In the extremely rare lesions of the pulmonary and tricuspid orifices of post-natal origin no especial modifications of the general plan of treatment are necessary.

Treatment of Congenital Heart Lesions.—The sole object of treatment in congenital heart lesions must be, in those cases where the condition is

compatible with a somewhat longer duration of life, to prevent the development of cardiac insufficiency through an injudicious mode of life, and to strengthen the organism as a whole, in order, as far as possible, to ward off death from intercurrent affections.

In a considerable number of the congenital defects of the heart an accurate diagnosis is quite impossible, and in this state of affairs an accurate prognosis is equally so. Such children should be brought up with especial attention being paid to ample diet, protection against sudden changes of weather, which is often productive in them of severe and even fatal bronchitis and bronchopneumonia, and with, if possible, removal to an equable, warm climate. While it is, in the very nature of things, undesirable to forbid an older child a certain amount of play, yet, on the other hand, every precaution should be taken to avoid even moderate strain of the heart, such as would be endured, with impunity, by even weakly children with normal hearts. Under any circumstances the treatment is extremely unsatisfactory.

In the rare cases in which a congenital valve lesion can be diagnosticated, and yet is compatible with the patient living to years of maturity, the treatment must take on a somewhat different aspect. These patients succumb, in the vast majority of instances, to pulmonary tuberculosis. The reasons for this are sufficiently obvious, and depend upon the imperfect oxygenation of the lungs, since nearly all congenital valve lesions affect the right heart. In general terms it may be stated that in cases of pulmonary stenosis, which is practically the only lesion compatible with living to adult years, imperfections in the ventricular septum are, in a sense, compensatory in character, and relieve the overburdened right ventricle, yet, nevertheless, paradoxical as it seems, the cases with defective septa offer a much graver prognosis than those in which the stenosis occurs by itself. This is due to the fact that in order that there be a defective septum the lesions must have been acquired at a very early date and must be of fairly high grade, so that in spite of the better hydraulic conditions such cases as a rule die sooner.

It may be said, then, that in cases of pulmonary stenosis which have passed successfully through the first few years of life without cardiac insufficiency developing to an untoward degree the outlook is fair if their principal danger, pulmonary tuberculosis, can be warded off. To this end every effort should be made to have them removed from all possible sources of infection, to be brought up, when possible, under favorable climatic conditions and as much in the open air as possible. These prophylactic measures are all the more important since, when once tuberculosis develops, its course is rarely to be stayed by any measures. In a case recently recorded by the writer with E. S. Moore the patient was able to perform hard manual labor up to the age of twenty-four, when, owing to very unfavorable hygienic surroundings, she acquired pulmonary tuber-

culosis, which ran a rapidly fatal course. The autopsy showed pulmonary stenosis with an open septum with minor abnormalities. It can hardly be doubted that in such a case, had the patient come under observation before the development of tuberculosis, suitable treatment would have insured her an indefinite lease of life under tolerably comfortable conditions.

In the event of cardiac insufficiency developing in the course of congenital cardiac lesions it is to be treated along precisely the same lines as in the heart failure of acquired valvular lesions. Obviously the results to be looked for are in no wise so good as in acquired lesions.

Symptomatic Treatment

Dyspnea.—The first indication in the treatment of dyspnea is generally performed automatically by the patient himself, who, as soon as the dyspnea becomes severe, takes the upright position. Here several precautions must be observed. A patient who has to maintain a nearly upright position to make his dyspnea tolerable is generally better off in a large easy chair where the legs may be allowed to hang down and where, by means of suitable side pieces, the patient does not run the risk of having his body fall to one side during sleep. A second point gained by the use of a chair is that the patient is not doubled up like a partially closed jackknife because of the buttocks sinking into the bed. In short, the bed, while ideal for patients who can lie down, even partially, is unsatisfactory for patients who have to sit up. The writer has seen in some European hospitals mattresses arranged on the principle of the examining table so frequently used in physicians' examining rooms, where the upper portion can be raised and the lower portion lowered. He is not aware that they are to be obtained in this country. Since this symptom is directly dependent upon the cardiac insufficiency it is manifest that all the measures directed toward its improvement are to be regarded as of direct benefit to the dyspnea. Few cases of severe dyspnea will be able to dispense with morphin or its substitutes. The writer prefers codein for the milder cases and morphia itself for the more severe ones, beginning with quite small doses of the latter and repeating with sufficient frequency to accomplish the purpose.

The use of oxygen inhalations for severe dyspnea in cardiac cases is a measure which has hardly received the approval of theory. It seems quite clear that no more oxygen is taken up in the lung than when it is not administered, nor has the writer ever been able to see any definite improvement in the accompanying signs. The cyanosis does not improve nor do the respirations grow more tranquil. In spite of this one sees occasionally such striking subjective improvement from the administration of oxygen that the writer feels that its use is to be recommended under such condi-

tions. Indeed, it seems fairly clear that the great feeling of relief which a goodly number of patients experience at once is, in and of itself, sufficient indication for its use, even though we cannot assign precise scientific justification for it. Bence has shown that in severe cyanosis the viscosity of the blood is increased and this is diminished by oxygen inhalations. Since it is well known that the resistance in the peripheral vessels depends in large measure upon the viscosity of the blood it is evident that the effects of oxygen in lessening the viscosity would be to diminish at the same time the peripheral resistance.

Cardiac Asthma.—Of all the symptoms which render the life of the patient with the higher degrees of cardiac insufficiency so abjectly miserable, none plays a greater rôle than the so-called cardiac asthma. As a rule the attacks occur in the evening, or, perhaps still more frequently, at night, and the constant struggling for hours at a time with the most horrible dyspnea and sense of suffocation causes the patient to lose, only too rapidly, his strength, his courage, and his hope.

If the asthmatic attacks are just commencing to develop something can frequently be done in a prophylactic way by the administration of small doses of codein or morphin. The use of strychnia, because of its well-known power of increasing the activity of the respiratory centers, is to be warmly recommended as a prophylactic measure, although it is absolutely useless when the attack has once developed. Every effort should be made to determine whether there is a tendency for the attacks to recur at certain hours, so that the prophylactic measures just mentioned may be taken shortly before.

With the attacks of asthma developing in the evening or at night especial care should be taken to see that the stomach is not overloaded at this time.

For the attack itself the one thing which is really efficient is a subcutaneous injection of morphia. Since the condition of the patient is such as to make even swallowing a matter of great difficulty, and since the absorption from the gastrointestinal tract is exceedingly slow, stimulants, which are generally in place, should be given either hypodermically or intravenously. The greatly perturbed condition of the patient makes intravenous injections somewhat difficult, although, perhaps, when feasible, the method of choice. A full dose of caffein subcutaneously, or, better still, the use of digalen, has given the writer the greatest satisfaction. Digalen is absorbed with great rapidity from the stomach even under these unfavorable conditions. Its subcutaneous use is not to be recommended. In the severest cases, if digitalis has not been given to such an extent as to form a contraindication, the use of strophanthin may be tried intravenously in doses of half an ampoule.

The question of venesection occasionally arises under these conditions. While it has been recommended by several authors, the writer has felt a

certain hesitation in its use because of the tendency of the attacks to recur. In one or two cases he has seen it afford striking relief. These were cases associated with overdistention of the right heart, and in them the venesection would be justifiable on these grounds alone.

Bronchitis.—More attention should be paid to this symptom and to its treatment than is usually done, because of its tendency to set up a vicious circle, in that the obstruction of the bronchioles renders breathing more difficult, this reacts upon the heart, which, in turn, furnishes a poorer supply of blood to the lung, etc., etc. It should be borne in mind that primarily the bronchitis is a phenomenon of stasis and not a simple catarrhal inflammatory process in an otherwise healthy organism. The leading indication is not to deluge the patient with innumerable expectorants, but to increase the flow of blood through the lungs. In other words, we regard the bronchitis as a symptom of a lesser degree of cardiac insufficiency. It is primarily combated by the same measures which are generally applicable in the milder grades of heart weakness—the administration of digitalis, etc. The patient should be especially carefully sheltered from the vicissitudes of weather, since, in patients with venous congestion of the lungs, the ordinary bronchitis from exposure is much more likely to engraft itself upon the pulmonary stasis. Cold ablutions to the chest every morning and evening, or the application of a Priessnitz compress, are often of service. Minute doses of codein or morphin, especially the latter, combined with small doses of apomorphia, are useful. The German authors recommend the inhalation of the alkaline-saline waters, especially where there is a tendency to severe cough. The writer's experience with this procedure is too limited to permit of an individual judgment.

Of the greatest importance is the climatic treatment. Since the unsatisfactory conditions of circulation in the lung are especially likely to be complicated by true inflammatory bronchitis with the onset of the cold and changeable weather, the avoidance of the latter is to be recommended wherever possible. It is to be remembered that in mitral lesions, especially mitral stenosis, there is normally an increased pressure in the pulmonary capillaries, even when compensation is good, and in the cardiac insufficiency due to these cases, or, indeed, even during the stage of compensation, to avoid exposure to sudden vicissitudes of weather is to avoid a prolific cause of much discomfort during the winter and spring months. The resorts of southern California, the Gulf coast, Florida, Georgia, and the Carolinas are most suitable for our American patients during the season of the year which is marked by decided inclemency in the northern half of the United States.

Gastrointestinal Symptoms.—The most important of these which call for special treatment are the sense of weight, pressure, and soreness in the epigastrium, due to the venous congestion of the liver, the fullness in the stomach with belching of gas and like dyspeptic disturbances due to a

similar condition in the stomach. Since these are pure stasis symptoms it is folly to expect really successful results from any treatment other than that designed to relieve the decompensation. The patient may well be spared the numerous carminatives, HCl and pepsin, with which he is commonly drenched. Only in the most inveterate cases where the heart is damaged to such an extent as to render perfect compensation impossible can an effort be made to make these symptoms of cardiac insufficiency a little less irksome. Since the hydrochloric acid of the stomach is generally subnormal in quantity, or even absent, some slight improvement may be produced by liberal doses of this, taken in a considerable quantity of water, with or after each meal. The simple bitters, such as nux vomica and the cinchona preparations, may aid somewhat, but in general it must be said of all these measures that they are thoroughly unsatisfactory. A common error is to regard cases of enlarged liver with very moderate tenderness as instances of cirrhosis, and some of the very happiest results of therapy which the writer has been fortunate enough to encounter in private practice have been in just this class of cases, where no attempt had been made to treat the case by digitalis, etc., and hence, when these measures were actively employed, the tonicity of the heart promptly improved and the supposed cirrhosis disappeared in a fortnight's time. Should diarrhea exist it may be generally successfully combated by such simple dietetic measures as the limitation of the diet for a short period of time to cereals, boiled milk, well-baked toast, etc. If this be not quite sufficient the administration of tannigen or tannalbin in doses of 1.0 gm. (gr. xv) of the latter, and half that dose of the former, three or four times a day. Only in severe cases does it become necessary to resort to the use of opium, which is then best given in the form of powdered opium combined with tannic acid, 0.06 gm. (gr. i) of the former to 0.30 gm. (gr. v) of the latter, three or four times daily until the results are produced.

Constipation.—This is a symptom which is especially likely to prove troublesome during the stage of compensation, when there is no venous congestion of the bowel, and when the primary heart trouble is sufficient to preclude enough exercise to regulate the bowels in this way. Since the usual treatment of constipation, in which exercise plays an important rôle, is generally impossible with these patients, we are compelled to rely largely on dietetic means, or, at worst, on medicinal measures. In patients who are under-nourished and thin, and whose constipation is aided to some extent by the small amount of food taken, quite good results may be obtained by the administration of a glass of half milk and half cream, or even pure cream with the addition of a little lime water, twice or even three times daily. With an already existing tendency to obesity this would be contraindicated. The addition of coarse foods, such as whole wheat bread, bran biscuits, etc., to the dietary, as is commonly done, has not been productive, in the writer's hands, of really satisfactory results. On the

other hand, the use of agar agar has been, in most cases, eminently satisfactory. Care should be taken to obtain the very best article, since most of it is intended for technical purposes and is filled with grit and sand to such an extent as to render it inedible. After much experimentation the writer has come to prefer the method of administration already discussed under the caption Diet. This is generally productive of satisfactory results. At times a simple glycerin suppository in addition to the agar agar may assist in rendering defecation easy and painless. It should not be forgotten, especially in women with relaxed pelvic diaphragm, that the constipation is frequently due to atonic conditions in the rectum itself, and under these circumstances the use of enemata of soap water or, which the writer prefers, olive oil accomplishes the desired end. If laxatives must be given the cascara preparations are most satisfactory. Salines should be avoided whenever possible, since their use is attended by considerable weakening and the bowel rapidly grows accustomed to them.

Nervous Symptoms.—The most troublesome of these are of a psychical nature and, in general, are coupled with a strong hypochondriacal bias. Cardiac patients are, as a rule, when they do not ignore their disease entirely, likely to overestimate its importance. The perfectly frank understanding with the patients, upon which the writer has already insisted, is perhaps the best means of combating these. The patient should be made to understand that the physician is acquainting him with the facts of his case, neither exaggerating nor minimizing them, and if this can be accomplished a long step will have been taken in the direction of gaining his confidence, which is half the battle.

Cutaneous Symptoms.—The principal of these, edema, has already been discussed in detail. Not infrequently excessive sweating is a symptom which calls for special treatment. This is most readily combated by the use of alcohol sponges once or twice daily.

The utmost care should be taken when edema of any consequence exists to insure the most perfect cleanliness in the skin folds, since these are exceedingly apt to become the sites of very troublesome and annoying intertrigo. Careful washing with tepid water twice daily and liberal dusting with a good talcum powder are satisfactory. If the intertrigo is already developed scrupulous cleanliness and the frequent use of a simple zinc oxid ointment generally sufficed to bring about a cure. If the edema is very great, so that the folds in the groin and similar places come in contact with each other to a considerable extent, they should be separated by means of a soft linen cloth, or a thin layer of cotton saturated with the protective ointment. At times the edema may reach such proportions that the genitalia, especially in the male, become enormously swollen, and it is a not infrequent occurrence to find the prepuce of such great size as to render micturition very difficult, if not impossible. Under these circumstances catheterization, under the most scrupulous asepsis, must be

resorted to. Scarification or puncture of the genitalia would better not be employed, because of the great liability to infection and inflammatory processes in this region.

Angina Pectoris.—The treatment of this symptom will be discussed under the diseases of the arteries.

Treatment of Intercurrent Diseases

Any pathological condition developing in a patient with cardiac disease, even though this latter be perfectly compensated, calls for an increased vigilance on the part of the medical attendant. While it is impossible to lay down any specific rules, it must be regarded as a general principle to be followed that the patient is to be allowed to resume his usual vocation, much more guardedly than would be the case did not the cardiac condition exist. This is especially true after the various acute infections. After long-continued rest in bed, such as may result from surgical injuries and operations, the patient should be allowed to get up and return to work only after the heart has been gradually trained by the various forms of exercises in the manner described under that caption.

In the treatment of such chronic affections as diabetes, gout, arthritis deformans, and nephritis due consideration must always be paid to the condition of the heart. It is not a very uncommon experience to see that a patient with a well-compensated cardiac condition is made much worse through an injudicious severity of treatment addressed to such conditions as those just named. Bearing in mind the old admonition *primum non nocere,* the physician should be exceedingly guarded in regard to the hygienic, dietetic, and medicinal measures employed in such cases.

Anemia.—While, of course, not a disease, anemia is so common a symptom of so large a number of diseases, and occurs with such great frequency in patients with pathological heart conditions, that it should be most carefully sought for, and equally carefully treated when found. Especial care should be taken, in judging of the presence or absence of a normal amount of hemoglobin, to take into consideration the age curve. Unless using an instrument such as the Miescher, which gives absolute values, the result is usually obtained in percentage, and if this be applied to a younger person, with no consideration of the variations of hemoglobin dependent on age, the result will be wide of the mark. The effects of a moderate degree of anemia upon the respiratory activity are insufficiently appreciated, and yet a moment's reflection makes it clear that a reduction of thirty per cent. in hemoglobin means the same reduction in the oxygen-carrying capacity of the blood, which, in turn, influences the circulation. It should be made an invariable rule to examine carefully for the existence of anemia, especially in the usual form of a diminution of hemoglobin. The details in the treatment of this need not be entered

upon here. Suffice it to say that the simple administration of iron by mouth, generally, but not invariably, is productive of a prompt increase in the hemoglobin. Where absorption is impaired, and especially when iron has a tendency to produce constipation when administered orally, it would better be given hypodermically. This may be done with great ease and freedom from irritation by use of the green citrate in one per cent. solution, 1 c. c. (15 minims), once daily, being the usual dose. This may be obtained in the form of ampoules under the trade name of Vaporoles, which contain, in addition to the iron, a small quantity of arsenic.

Anesthesia in Patients with Heart Lesions.—One of the questions which the internist is often called upon to decide is whether a patient, either supposedly normal or afflicted with heart conditions of various sorts, is a proper subject for the administration of chloroform or ether for the purposes of narcosis. One of the very commonest occurrences is to see either physician or surgeon, when the patient is perhaps just ready to go under the anesthetic, auscultate the heart rather hurriedly, and on that basis pronounce the patient as in good condition, or vice versa, to be anesthetized. To those who have given the subject any attention it will be perfectly evident that little or no information can be obtained in this way. Mackenzie has expressed the matter with customary force when he says: "The stethoscopic examination of the patient just before administration is useless; the decision must be made independently of any results obtained by it, for no form of murmur, irregularity, or rate is a bar to the administration of chloroform. I am not aware of a single form of heart ailment discoverable by auscultation that would render the administration of chloroform dangerous. The dangers do not lie in the action of chloroform upon the heart alone, but on other considerations."

The following general considerations should guide the practitioner in this matter: Practically all of the various cardiac conditions which are perfectly compensated, such as the valve lesions, the hypertrophied heart of chronic nephritis, the hypertrophies of the right heart in the various pulmonary conditions, are capable of undergoing anesthesia with safety, but, on the other hand, should not be subjected to anesthesia unless the underlying condition really warrants it. In other words, unless the condition requiring operation is such that this cannot be done without the administration of a general anesthetic, and unless the operation itself is imperative to relieve a condition which endangers life, such patients should not be anesthetized. In cases of arteriosclerosis, especially when associated with coronary sclerosis with myodegeneration, and in such valve lesions as mitral stenosis with coexisting chronic myocarditis, extreme care should be taken in the administration of the anesthetic. It is in this group of cases that the fatal accidents are especially prone to occur, the reason being that the damaged heart muscle is probably more susceptible to injury by the anesthetic than when it is sound.

In the more severe degrees of cardiac insufficiency anesthesia is always a more or less serious procedure. Under these circumstances an attack of angina pectoris or cardiac asthma may lead to fatal results. Yet, in spite of all this, the writer has several times seen patients with the severest degrees of cardiac insufficiency anesthetized and subjected to operations of considerable magnitude, making perfect recoveries, with no untoward symptoms having developed. In brief, we may say that the action of anesthetics is such as to make it almost impossible, in a particular case, to say with any degree of certainty that the patient's heart is in such condition that he may be safely anesthetized. Chloroform is properly regarded as being particularly dangerous for patients with cardiac ailments, since the diseased heart seems especially sensitive to a slight overdose of this anesthetic.

In patients with venous stasis in the lungs, from cardiac disease, ether is almost equally dangerous because of the great liability of this anesthetic to produce severe bronchitis and pneumonic infiltrations. Some authors recommend the induction of anesthesia by chloroform, changing to ether as soon as the patient is well under. This is especially practiced by foreign surgeons in cardiac patients.

Laughing gas is distinctly contraindicated, as is also ethyl bromid. Whenever an operation may be done under local anesthesia this is to be strongly recommended.

ACUTE ENDOCARDITIS

We may, for convenience, adhere to the distinction which is generally made between the acute simple endocarditis and the malignant form. This is done merely for simplicity of description rather than because there are any thoroughgoing distinctions between the two. We may say, in broad general terms, that the differences between these are equivalent to the differences which exist between a very mild and a very virulent infection anywhere. The actual etiology may be precisely the same, the clinical differences being due to the fact that in the one case a mild, and in the other a virulent, strain of organisms existed. Indeed, it is not improbable that different strains of organisms of the same virulence may produce results of vastly different severity dependent upon the different resistive powers of the individual.

Acute Simple Endocarditis.—Prophylaxis.—We are greatly hampered in an exact and scientific prophylaxis and treatment by our lack of knowledge of the etiology of endocarditis. In spite of the many efforts made to isolate a specific organism in rheumatism, with which acute endocarditis is associated in from one-half to two-thirds of the cases, the results have remained inconclusive. Poynton and Paine have isolated an organism (micrococcus rheumaticus) which they regard as either specific or

at least a specific strain. It assumes the diplococcus form in the joints, but takes on the streptococcus form on the various artificial media. This behavior occurs with many ordinary streptococci as well.

Sahli regards acute articular rheumatism as an infection dependent upon attenuated pyogenic organisms. This hypothesis, which was advanced nearly twenty years ago, is in many ways still the most satisfactory explanation of this disease, which, on this theory, is to be regarded as a clinical disease group, rather than a specific single disease, and its origin to be sought for among a number of attenuated cocci.

In addition to rheumatism, the pyogenic organisms from the various septic sources, the pneumococcus, the gonococcus, the bacillus diphtheriæ, the bacillus influenzæ, and the organisms of scarlet fever and small-pox are all responsible for some cases of endocarditis. The influence of syphilis in causing an acute inflammatory change in the endocardium cannot at the present time be accurately estimated, nor is it absolutely proven that the spirochæta pallida can produce valvular lesions. There is, however, an ever-growing amount of evidence showing that cases of aortic insufficiency can be caused by this organism.

It is highly improbable that by treatment of the causes above enumerated the development of an acute endocarditis may be prevented. A possible exception might be made to this statement in the case of syphilis. Nevertheless, even though the development of an acute endocarditis following one or the other of these causes may not be prevented, yet, for all that, something can be accomplished by prophylactic measures. The first precaution is to insure prolonged rest in bed, with a minimum of physical exertion, since in this way the work of the heart is materially lessened. In the cases due to rheumatism a prompt and energetic treatment of it may diminish somewhat the liability to endocardial complications, although this is doubted by many of the best clinicians.

A more important point is to prevent the possibility of reinfection. The frequency of tonsillar involvement is so great in rheumatism that this should be seen to with special care. One of the commonest occurrences is to have small foci of infection, even small abscesses, persist in a tonsil, apparently not much enlarged, for a long period of time, and to give rise to repeated recurrent attacks of endocarditis. The tonsils should be completely extirpated, not merely snared or cut off, to prevent reinfection. Chronic sources of infection should be sought for from head to foot, not forgetting the teeth, leg ulcers, urethral infections, salpingitis in the female, ingrowing toe nails with suppuration, and especially chronic nasal infections and those of the accessory sinuses. Chronic cystitis, prostatic abscess, and infections of the biliary tract are all of great importance. With each year the evidence accumulates to a greater extent that cases of endocarditis may frequently be brought to a definite arrest through the extirpation of such foci of infection as have just been enumer-

ated. While a thickening of a retracted valve segment cannot be made to heal out in the anatomical sense, yet the cessation of the inflammatory process is, in many instances, almost equivalent to a cure, since the wonderful adaptability of the heart muscle permits these patients to enjoy life with a surprisingly small number of restrictions.

These prophylactic measures are even more important in patients who have had previous attacks of endocarditis which have left them with sclerotic valves. It has been abundantly shown that these sclerotic valves become the seat of a recurrent endocarditis much more readily than a normal valve becomes diseased. Whether this is because of the persistence of foci of infection, or whether it be that bacteria lodge more readily in diseased structures, cannot definitely be stated. It should be borne in mind that nearly all experimenters have produced experimental endocarditis by the injection of bacteria into the blood stream much more readily after injury to the valves.

Treatment of the Attack.—We have no drugs in any way capable of influencing the development of vegetations in the valves. It is almost certainly true that small excrescences, superficial in character, especially when occurring in childhood, may practically disappear, leaving little or no thickening behind. Once the fibrous tissue of the valve itself be involved sclerosis and permanent changes are inevitable. Our efforts must be directed toward minimizing the damage. The strictest rest, in the sense described under that heading, should be enjoined upon the patient. This, in and of itself, may reduce the work of the heart from a fourth to a third. The underlying causal infection should be vigorously combated; if this be rheumatism a vigorous salicylate therapy should be carried out. The evidences as to whether the use of salicylates reduces the liability to cardiac complications is conflicting. The majority, among whom the writer wishes to be classed, hold that they have little effect in this respect; a few believe them to be of real value in preventing endocarditis, while lately a few voices have been raised expressing the belief that the excessive use of salicylates at least renders the valves more vulnerable. Under these circumstances the practitioner will do well to make use of the salicylates, reinforced by the mild alkalies such as sodium bicarbonate, to such an extent as the severity of the rheumatic manifestations warrants, uninfluenced by the theoretical considerations as to its effect upon the endocardium. In patients with severe endocarditis and rheumatism simultaneously the salicylates are frequently quite depressing. Under these circumstances the use of antipyrin is often very satisfactory.

The diet should be that appropriate for any mild acute fever. A milk and cereal diet with moderate amounts of fluid and alkaline drinks fulfills all indications. During convalescence the diet should be quite full. Especially should milk, eggs, and fresh vegetables be liberally given.

Symptomatically the cases associated with rheumatism may require

special measures to be taken for the joint pain. A good plan is to immobilize these by means of a light splint, surrounding the joint with large quantities of cotton wool and bandaging firmly. Hot compresses, sprinkled with oil of wintergreen, to the skin over the joint are useful. The anemia of convalescence is generally of a high grade, since both the rheumatism itself and the endocarditis produce anemia rapidly. Iron may be given by mouth in the form of the ordinary Blaud's pills or, as the writer prefers when practicable, subcutaneously, as described under the caption Anemia. Especially valuable is the simultaneous injection of iron and arsenic, the latter in the form of the liquor sodii arsenatis in one per cent. solution, beginning with small doses and increasing until the physiological effect is produced.

For the dilatation often associated with acute endocarditis the writer recommends the use of digitalis in small doses, such as powdered digitalis, 0.1 gm. (gr. 1½), or the same dose of digipuratum (8 frog units), once daily. There is sufficient experimental evidence to justify this procedure. When all acute symptoms have subsided the use of carbon dioxid baths and gymnastics is in place, since the case is now no longer to be treated along the lines of acute endocarditis, but along the lines of a fully developed valvular lesion.

Malignant Endocarditis.—The treatment of this does not differ essentially from that of the acute simple form. Drugs are practically worthless. The condition is really one of general septicemia. The most absolute rest and easily digested and nutritious diet, but in liberal amounts (2,500-3,000 calories per day), are important.

Intravenous medication, especially with the colloid silver salts, has been very warmly recommended by a number of authors. The writer has had the opportunity of using this method in a number of cases of both simple and malignant endocarditis, but the results have been so discordant as to afford but little encouragement. The antistreptococcus sera of all kinds have been extensively used without, however, any very favorable results.

Vaccine Therapy.—This method, consisting in the inoculation of the patient with small doses of killed cultures of the organism, aims at an increased production of protective substances, in the hope of combating the infection this way. While the method is too new to admit of certain conclusions being drawn it has failed utterly in the hands of excellent observers. In two personal cases no improvement could be made out under its use. The ingestion of large quantities of fluid, and especially subcutaneous saline infusions, has been recommended with the idea of increasing the elimination of toxic substances. It must be borne in mind that such measures, by increasing the total volume of blood, add considerably to the heart's work and thus favor dilatation.

The use of alcohol in large doses, which is by many considered to be

the mainstay in all forms of septic disease, has, in the writer's experience, utterly failed to vindicate its many recommendations. Many of the most experienced clinicians who previously made use of alcohol in large doses have gradually come to use it less and less. In small quantities, especially in the form of eggnogs, rum punches, etc., it may have some use. As a stimulant to the appetite a little good wine or diluted whiskey or brandy may be of service, particularly to patients accustomed to their use.

Symptomatically caffein and camphor may be used to combat the progressive diminution of the vasomotor tone. In these severe cases, while digitalis in small doses may be appropriately tried, it is rarely of much use. The irregular and profuse sweats may be controlled by use of antipyrin, pyramidon, lactophenin, etc., but, best of all, by the systematic use of hydrotherapy in the form of sponging with ice water, cold packs, etc.

ACUTE MYOCARDITIS

Acute myocarditis occurs under three clinical forms: Acute simple (infectious) myocarditis; septic myocarditis; the acute primary form. The first of these is the only one that attains clinical importance. The small number of cases in the literature which have been reckoned as being primary, i. e., in which no previous or coexisting infection could be made out, are so few in number as hardly to afford satisfactory proof of the existence of myocarditis as a primary disease. On the contrary, the existence of albuminuria and enlargement of the spleen and similar marks of a general infection, in some cases associated with rheumatic pains, make it seem much more probable that these supposedly primary cases are, in reality, part of some general infection of unknown origin. Septic myocarditis is not possible of clinical recognition, since the symptoms due to it, and those due to the toxic, infectious nature of the primary disease itself, cannot be distinguished with certainty.

The Acute Simple (Infectious) Myocarditis.—This is the only form which is capable of certain recognition. It is invariably associated with one of a considerable number of infectious diseases, hence the justification for the name—acute infectious myocarditis. The treatment of this condition is so inextricably bound up with that of the underlying and causative infection, and the frequency of its occurrence varies so greatly in the different infections, that it is a matter of some importance to keep ever before us which are the infections in which we are likely to encounter this complication. This is all the more necessary in view of the fact that it is only very recently that acute myocarditis has been recognized, even by those who have had opportunity to see the most of it, as a clinical entity of frequent occurrence to be diagnosticated and treated.

The frequency of the disease will, of course, vary greatly depending

upon which infections come most frequently within the circle of observation of the physician. The classical cases, meaning by those the cases in which the symptoms are most clearly pronounced, and easiest of recognition as being due to the myocarditis, occur in the course of diphtheria, generally about the second or third week of the disease, but not infrequently as late as two months after its beginning, at a time when convalescence seems assured. Romberg places the frequency of its occurrence, according to his own figures and those of Schmaltz, at from ten to twenty per cent. of all cases. In typhoid myocarditis is an uncommon complication occurring generally in the first two weeks, rarely later, after the temperature has become normal, and occurring quite independently of the strain of getting up, etc. In scarlet fever acute myocardial involvement is relatively rare, occurring usually about the tenth or twelfth day. Gonorrhea has been responsible for a few cases, but the rarity of these, in contrast with the frequency of the other metastases of gonorrhea, only serves to emphasize its rarity. No case has fallen under the writer's observation. The same is true of measles.

It is a matter about which there is a considerable difference of opinion as to whether cardiac disturbances, which are so frequent following influenzas, especially in elderly people, and in epidemics of unusual severity, are to be reckoned to the cases of acute myocarditis. When we reflect upon the profound depression of the nervous system which is occasioned by influenza, and upon the profound muscular weakness and anemia which are its frequent sequels, it seems much more rational to assign these cases, following the example of Romberg, to the group of cardiac insufficiencies due to disturbances of the general nutrition. This adequately accounts for the arrhythmia, bradycardia, and the symptoms which follow myocardial weakness. In the usual run of practice in our large cities acute articular rheumatism is the disease in which acute myocarditis is most frequently seen. The frequency of endocarditis is so great, and its symptoms so pregnant, that the attention of clinicians has been riveted upon the endocardium to the almost total exclusion of the myocardium. Only in the last years have the researches of Krehl, Romberg, and their co-workers in the Leipzig school made clear the great importance of both the acute and chronic myocardial changes associated with rheumatism. Its frequency is placed by Romberg at from ten to fifteen per cent. of all cases of acute rheumatism, and these figures are certainly in striking contrast to the frequency with which it is diagnosticated. It occurs by far most frequently as an accompaniment of acute endocarditis, less frequently without it, as an isolated affection. It may develop at any time after the height of the disease to a period well into convalescence.

Prophylaxis.—In one sense there can be no prophylaxis of this affection, since no measures at our command can prevent the toxins of the infectious processes enumerated, once they have developed, from attacking

the myocardium. The researches of Gottlieb and Rolly, who experimented with the toxin of diphtheria, have made it plain that this toxin may be, as it were, anchored in the heart muscle very early, to unfold its action only after some time. It does not seem at all certain that even the most prompt and efficient treatment of diphtheria by antitoxin is capable of entirely preventing the development of myocardial changes. This is explicable in the light of Gottlieb and Rolly's work. On the other hand, since it seems highly probable that the occurrence of such inflammatory changes in the heart muscle is dependent upon the concentration of the toxins rather than upon the duration of the disease. it can scarcely be doubted that the more promptly and more efficiently the toxemia is neutralized by antitoxin, and in particular by the administration of sufficiently large doses, the less likely will be the development of myocardial changes.

Above all, it cannot be too greatly emphasized that the need of prolonged and absolute rest, even in supposedly mild cases of diphtheria, is imperative. The first case of this disease which came under the writer's observation was that of a young lad who, apparently convalescing from a mild attack of diphtheria, and while waiting for his mother to take him home from the hospital, after a sharp burst of running died in a few moments. The autopsy revealed nothing in addition to the changes in the myocardium. Whether or not any part in such cases be played by paralysis of the vasomotor center is not absolutely certain, but at all events the moral is sufficiently obvious. A much more careful surveillance of supposedly convalescent diphtheria cases, and much more careful examinations of the circulatory apparatus than the mere routine auscultation affords, are urgently needed. The slightest abnormality in the cardiac rhythm, or the force of its beat, or an otherwise unexplained vomiting, which is often the pronounced feature of acute myocarditis in diphtheria, or swelling and tenderness of the liver—any of these symptoms suffices to warn the attending physician of the development of this complication.

In rheumatism the prospects for successful prophylaxis are no different from those which obtain with endocarditis. Reference is made to the remarks under that heading.

Treatment.—The disease once ushered in, the predominant indication is again for the most absolute and complete rest which it is possible to obtain. This complete rest should be maintained until all symptoms of cardiac weakness have disappeared. This statement is to be taken literally, and with probably no exceptions in the case of diphtheria, but with a certain amount of qualification in the case of acute rheumatism. In this latter disease endocarditis is so frequently present, and its development not to be prevented, that a certain degree of cardiac insufficiency may remain for an indefinite period of time, or, indeed, be permanently present. Under such circumstances it would be manifestly impossible to condemn the patient, because of a coexisting myocarditis, to an indefinite

stay in bed. On the other hand, even in rheumatism, all but slight symptoms must have disappeared before the patient may be allowed to sit up or commence to help himself in any way. It is sometimes difficult for a physician to convince himself that this prolonged stay in bed, which may amount to two months or even more, is, in such cases, absolutely necessary. The writer's experience is that the attending physician is much more likely to insist upon prolonged rest because of a murmur from any cause whatsoever than for even much more serious symptoms unassociated with auscultatory phenomena. Nowhere is it more necessary to free ourselves from the thrall of an exaggerated dependence upon the methods of physical diagnosis. Having allowed an abundance of time for the disappearance of the acute inflammatory process the patient should be allowed first to sit up for a few moments at a time under careful observation, then gradually, if all goes well, to get up into an armchair in the same way. It cannot be too urgently insisted upon that this should be done very slowly, taking many days before the patient is allowed to be up all day.

Medicinal Treatment.—The value of digitalis in myocarditis is at best very small. Digitalis cannot, under any circumstances, increase the absolute force of the heart's contraction, simply enabling that organ to make use of the power which it already possesses to the best advantage. In the severe cases, where there is widespread degeneration of the muscle fibers, and where digitalis might, at first thought, seem to have its greatest value, it is not only practically useless, but fraught with considerable danger of producing overstimulation, and of accelerating the fatal end. In the relatively mild cases, especially those occurring with rheumatism, digitalis may be of use. It may be doubted whether strophanthus offers any advantages.

The use of such drugs as camphor and caffein, more rarely strychnin, may be occasionally of value, especially if there be associated vasomotor failure. At best they can produce but slight temporary improvement.

Ice-bag.—A light, but constantly filled, ice-bag to the precordia is of great value in relieving the subjective sensations of the patient. The statement which is sometimes made, that in cases of rheumatism the application of an ice-bag may produce recrudescences in the joints, seems to the writer unfounded.

The diet would best be confined to milk during the most acute stages, especially if there be marked gastrointestinal symptoms. As the condition improves the various cereals, beef-juice, purées may be added. Since, in general, diets of this nature are apt to induce constipation, which is of course accentuated by the absolute rest, the greatest care should be taken to produce soft, copious stools by the administration of suitable laxatives. This is best accomplished by the various cascara preparations. The patient should not be unduly purged.

In the after-treatment of such myocardial affections, but, of course,

never while they are active, carefully graded gymnastics may be of the greatest utility. It should not be lost sight of that these may be a two-edged sword, for, while their judicious, cautious, and, above all, carefully dosed use may be of great service in bridging over the interval which must elapse before the patient is allowed to climb stairs or to take similar exercise, yet, on the other hand, the application of them in a careless or unskillful manner is capable of doing incalculable harm.

The application of CO_2 baths stands about on the same footing with that of gymnastics. They should not be thought of until the patient has progressed far enough to admit of his being up in a chair for the entire day, and of walking about, but without climbing stairs, with no symptoms of overexertion setting in. It need hardly be said that these must, in the very nature of things, be carried out at home, since the strain involved in sending the patient either to some institution or to some health resort would be utterly unjustifiable.

Care should be taken to examine into the existence of an anemia, which is so very common in all such postinfectious cases. Since its presence operates, as has been elsewhere mentioned, most deleteriously, it should be at once actively treated either by the use of the simple iron preparations by mouth, or, if the anemia does not promptly respond to oral medication, by the hypodermic use of iron.

ACUTE VASOMOTOR PARALYSIS

(*Vascular Insufficiency*)

While the importance of the blood vessels and the pressure existing in them has long been recognized in chronic cardiovascular conditions it is only comparatively recently that the importance of the blood vessels as a factor in producing heart failure in the acute infections has been given its due importance. The fundamental researches on the subject were made by Romberg, Pässler, and their co-workers in the Leipzig clinic. These observers were the first to express the opinion that in the acute infectious diseases the failure of the heart which develops toward the end is not to be attributed directly to the infection, but rather to a deficient blood supply of the heart muscle, dependent upon vasomotor paralysis. Their experiments were made with rabbits, which were artificially infected with pneumococci, diphtheria bacilli, and bacillus pyocyaneus, and in this way injured the circulation by paralyzing the vasomotor centers of the medulla. This vasomotor paralysis is the cause of the fall in blood pressure. In addition there is an altered distribution of the blood in the organism, which, from the clinical standpoint, is of the utmost consequence. The splanchnic vessels are greatly overfilled, and at the same time the vessels of the brain, the muscles, and the skin become relatively empty.

Pässler and Rolly, in their further series of investigations, found that, when the vasomotor paralysis was increasing steadily in the infected animals, the strongest possible action of the heart would not suffice, in the long run, to keep up the blood pressure at its normal height. While the heart's action, when stimulated to its utmost, might suffice to maintain the blood pressure for a short time, the carotid pressure soon sinks and the temporarily improved cardiac action grows worse again. When the arterial pressure has become very low, the condition of heart weakness develops. In the diphtheria animals this heart weakness is the result of vasomotor paralysis, just as would occur in an animal after resection of the splanchnic. It can be improved temporarily by all those means which bring about a better filling of the relaxed vessels.

In the acute infections, as they affect the human being, the so-called heart failure would better be termed vasomotor failure, since in reality the impairment in the circulation is due to a failure of the vasomotor center in the medulla. This is especially the case with the more rapidly progressing infections, which most closely resemble the experimental infections in animals. In those infections which last a longer time, the heart muscle itself may become involved, either as a functional weakness or as an actual myocarditis.

The vasomotor paralysis and especially the overfilling of the splanchnics account for certain of the clinical symptoms very satisfactorily. On this basis the pallor of the face, generally regarded as a symptom of bad prognostic import, and the relatively slight cyanosis and edema in the presence of heart failure of so extreme a grade are readily explicable. The splanchnic paralysis has as its result the accumulation of a large part of the blood in the vessels of the abdominal cavity. The heart must, of course, receive but small quantities of blood, which it is still capable of propelling.

Treatment.—The above summary of the pathological physiology of circulatory failure in the acute infections is all-important from the standpoint of treatment. It is evident that the treatment of such conditions, aside from causal treatment, as in the case of diphtheria with antitoxin, must be addressed especially toward combating this vasomotor paralysis. Pässler, in a research directed especially toward this point, comes to the conclusion that, while none of the drugs tested by him were able to check the absolutely fatal artificial infections in animals, the condition in the infectious diseases in man is by no means the same. If we are successful during the critical period, when vasomotor failure is developing, in maintaining the vasomotor centers in a functionating condition, we may hope to tide the patient over until such a time as the natural course of the infection brings with it a cessation of the injury to the circulation.

The principal point to be borne in mind is that those drugs and measures which act by increasing the strength of the heart are of very slight

value in any condition of circulatory weakness dependent upon vasomotor paralysis. Digitalis, for example, exerts only for a very short time a favorable influence, in doing what it can to enable the heart to use its strength to the best advantage, but it does not succeed for very long in enabling it to successfully cope with vasomotor paralysis. This fact, in addition to the experimental evidence above named, is abundantly proven by clinical observation. In the same way, such measures as the injection of ether are useless. Strychnia and ergotin, which, especially in English-speaking countries, are given with almost reverential faith, have been shown to have no effect in increasing the blood pressure except when given in toxic doses.

The use of hypodermoclysis or intravenous infusion of salt solutions has been shown to be capable of temporarily increasing a blood pressure which has sunk very low in consequence of vasomotor paralysis. The fear of overburdening the heart by the introduction of an excess of fluid has been shown to be groundless. By far the most valuable drugs in vasomotor failure are caffein and camphor, and of these two caffein has been shown by Pässler to be by far the most valuable. The value of alcohol in this condition is very questionable, and its administration would probably be better limited to such patients as are accustomed to its habitual use, and then only in small doses.

Just in proportion as the duration of an acute infection is longer, in that same proportion does the influence of the vasomotor system diminish, at least relatively, and the part played by actual weakening of the myocardium increase. Under these circumstances, digitalis or strophanthus may be appropriately given, even though no such striking results may be expected as in the condition of chronic myocardial insufficiency (see chapter on Lobar Pneumonia).

ARTERIOSCLEROSIS

(*Atherosclerosis—Marchand*)

While the final word has by no means yet been spoken in regard to the pathogenesis or the morbid histology of the heterogeneous conditions grouped together under the clinical name of arteriosclerosis, yet the histological work of the last few years has shed much light upon the condition. The results of these researches have been to place arteriosclerosis among the nutritional diseases. This view, whose chief exponent is Marchand, regards arteriosclerosis as caused by a progressive disturbance of nutrition of the vessel wall, due to a functional overuse, to a "using up" of the vessel. This is accurately expressed by the German term, "Abnutzung."

Since there can be no thought of an actual cure of arteriosclerosis, in the sense that the production of connective tissue, fatty and calcareous changes in the intima, can be made to disappear, the treatment of arteriosclerosis has to do primarily, either with the prophylaxis of the condition, or, much more frequently, with its arrest when it has been recognized in a comparatively early stage. No therapeutic resources at our command can in any way modify, much less cause to disappear, the anatomical changes in the arteries when once they are actually developed. From the therapeutic standpoint, therefore, the most important factors to be considered are those which have to do with the etiology of the disease, and with the means by which these factors may be rendered inoperative.

Etiological Considerations.—In consonance with the definition, the most important factors are those which, through the long course of the years, increase the normal amount of wear and tear of the arteries, by making increased functional demands upon them. In hospital practice these increased demands upon the arterial system result generally from hard physical work. This finds its expression in the fact that those individuals who have carried on the most laborious work, and especially work of a character which produces overdistention of the blood vessels, because of sudden increase in the blood pressure, are particularly prone to arteriosclerosis. Thus, porters who carry very heavy weights for short periods of time, and workmen whose occupations necessitate heavy lifting, make extra heavy demands upon the blood vessels. In similar manner, we find a predominance of the severer grades of arteriosclerosis in the arteries of the upper extremity in men, since their work, in most cases, makes its heaviest demands upon these vessels. In women of the peasant classes the changes have been most frequently found in the arteries of the lower extremities. Conversely, in men whose pursuits are such that their work is mental rather than physical, arteriosclerosis is prone to skip the arteries of the extremities, and to settle upon those of the brain and heart.

Obesity plays a more important rôle than is commonly appreciated. This is seen much more frequently in the better classes of private practice than in hospital or out-patient work. It is easy to comprehend how the increased work on the part of the heart and arteries, which is necessitated by the abnormally heavy body, makes itself especially noticeable in the coronary vessels, and in the arteries of the lower extremities.

Nervous influences are of as great, perhaps greater, importance than hard manual labor. The changes in tone of the vessels as a result of nervous stimuli almost inseparably connected with the exigencies of modern life make increased functional demands upon the arteries, just as truly as does physical work. These will, of course, be greatest in men whose vocations are such that they live under a constant nervous tension. This

does not mean necessarily close mental application, since the most studious of lives may be a fairly tranquil one. It is the ups and downs of fortune in business life, the fluctuations of the stock market, the strained expectation and the hope of a fortune to-morrow, and the harrowing uncertainty of its possible loss the next day—these are the things which use up the arteries and shorten their life. In the mental sphere it is worry and not work which is baneful. Further, such occupations as those just mentioned, especially such as are of a more or less speculative character, and too often filled with "the sickening pang of hope deferred," lead almost inevitably to neurasthenic conditions. In these the vasomotor changes are especially pronounced, or, as we say, the vasomotor system is especially labile, and this increased reaction to nervous influences aggravates by just so much the strain on the blood vessels. Such patients become the especial prey of cerebral and coronary sclerosis, following the general rule that an individual develops arteriosclerosis of that particular vascular area upon which he has thrown the greatest strain.

Heredity plays an important rôle, albeit one which is practically impossible to estimate in a given case. The life of a given set of arteries depends upon the quality of the materials of which they are composed. There is as much difference in this respect in the capacity of the arteries of different individuals to stand strain and remain elastic as there is in the durability of a well-tempered spring and one of inferior material. Otherwise expressed, the arteries of some individuals possess a high degree of resistance and durability which are lacking in others.

It is not unlikely that, when a given set of arteries are but very little used, they degenerate in much the same way as rubber does, becoming brittle, and losing their "life," as it is commonly termed. This is a factor which is difficult to estimate, but it is well known that individuals of extremely sedentary habits, especially when addicted to the pleasures of the table, are prone to arteriosclerosis. In other words, it is not improbable that there is a certain minimum of use which is necessary to keep the blood vessels at their best. If this be so, it finds its analogy in the similar condition already described for the heart.

A number of chronic intoxications are of importance in the production of arteriosclerosis, because of their influence in producing changes in vascular tonus. The most important of these are alcohol, tobacco, coffee and tea, and especially lead. [Autointoxications from different sources are a common factor in the etiology of this disease.—Editor.]

The influence of alcohol is one about which there exist great differences of opinion. This is because of the fact that it is almost impossible to find cases, clinically, in which, in addition to alcohol, numerous other factors have not been at work, all acting in the same sense. Either the alcoholic belongs to the laboring classes and has worked hard, smoked hard, and perhaps been a victim of syphilis, or, if he belong to the class who work

with their brains, he has been subject to the nervous influences, the importance of which as a factor in the production of arteriosclerosis has already been dwelt upon. The majority of clinicians attribute great importance to it, and yet some, of wide experience, deny its influence entirely, since even the most excessive use of alcohol is by no means invariably accompanied by hardened arteries.

The influence of tobacco is equally difficult to determine. Experimentally, Lee has shown that it is not difficult to induce changes in the aorta in animals by causing them to inhale tobacco smoke over considerable periods of time, and yet how often do we see individuals who have used tobacco to great excess for many years and yet have no perceptible changes in the arteries.

The influence of lead in producing arteriosclerosis is probably through the kidney, since the contracted kidney is frequently found in lead workers.

The influence of the various infections has only recently been appreciated. Of the acute infections, typhoid fever has been shown by Thayer to be associated with arteriosclerotic changes in the aorta. Of the chronic infections, pulmonary tuberculosis is a frequent causative factor. The important influence of syphilis has been recognized for a long time. It can hardly be questioned that individuals who have been infected with syphilis are more prone to acquire arteriosclerosis than are healthy individuals. On the other hand, there is a tendency at the present time to overestimate its importance. This is probably due to the fact that many authors, especially clinicians, have not drawn a sharp line of demarcation between arteriosclerosis on the one hand and the specifically syphilitic arterial thickening on the other. It should be kept in mind that the specifically syphilitic arteritis is quite distinct, pathologically, from arteriosclerosis.

Lately there has been a considerable amount of work done in which sclerotic changes have been produced in the aorta by long-continued injection of bacterial toxins.

High Blood Pressure.—The relationship which exists between high blood pressure and arteriosclerosis is a complex one. It should be borne in mind that the most important factors, so far as the arteries are concerned, in the raising of the blood pressure are not the arteries of the extremities, but rather the arteries in the splanchnic region. These latter, which are in reality the deciding factor in the elevation of the blood pressure, are generally not extensively involved in the sclerotic process. The researches of Sawada have shown that only twelve per cent. of the cases of arteriosclerosis are associated with an increase in blood pressure, provided nephritis can be excluded. Romberg considers systolic blood pressure above 160 to 170 mm. of mercury as indicating almost certainly a concomitant kidney lesion. Clinically these facts are most important to

bear in mind, since it has been assumed by many authors that an increase in blood pressure precedes and produces the arteriosclerosis. On the other hand, it is unquestionably the case that the increased blood pressure which accompanies even a latent kidney lesion is productive of arterial degeneration. It should be observed that many of the factors which tend to produce arteriosclerosis produce with equal frequency degenerations of the kidney. This is notoriously the case with overeating, which acts not only in producing overdistention of the blood vessels, but also by throwing increased strain upon the kidneys. Again, it is possible that in notorious overeating metabolic products may be formed which possess a greater or less degree of toxicity. This may explain many of the cases of arteriosclerosis in the well-to-do and sedentary classes, who frequently indulge in great excesses in the matter of eating, and at the same time take little exercise.

The production of degenerative conditions in the arteries from adrenalin injections has led to the suggestion that the increased blood pressure in both nephritis and arteriosclerosis is due to an overfunctionating of the adrenals. No actual pathological evidence has been brought forward in support of this view, and some of the recent experimental work is not in favor of it.

Treatment.—Patients with arteriosclerosis come under observation under three conditions: First, they may be brought to our notice only when the heart, as a result of a coronary sclerosis, has become insufficient. The measures to be followed have been discussed under the head of Chronic Myocardial Insufficiency. Second, the arteriosclerotic may come under observation because of some local symptoms due to his arterial disease, such as an angina pectoris, intermittent limping, cerebral symptoms, etc. Third, the arteriosclerosis may be discovered accidentally, having made no symptoms of any kind. In this latter group of cases, where the disease is often detected in a relatively early stage, our endeavor must be to arrest its progress, an attempt which will be successful in proportion to our ability to ascertain the causes which operate in this particular case, and to remove them.

The first inquiry should be directed toward the diet, and a careful estimate made of the amount of food consumed as compared with the amount of exercise taken. Nor should it be lost sight of that the great majority of patients, especially men in the well-to-do classes, past the fortieth or forty-fifth year, eat decidedly too much. This overindulgence is especially likely to take the form of an excessive consumption of proteids. These latter should be reduced to a very little above the minimum, and the other foods proportionately. If the patient be obese, especially if he have a strong tendency to take on weight, a slow and careful reduction cure may be undertaken. As has already been emphasized under the head of Cardiac Insufficiency of the Obese, such a reduction cure should never

be undertaken without careful reflection, and with the heart in fair condition. The strict milk diet carried out for considerable periods of time is not to be recommended. On the other hand, a menu consisting largely of fruits and vegetables, with milk in moderate abundance and meat in only small quantities, is most suitable. The amount of salt should be low, although it is not necessary or desirable to go to the length of prescribing a salt-free diet. Those meats which contain large amounts of purin bodies should be avoided. It is absolutely impossible to lay down a dietary with exactness which can be regarded as suitable for all or even a majority of the cases. In one sense arteriosclerosis is a condition rather than a disease, and the patients present such vast differences that any schematic plan of treatment must result in harm rather than good.

Some observers, notably Rumpf, have recommended the giving of a diet which is poor in calcium salts, in the hope of preventing the deposition of calcium in the vessels. Such a diet meets neither theoretically nor practically the needs of the situation. In the same way, all medication directed to the diminution of the calcium salts has probably no effect whatever.

Especial care should be taken in the diet not to produce constipation. This is exceedingly likely to develop if the diet be sharply reduced in quantity. Bearing in mind the very considerable rises in blood pressure which occur during the act of defecation, and which are of especial danger with cerebral or coronary sclerosis, this is a complication which should be energetically treated at its very inception. Above all, the physician should not content himself, as is so often done, by a general suggestion to the patient that he "take something for it." An early resort to purgatives lays the foundation for an infinite deal of vexation later. In those who overeat, and in whom it has been found necessary to reduce the amount of food, this constipation is generally due to the simple lessening in the bulk of the food below that to which the bowel has been accustomed. This may be partially compensated by prescribing foods which have a large bulk, but with a low caloric value. Should these fail and the stools remain small in bulk, dry, and hard, the use of agar-agar, in the manner described under the head of Cardiac Insufficiency, has, in the writer's experience, proven of the greatest benefit.

Alcoholic drinks of all kinds would better be dispensed with if the patient be in otherwise vigorous health. This is especially the case with the individual who drinks, perhaps during business hours, the stronger liquors, for the sake of the stimulation obtained. In elderly patients in an indifferent state of nutrition small amounts of a light wine with the meals may be permitted.

Even in spite of the fact that the evidence against tobacco is not absolutely conclusive, it certainly seems wisest to forbid its use entirely, in view of the digestive disturbances which occur with it. Only the exces-

sive use of coffee and tea need be interfered with, although the substitution of a coffee poor in caffein is to be highly recommended.

A much more difficult problem to solve is in relation to occupation. While excessive physical exertion, and no less mental excitement and worry, are to be as far as possible avoided, it is a mistake to insist that a man who has been perhaps engaged in active business enterprises shall suddenly retire and lead an absolutely inactive life. On the other hand, the patient should, when possible, as middle age is passed, gradually lessen the field of his activities, and in this way reduce the demands which he makes upon his circulation.

The question as to the limitation of fluid is to be decided in each individual case upon its own merits. It is a common habit in the better classes in America for patients to drink large quantities of water at one time, for the reason that some one has told them that it is "healthy" to do so. This seems to be a tolerably widespread idea, and one which has little foundation in fact. It is rarely wise to establish any amount arbitrarily as being the optimum, since this will vary greatly, depending upon the amount of water contained in the diet, the exercise taken, the temperature, etc. In general, it is a safe rule to instruct the patient to take just such quantities of water as are really necessary to quench the thirst, and neither more nor less. In patients who have acquired the habit of gulping down several glasses of water in close succession the writer has adopted the expedient of permitting them to drink as much as they like, provided not more than a quarter of a glass be taken at five-minute intervals. They generally find that a much smaller amount of fluid than that to which they have been accustomed amply suffices to quench their thirst. To reduce the amount of water ingested to a minimum, with the idea of reducing the blood pressure thereby, is almost certain to produce troublesome dyspeptic and nervous symptoms, with no real gain.

The amount of exercise which it is proper for an arteriosclerotic patient to take varies within very wide limits. In an otherwise robust man of forty-five, who has presented no pathological symptoms and in whom the sclerosis of the arteries has been accidentally discovered, the physician may permit all such forms of exercise as are not accompanied with sudden rises in blood pressure of too high a degree. While such a patient should not play tennis, a moderate amount of golf, played in a sedate way, would be permissible. Walking, especially cross-country walking, is one of the best forms of exercise, since it serves at the same time to bring the patient into the open, under good hygienic conditions, and yet is not likely to be overdone. The details of exercise will suggest themselves very readily, but it cannot be too strongly emphasized that the increasing tendency for middle-aged business men who are obese and badly trained to seek the advice of untrained gymnastic instructors, or boxing teachers, who subject them to severe overexertion, is fraught with the gravest dan-

ger. It is self-evident that no increase in the amount of exercise taken should be prescribed except where there is reason to believe that the patient has been accustomed to so little physical exertion that this may have been a factor in the production of his disease.

Sleep in abundance should be sought for by all possible means. There is a great deal of difference in patients in this respect. Elderly patients are not infrequently poor sleepers, and their habits in relation to sleep are of many years' duration, and correspondingly hard to overcome. Especially is this the case with older patients who wake up very early in the morning. Excellent results are frequently obtained by a warm bath at the indifferent temperature, or a degree or two above it, for ten or fifteen minutes just before retiring. A hot drink, such as a glass of hot milk, sometimes has a soothing effect. Where such measures are not sufficient, it is a good plan to encourage the patient, when possible, to take an hour or two hours' nap in the afternoon. Some patients can do this with ease and with no detriment to their sleep at night; others, again, find so much greater difficulty in getting to sleep at night, after an afternoon nap, that there is no net gain. The administration of hypnotics should be the last resort, and these should never be given continuously, but for a few days at a time with interruptions of like duration.

Climatic treatment offers by no means the same advantages in arteriosclerosis as in some other conditions, as, for example, emphysema. Yet the arteriosclerotic, especially when the arteries of the brain and heart are involved, is but ill equipped to withstand the rigors of the cold weather and especially the sudden changes in temperature which are incident to the winters in many of our northerly states. Conditions permitting, they may frequently spend six weeks or two months in a more equable climate with advantage. A good plan is to have them take a winter vacation rather than one in summer. During the more inclement months careful attention should be given to the avoidance of undue exposure, and sudden chilling of the skin prevented by wearing either woolen underwear of appropriate weight or that made of mixtures of wool and silk.

Hydrotherapy.—The value of hydrotherapy in the treatment of arteriosclerotic conditions is insufficiently appreciated. By far the most valuable procedures are the warm full bath and its various modifications. These act by dilating the cutaneous capillaries much in the same way as amyl nitrite does, except that the effects are felt in the vessels of all the cutaneous territories. Where it is inconvenient or difficult to obtain a warm full bath, the warm shower bath answers equally well. The duration need not be great, four or five minutes being amply sufficient. The great advantage of these warm baths is that the patient does not become accustomed to them, and so fail to react. Furthermore, there is no unpleasant after-effect, as is so often the case with drugs. One or the other of these measures should be applied in the great majority of all cases,

unless there are some especial contraindications. They may be given morning and evening in the more severe cases. Conversely, the cold bath, especially the cold plunge, should be carefully avoided, since the constriction of the blood vessels induced by them may precipitate an attack of angina pectoris. Swimming is especially hurtful because of the combination of the effects of the cold water and the vigorous exercise.

Medicinal Therapy.—Two groups of drugs have been found, in the experience of nearly every one, to be of value. These are the *iodids* and the *nitrites*. The action of the iodids has been the subject of a great deal of controversy. Mueller and Inada, under Romberg's direction, came to the conclusion that its principal effect was in diminishing the viscosity of the blood, the effects setting in after several days' use of the drug, and increasing with the length of its administration. Their results, however, are far from convincing. Determann was unable to confirm their observations. Further investigations by Mueller and Alwens (Romberg) have confirmed Mueller's original results. Pending confirmation, the entire question of the action of the iodids in arteriosclerosis must still be regarded as an open one. Even in cases in which syphilis may have been present the effect of iodids is almost certainly not dependent upon any antisyphilitic effect. If Mueller's results are correct, the viscosity of the blood, which is one of the most important factors in determining the resistance, would be reduced, and thus make up for the increased resistance to blood flow produced by the arterial disease itself.

Too much should not be expected of this drug. It is certain that it is not capable of removing the anatomical changes in the arteries, once these have developed. Its principal value lies in early cases where the reaction of the artery to external influences and to drugs has not been too greatly impaired. It is, of course, worthless in removing the anatomical effects of arteriosclerosis, such as the foci of degeneration in the heart muscle or in the kidney, which depend upon obliteration of the small vessels.

The iodids are useless where quick action is desired, as in angina pectoris, cardiac asthma, or in the cerebral manifestations of arteriosclerosis. The effects of the iodids are accomplished quite as satisfactorily, or more so, by the use of small doses as by the use of large. In general, doses of five grains (0.30 gm.) t. i. d. after meals are sufficient. It should be given over a long period of time, with occasional interruptions. Even during the period of interruptions the effect is not entirely lost, because of the slowness of excretion. The iodid of potassium and the iodid of sodium are almost universally used. They are of equal value. It is stated by some that the gastric disturbances may be avoided by combination with an alkali and by the avoidance of acids, as far as possible. [The best way to prevent gastric disturbances is to give pepsin with the iodin.—Editor.] Under all circumstances they should be given well diluted and

on a full stomach. Of the large number of substitutes for potassium iodid, the most useful, in the writer's experience, has been sajodin. Its dosage is approximately the same as that of the potassium salt.

The nitrites have no influence in removing the new-formed tissue, nor do they influence the development of the disease in any way. They cannot be regarded as having anything more than symptomatic value. Nevertheless, their value should not be underestimated, since symptomatically they accomplish what no other drugs can accomplish. Their action has been discussed in some detail under the caption Nitrites. If there is no increase in blood pressure, there is no indication for the continuous use of nitrites in any form, and, even with persistent high blood pressure, the results are not always favorable. On the whole, dietetic methods of reducing persistently high blood pressure are infinitely superior to the use of drugs.

Various attempts have been made by the administration of combinations of salts to keep the calcium phosphate in solution. One of these, known as Trunecek's serum, is a mixture of salts similar to those of the blood, which is to be injected subcutaneously. Antisklerosin is a similar mixture designed to be taken internally. They are both superfluous.

[Phlebosclerosis—hardening of the veins—usually accompanies arteriosclerosis. The same etiology, especially increase of pressure and function, obtains in phlebosclerosis as in arteriosclerosis. One form, due to debility, is found not infrequently in the young and especially in the peripheral veins (Osler).

The treatment of phlebosclerosis is the same, in the main, as that of arteriosclerosis. In the last form, which is not associated with arteriosclerosis, measures should be directed to the general condition. When the debility has been removed tentative efforts to produce effects upon the hardened coats of the vein should be made. For this purpose the treatment is the same as in arteriosclerosis.—Editor.]

ARTERITIS

Secondary arteritis, occurring as a result of the extension of local infectious processes, will not be discussed here. Primary arteritis occurring in the course of the acute infections is of great rarity. The treatment is entirely symptomatic.

Acute Aortitis.—This condition, described especially by the French writers, is of still greater rarity. No case has come under the writer's observation. The principles of treatment would not differ from those which obtain in acute endocarditis.

Chronic Arteritis.—The chronic inflammations of the arteries occur in connection with syphilis and tuberculosis. The latter of these is a pathological rather than a clinical conception and need not be discussed.

Syphilitic Arteritis.—This affects especially the cerebral arteries (Heubner), the coronary arteries, and the ascending aorta. Specific gummatous changes occur, especially in the media. In the aorta the picture is often very characteristic. The inner surface is drawn in in places, sometimes very deeply, and the whole aorta, in its affected part, has a gelatinous appearance. Even when the changes are of a high grade, calcification is almost invariably absent. Some of the cases pursue a subacute course.

Treatment.—When the diagnosis can be made with a fair degree of certainty, which is usually possible when sclerotic arterial changes develop in youthful patients, an energetic antisyphilitic treatment should be at once instituted. In one personal case, associated with moderately severe attacks of angina pectoris, a vigorous inunction treatment, with fairly large doses of iodid of potassium, led to a very great and prompt amelioration of the symptoms. Every effort should be made to distinguish these cases from those of arteriosclerosis, since the specific luetic cases are infinitely more amenable to antisyphilitic treatment.

ANEURYSM

The rare cases of aneurysm which heal spontaneously do so by one of two processes, either by the development of connective tissue in the walls of the vessel, which thus serves to strengthen the wall at its weakest spot, or by the development of fibrin formation in the aneurysm itself.

The first method occurs almost exclusively in aneurysms of small arteries, the exceptions to this being very rare. The intima plays the most important rôle in the production of this connective tissue. In the larger aneurysms the fibrous connective tissue is formed principally by the adventitia. This method of healing plays a very subordinate part in such aneurysms as come clinically under observation, since the cases in which an aneurysm heals spontaneously have almost invariably been latent ones.

The method of healing, upon which all the various schemes of treatment are based, depends upon the formation of laminated fibrin in the sac itself, as the result of thrombosis. A number of factors influence this. It occurs most readily in sacculated aneurysms communicating with the artery by a narrow opening. In these the current is necessarily slow and the mechanical conditions for clotting most favorable. Even under these circumstances the expected clotting may not occur. Two varieties of clots are recognized, the white, firm, laminated deposit of fibrin and the soft, red clot which sometimes fills a large portion of the aneurysmal sac (Birch-Hirschfeld).

From the standpoint of treatment these two varieties of thrombi are of very unequal value. The former is deposited on the walls in successive

layers, sometimes to the number of thirty or more, which are hard and tough, almost leathery. They may sometimes be peeled off, and in cases which go on to complete recovery may fill the entire sac to the mouth. These layers of laminated fibrin are of considerable strength and, when deposited in sufficient amount, form a fairly effectual barrier against the increase in size of the sac. The soft red clot which is formed in aneurysmal sacs, sometimes spontaneously, and sometimes as a result of various therapeutic procedures to bring about rapid clotting, is much less resistant. The writer has seen one case in which the entire aneurysmal sac was filled with such a clot and yet increased in size. At least such was the interpretation placed upon the case at the autopsy.

Treatment.—In most of the aneurysms which come under the observation of the internist the treatment is exceedingly unsatisfactory. The percentage of cures is certainly exceedingly small. But one instance has come to the writer's observation, that of a small sacculated aneurysm of the ascending aorta, which developed rather acutely, and at the end of four years is apparently perfectly cured. In most instances the best result which can be expected is a moderate degree of improvement lasting for a greater or less period of time, only to give way eventually to the steady onward progress of the disease. Indeed, a very considerable number of hospital cases in whom rather strenuous efforts are made to effect a cure are made worse, rather than better, by the treatment. It is not an uncommon experience to see patients with aneurysms of such size as to preclude practically every possibility of a cure subjected to such restriction of food and drink that their strength is so greatly reduced as to favor, rather than retard, the fatal end. It is well, then, to classify the cases, from the very beginning, into those in which the treatment should be entirely symptomatic, and those in which a cure may be undertaken with a hope, even though a small one, of effecting a complete recovery. An attempt at cure should be made only when the diagnosis can be made early and when the sac can be made out, either by physical examination (which is rarely possible), or by the fluoroscope, to be of small size. In young patients, especially with a clear-cut history of syphilis, the attempt may be made somewhat more frequently.

The fundamental principle of the medical treatment of aneurysm is *to secure for the patient the strictest possible bodily and mental rest.* Not only does the recumbent position bring about a diminution in the pulse rate, but in the blood pressure as well. This takes a considerable portion off the walls of the vessel, and in cases where recovery is possible is the principal means of bringing about a cure. It should further be borne in mind that, as previously stated, the normal metabolic activities involve some work for the heart and for the arteries as well. The effort should be made, therefore, to reduce the intake of food and drink to a minimum.

Practically, the rest must be as nearly absolute as possible. Not only

must the recumbent position be rigorously insisted upon, but every unnecessary motion should be forbidden the patient. He should not be allowed to feed himself, nor to assist in any way in his personal care. This period of rest should be continued for from two to three months at least, in spite of the very considerable hardships which are imposed by such treatment upon the patient.

The restriction of diet, according to a systematic plan, is generally associated with the name of Tufnell. Tufnell permitted ten ounces (300 gms.) of solids, and eight ounces (240 gms.) of liquids in the 24 hours. This he divides as follows: For *breakfast,* two ounces (60 gms.) of bread and butter and two ounces (60 c. c.) of milk or tea; for *dinner,* three ounces (90 gms.) of mutton, three ounces (90 c. c.) of potatoes or bread, and four ounces (120 c. c.) of light red wine; for *supper,* two ounces (60 gms.) of bread and butter, and two ounces (60 c. c.) of tea. Water is not allowed at all. The hardships of this method are very great, and the writer's personal feeling is that many more patients have been injured by the rigorous application of it than have received benefit from it. This is especially true when the patients, as not infrequently happens, are already poorly nourished. Under these circumstances a carefully selected diet which makes small demands upon the heart, but which is, at the same time, sufficient to improve the nutrition, is greatly to be preferred.

Both of these measures, although in somewhat less systematic form, had been already advocated in the treatment of aneurysm by Valsalva. In addition, this author laid great stress upon the reduction of the amount of blood by copious and often-repeated bloodlettings. This was carried to the point of rendering the patient so weak that he could barely raise his head from the bed, after which time the dietary was gradually increased. Even in the tempered form of abstraction of blood in small quantities this method has nothing to recommend it.

Practically, while recognizing the correctness of the principle of restricted diet, the extreme restriction practiced by Tufnell seems unjustifiable. Especially is this true of the great limitation of fluid. A dietary containing about half as much again, both of solids and fluids, as that recommended by Tufnell, and composed principally of milk, toasted bread, and the lighter vegetables and fruits, sufficiently meets the indication. This would better be divided into a number of small meals so that the quantity ingested at any one time is inconsiderable.

Especial care should be taken to avoid constipation, with its dangerous attendant rise of blood pressure on defecation. This is best done by some of the cascara compounds. The salines would better be avoided, because of their tendency to overpurge.

Medicinal.—The only drug which is really of any service in the treatment of aneurysm is iodid of potassium. This drug, introduced first by Bouillaud, and later into the English-speaking world by Chuckerbutty,

is at least of considerable symptomatic value in that the pain and sometimes the pulsation are generally favorably influenced by it. It is highly improbable that its supposed effect in increasing the coagulability is the reason for its utility, but far more likely that its usefulness depends upon its power of favorably influencing the syphilitic arterial affection upon which aneurysm so frequently depends. It should be given in moderate doses, from 45 to 90 grains per diem (3 to 6 grams).

The question as to whether anti-syphilitic treatment by mercurials should be instituted depends pretty largely upon the prospect of a cure. In small aneurysms, where the luetic infection is of recent date and the hope of cure seems a reasonable one, vigorous mercurial treatment should be instituted.

Since many aneurysms prove ultimately fatal through the myocardial insufficiency which develops, careful watch should be kept for this, and when found it should be combated by digitalis or strophanthus, according to the methods already described. It is hardly necessary to say that every form of gymnastics or carbon dioxid baths is to be sedulously avoided.

Infinitely more frequent than a complete cure, after several months of rest and restricted diet, is a temporary improvement. While under this treatment the pulsations grow less, the pain diminishes, and, perhaps, as subsequently determined at autopsy, a certain amount of laminated fibrin is deposited on the walls of the sac. The duration of this improvement is rarely great, since on getting up the pulsation soon returns and the sac again begins to increase in size. Under these circumstances it seems decidedly best to permit the patient to be up and around so long as his sufferings are endurable, endeavoring to make life a little less intolerable for him by narcotics. In large aneurysms, where the sac is already bulging, a properly devised support is of some assistance.

The use of gelatin, either subcutaneously or by oral administration, has not fulfilled the expectations of those who have used it most extensively. The subcutaneous use of gelatin was introduced by Lancereaux, who injected rather large quantities, about 250 c. c. of a 2 per cent. solution. It is, however, more conveniently given in 10 per cent. solution, injecting 50 c. c. at one time. Carefully sterilized solutions are obtained commercially. This careful sterilization is extremely important because of the number of fatal cases of tetanus which have been observed from the use of improperly sterilized solutions. It is stated that from 75 to 175 grams of gelatin are necessary to produce a satisfactory result, the injections being made once a week in the beginning, later every second or third day. More convenient and probably just as satisfactory is the oral administration of from one to two ounces of gelatin daily.

Surgical Treatment.—The considerable number of operations which have been devised for the treatment of internal aneurysms is a good indi-

cation of the unsatisfactory results achieved. The best known of these methods depends upon the introduction of some form of foreign body into the sac. In its modern form this operation is generally carried out after the plan of Moore by introduction of iron wire. This method by itself has proven unsatisfactory. A modification of this consists in the introduction of iron wire into the sac, subsequently passing an electrical current through the wire. The field of application of this method is a very limited one. Macewen's operation of needling the sac has proven successful in a limited number of cases.

In aneurysms of the abdominal aorta digital compression has been successful in some cases. Ligature of the abdominal aorta has been invariably fatal. Somewhat better results may be looked for from the method of occlusion by means of metal bands, as practiced by Halsted. For the indications for the different methods of surgical treatment the various text-books on surgery are referred to.

ANGINA PECTORIS

The symptom-complex, for convenience referred to under the name of angina pectoris, represents the most characteristic of the various painful sensations localized in the region of the heart. While the so-called classical cases are generally associated with a greater or less degree of coronary sclerosis, it is entirely erroneous to regard these as equivalent, since many cases of coronary sclerosis run their entire course with symptoms in no wise differing from the general picture of chronic myocardial insufficiency, and, on the other hand, attacks frequently indistinguishable from angina occur with normal coronaries. For the cases of angina pectoris occurring without coronary sclerosis the designation of pseudoangina is commonly used. The term, however, is a very unfortunate one, as has been repeatedly pointed out, since "angina" is the term used to designate a *symptom,* and a very characteristic one at that, and to speak of a pseudosymptom is, if not more or less of a contradiction, at least a very incorrect use of terms. The designations of *reflex angina*, given them by Huchard, or, better still, *vasomotor angina,* of Nothnagel, are much more accurate.

Angina Pectoris Vera.—Any consideration of the treatment of angina pectoris must take cognizance of the attack itself and the underlying pathological conditions. Angina pectoris vera, which designation embraces all those forms dependent upon organic changes in the heart, may be associated with a number of clinical conditions, of which the most important are the following:

Coronary sclerosis, or sclerosis of the aorta, which narrows the mouths of the coronary vessels, they themselves being normal.

Aortic insufficiency, less frequently other valve lesions.

Aneurysm.—This may be of any part of the ascending aorta, but is especially frequent with involvement of the sinuses of Valsalva.

Pericardial Synechiæ.—In acute dilatation of the heart there is occasionally severe pain, which at times takes on the character of a typical angina. In these cases the coronary vessels are generally normal, and the pain is probably to be brought into association with the dilatation rather than with coronary spasm. These cases occupy middle ground between the cases of angina pectoris vera and the cases of angina pectoris vasomotoria.

Angina Pectoris Vasomotoria.—The vasomotor anginas are associated with the following conditions:

Nicotinism (Tobacco Angina).—This usually occurs from acute overindulgence, in semioccasional smokers.

Abuse of Coffee and Tea.—These cases are much rarer than those due to tobacco.

Neurotic States.—Closely associated with these are the cases occasionally seen in Basedow's disease. The so-called gastrointestinal cases are, in most instances, merely cases in which both gastrointestinal and cardiac symptoms occur in a highly neurotic subject.

Treatment of the Attack.—For the intense pain, which at times exceeds all description, a subcutaneous injection of morphin should be promptly given. The dose should not exceed one-sixth grain (0.01 gm.), and may be repeated if necessary. Some of the most experienced clinicians warn against its use, and consider it dangerous, but the writer has used it almost as a routine, and has seen nothing but good effects from its use. Dionin may be used internally in the milder cases.

Value of Nitrites.—The classical remedy for the relief of the attack is amyl nitrite, introduced by Lauder Brunton. The experiences of different clinicians with this drug vary so widely that the discrepancies are scarcely explicable. A large number of writers on the subject report the most brilliant results from its use. Mackenzie considers it the best of all remedies in this condition, and states that "this drug is not successful in all cases, but in many its action is rapid and the relief is generally complete." So careful an observer as Romberg considers it practically useless and says that only in one case has he ever seen striking improvement from its inhalation. Hirsch, writing in the Penzoldt-Stintzing work, says that he has never been able to convince himself of any favorable action. Such conflicting testimony cannot but help us to the conclusion that many of the supposedly favorable results depended rather upon the spontaneous cessation of the pain than on the therapeutic effects of the drug. In some cases, nevertheless, especially those associated with incipient coronary sclerosis, the effects are so striking that it is difficult to believe that they are not directly due to the drug itself. The dangers of the drug are somewhat exaggerated. In considerable experience with it

the writer has never seen any untoward effects from its use. It is best given to the patient in the form of pearls, containing three minims, which can be crushed in the handkerchief and inhaled. It may be repeated, if necessary. Its action is probably not so simple as has hitherto been supposed, and it will be remembered that Hewlett has found an *increase in blood pressure,* to considerably above the original height, occurring immediately after the primary fall, which lasts only about forty seconds. The effects of the inhalation of amyl nitrite should be immediately supplemented by a more slowly-acting nitrite, preferably nitroglycerin. This may be taken at once in doses of one or two drops, either by mouth or subcutaneously. In patients who have not been accustomed to its use the oral administration is preferable. Care should be taken to have a fresh preparation, which the patient carries about with him. Many of the commercial tablets are practically worthless. Romberg recommends sodium nitrite, in aqueous solution, subcutaneously in doses of gr. 1/6 (0.01 gm.).

The posture of the patient is not without influence. While, if the attack be of great severity, the patient will stand immobile, it is far better to have him lie down at once. Warmth is strongly conducive to the amelioration of the pain, especially if copious perspiration be induced. A glass of one of the heavier wines or spirits, or a cup of black coffee, if this be obtainable, is useful.

An important part of the therapy of the severe cases is to combat the danger of collapse which is frequently imminent. While the physician himself is not often in a position to see the actual attack, yet an effort should be made to secure the prompt administration of a cardiac stimulant in all such cases. Caffein, subcutaneously, is perhaps the most satisfactory, but is, under the circumstances, difficult to have administered. Digalen, because of the rapidity of its absorption, may be used with satisfaction orally. It need hardly be said that, even where one attack of angina has occurred, the patient should go armed with the necessary remedies and be carefully instructed as to their use. In the vasomotor anginas these measures are largely superfluous, especially in the neurotic cases. If, however, the suffering seems really to be intense, similar measures may be instituted.

Treatment in the Interim.—In the cases of angina vera, when associated with coronary sclerosis or sclerosis of the aorta, or with aneurysm, the general principles laid down under the treatment of arteriosclerosis are applicable. It must never be forgotten that a single overexertion may bring on a fatal attack, hence the physician's first duty is to analyze the patient's status for him, and, even at the risk of causing him some worry, tell him the exact condition of affairs. At the same time the outlook should be pictured to him as favorably as is consistent with the facts of the case, to avoid the production of neurasthenic symptoms. The most

valuable drug for continuous administration is potassium iodid or one of its substitutes, in moderate doses, say, gr. v (0.30 gm.) t. i. d. The best results are often obtained by the continuous administration of small doses of digitalis, since the condition of the heart is frequently one of slight insufficiency. This is especially valuable with mild and often repeated attacks. After a reasonable experience with the use of digitalis, on Romberg's recommendation, the writer's experience is strongly confirmatory of this author's position. In view of the work of Hewlett and Mackenzie on arrhythmia and heart-block produced by digitalis, such cases should be excluded from digitalis treatment. A certain degree of care should be exercised in the use of digitalis in cases of coronary sclerosis, because of the greater liability to disturbances of conduction in this affection. The use of the theobromin and theophyllin preparations is occasionally followed by good results, but a number of personal cases have shown no apparent effects whatever.

Diet.—The question of diet is all-important. It should be reduced to the smallest amount which will maintain the patient's weight in equilibrium. The proteid content should be low, well below a hundred grams per diem, and the main bulk of the diet be made up of milk, cereals, vegetables, and fruits. The purin bodies should be reduced to a minimum. Especial attention should be paid to the avoidance of flatulence, since it seems quite certain that overdistention of the stomach may precipitate an attack. Similarly, this condition induces the habit of air-gulping, to which reference has been made elsewhere, and this greatly aggravates the condition. In view of the idiosyncrasies of certain patients in regard to flatulence produced by some articles of diet this should be inquired into very carefully. The amount of salt would better be kept low, although it is probably not wise to endeavor to eliminate it entirely. Smoking should be absolutely prohibited, and alcohol, if not absolutely forbidden, at least reduced to a small glass of light wine with the meals. The importance of the avoidance of constipation is very great, since the very considerable rise in blood pressure which occurs during strained defecation may prove disastrous. The same is true of the sexual act.

A difficult question to solve relates to how much we must restrict the patient's participation in business and professional life. The condition of affairs is distinctly different from that which obtains in arteriosclerotic patients who have never shown any tendency to angina. While these latter must lessen the work which they do to avoid further arterial degeneration and the dangers of cardiac insufficiency, yet, as a rule, they do not live with the sword suspended above their heads. Patients with angina pectoris must not only greatly diminish their physical work, but must see to it that at no time shall the amount of work exceed, even for a moment, that which they are capable of accomplishing without injury. They must learn to view life with perfect equanimity, and to let nothing interfere

with their determination to smooth over all its rough places. It is a hard matter to convince a patient who, in the interim between attacks, feels perfectly well, that he must, under no circumstances, run fifty yards to catch a car, or indulge in a romp with the children, or lift a heavy weight.

The first duty of the physician is not merely to explain these things to him in an academic way but to see that they are brought home to him and put into practice not only in the letter but in the spirit.

Psychical excitement is, in many ways, to be placed on a par with physical overexertion. The patient who is mentally so constituted that he cannot or will not avoid flying into a passion at small provocation has but a small chance of securing much relief from his attacks. Just how far a continuation of the patient's occupation is compatible with keeping within the safe limits, in respect to both physical and mental exertion, can only be determined by an accurate knowledge of just what the patient is required to do in his vocation, both on ordinary and extraordinary occasions, and by a careful analysis of all the factors involved. A patient may be perfectly capable of carrying on some simple clerical work, but not be able to climb two or three flights of stairs to an elevated train which takes him to and from his work. No generalizations in such matters are possible, and it is the imperative duty of the physician to analyze and decide each case on its own merits.

The treatment of the reflex cases is, of course, entirely different, and depends largely upon the factors which underlie the cardiac condition. If this be hysteria or neurasthenia the patient should be reassured as to the absence of gravity of his condition. Too much attention should not be paid to the cardiac symptoms, but the stress of the treatment laid upon the underlying neuropathic conditions. This is important since measures directed to the relief of the precordial pain, which is generally but one of many localizations of discomfort, merely serve to focus the attention of the patient upon his heart. The gastrointestinal tract should be examined with especial care for evidences of hyperchlorhydria, with gaseous distention of the stomach, or for evidences of *air-gulping*, which, in these patients, is of great frequency. In women enteroptotic conditions should be sought for with especial care, since these are frequently productive of a general neurotic state, which may readily take the form of a reflex angina.

It should never be forgotten that all anginoid conditions which occur even in outspoken neurotic patients need not be of purely nervous origin. This is especially the case in middle-aged individuals. The writer was early taught a lesson in this respect. A middle-aged man, with no apparent arteriosclerosis, and with the most manifest hysterical phenomena, which had been made the subject of clinical lectures by a neurological colleague, presented a rather atypical picture of angina pectoris. After careful study it seemed justifiable to regard the case as one of angina vaso-

motoria. One attack, personally witnessed, seemed to bear out the diagnosis, yet the third attack, which occurred while the patient was on his way to the clinic, proved instantly fatal. Whether we regard this case as one of coronary sclerosis, pure and simple, or as a case of coronary sclerosis with a superadded vasomotor factor, is more or less irrelevant. The important point to be remembered is that apparently neurotic symptoms may be neither associated with, nor be actually due to, severe organic lesions. In general, too many cases are regarded as of vasomotor origin, and subsequently prove to be due to the insidious onset of a coronary sclerosis.

HEART BLOCK AND THE ADAMS-STOKES SYNDROME

This name is given to a symptom-complex which includes both cardiac and cerebral symptoms, the former depending upon disturbances of conductivity in the bundle of His. The treatment of this condition is entirely unsatisfactory, since, with our present knowledge, there is no drug which is capable of improving conductivity. Atropin is occasionally of temporary benefit only.

In those cases where there is the least suspicion of syphilis vigorous antiluetic treatment by means of inunctions of mercury and the iodids should be instituted. Occasionally it happens, as in one of Stokes' cases, that the patient himself will find out some posture which will prevent or abort an attack.

Rarely, acute myocarditis may be productive of this syndrome. The therapy in this event should be that given under that caption. In general, the treatment outlined under the head of angina pectoris is applicable to these cases, so far as its prophylactic aspect is concerned.

FUNCTIONAL DISEASES OF THE HEART

A. General Cardiac Neuroses (with ill-defined symptoms).
   1. Cardiac neurasthenia.
   2. Reflex neuroses.
      a. Of gastrointestinal origin.
      b. Of sexual origin.
      c. Of respiratory origin.
   3. Toxic neuroses.
      a. From tobacco.
      b. From alcohol.
      c. From coffee and tea.

B. Neuroses with well-defined symptoms.
   1. Paroxysmal tachycardia.

2. Paroxysmal bradycardia.
3. Phrenocardia (Herz).

General Cardiac Neuroses

This motley group constitutes one of the largest classes of cases, if not indeed the very largest, with which the practitioner is called upon to reckon. We class under the head of functional diseases of the heart such functional disturbances as are not associated with changes in the size of the heart or with an altered distribution of the blood mass, and which in their course do not lead to these or to any impairment of the general circulation. In general we distinguish two groups, those with ill-defined symptoms and those with symptoms which are sufficiently alike in the different cases to form sharp, well-defined symptom-complexes.

Cardiac Neurasthenia

The essential point to be noted in the neuroses of this group is that the subjective symptoms of the patient constitute the entire disease. This being the case, the indications for treatment must necessarily be sought either in the underlying neurotic condition or in the treatment of the individual symptoms complained of. We may regard this group of symptoms as the expression, on the part of the cardiovascular system, of those underlying neuroses which we ordinarily label neurasthenia and hysteria. The patients come under observation complaining generally of attacks of palpitation, by which we are to understand a condition in which the movements of the heart are perfectly normal but in which the patient feels these movements, which normally lie below the threshold of consciousness, as unpleasant sensations. With this is a feeling of anxiety and oppression in the precordial region. These symptoms may vary from an intensity so trifling as to be barely noticeable to the most intense subjective distress. A frequent symptom, and one which has impressed the writer as especially characteristic, is the deep, sighing respirations which occur every few moments in the course of an otherwise normal respiration. As in all neurotic conditions, the patients detail their symptoms with great minuteness and glibness. The patient pictures the pains in every conceivable way, as constriction, as oppression, as hot or cold sensations, as pricking—all of these not infrequently extending into one or both arms. Examination of the patient shows absolutely nothing objective, excepting, perhaps, a pulse increased to one hundred and thirty or one hundred and thirty-five.

The intermediate causation of the attacks, which, as a rule, do not last more than a few minutes, is important from the standpoint of treatment, yet it, too, is as bizarre and varied as can be well imagined. The deter-

mination to consult the physician, the getting into a street car, conversation with a stranger, a fit of anger or grief, a visit to some place of entertainment, any one of these, as well as innumerable other causes, may suffice to promptly bring on an attack.

In other cases the symptoms from which the patient seeks relief are physical and mental lassitude, weariness upon slight exertion, syncopal attacks, and, above all, alterations in the rhythm.

Arrhythmias.—These are exceedingly frequent in all the types of general cardiac neuroses. They may be more or less dependent upon respiration, with an inspiratory slowing and an expiratory quickening of the pulse. A common complaint of the patient is that the heart intermits, and these, in most instances, are due to extrasystoles. The interpretation of these extrasystolic arrhythmias is not always easy, and some authors consider them as invariably indicative of beginning changes in the myocardium. It may be stated, however, that in a large number of conditions, when the heart symptoms are apparently of pure nervous origin, extrasystolic arrhythmia occurs and may later disappear. From the practical standpoint the writer considers it of the greatest importance to reassure the patients presenting such an arrhythmia, by telling them that a simple nervous disturbance may be at the foundation of the entire trouble. While the presence of extrasystole should lead us to institute an especially thoroughgoing examination of the heart, yet it is quite certain that much harm is done by laying too much stress upon such an arrhythmia and thereby focusing the patient's attention upon it. Especially should every effort be made to do away with the pernicious habit of feeling their own pulse, which is so commonly done by these patients. It is a rather common clinical experience to find that patients whose hearts are beating in perfect rhythm may, by the simple process of feeling their own pulses, produce an arrhythmia. This, of course, renders them still more anxious about their condition, which, in turn, leads them to feel their pulses still more anxiously, and thus a real vicious circle is set up.

Prophylaxis.—There is little to be said in regard to the special prophylactic treatment of the cardiac neuroses. One may say, in general terms, that their prophylaxis is identical with the general measures of treatment in neurasthenic and hysterical states in general. In some instances, in patients of a not especially nervous temperament, cardiac neurasthenia, particularly arrhythmias, may develop after long periods of sustained hard work and worry with insufficient exercise and recreation. The diagnosis of such conditions as of strictly nervous origin may be often open to criticism, since toxic influences, especially associated with the gastrointestinal tract, may be a factor in their production. The essence of both the actual treatment and the prophylaxis of further attacks is to be sought for in a better regulation of the work and recreation of the patient. No greater mistake can be made, in a case which is clearly of neurotic origin, than to

coddle the patient, and to thus confirm him in his habit of introspection. A careful examination and strict attention to all of the infinite variety of symptoms which the patients love to recount will obtain their confidence. This, the first great step, once gained, it should be made perfectly clear that the ultimate recovery from such a condition and the prevention of further trouble lie in the systematic regulation of the patient's life, with a due proportion of work and play, and particularly of exercise in the open air. The physician should take to heart in this connection what was emphasized under the caption Gymnastics, namely, that *exercises should be found which are congenial to the patient.* To condemn a pale, sallow-looking, neurotic man to a course of gymnasium exercises, which he loathes with all his very soul, is to concentrate his mind upon the fact that he is in reality doing a sort of penance. Nearly every individual has some one channel through which his interest may be aroused. One particularly rebellious case which came under the writer's observation was cured by horseback riding, which the patient, a middle-aged man, had not indulged in since his youth. Becoming again interested in the sport, he pursued it from the love of it and, in this way, obtained sufficient exercise and diversion to result in a cure of his arrhythmia.

Treatment.—While frequently the physician will have made up his mind almost before the patient has finished his account of his troubles as to their nervous origin, yet he should be careful not to fall into that very common error of treating the matter lightly and of making the examination a purely perfunctory one. Even though they may have no organic substratum the patient's troubles are precisely as real to him as if they had, and he is entitled to just as careful and interested an examination. This, not alone from the standpoint of professional pride in thorough work, but also from the standpoint that such an examination is in reality the first and by no means the least important step in his treatment. The second commonly made error should be avoided, namely, that of endeavoring to laugh the patient out of his troubles by telling him that there is nothing the matter with him. The patient should be assured in a positive manner that he has no heart disease, and that his symptoms arise from no cause which could lead to heart disease. If he be of sufficient intelligence it may be desirable to place before him, in simple language, the exact facts of his condition. In most cases probably it will be better to content ourselves with assuring him that he has no organic trouble and that his symptoms, being of nervous origin, will yield readily to treatment if he will only give his hearty coöperation. While it is impossible to discuss in this place the details of treatment of an underlying neurasthenia or hysteria there are certain details which apply especially to patients presenting the cardiac manifestations of these conditions.

Reference has already been made to exercise as being exceedingly important in prophylaxis. It would be a mistake to adhere to any rigid

schema in prescribing exercise. It may happen that the patient's mode of life has been such that he is both bodily and mentally exhausted by it and, under such circumstances, vigorous outdoor exercises would be quite as likely to be productive of harm as good. Such patients need rest, not often rest in bed, but complete rest for a period of several hours daily. A couple of hours' absolute repose on a couch or hammock, either in the open air or with all the windows wide open, is especially beneficial. This should be persisted in until a distinct improvement is noted, when, little by little, the patient may proceed to do more and more. In the severest cases, with symptoms so marked as to seriously interfere with the patient's vocation, complete rest in bed may be necessary in the beginning.

Just as soon as the improvement permits the patient should be made to carry out exercises which should be regularly increased in amount and severity. While these are not done with any particular idea of strengthening the heart, yet they are of no less value in such cases because of this. The patient is encouraged to find that there is some exercise which he can do without bringing on his attacks, and this goes a long way toward aiding his further improvement. Because of their rhythmicity the inertia or pendulum movements, as recommended by Herz, are especially valuable. The apparatus is simple and can generally be set up at home (see Gymnastics).

The diet must be simple, easily digestible, and sufficiently abundant. Since most of the patients are in a condition of poor nutrition a diet aggregating 3,000 to 3,300 calories would be appropriate. Under no circumstances should the physician content himself with mere general directions in this regard. The patient should be instructed or, better still, be given a carefully made out and individual menu, in which his foods, their amount, hours of taking, and methods of preparation should be accurately stated. The writer is firmly convinced that much of the nonsuccess which obtains with these patients is due to the fact that the physician fails to be precise and explicit in his directions. Much of the virtue which is inherent in the sanatorium depends upon this basis of precision.

Two diet lists may be equally good and two régimes of treatment though differing greatly in detail may be equally good, but it is quite certain that the one which is prescribed with precision and insistence upon detail will be the one from which the patient will derive real benefit. In general alcohol must be forbidden; occasionally a glass of light wine may be prescribed with the meals. Tobacco must be absolutely interdicted.

The question of sleep is all-important. The patient should have eight, and, if possible, nine hours of sound sleep. The weather conditions permitting, sleeping in the open air will sometimes work wonders. Here again the exaggerated notions as to what may be accomplished by fresh air which are at present rather widely prevalent must be avoided. Above all, drugs of all kinds should be eschewed. An exception may possibly be

made for those which have a largely suggestive effect and, very occasionally, for the mild hypnotics. The various hydrotherapeutic procedures accomplish a good deal in this line, and have the great advantage that there are practically no contraindications to their use.

There is considerable difference of opinion as to the utility of the various baths, especially the CO_2 bath. While they may occasionally be of service in neurotic cases through their suggestive influence it is probable that in most instances the suggestion works very differently. The use of such baths is pretty well known to the better informed class of patients as being frequently used in organic diseases of the heart, and for this reason, if for no other, the suggestive influence of the baths is apt to be deleterious and to lead the patient to think that, in spite of the physician's assurances, he has really some organic lesion.

Where all of these various procedures are with difficulty carried out at home the question of sending the patient to a sanatorium or to some health resort arises. No general rule can be laid down on this subject, except to say that as a rule the patients require, first and foremost, skilled medical supervision, and that any place where this is unobtainable is unsuited for them. The carefully regulated life in a really well-conducted sanatorium may be frequently an advantage, provided that it be not offset by contact with many other patients with similar maladies. Should this be the case the effect is likely to be that each patient, by recounting his symptoms over and over again, makes his fellow patient just that much worse.

The writer's experience leads him to believe that, in general, travel is distinctly detrimental, especially for such patients as are really exhausted in mind and body through business cares or household worries. To order for such patients a trip to Europe, with constantly changing environment, indifferent food, the excitement of sight-seeing, and the mental weariness induced by the thousand and one small annoyances incident to travel, is not to give them rest, but to add still further to their exhaustion. On the other hand, to send them directly to a carefully chosen, quiet, agreeable nook, where the conditions of living meet the physician's approval, and where his directions may be carried out and the patient's life supervised, may prove of the greatest benefit.

The various hydrotherapeutic measures, which are so frequently of great use in neurasthenic conditions, such as the sheet rub, may be employed in suitable cases. Here, too, no rigid scheme should be followed, but the measure prescribed should be carefully adjusted to the patient's strength and general condition.

Electricity is of no value except through suggestion. In the form of the electric four-celled baths Romberg has found it of use, especially in neuroses in which the vascular symptoms predominate. It is not, however, unlikely that suggestion plays an important rôle.

Medicinal.—Except occasionally in combating symptoms drugs are of relatively small importance. The drugs of the digitalis group are rarely indicated, in spite of their almost universal use. Fortunately, in the doses usually prescribed, they do no harm, except in that they confirm the patient in the notion that he has something seriously wrong with himself. The bromids, in moderate doses, are sometimes of use, especially if tachycardia exist. The nitrites have been often recommended when there is outspoken vasoconstriction, but the writer has never been able to see much benefit derived from them. The same is true of the iodids, except in such cases as may be associated with an arteriosclerosis, under which circumstances the iodids are of great service.

The symptoms which most frequently require special treatment may be either an attack of angina pectoris nervosa or of palpitation. The former is discussed with the treatment of true angina. Palpitation is most satisfactorily treated by the application of a well-filled ice-bag. Massage is occasionally of use, but in by no means all cases. Conditions of general nervous excitement are frequently much benefited by baths with the temperature of the water at the indifferent point or slightly above it.

The principle which should guide the physician in the management of this difficult group of cases is that it is primarily the patient and the patient's nervous system which are to be treated, and not merely the cardiac symptoms. As in nervous conditions elsewhere, the best results are to be obtained by him who possesses, in addition to a correct technical knowledge of the case, an insight into human nature and an exact acquaintance with the conditions of life under which the patient lives. When to these two prerequisites he can add the third indispensable qualification, that of a genuine interest in the patient and his welfare, and not a mere tolerance of him, he may expect to obtain thoroughly satisfactory results.

Reflex Neuroses

Reflex Neuroses of Gastrointestinal Origin.—Of the reflex neuroses of the heart those which take their origin in the gastrointestinal tract are the most frequent and the most important. The reasons for this are sufficiently obvious. A number of different conditions of the stomach and intestine, such as chronic gastritis, hyperchlorhydria, constipation, and aerophagia, give rise to precordial discomfort, palpitation, anginalike attacks of pain, arrhythmia, and sometimes tachycardia. These symptoms the patient regards as much more serious than those of the underlying gastrointestinal disturbance, and in consequence they lead him to seek medical advice much sooner. Especially is this true of arrhythmia, when subjectively noticeable.

Hyperchlorhydria is perhaps the commonest of these affections, and the cardiac symptoms in it are the result of several factors. First and

foremost, hyperchlorhydria itself is, in reality, little more than a symptom of neurasthenia, hence we have the underlying neurotic foundation present. Again, the gas which accumulates in both stomach and intestines pushes up the diaphragm, and this in turn leads to a further development of the cardiac symptoms. Associated with hyperchlorhydria is very often a gastric hyperesthesia which still further accentuates the stimuli arising from the gastric mucosa. Intimately connected with the subject of gastro-intestinal fermentation and the production of gas is the subject of aerophagia. This habit, which is much more common than is generally recognized, owes its origin to the following fact: Patients whose stomachs are distended somewhat with gas find that they obtain a certain measure of relief after belching. It gradually comes about that they seek to induce belching by forcible swallowing. Sometimes this gives temporary relief, but much more frequently only serves to aggravate the discomfort. In bad cases the patients are continually belching with a loud noise and at the same time become more and more uncomfortable. It has been shown that the mechanism of involuntary belching and that which is artificially forced is quite different.

The artificial introduction of air into the esophagus and stomach, air-gulping, Wyllie explains as follows: "Here the tongue is placed in the same position as for the pronunciation of the letter 'T,' a position in which the tip and edges are applied closely along the upper gum, so as to prevent the escape of air either forward or laterally. Behind this margin of contact the cavity within the mouth and pharynx is then filled with air from the larynx; and this air is, at the same time, imprisoned in the cavity, owing to the elevation of the soft palate, which shuts off communication with the nares, and the firm coaptation of the vocal cords which shuts off communication with the trachea. Thus imprisoned on every side, the air in the cavity is then, in the act of gulping, put under strong and sudden compression by the elevation of the larynx and dorsum of the tongue. Under this strong compression it forces a passage for itself into the cavity of the esophagus, entering the upper end of that tube with a noise not unlike that of a slight eructation. Having forced the air into the esophagus by the process of gulping, the patient, if he wishes to do so, can then expel it by putting pressure on the esophagus within the chest. This he can do by making a slight expiratory effort with the glottis closed. The air then escapes with the characteristic noise of a true eructation. Or, if the patient choose to do so, he can refrain from eructating and go on simply gulping air until he has caused a large quantity of it to pass into his stomach."

In other cases some of the air is swallowed and some regurgitated, and a certain amount of residual air remaining in the esophagus produces the unpleasant sensation that patients so often describe as "though something were stuck in the throat." It is probable that the residual air, of which

there remains at all times more or less in the esophagus, is quite as important as the overdistention of the stomach in the production of the cardiac reflex disturbances.

The treatment of aerophagia is as important as it is difficult. It is stated that the habit may be prevented by keeping the mouth open, a practice which is enforced by veterinary surgeons by means of a mouth-gag, in order to prevent the serious results which develop in horses from this same habit. The writer's experience has not been satisfactory in connection with the application of this therapeutic trick. The habit is often so deeply ingrained that it is a matter of much difficulty to overcome it. The most marked case which has come under the writer's observation occurred in a middle-aged woman of great force of character. After explaining to her the nature of the trouble she was induced to allow a stomach tube to be passed and to sit with it thus introduced for a half hour at a time. The second application of this method effected a permanent cure. In other cases the same procedure failed utterly. More success attends treatment if the patient be asked to belch a few times to show how she does it. Having assured himself that the belching is in reality voluntary, which the patient is always very loath to believe, the physician should explain the mechanism of the process to the patient and endeavor to obtain her coöperation in overcoming it.

The cardiac disturbances resulting from enteroptosis are the result of several factors. The mechanical effect of enteroptosis is that the diaphragm is flattened and the dome lower than normal. The abdominal respiration is thus of necessity diminished. The presence of this flattening has for its effect a drawing in of the lower ribs as well as of the epigastrium, thus diminishing the inspiratory capacity. This in turn diminishes the effect of suction in aspirating blood into the thorax.

In the same way the diminished movements of the diaphragm lessen by that much the effects of respiration in forcing the blood onward from the abdominal veins. These mechanical effects upon the heart produced by enteroptosis, while perhaps more easy of comprehension, are very probably of less import than the neurasthenic states which so often form an integral part of the general picture of that condition. Be the explanation of the cardiac disturbances what it may, the successful treatment depends upon the removal of the enteroptosis. Briefly, this is accomplished by (a) measures to increase the intraabdominal fat; (b) measures to strengthen the abdominal walls; (c) exercises designed to enlarge the lower aperture of the thorax; (d) the application of a well-fitting, straight-front corset. The various devices arranged with pads to support the kidneys, etc., are in most cases worse than useless. In severe cases a systematic Weir Mitchell-Playfair rest cure, with overfeeding, should be resorted to. For the details of treatment the reader is referred to the article on Enteroptosis. The results obtained are, in many cases, of the most

brilliant character. In some cases symptoms which had persisted for years were permanently relieved.

Of Sexual Origin.—Some of the most rebellious of the reflex neuroses are associated with the sexual organs, both male and female. The treatment will, of course, depend upon the underlying causal conditions, some of the more important of which will be here mentioned.

In men chronic gonorrhea with its various sequelæ, especially prostatitis, is the most frequent cause. The influence of masturbation is variously estimated, but is undoubtedly a factor to be reckoned with. Sexual excesses are, in some cases, of importance, especially when combined with other causes, such as overindulgence in alcohol, heavy smoking, loss of sleep, etc. Occasionally, in lads at the age of puberty, cardiac symptoms develop when no contributing cause can be elicited.

In the female sex precisely the same symptoms are frequently found in girls just beginning to menstruate. A contributing, and perhaps even more important, cause is to be sought for in the chlorotic conditions which are so prevalent at this time. Sexual excesses play the same rôle in women as in men. The menopause is a prolific cause of nervous cardiac symptoms of widely different kinds and intensity. They are most prone to occur on the days in which menstruation would have occurred, but where the latter either is completely absent or occurs at a later period.

The cardiac symptoms which have been described by numerous observers as occurring in uterine myomata are of doubtful origin. It seems probable that they are not neurotic in origin, nor in any way peculiar to myomata, but are merely the expression of the anemia which results from long-continued bleeding.

Of Respiratory Origin.—The respiratory organs are, in a smaller number of cases, responsible for cardiac symptoms. The most important of these are pathological conditions of the mucosa situated opposite the middle turbinated bone on the nasal septum. Irritation of the mucous membrane at this spot produces, in some instances, an arrhythmia. Pathological nasal conditions in this location may give rise to cardioneurotic symptoms, especially arrhythmia. Adenoid vegetations occasionally produce similar cardiac symptoms, probably because of the interference with the respiration. The treatment of all the reflex neuroses is to be carried out primarily by removal of the cause, once this has been definitely ascertained. In most instances this alone suffices to effect a cure; where it does not the cases should be treated along the lines indicated under Cardiac Neurasthenia.

Toxic Neuroses

Tobacco Heart.—The justification for the inclusion of the cardiac disturbances from the excess of tobacco, under the neuroses of the heart, may possibly be called in question, since it is not certain that the primary effects of tobacco may not be on the heart muscle. On the other hand, universal custom dictates their inclusion among the neuroses of the heart.

We may distinguish two groups of cases, first, those disturbances which occur in nonsmokers who are indulging in tobacco for the first time, or, which amounts to the same thing, very light smokers who indulge only semioccasionally and then, on some special occasion, smoke rather heavily. The second group of cases are those of subacute nicotinism, which develops especially in young patients, more especially in young cigarette smokers, occasionally young smokers of short pipes.

The essential facts of the pathological physiology of smoking which bear on treatment have been well brought out by the researches of Lee. This observer analyzed both the leaf and the smoke from different tobaccos, using Manila and Virginia tobaccos as the standard of the two types. The analysis of the smoke was made by means of an aspirator, and in such a way as to imitate as closely as possible the process of smoking. The chemical composition of this varies materially with the variety of tobacco used, but still more according to the manner in which it is smoked. In an analysis of the smoke obtained from 100 grams of tobacco Lee found the nicotin content to be 1.165 grams, representing 50 per cent. of the total nicotin present before combustion. In addition there is 0.146 gram of pyridin bases, chiefly pyridin and collidin, the former being derived from the destruction of a portion of the nicotin, the latter from combustion of the fiber in the tobacco. In addition there is HCN, 0.08 gram; ammonia, 0.36 gram; carbon monoxid, 410 c. c.

Nicotin is present in Manila tobacco in much smaller quantities than in Virginia, but after combustion the smoke of the Virginia contains a considerably smaller percentage than that of the Manila. The mode of combustion is all-important, and may determine to a considerable degree the amount of nicotin inhaled. In ordinary cigar smoking, where the combustion is slow, there is, immediately behind the point of combustion, an area in which the water and other volatile substances undergo condensation. In the process of smoking a large part of the nicotin at the seat of combustion is destroyed. This amounts to about fifty per cent., and the remainder of the nicotin, that part which finds its way into the mouth of the smoker, is, in all probability, derived from the hot gases which, when they pass through this moist area of condensation, volatilize the more volatile substances in the tobacco. Of these nicotin is by far the most important. It follows from this that the larger the moist area just behind the

zone of combustion the more likelihood there is of the smoke containing the toxic volatile principles, and conversely a smaller moist area implies a lessening of the amount of these principles which reaches the smoker. In the case of a cigarette or a thinly rolled cigar, such as a "stogie," there is relatively a great amount of evaporation, and in consequence a smaller moist area, with, as a result, fewer of the volatile toxic substances reaching the mouth. These same authors found that if a thick cigar be unrolled and the tobacco of which it is composed be remade in a thinner shape, the amount of nicotin which is destroyed during the process of combustion is much increased. They quote the experience of many habitual smokers who reject a thick cigar because, irrespective of the strength of the tobacco of which it is composed, they find that it will produce invariably symptoms of nicotinism, and when a thin cigar is selected these symptoms remain absent. Their conclusions, which may be fairly taken as representing a consensus of the best opinion in the light of our present knowledge, are:

Nicotin is the most important poison in tobacco smoke.

Pyridin bases, in the quantities in which they are present in tobacco smoke, are not injurious to the smoker.

Smoking raises the blood pressure by vasoconstriction, accelerates the heart and respiration, and increases the intestinal movements. In excess cerebral depression may occur, and with the coexisting depression of the vasomotor center may lower the blood pressure to such an extent that collapse may be induced.

The amount of nicotin inhaled during smoking depends not so much on the tobacco smoked as upon the form in which it is smoked. The greater the condensation area between the point of combustion and the entrance into the mouth the more nicotin will be inhaled.

There are one or two other factors which enter into consideration in this connection. The first of these is the inhalation of smoke, which is the common practice of many when smoking cigarettes. The writer is not aware of any experimental evidence bearing directly on this subject, but it is safe to assume that the good effects of the cigarette in permitting of more rapid evaporation would be far outweighed by the inhalation of the smoke. In pipe smoking considerable difference exists, depending upon the length of stem of the pipe. In the short-stemmed pipe, so universally seen nowadays, the smoke does not have an opportunity of cooling before reaching the mouth of the smoker, and hence the larger part of the nicotin is inhaled. In the long-stemmed pipe, on the contrary, the smoke is cooled before reaching the mouth and much of the nicotin again condenses in the stem.

From the consideration of the pharmacological properties of nicotin it is a matter of great difficulty to explain the undeniable pleasure which so large a number of people take from the use of tobacco. The investigations which have been made by measuring the amount of work which could

be done before and after the use of tobacco, in an attempt to determine whether or not the mental energy is increased or diminished, have led to widely discordant results. It seems quite certain that the tobacco habit is not comparable in any way with the alcohol or morphin habit. Indeed, taking all things into consideration, it seems to be not even established that the pleasurable effects which accrue to habitual smokers from the use of tobacco are due to the nicotin absorbed. Various other suggestions have been made, each of which probably contains a certain amount of truth. The rhythmicity of the movement, which makes practically no demands upon the smoker in the way of physical exertion, is, in and of itself, pleasurable. Many smokers derive no pleasure when smoking in the dark when the smoke cannot be seen, and this is a further fact which goes to show that in such smokers, at least, the effects of nicotin play little, if any, rôle in the pleasure derived from the habit. Further, it seems quite clear that, to many, an important factor in the pleasurable effect produced is the local action of the warm smoke upon the throat.

Aside from the acute nicotinism which occurs in novices as the result of smoking for the first few times, and in whom the effects are so well known as to need no mention here, it may be stated that in moderate smokers a single cigar produces only a slight rise of blood pressure and perhaps a little palpitation. In habitual smokers practically no objective effects could be determined from a single cigar or, at most, an insignificant rise in blood pressure.

Other observers, in repeating Lee's experiments, have found that a vasoconstriction, as determined by the volume of the hand, is constantly present during smoking. These observers have come to the conclusion that, in a man accustomed to smoking, the effects are very little, if any, greater from the moderate use of tobacco than are the effects of such stimuli which are the necessary concomitants of a highly developed civilization. We may assume, therefore, that so far as the pathology of the heart is concerned the use, or rather misuse, of tobacco must be continued for a very long time in order to produce effects which are of any consequence.

In connection with the treatment of the tobacco heart it should be borne in mind that its frequency is very greatly overestimated. This is especially the case in middle-aged men who have smoked for many years with apparently no bad results, and who now commence to show symptoms which are interpreted as being due to tobacco. When we reflect on the insidiousness with which coronary sclerosis sets in, and on the indefinite and vague character of its symptoms, it will be evident that the coronary sclerosis, rather than tobacco, is in reality responsible for most of these cases.

Very especial care should be taken by the practitioner to avoid reassuring such middle-aged men, who are perhaps smoking to excess, by telling them that

"the trouble is entirely due to tobacco and will disappear if its use be discontinued." On the other hand, in young smokers, especially those who inhale cigarettes, the prognosis of a tobacco arrhythmia or palpitation is much more favorable.

Having determined with a reasonable degree of probability that the condition in question is due wholly or in large measure to the abuse of tobacco the indication for treatment is, of course, perfectly plain. To the writer it seems unwise to content oneself with simply advising moderation in the use of tobacco, at least for the first few months. A moderate smoker will generally be able to muster up sufficient moral courage to give up tobacco entirely for such a period of time, while the heavy smoker is made just about as miserable, indeed, possibly even more so, by his effort to reduce his daily allowance of tobacco. Real symptoms due to the cessation of the use of tobacco, in the sense that symptoms develop after the withdrawal of morphin, can hardly be said to exist. That many patients complain bitterly of the deprivation is quite certain, but these are in reality more the symptoms due to a parting with something to which the patient has been accustomed, and which has become a firmly rooted habit. In a majority of cases the absolute cessation of the cause brings very prompt relief from the cardiac symptoms. Many of the patients may resume the habit after a lapse of many months, in a more moderate form, without the reappearance of any untoward symptoms. In a number of cases it has seemed to the writer that the mechanism of the action of tobacco on the heart was through the intervention of the gastrointestinal tract. The various derangements of the stomach which accompany the excessive use of tobacco seem to be productive of cardiac neuroses in the same way as gastrointestinal derangements from other causes. The bearing of this on treatment is that in these cases the simple cessation of the use of tobacco does not alone suffice for a cure. An exact diagnosis must be made of the condition of the gastrointestinal tract, and this appropriately treated, before good results may be expected.

The rock on which the treatment of these conditions most frequently shatters is that on which the treatment of most other conditions due to our petty vices most frequently comes to grief, namely, the unwillingness of the patient to pay the price of his recovery in self-restraint and self-denial. Every physician of experience well knows how such patients will use every argument to induce the physician to believe that the latter is mistaken in his judgment, that smoking never did hurt him, that he is in reality a moderate smoker, that his digestion is greatly improved by smoking, etc., etc., *ad nauseam*. The tact of the physician and the control which he has over his patient will almost invariably decide the issue. In mild cases a reduction in the amount of the tobacco used, or the substitution of a thin for a thick cigar, or of a long-stemmed pipe for the now fashionable short stem, or the limitation of smoking to the time immediately after the

meals—such measures may prove effectual where the complete abolition of the habit cannot be secured. A ruse which the writer has used with some degree of success is to induce the patient to throw away each cigar, at first when two-thirds burned, later when half burned, etc. The patient is often so accustomed to smoking so and so many cigars a day, perhaps two after each meal, that this seems easier to him than smoking a lesser number, in spite of the fact that it amounts to precisely the same thing.

Alcohol.—Pure cardiac neuroses due to alcohol belong, in the writer's experience, to the rarities. The instances which have come under personal observation have been in semioccasional drinkers, or, rather, in those who so seldom indulge as to render the term "drinker" inappropriate. A patient of this kind who may take, perhaps, one glass of wine with impunity will, after a second or third, develop marked symptoms on the part of the heart. Of these palpitation and arrhythmia are the most annoying. Since these symptoms are generally found in the semioccasional drinker it is a much easier matter, once the cause has been definitely determined, to obtain the patient's acquiescence in keeping within the limits of his tolerance. It is hardly necessary to refer to the danger of mistaking, in habitual drinkers, an incipient coronary sclerosis for a neurotic condition.

Coffee and Tea.—The effects of both coffee and tea are described at some length in the articles on Caffein and Diet. The effect of both of these beverages in producing sleeplessness is not infrequently very pronounced. A patient accustomed to drinking a single cup of coffee after the evening meal may present no disturbances of sleep, but after a visit of a couple of months, where coffee was not served in the evening, this tolerance may be absolutely lost, and the accustomed cup of coffee may now produce a night's wakefulness. It is not clear to just what extent this sleeplessness may be a factor in the production of the nervous cardiac symptoms, but it is probably of some importance. Many patients can take considerable quantities of coffee or tea in the morning or at noon with impunity, whereas a single cup, even in the early evening, produces sleeplessness. The points in treatment have been discussed under Diet.

Neuroses with Well-defined Symptoms

Of the cardiac neuroses which present symptoms sufficiently characteristic and well defined to deserve a special name the most important are the paroxysmal tachycardia, paroxysmal bradycardia, and the symptom-complex described by Herz under the name of phrenocardia.

Essential Paroxysmal Tachycardia

The cardiac derangement to which this name is applied is in reality a symptom which develops in a considerable number of cardiac diseases.

Not only this, but in addition to its occurrence as a symptom of cardiac affection it occurs as a symptom of organic disease of the brain. In the majority of cases it is of so-called idiopathic origin, that is, it occurs as a purely functional alteration in the cardiac rhythm and independent of other organic or nervous diseases.

Treatment.—We have no measures at our command of a prophylactic character, excepting such hygienic measures as improve the general health. When the patient is seen during the attack various artifices may be tried in the hope of cutting it short. This may occasionally be accomplished by repeated very deep inspirations or by pressure upon the vagus. Herz recommends the induction of belching in the following manner as an effectual means of cutting short the attacks. The patient is directed to fill his mouth with water, and then, with his head bent backward as far as possible, to swallow. This generally is successful in inducing belching, and with the eructation of large quantities of gas the attack may come to a close. The induction of emesis is occasionally successful. A few cases are cut short through a subcutaneous injection of morphin.

The various remedies which are usually effectual in cardiac conditions are generally useless. Digitalis, either by mouth or in the form of digalen or strophanthin intravenously, is useless. The same may be said of aconite, amyl nitrite, strychnia, or chloroform. The application of cold to the precordium in some cases seems to lessen the subjective sensations although it has no effect upon the rate.

The interim treatment is as unsatisfactory as the treatment of the attack itself. Regulation of the diet, the prohibition of tobacco, alcohol, or excessive consumption of tea and coffee, together with a quieter mode of life, may prove more or less effectual in diminishing the frequency of attacks, but cannot be considered in any sense curative. In the writer's hands a long-continued rest cure has been sometimes successful, but has more often failed. Only in the symptomatic cases are we occasionally able to achieve a cure; the idiopathic cases are rarely influenced, to any notable degree, by any of the therapeutic measures at our command.

Paroxysmal Bradycardia

This may be described as the obverse of the symptom-complex just mentioned. Its occurrence is much more infrequent than that of paroxysmal tachycardia and its nature equally obscure. The symptoms which initiate the attack are almost the same as those which initiate the tachycardial attacks with which they may alternate. No case has come under the writer's observation. Treatment must be symptomatic. Care must be taken not to confound such cases with the bradycardia which occasionally follows the acute infections.

Phrenocardia (*Herz*)

It is more or less questionable whether the consideration of this symptom-complex as a well-defined disease picture is justifiable. At all events, cases are not infrequently met with in which patients complain of painful sensations in the vicinity of the apex, in general a little to the left and below it, to which may be added a sense of suffocation and palpitation. The respirations are superficial, with occasional sighing inspirations. The term phrenocardia was designed by Max Herz to indicate the dependence of these symptoms upon the diaphragm, which he assumes to play a rôle in their production.

The matter of greatest importance in connection with this symptom group is the recognition of its dependence upon the sexual organs, and especially upon exaggerated sexual desire, with lack of opportunities for its satisfaction. It is found much more frequently in women than in men. Aside from the measures which may be suggested by this etiology the liberal use of the bromids is the measure which has proven of great service.

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IV. DISEASES OF THE BLOOD

CHAPTER I

THE ANEMIAS

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GENERAL INTRODUCTION

The rational therapy and prophylaxis of any given disease must naturally deal with the etiology, with the removal of the etiological factors, as well as with the alleviation of the various symptoms which, in the course of that disease, require special treatment. Some discussion of the etiological basis upon which a classification can be made is, therefore, in place here.

Unfortunately, in the case of many of the anemias the etiology is so obscure, and the varieties of the anemias so diverse, that a proper classification is quite impossible.

While many of the anemias, such as those following hemorrhage, have an obvious causation and produce their own spontaneous cure, yet many, especially of the severer form, have so complex or, at all events, so obscure an etiology, as to render rational therapeutics in many of these types extremely difficult, if not impossible.

A careful analysis of the abundant literature dealing with various forms of anemias (and the "Folia Hæmatologica" need only be glanced at to demonstrate the amount of literature in connection with diseases of the blood) shows all too conclusively that we are far from a satisfactory understanding of the subject.

The scientifically exact classification of the anemias must be left until further facts are evolved upon the origin of blood cells, upon the relation of toxins to peripheral cells and to bone marrow functions, as well as upon the significance of the presence of various types of cells, both red and white, in the circulating blood and in the tissues.

[1] The author wishes to acknowledge the very valuable assistance of Dr. Maude E. Abbott in the preparation of this and the following chapters.

In the present state of our knowledge it must be admitted that transitions of a qualitative and quantitative character occur in all varieties of anemias, from the mildest forms of either primary or secondary anemia to the severest and most fatal cases of these varieties. In a broad general way one might say that the primary types are those in which the blood-forming organs are chiefly involved, in the absence of any obvious local or well defined cause elsewhere, while the secondary types are associated with apparent and serious lesions in the organs or tissues, or with known poisons in the system, one or all of which may lead to a secondary disturbance of those organs where new blood is generated. Any such statement, however, when subjected to more detailed analysis, leads to many sources of confusion.

Many questions arise, for example, in regard to the diagnosis of some of the more severe anemias. To what extent is the bone marrow really responsible for some of these grave varieties, e. g., pernicious anemia? Is the marrow to be regarded as an organ with a definite function, even as is the heart, or is its disturbance but one of the factors concerned in every anemia?

To what degree, again, is the anemia directly due to changes in the peripheral circulation? Does the action of toxins produce an hemolysis, or do these toxins merely act on the regenerative function of the marrow and prevent here the formation of new blood elements?

Or, again, is there a combination of these two factors, peripheral hemolysis and defective hemopoiesis?

Do we imply in the term anemia changes occurring, too, in the leukocytes, or should the word anemia be confined to the diminution of red blood cells and deficient hemoglobin?

Too much stress cannot be laid upon the fact that anemia, in any form whatever, is merely a symptom secondary to some definite cause, be it known or otherwise, and the term primary anemia, as applied to the cause, is a pure misnomer, to be used only as a convenience, or, if you will, a cloak to our ignorance, implying, as it does, that, in the present state of our knowledge, the anemia is often cryptogenetic.

The so-called Addisonian or Biermer's idiopathic primary anemia is in no sense primary, any more than is that due to the Tænia bothriocephalus latus, for both are due to a definite toxic cause, in the first unknown, in the second well defined. Even then, where we have reasonably conclusive evidence that the primary seat of the lesion is in the functioning organ of the blood—the bone marrow—we must recognize that anemia is a symptom only, not a disease entity. Just as a systolic murmur in mitral endocarditis is merely symptomatic of an underlying cause. Presumably the difference between primary and secondary types lies in the fact that, in the one, defective hemopoiesis is fundamental and, therefore,

of so severe a character as to induce formation of abnormal and probably embryonic types of cells, while in the secondary variety the erythroregeneration is either of a different type or a milder degree, less fundamental changes in hemopoiesis resulting, and, therefore, cells less abnormal in type and fewer of the embryonic character appearing in the blood stream.

As we will see later, the so-called primary blood disease, known as pernicious anemia, may be divided into two main types: the curable or so-called phanerogenetic, i. e., where a definite cause is known and can be removed (bothriogenetic anemia, for example), as opposed to the other type (Addison's) in which no cause can be defined, but where a definite clinical picture exists and the patient dies sooner or later from the malady, showing at the autopsy certain well defined pathological changes.

Clinically, both these types show the same morphological blood picture, and the etiology is the differentiating picture.

In chlorosis, again, we have another so-called primary blood disease, which is easy of diagnosis after exclusion of all other possible causative factors, and by the blood examination. In its typical form it, too, though secondary to some cause as yet unknown, has its own peculiar symptom-complex, even as that in Addison's anemia.

Again, the secondary anemias, so called, have an ever-varying blood picture, sometimes like that of pernicious anemia and sometimes that of chlorosis, more often like neither, and all transitions may exist showing various types of blood pictures. It is this variation which makes a classification so difficult, for only by a combination of all the features, etiological, clinical, and pathological, can we attain near to the diagnosis and hope to formulate a satisfactory idea—and even with all these facts we are all too often left so much in doubt that a perfectly accurate conclusion cannot be formed.

Certain fallacies exist and should be recognized, in order to be refuted. In the first place, the morphological features in the blood are not so all-important as has hitherto been believed. Poikilocytosis, anisocytosis, polychromasia, basophilic granular changes, etc., have much less diagnostic significance than has usually been attached to them, and possess a general rather than a special significance.

Secondly, hydremia and anemia are not synonymous terms, and the former does not imply the sequence of the latter.

Thirdly, hemolysis, while present in all anemias, is in all probability far less important as a cause of anemia than is defective hemopoiesis. In other words, the bone marrow is the site of original trouble much more than is the peripheral circulation, and this applies both to the primary and secondary anemias.

The toxins which circulate in the blood do not necessarily affect the

corpuscles, and probably do not act on the blood in the peripheral circulation so much as primarily upon the regenerative powers of the marrow, and thus the injury to the functions of the marrow may be the sole cause of the peripheral changes.

Pappenheim divides the severe anemias which resemble the pernicious variety into two types, the cryptogenetic (where no known cause exists) and phanerogenetic (with obvious cause), pernicious anemia.

The cryptogenetic form of pernicious anemia he declared to be also secondary and probably toxic in origin, the result of some blood intoxication, that is, an intoxicative hemolysis, be this an erythrolytic blood poison or a hemolysis in the immunity sense. Hemolysis is first the result of hemintoxication, and then becomes the stimulus to regeneration in the bone marrow. In this sense Addison's anemia is not idiopathic myelopathic, but the myelopathy is also secondary as result of hemolysis.

Therefore, in his view the primary lesion is not disturbed and altered erythroblastic growth, but the disturbed, strong, and relatively increased erythroregeneration.

There is, then, no primary pernicious anemia, but merely cryptogenetic.

The aplastic type of pernicious anemia, in which no evidence of regeneration is found post mortem in the marrow, he explains also as belonging to the same category of secondary anemias, in the sense that the condition is due merely to an absolute loss of secondary regenerative power in the bone marrow, which has been totally destroyed by some all-powerful toxin.

In the same sense Ehrlich's megaloblasts do not mean primary defective blood formation, but rather an indication of disturbed and overstrained secondary regeneration. The greater number of megaloblasts, however, does not indicate a more grave prognosis necessarily, but merely a greater effort at regeneration. We have, then, not a new growth, but a mere metaplasia, the cells having a definite function, that is, regeneration under greater hemolysis. There are more and more immature cells entering the blood, until finally in the supreme effort at regeneration on the part of the marrow, embryonic types appear. Such, at all events, are Pappenheim's views as expressed in his recent contributions on this subject. His classification is worthy of presentation.

The Secondary Anemias

(All anemias are secondary to some toxin.)

I. Primary hemotoxic, secondary myelopathic (primary increased hemolysis), increased but insufficient secondary hemopoiesis.

1. Traumatic or post-hemorrhagic anemia.
2. Simple primary hemotoxic secondary anemia.

II. Primary hemotoxic, myelotoxic, so-called pernicious secondary anemia (primary increased hemolysis, with secondary regenerative myelopathy and simultaneously primary disturbance of hemopoiesis).

1. Cryptogenetic Biermer's anemia.
2. Phanerogenetic symptomatic pernicious anemia (from bothriocephalus, leukemia, carcinoma, etc.).

III. Primary myelophthisic, myelometaplastic, aplastic hypoplastic anemia (primary reduction of blood formation, followed by secondary increased hemolysis).

Naegeli, on the other hand, insists upon the importance of primary disease of bone marrow function, as distinguishing one type of anemias which he calls primary, because the important feature is the disturbance in the function of the bone marrow inducing essential changes in the blood. These changes are shown in the character of the cell in the circulating blood and are both qualitative and quantitative. Such primary anemias include chlorosis and Addison's anemia. In both of these he regards the bone marrow as primarily at fault, and so disturbed in function as to be unable to produce cells that are completely developed. Hence the appearance of many embryonic forms. In chlorosis the defective hemoglobin or defective staining reaction (*polychromasia*) indicates this tendency. In pernicious anemia the same defective power is seen in the presence of large red cells and megaloblasts, representing what may be called qualitative changes and embryonic types. Or else quantitative alterations may occur in the number and variety of the cells. To him the diagnosis of pernicious anemia is easy, the blood picture invariably determining the type by the character of the cells.

Naegeli distinguishes two great classes of anemias, the one primary myelogenetic including the two conditions, pernicious anemia and chlorosis, as above mentioned, the other secondary myelogenetic. In this latter group he includes all the anemias other than chlorosis and the pernicious form, all of which show a blood picture different from that of the primary group in that the new cells are of a less embryonic type, giving less evidence of primary disturbance of bone marrow function. To these secondary forms, which he describes as purely symptomatic in nature, he attaches as the etiological factor either some general malady or some disease of other organs, which affects the bone marrow secondarily and induces the anemia. In these cases he thus assumes that the bone marrow is not the primary seat of disease. It is in this way, for example, that he explains the anemia in sepsis, puerperal fever, syphilis, malaria, cancer, nephritis, and the parasitic diseases.

Naegeli's classification is herewith appended:

Primary myelogenic—

Chlorosis (defective qualitative blood regeneration).

Pernicious anemia (defective qualitative and quantitative blood regeneration).

Secondary myelogenic, to be grouped merely according to known causes—

Hemorrhagic (traumatic, or associated with infections or chemical poisons, or malnutrition).

Infectious diseases (parasitic or toxic causes).

Cachectic conditions (with chronic infections and intoxications, cancer, nephritis, and starvation).

Chemicals [arsenic, mercury, lead, chlorid of potash (direct hemolysis), pyrodin].

These various causes may act singly or together, and include in the widest sense the terms toxins and hemolysins.

This classification is, however, not quite logical, as Naegeli himself admits. All possible transitions in the degree of anemia may occur between the primary and secondary myelogenetic types, and, secondarily, in such grouping, etiological factors are necessarily somewhat confused with associated conditions. The extent to which some toxins may affect the bone marrow so that the embryonic blood picture is produced, while other toxins or the same toxins in other cases produce no such picture, is hard to determine or explain. Parasitic diseases, for instance, sometimes produce primary pernicious anemia, and sometimes his secondary myelogenetic variety (symptomatic anemia), the explanation being that in the first case the toxin produced by the parasite affects the bone marrow function severely, while in the second it only acts upon this to such an extent as to favor the more moderate blood changes. The same is true of some cases of puerperal anemia, syphilis, and carcinoma, in which the specific "pernicious" embryonic blood picture is seen instead of the appearances usually characteristic of a simple anemia developing in the course of these diseases. Thus it is impossible to separate these two forms of anemia from an etiological standpoint.

Naegeli's views coincide with those of Pappenheim, however, in one essential feature, namely, that, whatever the result of the blood or the blood-forming organs, there is some primary toxic cause at work.

For practical purposes we may conclude that anemia in whatever form is merely a symptom. That there is further a cause for every form of anemia that exists in disease, and that the cause is sometimes unknown and the condition, therefore, cryptogenetic; at other times is known and therefore, phanerogenetic. On this basis we may best classify as follows:

Cryptogenetic Anemias.—Two groups of cases may be included in this cryptogenetic variety:

1. Addisonian or Biermer's idiopathic (pernicious) anemia, an entity in so far as it presents a peculiar and characteristic clinical picture and morbid anatomical changes. These cases should be termed primary pernicious anemias.
2. Secondary forms, with undiscoverable cause, in which the clinical picture differs from that of the Addisonian type, and in which the patients affected either get well, or, if the condition ends fatally, the morbid anatomical picture differs essentially from that of the Addisonian type.

Chlorosis may be included in this class.

Phanerogenetic Anemias.—Two groups of cases may be included:

1. Anemias with a specific blood picture as found in the Addisonian type, but with an obvious cause which, if removed, results in cure, e. g., bothriocephalus anemia, also some varieties following certain infections and intoxications. These should be termed secondary pernicious anemias.
2. Anemias of the ordinary so-called secondary types—the blood picture varying within wide limits—sometimes exhibiting a diminution in formed elements and coloring matter proportionately, sometimes showing more a chlorotic type. All transitional varieties from the mildest to the gravest forms may occur, the appearances closely resembling those of Addison's anemia and yet not quite identical because lacking certain elements which indicate embryonic types, megaloblasts in abundance, myelocytes and a high color index.

It is these secondary forms of the phanerogenetic type which constitute by far the greater majority of all anemias, be the cause what it may, post-hemorrhagic, traumatic, septic, toxic, or cachectic.

SECONDARY ANEMIAS

These may be roughly classified into those due to definite blood loss and those due to toxic causes.

Post-hemorrhagic Anemias

Post-hemorrhagic anemias typify those associated with blood loss. The anemia may be mild or severe, sometimes so severe as to simulate pernicious anemia; indeed, quite a few cases are recorded in which the typical pernicious variety seems to have followed the post-hemorrhagic anemia.

Repeated bleedings, it is thought, may paralyze the functions of the blood-forming organs. After hemorrhage has occurred, however, increased coagulability soon takes place. The fine veins of the marrow are too small to allow a very hasty flow of blood, and thus the substitution of new blood is kept back. Oligemia occurs, but gradually is overcome by tissue fluid. The serum becomes more "watery," and hydremia results. The hemoglobin and red cells fall, but the index remains at 1.0. Later, the marrow gives out new mature cells and regeneration begins. With severe hemorrhage and severe anemia one may get marked qualitative changes in the blood. With repair the red cells return to normal much more rapidly than the hemoglobin, thus giving a low index and a chlorotic blood picture.

Toxic Anemias

The toxic anemias arise from two sources:

1. Extraneous poisons of a chemical nature, inorganic and organic, produce anemias (e. g., chlorate of potassium, anilins, benzol, pyrogallol, phenylhydrazin, etc.).
2. Autogenous poisons, formed within the organism as a result of different metabolic processes, likewise lead to anemia in a way that is similar to that arising from chronic suppurations, and perhaps the anemia of this variety comes under a similar category.

Many influences affect the blood through producing a state of lowered nutrition leading to defective hemopoiesis, and the anemias arising may be placed in the group of post-hemorrhagic anemias as being caused by blood loss. Such, for example, are the effects of deficient light, of poor nourishment, of insufficient iron-containing food, and of too much food of a single variety, as, for instance, prolonged milk diet, all of which are accompanied by various forms of secondary anemia.

Many anemias arise partly from toxic causes, partly from bacterial or parasitic invasions, and some from this combined with hemorrhages of varying degrees.

All forms may be mild or severe, and often are transition types which merge insensibly into pernicious anemia. From a therapeutic standpoint, the severe secondary anemias call for remedial agents as along the lines discussed in pernicious anemia.

Treatment

In post-hemorrhagic anemias absolute rest is essential to prevent recurrence and to permit undisturbed recuperation.

The cause, if possible, must be dealt with and the primary disease

treated. Sometimes it is well to leave undisturbed the seat of trauma, as, for example, in the gastric hemorrhages which come on with sudden gushes of blood and seem to demand attention. Surgeons, however, leave such cases severely alone, allowing nature to do the healing.

Sometimes, where collapse is imminent, an intravenous injection of saline solution is advisable.

Crile has recommended periodical pressure on the thorax to induce artificial respiration, and thus artificial circulation, advising at the same time saline injections, to which small doses of adrenalin chlorid may be added.

In chronic anemias the essential feature is to remove, where possible, the cause of the trouble, be it infection, parasitic invasion, or mineral poison.

Having once satisfactorily dealt with this feature, the anemia itself may be taken into consideration.

The diet should be generous and nourishing; all medicines which tend to stimulate hematopoiesis should be employed, as, for example, iron in the form of Blaud pill, arsenic, and dilute hydrochloric acid.

The following prescription has been found of benefit:

℞

Ferri reducti	gr. 80	(5.300 gm.)
Quininæ sulphatis	gr. 20	(1.300 gm.)
Strychniæ sulphatis	gr. 1	(0.065 gm.)
Arseni trioxidi	gr. 1	(0.065 gm.)

M. ft. pil. No. 40.

Sig.—One three times a day.

[When necessary to get quick results, or in refractory cases, iron should be given hypodermically; for this purpose 1 c. c. of a ten per cent. aqueous solution of the green citrate of iron or of the ammoniocitrate of iron may be employed. The ammoniocitrate presents fewer difficulties in preparation. Both solutions should be as little acid as is possible—Editor.]

Others have recommended doses of perchlorid of mercury, while for the debility phosphates are specially recommended.

The bowels should be kept open, and in suitable cases massage and change of climate are worthy of consideration.

The efficacy of high altitudes for secondary anemias of certain kinds is too well known to need repetition here.

In the severe grades of chronic secondary anemia there is great resemblance to ordinary anemia of the pernicious variety, and the therapeutics of the latter disease must be carefully followed.

CHLOROSIS

Chlorosis scarcely admits of a definition, for neither its immediate cause nor the pathological condition underlying its development is well understood. It presents, however, certain specific features which have been recognized ever since Vandeval first described it in 1620 (Stockman). It is a type of anemia coming on in girls or young women about the age of puberty, apparently of spontaneous development, and often appearing under good hygienic conditions. The most striking characteristic is a diminution of the hemoglobin normally present in the red cells, which may possibly be ascribed to an inefficiency of the blood vascular system showing itself under the exorbitant demands of puberty and the establishment of the menstrual period.

The subjects frequently show a family predisposition, and members of large families suffer more commonly than others. A first attack is said never to occur after the age of twenty-four, though relapses are frequent. The patients are usually well nourished, but present a characteristic pallor, which in extreme degrees is of the greenish hue from which the name is derived, and which is consistent in blond individuals with a bright red coloring of the malar eminences of striking contrast. They suffer from marked dyspnea on exertion and are quickly exhausted by slight effort, showing the need, too, of an abnormal amount of sleep, and in this way resemble early tuberculosis. In severe cases signs of slight cardiac dilatation, soft full pulse, venous stasis, and slight edema of the extremities appear. Digestive disturbances are common, but are not an essential part of the picture.

The blood examination shows only a slight reduction of the number of the red corpuscles, but a distinctly lowered hemoglobin content of the individual cells, so that the color index is reduced. The red cells also show a slight lessening in globular value, increased globular fragility, some polychromasia, and a lack of tendency to dispose themselves in *rouleaux;* there is relatively little poikilocytosis, as a rule, and nucleated reds are rare. The leukocytes are normal. The specific gravity of the blood is lowered both on account of the diminution of red cells and also because, according to Lorrain Smith, Haldane, and others, there is a marked increase of the plasma, and, therefore, of the total volume of the blood, a hydremic plethora existing.

Of complications occurring in chlorosis the most serious is venous thrombosis, with death from pulmonary embolism. Tragic deaths in chlorotic girls from thrombosis of the cerebral sinuses are also recorded, though, no doubt, quite rare. Few, if any, cases have come within the writer's knowledge.

Another and more frequent complication is gastric ulcer, which is so

often present that the association can hardly be considered accidental, and the question arises as to which of the two conditions is primary.

Chlorotic patients are also peculiarly susceptible to acute infections.

Most cases of severe chlorosis yield readily to proper treatment, the patient making a complete recovery in six to eight weeks. Relapses, however, are common, and are worse in the severe cases. Unfortunately they cannot be foretold, and if they occur year after year the prognosis must be guarded. The recurrence of a relapse may mean that the treatment was insufficient in previous attacks, and indicates the employment of more active measures. Some cases are obstinate, and there are habitual forms of chlorosis which give no sign of improvement in years. These are usually individuals of undeveloped vascular and sexual systems, in whom the disease has manifested itself unusually early in life, at the age of fourteen or earlier, and the prognosis is here bad. Perhaps these are not true chlorotics at all, as we understand the condition to-day, but the blood condition may be the effect of a true congenital hypoplasia of the blood vascular organs, under which picture the first cases of so-called chlorosis were described by Virchow.

Treatment

There is no question but that the specific feature of chlorosis is the reduced amount of hemoglobin in the red blood corpuscles, and that to restore the normal hemoglobin content of the blood, in other words to supply the iron required for the formation of the hemoglobin molecule, is practically to cure the condition.

Among the first to use iron in chlorosis were Sydenham and later Niemeyer, and since then it has come to be recognized as having a distinct specific action in this disease.

The question arises: Is medicinal iron necessary, or will rest, a diet rich in iron-containing foods, and mechanical therapy suffice for cure? Mild cases do well under such expectant treatment, the patient being put to bed or kept at rest in the sunshine and fresh air on a diet rich in iron and albumin, hydrotherapy, sweating, massage, etc., being employed to stimulate metabolism, and constipation being regulated, when necessary, by the free use of enemata of castor oil and glycerin (Ferreira). Severe cases, however, *need* medicinal iron, which alone produces marked progress. It must be combined with the above procedure to insure success, which is attained in all but a few intractable cases in one to two months.

The various therapeutic measures available must be severally considered.

Rest in Bed.—Confinement to bed until betterment is distinct (three to five weeks) is essential for all marked cases, especially for those with vascular symptoms. Even after the patient is allowed to go about, a

rest in the early afternoon, and sometimes during the day as well, must be enjoined. Abundance of fresh air and sunshine should be supplied. Under these conditions sleep is much better, and many complaints disappear quickly and forever. Even mild cases should begin treatment by a week's rest in bed, and then be made to rest much during the day and forbidden exertion of any kind.

Exercise, which was formerly advised, is now known to be injurious in all degrees of chlorosis, for it implies muscular effort which leads to the breaking up of the red corpuscles and to the waste of the hemoglobin which is so much needed by the patient; this is proved by the rapid exhaustion of these patients under relatively slight exertion, and by the early appearance of urobilin in the urine.

Food.—The importance of proper dietetic treatment cannot be overestimated, for the disease is primarily one of disordered nutrition. A generous diet rich in albuminous (iron-containing) material, such as meats, spinach, cream of beans or oats, fish, eggs, cream, etc., should be supplied. Raw meat, seasoned and given in sandwiches or minced, or as raw beef juice, is a valuable adjunct. Eggs in any form may be given for breakfast, and meat, roast or broiled, at the other two meals, with plenty of fruit and vegetables, chiefly of the green and less starchy varieties. Tea and coffee should be abstained from and water freely drunk. A light wine may be allowed at dinner.

The digestion of these patients varies and they suffer not infrequently from dyspepsia. This must be treated in all cases by removing the cause, where this is possible, and by careful feeding, giving five small meals daily and nothing between. Milk should be taken in fair amounts, both for its nutrient value and because it is a diuretic and influences gastric acidity; if necessary it may be peptonized or diluted with lime water. If there be emaciation, fats, as butter, cream, bacon, etc., should be given freely. An abnormal desire for abnormal articles of food is common to many chlorotics, and they will give preference at meals to olives, spices, pickles, sweets, etc., over food that is more nutritious. This idiosyncrasy is to be regarded more as a perverted taste than as a natural outcry on the part of the tissues for certain needs.

Hydrotherapy.—This has been shown to be a most useful adjuvant in the treatment of chlorosis, promoting metabolism and soothing the nervous system. It is of benefit especially in the milder cases, and a number of instances are recorded of cure by the use of hydrotherapy and hygienic measures alone, no medicinal iron being employed (Armbrust, 10). The many observations favorable to this method seem to indicate that real benefit occurs in a short time, the red cells increase in number, and the percentage of hemoglobin becomes greater; still, one can scarcely credit the rapid improvements in these, half an hour after treatment, which some writers, such as Winternitz, would have us believe occur. To be of use

the measures employed must be fairly active, and their effect must be carefully watched and the treatment arrested if unfavorable symptoms, as palpitation, etc., develop.

Hydrotherapy may be applied in various ways, cold, heat, diaphoresis, and combinations of these.

Cold Hydrotherapy.—There is little doubt that in many patients the administration of cold baths in various ways has the effect of a powerful tonic, and stimulates cellular metabolism, acting on the nerve endings and the cardiovascular system, and more or less directly improving the blood itself. Friction of the skin helps this action, for the circulation is mechanically stimulated and stasis and ischemia disappear, while organic oxidation increases.

In using cold hydrotherapy it is doubtless best to begin with warm water and then to proceed from milder to severer measures. The treatment is best given in the early morning and should be preceded half an hour beforehand by a glass of warm milk, a cup of tea, or a little whiskey.

The different methods employed are sponging, rapid cold immersion, friction with or without salt rubs, wet sheets, douche, cold Sitz bath, carbonic acid bath, etc.

The *cold Sitz bath* lasts from one to three minutes, and the abdomen should be rubbed by the attendant during the bath.

Friction is applied with the patient in bed, and it may be dry or wet. Winternitz's method of applying wet friction is to cover the patient, who is stripped of clothing, with a sheet, placing one arm wrapped in a towel wrung out of cold water outside the sheet. Rub through the wet towel, and follow by a vigorous dry rub. The extremities and body are treated thus in turn. Salt water may be substituted for fresh where special stimulating action is desired.

The *wet sheet* is applied with the patient standing erect. The sheet, wrung out of cold water, is wrapped about the body, beginning over the chest, descending under the left armpit, and then around the back and over the right shoulder and across the chest again to the left armpit. The sheet being thus held in position, rapid and vigorous friction is applied through it by an attendant, the flat of one hand being in front and the other at the back of the patient. This is followed by a vigorous dry rub.

Such treatment should be followed by rest or exercise, according to the individual case.

Hot Hydrotherapy.—Hot baths are recommended by Matthes and others. Rosin suggests baths at 40° C. for fifteen minutes, followed twenty minutes later by cold very rapid douche, then rest in bed an hour.

Diaphoresis.—Sweat baths are good where they can be borne, but it must be remembered that the treatment is somewhat depressing. They act upon metabolism and get rid of the excessive plasma in the tissues.

The methods employed are dry or moist warm packs, hot air baths, electric light baths, until free perspiration results. As Wandel has shown, these *Schwitzkuren* need something else to raise the hemoglobin of the blood, and they are, therefore, best combined with iron medication. The processes involved in diaphoresis help the iron to circulate and to become transformed into hemoglobin. This reflection applies to a greater or less extent to all the processes of hydrotherapy.

In our own experience very satisfactory results are attained by a combination of hot and cold treatment, first a short exposure to the electric light bath, about fifteen minutes, twice weekly, for gentle diaphoresis at a low temperature, and then hot douches, followed by gradually cooler sprays. All this treatment, however, is done in moderation and is invariably supported by dietetic measures, rest, mild gymnastics, aerotherapy, and iron medication.

Intestinal Antisepsis.—The obscure nature of chlorosis and its supposed toxic origin have led many physicians to believe that some form of autointoxication from the intestinal canal is responsible for the onset of this malady. For this reason the use of intestinal antiseptics—so called—have been used, and at times with some apparent benefit. Of course the use of any safe antiseptic medication for the alimentary canal is more or less without any marked diminution of the so-called septic state, but in a mild degree the use of such drugs as salol and β-naphthol seems to render the stools freer from bacteria, of a better odor, and less putrefactive in character. That they are any the less "septic" on that account is difficult to say, but that they are less likely to cause "autointoxication" is a fairly reasonable supposition. The presence of constipation in chlorosis likewise lends some color to this view, and it is certainly our experience that a preliminary preparation of the alimentary tract is of use before commencing the iron treatment. For this purpose, in addition to purgation, we use frequently β-naphthol in 5-grain doses three times daily for a week before giving iron in any form.

Iron.—The fact that iron cures chlorosis is well recognized, but the mechanism of its action is still unknown. Where in the organism is iron lacking? Is its diminution in the red corpuscle due to a defect of absorption in the stomach and intestines, or to insufficient assimilation in the cell itself? The supply of iron in the food is ordinarily quite sufficient for the hemoglobin, and chlorotics absorb all this food about as well as the normal individual. Why then, in severe cases, are the iron salts contained in the food insufficient for cure, even though a diet rich in proteids be given? And why is medicinal iron in addition necessary? Is medicinal iron absorbed by the gastric and intestinal mucosa, or does it produce its effects by acting locally within these viscera? Replies to these questions and many others of a like nature still remain largely problematical, in spite of the large amount of experimental work which has been done.

It is the consensus of opinion of the competent that the defect seems rather to be due to lack of assimilation in the red corpuscle at the place of formation in the bone marrow than to faulty absorption from the alimentary canal, and that the medicinal iron acts favorably by direct stimulation of the bone marrow to increased hemopoiesis. Certainly, no proof exists of the presence of intestinal disorder of any marked degree, or of non-absorption. The ingenious hypothesis of Bunge that inorganic iron could not combine in the organism to form the hemoglobin molecule, and that medicinal iron was not absorbed by the intestinal wall, but acted by remaining in the intestine and combining with the sulphuretted hydrogen and other bodies there, thus leaving the organic iron of the food free for absorption, has been now fairly disproved. The fact that chlorosis can be treated successfully by subcutaneous injections of inorganic iron argues against the first point, and, secondly, it is now known that both organic and inorganic iron compounds are perfectly absorbed in the intestinal canal and carried by the blood and by way of the liver to the hemopoietic organs, where they are stored up as reserve iron, or are used at once, if needed, to form hemoglobin. These iron depots keep their iron content until the reduction of the hemoglobin in the red cells demands a fresh supply, when the reserve iron is transformed from its loose combination (ferratin) into the more stable hemoglobin (Erich Meyer, 14).

The fact that giving iron cures implies the entrance of iron into the hemoglobin molecules, and it is certain that in chlorosis the stimulating effects of the drug are seen rather in an increase of the hemoglobin in the individual corpuscle than in an increase in the number of red cells. The old theory was that the curative action of iron took place by this simple chemical process. It is now known, however, that its effects are more complex, and are general rather than local. This is borne out by the fact that under treatment the red corpuscles are first increased while the hemoglobin lags behind, the color index remaining low for a long time.

v. Noorden held that the iron when administered stimulated in some specific way the germinating capacity of the blood-forming organs, especially the bone marrow, and this is the generally accepted view, although, as stated above, sufficient proof has not yet been accumulated.

Morawitz and Zahn watched thirty-eight cases with all the signs of chlorosis, in whom there was no deficit of hemoglobin, and gave them iron, in all cases with benefit, even when the general régime was not altered in any way. These cases, then, they considered were only pseudochlorotics, and yet iron did them good, from which they concluded it to be unlikely that either the theory of cure by simple chemical process or v. Noorden's theory of hemopoietic stimulation, cover the ground entirely. The evidence is scarcely sufficient to allow us to recognize as a special entity pseudochlorosis of the type described by these authors, for the symptoms of secondary chlorotic anemia are present in many forms of obscure infection and intoxication without the blood picture, making it probable that these cases of Morawitz and Zahn belong to this category.

Morawitz and Zahn (13) maintain that the results of experiments

on animals which are fed with a limited amount of iron and are then benefited by the use of metallic iron do not constitute an argument in support of v. Noorden's (9) theory. Of course, such animals are benefited, but the important thing is to see whether anemic animals to whom sufficient iron food is given are in any way influenced by the addition of the iron metal, that is, whether the blood formation itself is increased by these means apart from the improvement of the general condition. For this purpose they took a series of twenty-four rabbits which had been bled. In twelve cases iron was administered (liq. ferri alb. per os, or fer. cit. subcutaneously, in amounts equivalent to 0.003 gm. metallic iron daily). The other twelve cases received no iron. No difference was observed in the two series as regards blood regeneration, and they therefore concluded that iron does not work on these organs at all, but that its action must be general upon metabolism.

Such experiments, however, are not altogether convincing—quite apart from the fact that the metabolism of herbivorous animals is not necessarily analogous to that of man, and that the administration of iron to man is certainly followed by increased regeneration.

The action of iron in the body is probably of a complex nature. It stimulates hemopoiesis and stores iron for absorption. Whether it has in addition a direct chemical action upon the hemoglobin molecule, or a general action within the organism, other than the stimulation of hemopoiesis, as Morawitz and Zahn suggest, is not clear.

Van Gieson studied iron metabolism. He concluded that the old officinal preparations produce hemoglobin far more effectually than do the modern proprietary compounds. The preparations he considers the best for therapeutic purposes are the ferrous carbonate, the soluble oxid with sugar, the double salts with vegetable acids, and ferric chlorid solutions given in large quantities of milk. He lays stress upon the fact that in iron medication the question of defective metabolism is important. That is to say, where this exists, iron cannot be expected to give good results. Patients must, therefore, be individualized and prepared for the course of medicinal iron which is to be instituted; rest, massage, milk diet, intestinal antisepsis, as far as possible, are all means to this end. Digestive troubles are no contraindication to the use of iron, but in severe indigestion it is well to precede the administration of the drug by the treatment of the gastric disorders, and then to begin by small doses, gradually increasing and decreasing again before discontinuing.

There is no need of large doses of iron, but to be effectual the treatment must be carried on until recovery is well established. "Relapses" often mean insufficient cure. The form of iron most commonly employed is the simple pil. Blaud (ferrous carbonate), giving one pill three times daily (i. e., 7½ grs., 0.5 gm.) the first week; two pills three times a day (15 grs., 1.0 gm.) during the second week; and three pills three times

a day (22.5 grs., 1.50 gms., in the day) until the hemoglobin content of the blood is normal, then *gradually* reduce. Care must be taken that the pills are fresh, so that the iron is given as the true ferrous carbonate, and not transformed into an irritant oxid. On account of its astringency, iron is hard upon the digestion and tends to constipation; it must, therefore, not be given to excess, nor without due watch upon the bowel action. To obviate the latter difficulty it may be combined with cascara, aloes, or phenolphthalein.

If pil. Blaud disagree, ferric sulphate in one-grain pills three times daily may be used in the same manner as above, gradually increasing, or the dried sulphate, 5 grs., three times daily, but these forms are still more trying to the digestion than is the ferrous carbonate.

Vallet's pill is another good form of prescribing the ferrous carbonate. It differs from Blaud's pill in being made with sodium instead of pot. carb., and in containing licorice powder. It should be freshly prepared:

℞ Massæ ferri carb., 6.00 gm. (℥iss).
Pulv. glycerrhizæ, q. s.
M. fiat mass. Div. in pil. No. xxx.
Sig.—3-5 pills daily.

Tinct. ferri perchlor., 10-30 m. (0.66-2.00 gm.) is good when anorexia is present. It should be given in a syrupy vehicle.

A prescription sometimes useful where other inorganic salts are not well borne is the following:

℞ Ferri sulphatis
Potassii carbonatis, āā 5.0 gm.
M. ft. pil. No. 100.
Sig.—One three times a day after food.

The milder compounds of iron, such as those with the vegetable acids or the saccharated carbonate, are suitable for children:

℞ Ferri carbonatis saccharati, 0.65 gm. (gr. x).
Olei menthæ piperitæ, gtt. ii.
Pulveris cacao, 4.00 gm. (℥i).
M. fiat pulv. Div. in chart No. xx (wax paper).
Sig.—One powder 3-4 times a day.

Or:

℞ Ferri iodidi saccharati, 0.1 gm. (gr. iss).
Sacchari, 0.3 gm. (gr. iv).
M. ft. pulv. No. i. Mitte tales No. 24.
Sig.—One to two powders daily.

Or:

℞ Syrupi ferri iodidi
Syrupi simplicis āā 50.0 gm. (℥iss).
Sig.—One teaspoonful three times a day after food.

Organic Iron Compounds.—It has been claimed that organic iron compounds have a distinct advantage over the inorganic salts in that they are more readily absorbed through the intestinal mucosa, and also that, being more closely allied to hemoglobin in chemical composition, they enter into their formation more readily. Oerum (23) (Scandinavia) reports the results of experiments with organic and inorganic iron upon twelve rabbits and ten dogs, which had been made iron-poor by repeated bleedings. He used hematin-albumin, ferratin, ferri sulphas, and ferri lactas, and found that of all these, hematin-albumin acted most quickly in restoring the hemoglobin content. He concluded that both organic and inorganic compounds are absorbed and are stored up in the body as reserve iron in two different forms; but that the latter is of use only in stimulating the organism to the formation of new blood cells, whereas organic iron acts directly by entering into combination to form new hemoglobin molecules.

This conclusion, however, disagrees with the facts experienced in chlorosis, for tinct. ferri perchlor. quickly raises the hemoglobin content and improvement is rapid (E. Meyer, 14). As a matter of fact, no form of iron is directly absorbed and transformed into hemoglobin, but all forms pass through the liver first, as ferratin. Organic preparations have probably little real advantage over the inorganic compounds, except in so far as they are somewhat less irritant to the digestive tract, and contain perhaps food values of another variety. But there is already so much iron nucleoalbumin in the food that the further addition of so-called organic iron over the inorganic variety is of questionable benefit.

Various forms of organic iron are recommended by different authorities.

Iron somatose (Matzer, 22) in doses of 3 to 10 gms., in milk, bouillon, or beer, has given good results, so also *triferrin* (Kraus, 21), a combination with paranucleinic acid, and containing 22 per cent. metallic iron and 2.5 per cent. phosphorus.

Ferratin was originally prepared by Schmiedeberg from pigs' liver and is now made artificially; it is tasteless and easily administered, but is probably not superior to inorganic iron.

Hemoptan (Clemm, 19) is a mixture of blood and malt in equal parts, thickened in an air-free space. The hemoglobin and serum form easily soluble combinations with sugar, the blood albumin being formed into a saccharate which is a blood-colored, dry, crystalline, sterile preparation,

containing animal iron, blood, salts, albumin, maltose, lecithin, etc., in easily assimilable form.

Euferrol (Hauschild, 20), a good preparation for weak stomachs. It is stable, not unpleasant, easily assimilated, and retained. Given in capsules it has the essential constituents of Levico water. Its action is better when combined with arsenic.

[Whatever form of iron is given by mouth in chlorosis, its activity is materially increased by giving an intestinal antiseptic. I have shown this in the report of a number of cases, and it has been verified by Townsend. Salol, β-naphthol, or benzosol may be given in the individual indications called for.—Editor.]

Hypodermic Use of Iron.—In some cases the duodenal mucosa which usually admits iron to the system becomes insufficient. The subcutaneous method may then be employed, and has met with success (Morse, 26; Dickinson, 24).

Glaevecke (25) first used iron thus in 1883, employing ferratum citricum oxydatum, in which form the iron is not precipitated locally in the tissues, but passes quickly into the circulation (v. Secondary Anemia).

Baths Containing Iron.—Certain alkaline mineral springs are particularly rich in iron, and these often have a remarkably good effect on chlorosis, especially when the water contains much free carbon dioxid, which produces a stimulating effect upon the skin, with redness and tingling, and thus helps the absorption of the metallic iron. The bath is often combined with the internal use of the water, about a pint being taken daily at first and larger quantities later. If the water be from a cold spring it should be warmed before drinking, as iron in cold water is more irritating to the digestion.

The cure may be carried out at home by substituting some of the alkaline waters rich in iron for those with carbon dioxid.

An interesting table showing the temperature and percentage of iron-carbonate or sulphate, alkaline salts, and free CO_2 contained in the various European and American mineral springs is given in Potter's translation of Ortner's Treatment, pp. 164-165. St. Moritz and Tarasp, in Switzerland, Homburg and Schwalbach, in Germany, Marienbad and Franzensbad, in Austria, are all hot springs rich in iron and practically saturated with CO_2, and all except Schwalbach contain alkaline salts in addition. A number of alkaline chalybeate springs are scattered over the American continent. Among those so far analyzed the California Geysers, Sonoma County, Cal., and the Napa Soda Springs, California, are saturated with CO_2. Alkaline mineral springs containing iron with a relatively small amount of CO_2 are the Harbin Hot Springs, Lake County, Ga.; Indian Springs, Martin County, Indiana; Glen Springs, Schuyler County, N. Y.;

Bedford Springs, Bedford County, Pa.; Hot Springs, Virginia, and many others.

Plasmatic Treatment of Chlorosis.—Robin and others regard these anemias as due to demineralization of the plasma and prescribe a saline solution followed by iron medication as follows:

℞

Sodii chloridi, 27.00 gm.
Potassii chloratis, 20.00 gm.
Sodii phosphatis, 4.60 gm.
Potassii phosphatis, 12.00 gm.
Calcii phosphatis, 1.95 gm.
Magnesii phosphatis, 1.40 gm.
Potassii sulphatis, 2.00 gm.
Sodii carbonatis, 11.50 gm.
Ferri carbonatis, 1.00 gm.
Pulveris hemoglobini, 5.00 gm.

Div. in cachet No. 8, two before breakfast and before dinner.

Then, after twenty days, the plasma having adequate mineral composition, give iron for renovation, e. g.:

Tartrate ferrico-potassii, 0.10 gm.
P. rhei, 0.05 gm.
Calc. magnesiæ, 0.05 gm.
Quininæ, 0.10 gm.

One pill before breakfast and before dinner for four weeks.

Arsenic.—Arsenic is a good adjuvant to iron, especially in cases where the red corpuscles are much diminished, showing that the bone marrow needs stimulation. Fowler's solution is the best preparation to use, though other varieties are also employed in chlorosis. It may be combined with iron as follows:

℞

Ac. arseniosi, gr. 1/60 (0.001 gm.).
Blaud mass., gr. x (0.65 gm.).
Ext. aloes. soc., gr. i (0.065 gm.).

M. ft. pil. No. i.
Sig.—One pill t. i. d. p. c.

Manganese.—It has been claimed that manganese or a combination of this drug with iron sometimes gives good results in the few cases in which iron fails.

Vicciniini (29) investigated the use of albuminate of manganese in chlorotic women. He found it increased the hemoglobin and the number of red corpuscles, and that the increase persisted after the drug had been

stopped, which was not the case with the other hematogenous metals; he concluded, therefore, that manganese was probably cumulative in action owing to its slow absorption. The elective action, he believes, therefore, to be deep, not superficial or transitory, and considers this action is evidently due to a direct combination with the molecule of hemoglobin, for the reaction of manganese is absent from the separated serum, while present in the blood clot of the patient under treatment. It has also an indirect action by favoring oxygenation of the blood.

Cholesterin.—This has sometimes been found useful in chlorosis. Iscovesco's (30) successful cases were chiefly of this disease. Dose—1-2 grains (0.065-0.120 gm.) daily in pills.

Plasmotherapy.—The interesting results recorded by Piot (75) of the action of hemoplase in chlorosis, as well as in other anemias, have been fully discussed in the section on pernicious anemia. It is claimed that hemoplase not only supplies the fluid containing the antibodies and other properties of the cell-protoplasm, which may stimulate hemopoiesis, but also presents in an ideal form the iron constituents of the blood for subcutaneous use.

Serum Therapy.—Chlorotic patients have been successfully treated by the serum from sheep, into which 600 c. c. of anemic patient's serum had been repeatedly injected. Chloranemics improved, their red cells increased, and the color-index was raised.

Treatment of Special Symptoms

The digestive symptoms of chlorosis often predominate and render the recovery slow and unsatisfactory.

Anorexia is especially common, and is associated at times with gastric anacidity or hypochlorhydria. In such cases dilute hydrochloric acid is of benefit and may be best administered by adding 10 drops to a wineglass of water, sipping the mixture slowly after each meal. Sometimes pepsin is added to this, and though the scientific basis for such treatment is lacking, yet patients often affirm that its action is satisfactory. At other times stomachics and bitter tonics do good, and one may give with benefit gentian, etc.

Hyperacidity is even more common, according to Riegel, and when present is best treated with calcined magnesia, bismuth subcarbonate, and sodium bicarbonate, to which a few grains of taka diastase may be added, thus:

℞

Bismuthi carbonatis.
Sodii bicarbonatis, āā grs. x (0.65 gm.).
Magnesii oxidi, grs. iii (0.25 gm.).
Pulveris taka diastase, grs. ii (0.12 gm.).

M. ft. pulv. No. i.
Sig.—Three times a day, half an hour after food.

The bulk of the powder is an added benefit, as in all forms of hyperacidity.

Mineral waters are likewise commendable, especially the Carlsbad waters (Mühlbronnen), which should be given on an empty stomach.

In recent years, too, tinct. nux vomica in large doses, the so-called intensive treatment, has found favor in many hands, beginning with 10 gtt. three times a day after food, and going quickly up to 20, three times a day.

Others, again, praise the effects of olive oil, which, in the writer's experience, is most useful.

For gastrectasis, which is not common except in a mild degree, small meals are useful, and a wet Priessnitz compress night and morning; strychnin, where indicated, and, if ptosis be present, a suitable corset adjusted to exert pressure upward from the lower zone of the abdomen.

In all cases of chlorosis the diet is a source of difficulty, for, quite apart from digestive disturbances, there is often an unnatural craving for absurd and often non-nutritious foods, e. g., sweets, spices (olives, pickles, etc.), coffee beans, cracked ice, wines, etc., and although it is the opinion of some authorities that this disease indicates a need of the organism which should be satisfied it seems to the writer more a perversion of the nervous system and indicates the need of psychotherapy.

In these cases some such dietary as the following may be advised: In the early morning weak tea with much milk, or else some orange juice, before the bath. For breakfast, eggs and bacon, weak tea, toast. At 11.00 a. m. some nourishing food or some small drink to stimulate the appetite —eggnog made up of half an egg and glass of milk—or else chicken broth, or sherry and egg, with a soda cracker or stale bread. The mid-day meal to consist of proteids and easily assimilated vegetables. At five o'clock weak tea and toast, or stewed fruits—and the evening meal to consist of light food with beef, ham, game, etc.

For the constipation mild purgatives such as cascara, phenolphthalein, or aloes may be used. Or the so-called phenolphthalated ABS and C pill.

Aloini, gr. $^1/_6$ (0.10 gm.).
Strychninæ sulphatis, gr. $^1/_{60}$ (0.001 gm.).
Extracti belladonnæ, gr. $^1/_8$ (0.008 gm.).
Extracti cascaræ, gr. $^1/_4$ (0.016 gm.).
Phenolphthaleini, gr. $^1/_4$ (0.016 gm.).

The nervous symptoms so often present in chlorosis need special attention. Fresh air, good food, and iron will do much to help these, but as so

often happens there is perversion of the patient's "morale," and for this a judicious moral and mental discipline are needed and psychotherapy in its broadest sense should be employed.

For the neuralgias analgesics should be used with care. Local applications are best employed at first, a menthol plaster, and some counter-irritating ointment or liniment, e. g., capsicin.

PERNICIOUS ANEMIA

In the treatment of pernicious anemia the first essential is a correct diagnosis.

Much of the difference of opinion regarding the value of various forms of treatment has been in the past due to the wrong conception of what the term pernicious anemia implies or else to a faulty diagnosis. Even in the cases of pernicious anemia described by F. Müller, in which the results of treatment are fully discussed, several occur in which insufficient evidence is afforded of the true nature of the disease, thus rendering a rational criticism of his method of treatment of less value.

As stated in the introduction to this section, our purpose will best be served if we follow Pappenheim's broad classification of pernicious anemia into two types—those without known cause (Biermer's or Addison's cryptogenic anemia), and, secondly, those where the cause is known (phanerogenetic, or secondary, pernicious anemia), in which the blood picture is that of the idiopathic cryptogenetic type but the cause is clear.

Briefly, the symptoms are those of progressive general weakness, without noticeable emaciation, gradually increasing profound anemia, dyspnea, vertigo, slight edema of the subcutaneous tissues, palpitation of the heart increased on exertion, digestive disturbance with periodical attacks of diarrhea, general signs of indigestion, with nausea, frequently vomiting.

Further, numbness and tingling in the extremities as a result of the involvement of the spinal cord, and tenderness over the long bones, due no doubt to the changes in the marrow, form some of the important clinical features of the disease.

Remissions often lasting months and even years occur in the idiopathic type, though invariably after one or more relapses the patient gradually fails, dying from exhaustion or coma, or, more rarely, from hemorrhage of the mucous membranes.

The blood picture in its typical aspect has the following features: The red cells number less than 2,000,000, the color index is high, and the leukocyte count under the normal. Poikilocytosis is marked. Abnormally large red cells occur (megalocytes), with polychromatophilia, and there are many nucleated forms of varying size (megaloblasts, normoblasts). Of the leukocytes the polynuclear forms are relatively diminished and the lymphocytes correspondingly increased.

In the remissions the blood picture may almost resume the normal or assume the characters of a secondary anemia from other causes.

General Treatment

Medical science has of late years paid much attention to the treatment of pernicious anemia, and many new features have been discovered to aid in the methods of alleviation. Hitherto, however, no means have been found that indicate very great or decided progress in minimizing the gravity of the prognosis.

Hygienic, dietetic, mechanical, and arsenical treatment often do much good, and there are others who think that cures would be less rare were these patients to come earlier for treatment. Be this as it may, it certainly seems to be of importance to begin the cure as soon as possible, and hence to make an early diagnosis.

In general one may say that no treatment can be foretold as successful, and often what is of no good to one proves beneficial to another. Rest is an essential, and where the signs are at all well marked and fatigue easily induced the patient should remain in bed, or at least in the recumbent position.

Warmth is essential, and to this end the use of flannel gowns should be advised, while fresh air and sunshine and a salubrious climate are among the most important of all modes of treatment. High altitudes are distinctly contraindicated.

It has been our habit in the Royal Victoria Hospital to place those suffering from pernicious anemia under the influence of sun and fresh air as much as possible, and the results, even in the absence of any other treatment, have at times been remarkable.

The mouth should be cleansed several times daily, and the teeth carefully attended to, not only in view of Hunter's theory that oral sepsis is frequently the cause of the disease, but because the appetite itself is improved and the patient's general nutrition better maintained. This has the additional benefit of keeping the alimentary canal cleansed and is of protection against vomiting.

Diet.—No hard and fast rules can be laid down for the dieting, because of the well-known idiosyncrasies in regard to food to which these patients are liable. The more food that can be taken without causing indigestion and anorexia the better.

The food should be nicely served and given in small amounts frequently, and always as liberally as possible. For a fickle appetite milk and milk food with eggs, meat juice, and jellies are readily borne. Red bone marrow, fresh and uncooked, and served with pepper and salt, has been highly recommended, not as a specific, however, but merely as a food, and Croftan lays stress on the need of forced feeding with excess of al-

buminous foods, giving from five to six feedings in twenty-four hours, as well as rectal feedings of proteids twice daily.

Alcohol in the form of whiskey, burgundy, claret, or hock may be taken in small quantities.

Grawitz has recommended a diet consisting chiefly of milk and vegetables, with lavage of the stomach every second day, and daily enemata, while by the mouth he gives arsenic and hydrochloric acid. This treatment, however, which deals in a general way with a disease for which the individual treatment is all-important, is scarcely worthy of serious consideration. Lavage of the stomach every second day, for example, has scarcely a rational basis, when we know of no condition in the gastric mucosa that demands either washing out or stimulation. The atrophy of the gastric follicles, which is a degenerative process, and the consecutive absence of hydrochloric acid from the gastric juice would not seem to be easily influenced by internal hydrotherapy of this kind. While, on the other hand, the effort required to carry out this treatment is by no means trivial to a patient suffering from pernicious anemia.

Oxygen.—*Oxygen inhalations* are, as a rule, useless.

X-ray.—Mosse, in a series of observations, has shown that proliferation of megaloblasts occurs as a result of X-ray treatment given over the long bones.

Favorable results were shown by Hynek in eight cases and by Rénon and Tixier in one case (combined with the use of diphtheria antitoxin), but this treatment is not as successful as one would be led to believe.

Hydrochloric Acid.—The use of hydrochloric acid has been advocated by many authorities and with good reason. The absence of this ingredient from the gastric juice may or may not be a reason for its employment, but the practical results from its use have been time and again witnessed by the writer.

We are in the habit of administering it in the form of 5-10 drops in a wineglass of water, to be sipped during ten minutes after food, with the result that digestive disturbances often improve, food is better borne, and diarrhea often ceases.

Arsenic.—Byron Bramwell (45) has very successfully studied the use of arsenic in pernicious anemia. In a large proportion of his patients marked improvement and, in many cases, temporary cures resulted from this treatment, which was introduced by him in 1877.

The improvement under arsenic is greatest in the first attack and in cases in which the patient can take large doses; but in the majority of cases, notwithstanding the arsenical treatment, relapses occur and death ultimately takes place.

Arsenic, then, is sometimes useful, and at other times has no effect, and at other times again, while beneficial at first, soon loses its value.

There are those (Gunn and Feltham, 51) who think its action is protective to the red cells by being antihemolytic, as proved by its action on blood to which distilled water is added—the arsenic becomes rapidly united to the corpuscles and hemolysis does not take place. In strong doses, however, arsenic appears to be a poison of the blood, being destructive to it and to the hematopoietic organs, causing necrosis of these tissues, reducing the number of elements, and producing degenerative lesions with phenomena of the type of macrophage. This destruction gives way secondarily (in the case of acute intoxication) to a process of renovation. The red cells are increased and a mild myelemia takes place because of the reaction of normoblastic and neutrophile types in the marrow, followed by a mild reawakening of the myeloid activity of the spleen and glands.

In chronic intoxication both processes of destruction and repair evolve side by side. The anatomical features which present themselves are as follows: Destruction recognized by the ordinary phenomena of macrophage, sometimes resulting in pigmentary sclerosis in the spleen; regeneration with reaction in the marrow, and myeloid activity in the spleen and glands, and hyperplasia of splenoglandular follicles. The condition of the blood reflects the conflict of these two processes (Lefèvre).

Arsenic in medicinal doses, then, is not, properly speaking, hemolytic, but the contrary, for it ultimately excites hematopoiesis, acting similarly to the supposed good effects of the X-rays.

Varieties of Arsenic.—Fowler's solution is the form of arsenic most commonly employed in anemia, and is probably the most useful of all for routine administration. This consists of the liquor potassii arsenitis, containing 1 per cent. of arsenious acid. It is usually administered in gradually increasing doses, beginning with 3 drops (0.18 c. c.) three times daily, and increasing one drop at each dose every third or fourth day until 20 to 30 drops (1.2 to 1.8 c. c.) are given in the day.

In France the hypodermic method is preferred. A combination is made of equal parts of the solutio potassæ arsenitis, 1 per cent., and solutio sodii chlor., 1.33 per cent., and of this 6 to 20 drops are given daily for two weeks, followed by one week of abstinence.

Many other forms of arsenic are used, as the liquor arsenicalis hydrochloricus (dose 2 to 8 m., 0.12 to 0.48 c. c.), pil. arsenicalis, containing pure arsenious acid (gr. 1/60 to 1/20, 0.001 to 0.0032 gm.), etc., but it is questionable if any of the other varieties, including the organic compounds, are more beneficial than the old-fashioned Fowler's solution.

Organic Arsenic Compounds.—Various organic preparations, and especially the salts of cacodylic acid, have lately been much in vogue as being less toxic than metallic arsenic. Thus, when Fowler's solution is not well borne, one may use sodium cacodylate intramuscularly in doses of ½ to 3 gr. (0.03 to 0.20 gm.).

The organic compounds are best given subcutaneously, because, being

taken up by the leukocytes and distributed directly to the tissues, they are probably less poisonous to the nerve centers than is metallic arsenic. When taken by the mouth organic arsenic is apt to be acted upon by reducing agents and broken up into metallic arsenic, and the advantage of the less toxic organic preparation is thus lost.

Among favorite salts of cacodylic acid recently recommended may be mentioned the *arsycodyle, neoarsycodyle, ferricodyle, ferrocodyle,* and the disodium methylarsenate (arrhenal), all pure arsenic compounds containing 70 per cent. of latent arsenic. The last-named arrhenal, "new cacodyle," is said not to be transformed into cacodyle oxid when taken by the stomach. The dose is 2/3 to 3 grs. (0.042 to 0.20 gm.) by mouth or hypodermically.

Arsenic, however, is apt to disagree in any form and must not be "pushed" without careful observation. This applies especially to the organic forms, for neither the degree of their relative toxicity nor the exact limit of their therapeutic dosage is as yet fully established.

The arylarsonates are aromatic salts of arsenic acid in which the organic radicle that replaces hydroxyl in this acid consists of phenyl, toxyl, xylyl, or naphthyl. Of recent years the compounds atoxyl and arsazetin, belonging to this group, have been claimed to have especial value.

Atoxyl (sodii aminophenylarsonas, or sodium arsenilate) contains 27.2 per cent. of arsenic. The dose by the mouth is ¾ to 3 grs. (0.05 to 0.20 gm.) daily for three weeks out of every four. It is best given, however, hypodermically, a 15 per cent. to 20 per cent. solution being employed; it should be freshly prepared with cold boiled water and should be slightly warmed before using to insure a complete solution of the drug. One begins by using 6 m. (0.35 c. c.) of the solution, increasing the dose each day until 5 grs. (0.30 gm.) of the drug is given daily, continuing this for four weeks, then reducing the number of injections to two a week, and then to one a week; then omit treatment for six to eight weeks.

It is said that atoxyl acts by primarily deoxygenating the tissues, thus leading to an increase in the blood elements, in a similar way as polycythemia occurs in high altitudes. It first destroys part of the blood, giving rise to acute deoxygenation, and this is followed by increased blood formation. It thus acts similarly to small repeated bleedings, and in the same way, too, as does tuberculin.

Acetyl atoxyl or *arsazetin* (*sodium acetyl-p-amino-phenyl-arsonate syn. sodium acetyl arsenilate*). This is a still newer form of the aryl-arsonates than atoxyl, and one which seems to be a powerful agent for increasing blood formation, acting either by stimulating the bone marrow or by weakening disease agents. This discovery of Ehrlich's resulted from the unpleasant and even dangerous effects which atoxyl was known to produce in some cases, and which led to the attempt on his part to obtain a compound of similar action but of lower toxicity. As its name implies, arsazetin is

atoxyl, with an acetyl radicle added. It is a white, easily soluble powder which can be heated to 130° C. without decomposition, and can therefore be readily sterilized and resterilized, an immense advantage in hypodermic use. It has been proved experimentally to be much less toxic than atoxyl, and it is also relatively free from unpleasant effects. Such effects, however, sometimes do occur, especially in women, and the patient's tolerance should therefore first be tested by small doses. Optic atrophy occurred in a number of cases.

Klemperer (55) described arsazetin treatment in six cases of pernicious anemia. Only 0.60 gm. (9 grs.) was used for two successive days each week, with remarkable results. The red cells rose at the rate of 200,000 to 500,000 per week, and in one patient from 440,000 to 2,320,000 in eight weeks, but in each case when 4.8 gm. had been used the good results ceased, that is, there was no further increase in the red cells.

We should not give too large doses of this drug, both on account of the untoward effect it may have, and because the results in anemia are thought to be better when it is given in small quantities. Neisser's (58) directions, which were followed by Klemperer, are the best. He recommends 0.50 gm. (7½ grs.) given in heated solution hypodermically or by the mouth. Then rest eight days and repeat until 4.8 gm. has been given.

Ehrlich, however, thinks arsazetin is no better than atoxyl for many diseases, while admitting that small doses of it seem to favorably influence diseases of the blood.

Salvarsan ("606").—Byron Bramwell (61) used salvarsan in seven cases of pernicious anemia and obtained marked benefit in four of these, where previously arsenic in other forms produced but little improvement.

The favorable results were most striking in the first two cases reported. In these four doses of 0.2 to 0.3 gm. were given intramuscularly at intervals of three weeks. In one case the blood rose from 1,350,000 to 3,200,000 and the hemoglobin from 30 per cent. to 72 per cent. In the second case the red cells rose from 990,000 to 3,360,000 and the hemoglobin from 30 to 70 per cent., and this improvement continued long after the "606" was stopped.

Leebe (62) has had a similar successful result with a case of pernicious anemia which proved to have a luetic basis. He draws the conclusion that anemias yielding to treatment with "606" are probably of syphilitic origin, and suggests this as a point of diagnostic value. Others have had a similar experience. In one case of pernicious anemia the writer found no benefit from "606," and repeated the dose when the patient was *in extremis* with no good results.

Transfusion.—One needs but a glance at the literature on immunity to realize that at the present day we are again in the midst of humoral pathology.

It was in the beginning of the 19th century that transfusion was first used to save life in the case of *acute anemia,* and since then from time to time animal blood was used, and sometimes with good effects, and then for many decades the medical world neglected its importance.

In 1874 Boisnot used defibrinated blood intravenously in a case of severe hemorrhage with cure. And more recently the successes of Ewald in 1895, of Morawitz, Cahn, Schultz, and Crile have reawakened interest especially in the treatment of blood disease. Excellent results, moreover, have been recorded in cases of severe anemia by Quincke, Brackenridge, and Affleck.

Two ways of transfusion are recorded. First, the arm-to-arm transfusion—and, second, the injection of fresh defibrinated blood.

In *hemophilia* Duke (65) employed direct transfusion in three cases with great increase in the platelets, the bleeding time became normal, and the perilous condition was tided over.

It is of the greatest importance that the donor's blood, and that of the recipient, should be homologous, and this must first be ascertained by hemolysis tests. One takes a few drops of the defibrinated blood or serum of the donor and mixes it with 10 to 20 drops of the patient's blood, and after one-half to one hour observes macroscopically *in vitro* for agglutination and hemolysis. If there be no hemolysis, transfusion would take place successfully and the effect resemble that of a simple sodium chlorid injection. This conclusion is an empirical one only, for the conditions *in vitro* and *in vivo* are not identical, but experience teaches it is fairly safe.

Rehling and Weil (69) give the following practical procedure for the accurate carrying out of the hemolysis test: Five c. c. of blood are withdrawn from a vein at the elbow of each subject, patient and donor. Of the bloods thus obtained expel 1 c. c. of each into two test tubes, each containing 4 c. c. 1 per cent. solution sodium citrate (to prevent clotting). Pass the remainder into sterile test tubes and allow it to clot by standing. Centrifugalize the citrated blood four times, washing after each successive centrifugalization, so that all trace of native serum is removed. After the last centrifugalization suspend the red cells in fifty times their volume of isotonic saline solution (making a 2 per cent. solution of red cells). Then pour off the serum from the clotted blood in the other test tubes. Next test the serum of each individual against the red cells of the other, and retain the balance of the suspension of red cells as a control. Four test tubes are thus finally obtained containing (1) patient's serum and donor's red cells, (2) donor's serum and patient's red cells, (3) suspension of patient's red cells, (4) suspension of donor's red cells. Place all four tubes in the incubator at 100° F. for two hours and then place in ice chest over night. Note presence or absence of laking next morning.

The dangers resulting from the mixture of non-homologous blood sera

are well illustrated in the case reported by Pepper and Nesbitt, in which, after transfusion by arteriovenous anastomosis, an obscure hemorrhagic state occurred, with death a few days later from intense hemolysis.

One does not require a direct arm-to-arm transfusion, and the old theory of Panum, in 1863, that *defibrinated blood* was equally efficacious, still obtains.

In the use of defibrinated blood three methods are recommended, the *subcutaneous,* the *intramuscular,* and the *intravenous.*

The quantity of blood employed seems less important than the specific action, though whether this specific action chiefly affects hemopoiesis or is the effect of an antitoxin in the injected blood acting against the hemolytic virus is unknown. Some use little blood, 5 c. c., others use much more, and Sachs, in one case, employed 400 c. c. There seems to be no doubt, however, that the quantity is of some importance, for one must inject a sufficient quantity so that there will be enough of the specific to act as a hemopoietic agent. It was to this that Morawitz attributed his success over those who used smaller amounts.

The *subcutaneous method* with subsequent massage was first employed by v. Ziemssen many years ago. So painful was this method that chloroform narcosis was used. von Ziemssen believed in the actual transplantation of the blood, finding increase in the hemoglobin and red cells in twenty-four hours. This, however, has proved to be wrong, and later even he himself preferred the intravenous injection of fresh non-defibrinated blood.

Guido Mann (67) records three cases of post-hemorrhagic anemia with recovery after the use of the subcutaneous method of injecting fresh non-defibrinated blood, 20-25 c. c. daily, or every second day for weeks.

Huber, on the other hand, tried the *intramuscular method.* It seemed obvious to him that the mere transfusion of 200 c. c. of blood would not in itself cause increased hemoglobin and red cells, and the amount was too small to take an essential part in the function of the blood *per se,* nor was it likely that the newly introduced red cells would live long in the other anemic blood. Hence his view that the action was due to some antitoxin or some excitor of bone marrow function. For this reason he considered the intramuscular and subcutaneous methods as probably equally efficacious with the intravenous, and his results bore out his conclusions. 10 to 50 c. c. of defibrinated blood were used, and the improvement in the red cells and hemoglobin was quite remarkable in four out of the five cases quoted by him.

Weber employed the *intravenous* method chiefly, and had various results in several cases of different forms of anemia—two of aplastic anemia died, one of pernicious anemia improved, and others of doubtful character got well. The red cells seemed to increase, but Weber recommended supplementing this treatment with arsenic and good food. His

results on the whole may be considered as satisfactory. He used 5 c. c. of defibrinated blood.

Morawitz reports success in three out of six cases, and one failure, the other two cases having passed out of his observation too soon to pronounce upon the results. Of the three successful cases one had been subjected for three weeks to an energetic arsenic cure and had grown progressively worse, but after the employment of transfusion the blood picture slowly returned to normal. In the other two cases an absolutely bad prognosis had been given before transfusion, and in both the blood attained practically to the normal. The favorable results did not show until two to three days after the transfusion, hence his conclusion that the action is not directly due to the transfused red cells, but rather to an irritation of the bone marrow. He used 200 c. c. of defibrinated blood.

A larger series of cases was treated by Hanssen. In twenty-six cases of anemia of varying causes sixty-one transfusions were performed. Of these fifteen were cases of pernicious anemia, and of these six gave very good results. In two others the results were brilliant, and in the seven others improvement was observed. In one case of aplastic anemia repeated transfusions brought temporary relief each time, though ultimately the patient died.

Bovaird (63) has recently recorded some striking results even more favorable to the importance of transfusion. In his case immediate improvement occurred, the extreme pallor was changed rapidly to the color of health, the vitality increased and the hemoglobin was improved to an extraordinary degree, and the improvement lasted for months.

The dangers of transfusion may again be mentioned. First of all hemolysis; anaphylaxis with sudden collapse; great dyspnea, cyanosis, chill and fever, and the result is sometimes fatal.

So far as pernicious anemia is concerned one may say that transfusion is of dubious value, and, though it has temporary beneficial results, ultimately these cases do not recover. For a time the appetite may improve, the dyspnea become less marked, the fever diminish, and even hemorrhage may absorb. As a last resort, when the patient is *in extremis,* transfusion may often produce temporary revival.

Serum Therapy.—This differs from injections of defibrinated blood in that the serum separates only from the clot instead of the fibrin being whipped up and removed.

Horses that are repeatedly bled, for example, in the making of diphtheria serum, develop in their serum a kind of active hematopoietine, so that one may rationally give this serum to anemic patients, say in doses of 10 c. c., two or three times a week for two or three weeks, and manifest benefit may result, even greater than under arsenic and iron, and there need be no danger in the treatment.

The serum may sometimes be given in anemia with benefit by mouth in

doses of 10 c. c. for four consecutive days, then rest twenty days and repeat again, always upon an empty stomach. Normal horse-serum has also been given by mouth in dyspepsia, tuberculosis, etc., with good effect, which has raised the question whether the serum does not exert some stimulating effect on autocytolysis.

For the same reason such treatment might be used in cryptogenetic anemias of an unyielding character.

Gilbert and Weil (72) record three successful cases treated with injections of 40 c. c. of blood serum from a rabbit which had been repeatedly bled and rendered anemic. Great amelioration followed, but only of a temporary character, because the cause of the hemolysis evidently persisted.

Plasmotherapy.—Plasmotherapy has been much lauded, especially by the French, and several interesting theses have been written upon the subject. By plasmotherapy is meant the therapeutic use of the protoplasm of the cell freed from its envelope (hemoplase).

The action is supposed to be based upon the chemical composition of the cell, upon a plasmic energy, and on active principles, etc., acting according to the laws of immunity within its substance.

Plasmotherapy is considered by its supporters to be better than serotherapy, because antitoxic bodies are elaborated by the protoplasm and are only secondarily in the serum, and because it also contains the hemoglobin, lecithin, cholesterin, etc., present in the cell protoplasm. For a similar reason plasmotherapy should be better than opotherapy, because in opotherapy the protoplasm is inhibited by being shaken into extracts.

Thus hemoplase is a solution of blood plasma used in plasmotherapy. It is a solution, in an isotonic medium, of the active principles of blood corpuscles, the envelope of inert material being dissolved.

Method of Preparation.—The blood obtained by bleeding is at once mixed with a saline solution, energetically centrifugalized, and decanted. The corpuscles are washed with isotonic liquid several times and the original volume is restored with distilled water, then briskly frozen several times, heating each time to 35° C. This breaks the envelopes of the corpuscles and liberates the substances contained in the protoplasm. To separate the débris of cells centrifugalize again, decant the liquid, and make isotonic with saline solution, filter and preserve in sterilized flasks.

The blood from the sheep or ass will do, and thus prepared will keep from twelve to fifteen months. The resulting liquid is red, clear, and odorless, containing oxyhemoglobin. It must be kept below 30° C. to prevent coagulation. By weight 100 gms. is equivalent to 4.5 gms. hemoglobin. Toxicity is slight, it is nonirritant to the kidneys, and may be used subcutaneously.

Method of Administration.—The usual mode of administration is 10 to 20 c. c. given intramuscularly every two or three days for ten to twelve doses.

Advantages.—Clinical experiments seem to show that it has antitoxic and tonic powers. Its absolute simplicity and innocuousness and the simple technique are features which commend it in place of transfusion or similar methods, and there is no danger of embolism. A more widespread use of this form of treatment is necessary before passing judgment upon its efficacy.

Piot, in his thesis, 1909, records eleven cures in several forms of anemia, none, however, pernicious in type.

Hemoplase may now be obtained commercially without the inconvenience of preparing it. It is made in the Lumière laboratory, Paris, by Dr. J. Chevrotier, and is sold in small sterile closed flasks, each containing 10 c. c., that is, the amount of one dose.

Hemolysin Treatment of Pernicious Anemia.—Courmont and André have recently investigated the therapeutic value of stimulation of the bone marrow by the inducing of mere destruction of blood. The observation of Bordet (80) that the serum of animals injected with defibrinated blood becomes hemolytic led to the suggestion by Metchnikoff (84) that such serum, if hemolytic in large doses, should stimulate hemopoiesis in small quantities. A series of experiments were done by Cantacuzène (81), Bielonsky (79), and Metchnikoff and Besredka (84) on animals and human subjects, and on a series of patients suffering from mild grades of anemia, which verified Metchnikoff's hypothesis.

On the basis of these observations Courmont and André (82) treated several cases of severe anemias by the injection of serum from two goats which had been rendered hemolytic by the injection of human defibrinated blood. The results warranted the following conclusions: (1) Injections of hemolytic sera produce an increase of red cells and an eosinophilia, (2) such injections are painful and also the process is too complicated for general therapeutic practice. Moreover, slight anemias yield readily to treatment with iron. Therefore this measure should be reserved for use in the severe grades of anemia only, that have shown themselves refractory to other means. (3) In the cases treated the results were favorable *in some,* while in others the condition remained intractable. Finally in all the remedial effect was temporary, not curative.

Engel, following a slightly different line of thought, treated a case of intractable chloranemia by repeated injections of rabbit serum which had been rendered hemolytic by the introduction of defibrinated blood from the anemic patient herself, the theory being that the toxin causing the anemia in her would give rise to its own specific antibodies. A cure resulted, no other line of treatment being employed.

While these investigations are of much interest the therapeutic value

of the hemolysin treatment of anemia has not by any means been established.

Cholesterin.—The presence of cholesterin in the blood cells was first made known by Hoppe-Seyler, and its presence in the serum was detected by Hurthle, and it has been demonstrated by successive observers in practically all the organs of the body, as well as in the bone marrow, subcutaneous fat and milk. In the red blood cells it exists in proportions of 0.04 to 0.06 per cent. In the serum 0.234 to 0.19 per cent.

Its physiological importance, however, was not recognized until very recently, when the studies of the lipoid bodies, of which cholesterin is one, have shown the marked antihemolytic powers which cholesterin possesses both *in vitro* and *in vivo*.

Reicher (93) showed that the hemolysis of kobralezithid can be checked by giving cholesterin to rabbits. A proof of the increased accumulation of cholesterin in the blood serum is furnished by the fact that serum of animals immunized in this way by cholesterin furnishes a much higher protection against saponin hemolysis than the serum of untreated control animals. Further, the well-developed anemia produced in animals by kobralezithid can be almost completely banished by cholesterin treatment, and urobilin disappears from the urine, showing that the hemolysis has been checked.

It is reasonable to suppose, therefore, that cholesterin given to anemic individuals should, on the same principle, produce a rise of cholesterin in the blood and create protection against hemolysis. As cholesterinesters are not antihemolytic the greater part of the increased cholesterin must exist free in the blood.

Klemperer (90) is among those who regard its use with favor. He explains the usefulness of the drug as the exertion of an inhibitory action upon an antikatalytic substance, rather than by assuming any direct combination between it and the poison of anemia. He remarks that while the antihemolytic powers of cholesterin have been proven *in vitro*, and also in experimental animals, it is not at all clear that in pernicious anemia the virus at work is hemolytic in character.

He points out that while cholesterin in oily solution is very unpleasant to take, the treatment may be carried out in the food without artificial medication, by giving much milk, cream, and butter as above. Eight cases of pernicious anemia were thus treated by him with marked benefit. In only one of these, however, was the patient treated by this method alone and without arsenic. He concludes both from his own results and from those of Reicher that while cholesterin checks to some extent the action of the poison of pernicious anemia it does not exert any decisive effect upon its course.

Iscovesco likewise found it useful in certain hemorrhagic conditions, purpura, as well as in chlorosis and lymphadenoma, though not in per-

nicious anemia. To him it seemed also that the cholesterin protects the human blood cells against serums and other hemolytic substances.

Other investigations, however, seem to show that cholesterin has practically no action on the globular resistance of the rabbit, even though injected in a 3 per cent. oily solution which neutralizes hemolysin *in vitro*.

Dose.—30 to 45 grs. (2.00 to 3.00 gm.) are used daily, dissolved in 100 c. c. of olive oil, making a 3 per cent. solution. This may be taken in capsules, 15 c. c. in each, or it may be flavored with Ol. menth. pip. and taken in teaspoonful doses throughout the day. Or else 33 grs. (2.10 gm.) may be given daily in 1 liter of cream and 200 grams of butter, for these substances contain cholesterin ethers to the required amount.

Organotherapy.—In pernicious anemia this is expressed in the use of bone marrow. It is doubtful if bone marrow in pernicious anemia is useful for anything else than as a mere food. According to some its main benefit arises from the glycerin with which it is prepared, for, as we shall see later, glycerin in itself is recommended as efficacious in the treatment of severe anemia.

We are indebted to the French for their advocacy of bone marrow therapy, and they recommend it especially in those cases where myelocytes and normoblasts swarm, that is, where great activity of the bone marrow is obvious. On the other hand, they regard it as useless in the aplastic variety.

One usually selects the raw marrow from the long bones of the calf, and gives at least 2 to 3 ounces daily. It may be used in the form of sandwiches, as recommended by Fraser, or in well-seasoned broth—or a glycerin extract may be made with alcohol, though no preparation is so good as the fresh marrow bone.

The following prescription is sometimes used in the form of a jelly:

Red marrow, 1 part.
Port wine, 3 parts.
Gelatin, q. s.
Glycerin, q. s.

Cech reports a case of pernicious anemia treated with 0.50 gm. fresh calves' marrow daily for five weeks, with marked remissions for a time, but later on a fatal result. In this case no myeloid reaction was visible.

Glycerin.—Vetlesen (95) reports remarkable results in two cases from the use of glycerin. One tablespoonful was given three times a day with the juice of half a lemon.

In one case after one month's treatment the red cells rose from 990,000 to 4,360,000, and the hemoglobin from 20 per cent. to 69 per cent. He thinks the success of the organic extracts of the bone marrow depends upon the glycerin with which these are extracted.

Tallquist and Faust believe that pernicious anemia is a result of poisoning by oleic acid, and that glycerin combines with this to form a harmless compound.

The Antiseptic Treatment of Pernicious Anemia.—But little can be said as to the very great benefit that has been ascribed to the use of antiseptics. It was supposed that these might act against the infective processes which produce hemolysis.

William Hunter (39) recommended oral asepsis with forced feeding and serum therapy, but the results of his treatment, except in the case of ordinary secondary anemias, are more than doubtful.

Many so-called intestinal antiseptics have been recommended, and various degrees of improvement have been recorded. It must always be remembered that remissions frequently occur spontaneously, and many writers believe in the efficacy of no treatment whatever, or do not believe in the efficacy of any treatment whatsoever, so that even when occasional improvement is recorded by the use of glycerin of carbolic acid, bichlorid of mercury, beta naphthol, bismuth, and salol the relations between cause and effect must be first proven.

In the same category come such treatments as gastric lavage and intestinal irrigation. Apart from their aid in the administration of arsenic their value is very dubious.

Strümpell, indeed, regards lavage as quite useless. But this is not the only extreme tried in the treatment of pernicious anemia. Burch has even recommended appendicostomy and intestinal lavage through the opening, while others have recommended the use of antistreptococcic serum, because forsooth, streptococci were found in the mouth and teeth. Certainly if this serum is of any benefit it is quite apart from its specific action upon streptococci.

The Treatment of Special Symptoms.—The gastrointestinal symptoms require special care. Apart from watching the arsenic and the diet it will be found necessary to keep such patients at rest, and where *diarrhea* exists to give bismuth salicylate.

Where *constipation* exists, on the other hand, great care should be exercised regarding purgatives and only the mildest laxatives should be given.

Where *hemorrhages* occur the treatment should be as much as possible local. Nasal or uterine bleedings should be treated by adrenalin chlorid on gauze tape. For *intestinal hemorrhages* food should be withdrawn and styptic pill administered with lead and opium. Where the bleeding is low down in the bowel astringent lavage may be helpful. For hematemesis ice, silver nitrate, and withdrawal of food are usually all that is necessary. *Bad teeth* should always be treated, tartar removed, and useless stumps extracted, cavities cleaned and stopped. *Pyorrhœa alveolaris* should be treated with the brush and some such wash as hydrogen peroxid.

Insomnia is not uncommon, but where it is present a gentle hypnotic is usually sufficient.

Where *cord pains* occur it is well to bandage the legs, which must be kept at rest, and if necessary sedatives may be administered.

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CHAPTER II

LEUKEMIA AND HODGKIN'S DISEASE

C. F. Martin

LEUKEMIA

This disease, which was first described by Virchow and Hughes Bennett in 1845, and later by Neumann and Ehrlich, is even yet far from being thoroughly understood.

Originally two forms were described by Virchow—the splenic and lymphatic varieties, until Neumann demonstrated its probable origin in the bone marrow. This gave rise to the conception of a third variety; but Ehrlich, in his epoch-making work on this subject, showed that two great varieties alone existed, the one lymphatic, originating in the lymphatic tissues throughout the body (*lymphoplastic*), the other myelogenous (*myeloplastic*), taking its origin, at all events chiefly, in the bone marrow. While it is not even yet determined to what extent these two forms are correlated or interdependent, yet, for clinical purposes, this classification will serve as a basis of therapeutics in this article. It is important, however, to realize that all forms of leukemia must be regarded, not as maladies of local origin, but as system diseases in which the hematopoietic apparatus in general undergoes selective hyperplasia.

Pappenheim (25) defines them as autonomous, but cryptogenetic, primary malignant constitutional hyperplasias elective of the hematopoietic cytoblastic tissue parenchyma.

The new tissue is, however, not mere overgrowth of preformed cells, for heterotopia and metaplasia occur. Lymphocytes and myelocytes are found in places in which they do not normally occur postembryonically, e. g., myeloid metaplasia of the spleen occurs in myelogenous leukemia, and also lymphadenoid microlymphocytic metaplasia of the bone marrow in the lymphatic type. Metastases, if they occur, are of minor importance. New cells are morphologically and chemically normal cells, thus differing from lymphosarcoma, and, although transitional and embryonic forms appear, they also adhere to the type of the immature blood cell.

The leukemias are leukemic forms (with special blood symptoms)

of the aleukemic process known as pseudoleukemia; and, vice versa, pseudoleukemia is merely an aleukemic leukemia, both conditions being characterized by hyperplasia of the hemopoietic apparatus.

Both lymphatic and myelogenous forms of leukemia may be acute or chronic, and it may be said in general that all transitions occur, not only between these two forms histologically, but also clinically. It is important, however, where possible, to make a differential diagnosis, because the prognosis and therapeutics differ accordingly. The cause is undetermined, though some authorities are convinced that a toxin of exogenous or autointoxicative origin is at work.

Lymphatic Leukemia

The Chronic Type.—In this condition there is chronic hyperplasia with increased function of the lymphoid tissues throughout the body. The lymph glands are especially swollen, multiple lymphoid cell aggregations occur in all tissues and organs; the spleen is moderately enlarged; while, in the bone marrow, lymphoid elements are more or less predominant features. The thymus gland, the tonsils, the liver, the intestines, etc., all show multiple lymphomata.

The etiology of the disease is unknown. Its duration is, on the average, from three to five years, though cases have been recorded which have lasted more than thirteen years.

The Clinical Picture.—Patients afflicted with this disease usually show progressive weakness or emaciation, with pallor and gradually increasing painless enlargement of the lymphatic glands throughout the body. The cervical glands are usually first affected. Acute inflammatory disturbances are rare. With development of the disease the liver and spleen increase somewhat in size, the bones are tender, but the metabolism is practically unchanged.

The blood, however, shows characteristic features; the small lymphocytes predominate, often forming 90 per cent. of the leukocytes, and sometimes the large lymphocytes are increased. Myelocytes, on the other hand, are uncommon, but when present are of the fully matured variety. Leukocytosis is the rule, but a few cases with a leukopenia, but relative lymphocytosis, are recorded. The red cells and hemoglobin may be unchanged, though, with the development of the disease, there is diminution of both. Likewise, as the disease progresses, there are poikilocytosis, polychromasia, and cells with basophilic granulations, and usually some nucleated red blood cells and a few megalocytes.

The Acute Type.—The acute lymphatic leukemia is but a variety of the *chronic,* and is often hard to differentiate from it. The disease develops quickly, with fever, hemorrhages, gangrene of the mucous mem-

branes, and profound prostration; and, in the course of a few days, weeks, or months, death ensues.

Histologically the picture resembles that of the chronic variety.

Myelogenous Leukemia

In this form there is extensive hyperplasia of the myeloid tissue of the bone marrow, and myeloid metaplasia in the other tissues of the hemopoietic system. Not only, then, does the bone marrow show this change, but in the spleen, the liver, the lymphatic glands, and tissues there is very marked predominance of granulocytes and myeloblasts.

Here, too, the etiology is unknown, the disease is fairly uncommon and the duration averages several years.

The Clinical Picture.—As a rule, the disease is ushered in with signs of general malaise, and patients show weakness, pallor, some emaciation, and disturbance of digestion. The spleen enlarges early, and is often the only cause for which patients seek medical aid. Gradual dyspnea, cough, fever, sweating, and palpitation ensue, and, later on, hemorrhages from the skin or mucous membranes; defective vision and hearing are not uncommon. Enlargement of the glands usually follows soon after the splenic tumor has formed, though sometimes this feature may be quite absent. Infiltrations of the skin are not uncommon. With advancement of the disease there are pressure signs from enlarging glands in the thorax and elsewhere. The blood is pale, almost sticky, and very soon after the onset of the disease there is marked diminution in the red cells and hemoglobin, with increase in the blood platelets. The red cells show the usual changes occurring in grave anemias, and the white cells are enormously increased. Myelocytes predominate. While the polymorphonuclear leukocytes may be relatively normal in amount, there is always an increase in all forms of myelocytes (neutrophile, eosinophile, and mast). In other words, the granular cells are notably increased, while the nongranular elements are least of all affected.

The myelocytes in this form of leukemia show all transition forms, thus differing from those seen in lymphatic leukemia, where the myelocytes are mature.

Treatment

There is no specific for any form of leukemia, nor is there any cure. In the present state of our knowledge the most that can be hoped for is the relief of symptoms and the prolongation of life. The course of the disease, as has already been said, is very variable, the acute cases terminating in a few days or weeks, and the chronic cases sometimes last-

ing for many years. In quite a few cases there seems to be a spontaneous improvement regardless of any form of treatment.

The prognosis would seem to be more grave in youth, also where a great anemia exists, or where there are hemorrhages into the skin or from the mucous membranes. The presence of diarrhea or dropsy likewise adds to the gravity of the prognosis, and renders treatment all the more hopeless. There is probably not much relation between the immediate prognosis and the condition of the blood. According to some authorities, in the mixed forms of leukemia in which lymphocytes and myelocytes together predominate in the blood, the prognosis is more severe. And others, again, say that the form of leukocytosis is not necessarily of any prognostic value. Where cachexia develops from intercurrent infections, the prognosis is grave and the end probably near.

Rest in bed is imperative, and the patients, in consequence, should avoid exertion of any kind, mental or physical; all excesses should be avoided, the diet should be nourishing and nonirritating; no drastic purgatives should be given.

Drug Treatment.—Very few drugs seem to have even a temporary effect upon this disease. It has been claimed by many that arsenic is the only useful medicine. It is given as follows:

Liquor potassii arsenitis.
Aq. amygdal amara, of each 10 parts.
Two drops three times a day, gradually increase to 30 to 40 drops three times a day.

This should be used for months.

Or the arsenic may be given hypodermically in 1 per cent. solution of the arsenic acid and distilled water; this should be boiled for an hour, and five parts of phenol ½ per cent. solution should be added. One milligram of this should be given and increased up to 1 centigram in the same method as indicated above. Many other drugs have been employed, but with none have there been any encouraging results.

Drysdale has recently recorded a rather remarkable improvement from the use of naphthalin tetrachlorid, 8 grains every three hours, and later every four hours. The one result is sufficiently important to render its trial interesting.

Treatment by Mixed Toxins.—Coley's serum, that is, a mixture of the toxins of streptococcus erysipelatosis and prodigiosus, has been used frequently and with perhaps slight improvement, but the results are not so encouraging as by means of the X-rays, and such was recently the experience of Larrabee, who treated six cases by this method and observed a slight improvement in three in whom arsenic had been of no benefit.

Tuberculin.—Tuberculin has also been used, but is not only useless but often dangerous.

Extirpation of the Spleen.—This has been tried, but in nearly every case fatal results ensued. This method is, moreover, quite irrational, and takes no heed of the pathogenesis.

Radiotherapy.—The treatment of leukemia has had quite an impetus ever since Nicholas Senn, in 1902, published his reports of a case of leukemia temporarily cured by use of the X-ray. The patient, however, died later.

That the X-rays form a valuable adjunct to therapeutics is now beyond any doubt, and that they have a beneficial effect that is sometimes permanent in the treatment of diseases of the external tissues and superficial glands is likewise everywhere recognized. The experience of Desplats (9), who caused a mass of cervical glands to disappear under this treatment, is now a very common event, and the disappearance in many cases seems permanent. It is less common, perhaps, to find the deeper glands disappearing under this treatment, though Elischer and Engel (13) cured two massive mediastinal tumors by radiotherapy; in each case scar tissue of small size remained, and the subjective and objective symptoms were entirely relieved.

In *tuberculous adenitis* a favorable issue often occurs which Pirie (26) attributed to destruction of the giant cells, the bacilli becoming free and easily destroyed by the leukocytes. The dosage must be measured, for too small a dose would stimulate giant-cell formation, and too large a dose would kill the leukocytes.

Dupeyral (12), discussing the effect on adenitis, notes that on normal glands the X-rays have no effect, that they rapidly cure most inflammatory conditions of the glands, and that they have a most remarkable effect on the hard fibroid tuberculous variety. Where these glands suppurate, the pus should be removed and the X-rays then applied.

The value of radiotherapy in leukemia has been the subject of much research and discussion, the action being ascribed to various causes. The results on the whole are regarded as palliative, as delaying the fatal issue, and as being at present the most satisfactory mode of treatment at our disposal.

Mode of Action of Roentgen Irradiation.—Heinecke established the selective action of X-rays on bone marrow and lymphoid tissue, and Warthin, in a most interesting series of observations, confirmed this work. Certainly lymphoid, myeloid, and epithelioid cells are most affected by Roentgen rays, with resulting degeneration and disintegration.

Krause and Ziegler demonstrated the predilection for young cells, and proved that the X-rays killed the experimental animals by completely destroying the blood-forming organs and leukocytes in the blood, while inducing in the early stages degeneration in the spleen, temporary polymorphonuclear hyperleukocytosis, and then a disappearance of leukocytes. Under gentle irradiation the spleen showed early destruction of

lymphoid tissue, while hyperfunction occurred in the bone marrow, a secondary myeloid change. They upheld Ehrlich's dual theory that the antagonism of the myeloid and lymphoid series of cells is kept in equilibrium by spleen and bone marrow.

It is now generally recognized that Roentgen irradiation has a selective action for lymphocytes and myelocytes—hence its use in leukemia. Improvement occurs because these cells are removed from the blood and tissues where they collect. This, however, is a palliative, not a curative, measure.

Oettinger (23), *et al.,* observed the cellular effects in leukemia treated by X-rays with the following results:

In myeloid leukemia, splenic irradiation caused, first, slight polynuclear increase, and then rapid diminution of white cells, according to the amount of X-rays absorbed. Myelocytes and eosinophiles diminished in number, though the percentage of the polynuclears was increased. Red cells also increased. The spleen diminished rapidly. Strength and appetite improved, but, after a time, relapses occurred, nor could the fatal result be averted.

In lymphatic leukemia, lymphocytes diminished under treatment and the polynuclear percentage was increased. The white cells as a whole became less. The spleen and glands lessened in size and showed macrophage phenomena.

The radiosensibility of various types of cells has been studied with illuminating results by different observers.

Henri Béclère and Bulliard (5) studied the effects on various forms of leukocytes, and their results may be epitomized by examination of the subjoined tables showing the effects before and after treatment.

M. B. 39 yrs. old. Before treatment, Aug. 28, 1908. Leukocytes 487,000

	Relative No. per 100.	Absolute No. per cmm.	Normal Blood per cmm.
Polynuclear neutrophiles	32.8	159,756	5,100
Polynuclear eosinophiles	4.6	22,402	150
Polymast cells	0.6	2,922	150
Medium mononuclears	3.0	14,610	1,875
Large mononuclears	0.3	1,461	225
Lymphocytes	1.0	4,870	150
Transitional cells	0.6	2,922	150
Neutrophile myelocytes	52.8	257,136	150
Eosinophile myelocytes	3.3	16,071	150
Monomast cells	0.3	2,922	150

After treatment, Feb. 10, 1909. Leukocytes 43,000

	Relative No. per 100.	Absolute No. per cmm.	Normal Blood per cmm.
Polynuclear neutrophiles.....	62.3	26,913	5,100
Polynuclear eosinophiles.....	2.6	1,123	150
Polymast cells	3.0	1,296	150
Medium mononuclears.....	5.6	2,419	1,875
Large mononuclears.....	0.6	259	225
Lymphocytes	0.6	259	150
Transition cells.....	3.6	1,555	150
Neutrophile myelocytes.....	18.6	8,635	150
Eosinophile myelocytes.....	1.3	561	150
Monomast cells.....	1.3	561	150

The results of this investigation demonstrate in a most convincing manner the predilection in action of the X-rays for neutrophile myelocytes (i. e., the predominating pathological elements), then for other myelocytes and lastly to a mild degree for normal elements.

Eleven cases of leukemia examined by these authors with this purpose in view demonstrate this interesting fact. A scale of sensitiveness of the blood element toward radiotherapy has thus been formulated by them as follows:

	Diminution under Influence of Treatment
Neutrophile myelocytes	138.9
Eosinophile myelocytes	39.3
Basophilic myelocytes	26.2
Lymphocytes	22.8
Transitional	22.6
Polynuclear eosinophiles	22.3
Medium mononuclears	21.5
Polynuclear neutrophiles	16.2
Polynuclear basophiles	14.2
Large mononuclears	10.9

Elischer and Engel (13) find that the action on spleen and leukocytes continues long after treatment has been stopped.

Irradiation of the spleen alone often suffices to get effects elsewhere. Hence arose the idea that the effect of X-rays is to produce specific leukotoxins, which are diffusible throughout the body.

Aubertin and Beaujard (2) insist on the leukopenia being the result of degeneration of cells throughout the whole system, and in spite of

normal or increased function in blood-forming organs. It is a leukopenia due to hyperdestruction, not through insufficient formation of white cells.

It would appear that, as a result of the application of X-rays, leukocytic bodies develop. Even serum from animals treated with X-rays, when injected into another animal, causes leukopenia, as does also extract from irradiated spleen, whereas an extract of a normal spleen induces leukocytosis.

Capps and Smith (6) have recently published a most interesting work along these lines, which seemed to show that serum of leukemic patients who were improving under X-rays caused leukopenia when injected into animals, and when added to a hanging drop of leukocytes from another individual caused disintegration of cells, especially the mononuclears; and, further, when injected into leukemic patients who had not been subjected to treatment by the rays, induced a drop in the leukocytes. Such, too, were the conclusions of Harris after treating five cases, in four of them with palliative results.

This production of leukopenia has been noted by others; thus, for example, Luca (19) experimented with the serum of leukemic patients who had been successfully irradiated, with reduction of the leukocytes to normal. This serum was injected into other leukemic patients who had as yet not been subjected to X-ray treatment, and within two hours the white count was reduced, the maximum reduction being attained in twenty-four hours. The result, however, was temporary and later a notable increase occurred. On the basis of this observation the serum of irradiated animals was injected into animals in whom an experimental leukocytosis had been produced by turpentine, and here, too, a temporary fall in the white cells resulted, but after two days this gave place to a marked increase.

Uric Acid and Purin Bodies.—Linser and Sick (18) have shown that the X-rays cause increased uric acid and purin bodies in the urine of leukemic and normal subjects who were placed on a purin-free diet, and that the serum from healthy men treated with X-rays when injected into healthy individuals would cause increased uric acid and leukopenia—all of which favors the theory of the occurrence of what might be called Röntgenitic leukolysis.

Zuccola's (35) observations showed that, after treatment, uric acid is considerably increased, and that this may be used as a guide to treatment, for where, during radiotherapy for leukemia, a rapid diminution of uric acid occurs, the treatment should be stopped. Pseudoleukemias submitted to X-ray treatment have much less elimination of uric acid, probably because the white cell destruction is less marked.

Ambrozio (1) claims that he has produced diminution of leukocytosis, increased excretion of uric acid, and diminution in the size of the

spleen by injecting the irradiated blood serum of a healthy man into a leukemic patient.

Vas (30) studied more specially the elimination of nitrogen and ammonia. He confirms the current opinion which attributes the elimination of purin bodies to the destruction of the leukocytic nucleins, and he regards the increase of purin bases in the feces as a sign of grave import.

THERAPEUTIC EFFECTS.—The therapeutic effects of X-rays differ according to the type of leukemia.

In the myelogenous variety about 90 per cent. are favorably affected (Taussig, 29), though none were cured. As a rule the spleen diminishes in size, the myelocytes disappear, giving rise to what is known as the latent period; and patients improve subjectively often for months. However, the whole course of the disease is not greatly lengthened, and when relapses occur the irradiation seems less efficacious than when used in the earlier periods of the affection.

Stengel and Pancoast (28) found benefit in forty-six out of sixty-nine cases treated. They regarded the irradiation of the bone marrow of the whole skeleton (mapped in 8 districts and each district exposed in rotation) as being more efficacious than that of the spleen and glands. Less danger of toxic changes seemed to exist and symptoms were more easily relieved, for the seat of disease was directly attacked. The treatment requires longer time, but is more efficacious.

In some cases the treatment results in the development of an acute and rapidly fatal course, as instanced by Béclère and Béclère, in one of whose cases temporary benefit was followed by relapse with myeloblasts in the blood, characteristic of acute leukemia.

In acute lymphatic leukemia little satisfaction is obtained from radiotherapy.

Minerbi and Prampolini (21) treated one case, the white cells falling in a few days from 36,700 to 9,300, without noteworthy changes in the differential count, the lymphocytes predominating. But the red cells, on the other hand, fell too, the general condition became worse, and death occurred with hemorrhagic phenomena. During treatment there was a remarkable increase in the erythroblasts. This case was treated by the "rapid" method, which may account for the course and symptoms, for, as Von Decastello and Kienbock (31) have pointed out, this form of leukemia usually terminated by progressive leukemia and cachexia, the acute symptoms being usually lessened.

Failures come through insufficient irradiation, e. g., when the spleen alone is subjected to the rays.

Taussig (29) found little effect but advocated its trial in all cases.

THE TECHNIQUE AND MODE OF EMPLOYMENT OF X-RAYS.—Much variation in technique exists. As a rule hard tubes are employed; burns are best avoided when the minimum distance of the patient from the tube is

40 cm., though this needs close attention on the part of an expert to control during the exposures.

Best results are obtained from irradiation of the bones, and less commonly from the spleen, at frequent intervals, each exposure of short duration (five to ten minutes), and sometimes over the glands.

Dosage of the X-rays is difficult because of supposed individual susceptibilities, and much is yet to be learned to acquire greater accuracy.

Harris (14) used the X-rays three times weekly for three months, then five times weekly for two months, then at longer intervals. The current was taken from the coil, and a medium hard, or a medium, tube used; sometimes a medium soft was employed. The distance from the body was 25 to 30 cm., the amperage 7 to 10, with higher tubes. Voltage, 10 to 120. Time of exposure, seven to fifteen minutes. The regions exposed were the spleen (anterior and posterior), the thighs, epigastrium, and sternum.

Dangers of Roentgen Irradiation.—So long as the patient shows visible signs of improvement the treatment may be continued, and especially if the leukemia diminishes, and the appetite and general condition are good.

If, on the other hand, there develops a change for the worse, perhaps with fever, diarrhea, weakness, etc., and a rapid diminution of red and white cells and hemoglobin, the treatment should be stopped.

The longer the duration of the disease the more refractory will the patient be to beneficial effects, and relapses, too, respond but little to the irradiation.

Anemias are readily induced, and they are sometimes so acute as to be dangerous, developing a condition resembling pernicious anemia and acute leukemia.

Probably a leukocytic ferment is set loose by intense leukolysis, and this acts in thermic centers, causing "radiotherapeutic fever." At all events some poison is set loose from disintegrating cells and may cause fatal intoxication.

The anemia is a guide to the dosage, in one sense, for it gives a measure of leukolysis, and implies need for cessation of the X-ray treatment. Therefore the treatment should be controlled by regular blood counts.

Only experts should use X-rays, for ignorance of the technique may readily lead to disaster.

Radium.—Action on the Blood.—Aubertin and Delamarre (3), after a series of experiments on animals, concluded that the effect of radium was practically identical with that of X-rays, viz., an early, almost immediate, transient leukocytosis, followed by an essential leukopenia, which was relatively persistent. The changes could be detected sometimes at the end of one hour, and took place prior to the destruction of splenic tissue.

PSEUDOLEUKEMIA

(*Hodgkin's Disease*)

But a few words will suffice to deal with this condition from the point of view of therapeutics, inasmuch as the treatment is, in every particular, similar to that of leukemia itself. Indeed, the generally accepted view now seems to be that pseudoleukemia should be defined as an *aleukemic leukemia.* The tendency seems to be rather to regard it as a symptom, not as a disease entity, and to include it in the group of diseases which Trousseau, years ago, described as *adénie,* and which have lately been subdivided mainly into three groups, the one, simple *lymph-adénie,* which includes Hodgkin's disease, leukemia and similar nonmalignant growths of the hemopoietic cell constituent; secondly, the sarcomatous form in which malignant growths characterize the malady; and, thirdly, the granulomatous type in which the nature of the glandular involvement is that of a granulation tissue tumor.

As in leukemia, so in pseudoleukemia, the treatment consists mainly of the use of arsenic (and this is of very limited benefit), and, further, treatment by the X-rays, which likewise is merely palliative, relieving symptoms subjective and objective, but never entirely curing the disease.

For the X-ray treatment the reader is referred to the article on leukemia.

As regards the arsenical cure it is worthy of note that some of the newer preparations of Ehrlich, notably arsazetin, have been found to be of great benefit—and in one case, described by Naegeli, there seem to be evidences of a complete cure. The drug is given either hypodermically or by mouth.

The subcutaneous injections are given as follows: 0.6 gm. (9 grains) subcutaneously every two days in succession, omitting the treatment for five or six days, and then repeating for two days again.

By mouth one may give 0.05 gm. (¾ grain) four times daily, watching carefully for any of the ordinary signs of evil from large doses of arsenic.

Arsazetin seems safer and better than the newer arsenical preparations.

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CHAPTER III

HEMORRHAGIC DISEASES

C. F. Martin

PURPURAS

By purpura is meant a disorder of the system by which spontaneous hemorrhages arise in the skin and from the mucous membranes.

The original disease, described in 1775 by Werlhof, and known as morbus maculosus, was a clinical entity, and since then many subdivisions of purpura have been described.

Every classification hitherto submitted has been unsatisfactory for one reason or another, more especially as the etiology of the disease is by no means clear. Even the morbid anatomy is ill understood, though it is generally conceded that thromboses and lesions of the lining of the blood vessels are the main factors in the production of the purpura.

There are various forms of so-called idiopathic purpura, some mild, others severe, and in these the hemorrhages arise without any known cause and without any other important accompanying symptoms. The mild forms are termed simple purpura; the more severe, purpura hæmorrhagica. With others, again, joint pains develop, and to these the name purpura rheumatica has been given, otherwise called peliosis rheumatica (Schönlein), while in still another set of symptoms the purpura arises with prodromata, such as digestive disturbances, joint pains, and marked general malaise (Henoch).

These different types of purpura all vary in degree, in extent, in locality, and intensity, much more than they do in their real nature.

The secondary purpuras arise in many infectious diseases (typhus, typhoid, cerebrospinal fever, general sepsis, the exanthems, lues, cholera, etc.), likewise after intoxications (snake bite, blood poisons, etc.), in cachexia, in nervous conditions, and, lastly, sometimes as a result of mechanical causes.

The Clinical Picture.—The disease may be mild or severe, with or without prodromal symptoms. Hemorrhages appear in the skin and may vary in size from minute petechiæ to large effusions under the deeper

layers of the skin. These purpuric spots appear on the trunk or on the extremities, preferring the extensor surfaces. Their color varies and they go through all stages from a brown-red color to a blue, green, yellow, until finally the normal color of the skin returns.

There may be one or more crops in the severer forms of the disease, the spots appearing not only superficially but deep down in the subcutaneous tissue and in the muscles.

The mucous membranes may also bleed, and sometimes hemorrhages occur from nearly all the mucous surfaces, and the disease may run a fatal course.

Large hemorrhages may thus occur from the bladder, or the kidneys, from the intestines, from the stomach, and from the lungs, imperiling the life of the patient from sheer loss of blood.

Sometimes wheals occur, the so-called purpura urticans.

Treatment

Where possible the cause should be found and treated. Prophylaxis is useless to attempt except in so far as relapses are known to occur, and everything possible should be done to avoid this event. Except in the very mild cases, rest in bed is essential. The patients should not be allowed to move in bed, and the bedding should be made as smooth and unruffled as possible, for anything tending to cause injury to the skin is liable to induce hemorrhages in that spot. The air of the room should be cool, and the patient should be kept quiet. The diet should be of the ordinary plain, nourishing variety, milk being especially useful, perhaps on account of its calcium content. Stimulants should be avoided.

Serum.—By far the most useful adjunct in the treatment of purpura is fresh blood serum, and next in importance comes organotherapy.

This subject is fully dealt with in connection with the chapter on hemophilia, to which the reader is referred.

The satisfactory results attending the use of the serum treatment are particularly well described by Weil. Cases illustrating three types may be mentioned as a casuistic contribution.

Acute Purpura.—The case of an acute purpura in a woman whose symptoms were those of febrile polyarthritis, gastric disturbances, spongy bleeding gums, and epistaxis, and later on subconjunctival and cutaneous hemorrhages and marked hematuria.

The condition lasted one week, and the blood, on examination, showed marked diminution in coagulability. 15 c. c. of fresh bovine serum were given intravenously with marked improvement next day, and the disappearance of the fever, the joint pains, and the hematuria. One week later there was slight recurrence of all the symptoms, but in five days the pa-

tient's condition became normal, and she left the hospital with no signs of illness other than slight diminution of the blood coagulation-time.

Posttyphoidal Purpura Hæmorrhagica.—This case occurred in a man with fever, ecchymoses, melena, hæmorrhagic gingivitis, and hematuria, lasting three days. 30 c. c. of antidiphtheritic serum were administered hypodermically, and within two days all symptoms had disappeared.

Chronic Purpura.—A man, aged 42, an alcoholic, showing enlargement of the liver, joint pains, and purpura of the arms and legs for three months, had likewise continuous hematuria. It was also noted that all cuts remained bleeding for an abnormally long time. With care he improved and gained twenty-five pounds, but the purpuric conditions persisted. Bovine serum was given intravenously, and repeated in a week, when all the symptoms disappeared, and eight months later he was still well. Nevertheless, another 15 c. c. of serum was administered, and when seen eight months later no further purpura had occurred, even though he had resumed his alcoholic habits.

HEMORRHAGIC DISEASES OF THE NEW-BORN

In this disease the bleeding may occur from the navel, from the alimentary canal, mouth, stomach, or rectum, or from the nose, bladder, etc. It is usually accompanied by jaundice.

The causes are variable—injury at birth, sepsis, and lues are chiefly responsible for the onset of the condition.

Various forms are described: one, epidemic hemoglobinuria (Winckel's Disease); another, Buhl's Disease; and a third, morbus maculosus neonatorum.

The treatment of these conditions is similar in all cases, the object being to treat the cause where possible, sepsis or lues, and to control the hemorrhages as in hemophilia.

HEMOPHILIA

Hemophilia may be defined as a diathesis, hereditary or otherwise, characterized by a predisposition to hemorrhages which are either induced or spontaneous. Hemorrhage induced by the slightest wound is the chief factor, while the spontaneous hemorrhages are of secondary importance, and are often indeed hard to differentiate from certain forms of chronic purpura. Clinically three features are of importance: (1) Hemorrhages occurring after a cut, fall, pinch, or other injury, sometimes with an endless flux of blood that endangers life; (2) spontaneous hemorrhages from the skin, mucous membrane, viscera, and muscles; and (3) hemorrhagic swellings over and about the joints.

According to some authorities two types of hemophilia are described: (1) Familial, which is hereditary, transmitted by women, and occurring chiefly in males. This form occurs from earliest infancy, and the victims die from hemorrhage usually in early adult life, rarely reaching advanced age. The blood in this variety is abnormal in several ways and is thought to contain an anticoagulative body; (2) the second type, the isolated or sporadic, is an attenuated form and appears to be accidental and without hereditary predisposition. The tendency is revealed, however, in the slightest wound, but the bleeding is usually much less serious. In this variety it is said that the blood, which seems normal, has no coagulative ferment.

Analogous to this second variety are the hemophilic states, so called, which exist in hepatic, renal, and certain infective and toxic diseases.

Etiology.—The cause is still shrouded in mystery, the one fact remaining, namely, the incoagulability of the blood or its delayed coagulation. Whether or not, however, this is due to insufficiency of the thrombokinase secreted by the vessel wall, as Sahli (7) thinks, or whether, again, it be an imperfection of the thrombozyme, through insufficiency of the wall and leukocytes (Nolf and Herry, 43), is not determined. P. E. Weil (8) regarded the mechanism of hemophilia as being due, in the sporadic cases, to an insufficiency of plasmase secreted by the leukocytes, while, in the hereditary form, there was sufficiency of the plasmase, but the presence of anticoagulants. Labbé sums up the matter by saying that incoagulability alone is not the cause, that there exist a friability and some generalized loss of function of the vessel wall, some chemical process occurring which prevents coagulation.

Treatment may be described as general and local.

General Treatment

Diet

Diet is scarcely of importance, though one recommends victims of this disease to avoid substances that raise arterial tension, such, for example, as alcohol, tea and spices. Milk is recommended because of its calcium content.

Medicinal Treatment

It is of the utmost importance that time should not be wasted with drugs that are known to be useless, for many a life is lost in that way. The agents used as general hemostatics act in two ways: (1) Coagulants of the blood; and (2) constrictors of the vessels.

Coagulants of the Blood.—These use the absorptive power of colloids of the blood to modify their molecular state and obtain direct coagulation.

Two classes exist, the mineral ions, as, for example, calcium chlorid, sodium sulphate, Rabel water, iron perchlorid, saline solution, and artificial sera; and substances which form complex insoluble colloids, e. g., gelatin, serum, organic extracts, and peptone.

Mineral Ions.—Of the mineral ions the calcium salts are used internally, or locally, or as an irrigation. Arthus was among the first to show the important part played by calcium salts, especially calcium chlorid, in blood coagulation. Wright (11), Carnot, and others used it for hemorrhage, and it was found that calcium chlorid in 1 per cent. solution, applied locally to a wound, would stop the bleeding. Wright, too, showed that the same effect was produced when given by the mouth, the action taking place in a few hours after the first dose. 2.0 to 4.0, or even 8.0 gms. are given daily, well diluted. The following mixture may be of use:

℞			
	Calcii chloridi	12.0 gm.	ʒiii
	Aquæ destillatæ	120.0 gm.	ʒiv
	Syrup aurantii	120.0 gm.	ʒiv

One drachm of this mixture contains 1.0 gm. calcium chlorid, and this should be given three times daily. The same mixture has been used with success in hemophilics as a preventive when operations were necessary.

Many writers have cited the successful employment of this means of hemostasis both for preventive and curative purposes. Among others may be mentioned Clifford Perry, Manuel Simpson, Bryant, Fussell, and Wallis. However, in spite of these successful cases one may say that calcium does not "cure" hemophilia, and the treatment must be indefinitely continued. The results, too, are inconstant and temporary. While, in some of the cases cited where the coagulability was diminished, the calcium chlorid may act *inversely,* and coagulation will diminish if the injection of the salt be continued for three or four days. For this reason one must intermit the treatment every third day. Hypercalcification of the blood leads to diminished coagulability just as much as does decalcification. Boggs, Wright, and Paramore used calcium lactate in similar doses, finding it better tolerated and more efficacious. The English lay great stress on the efficacy of the calcium salts, while the Germans, as a class, are very dubious as to its benefits. Sahli and Nolf, for example, showed that it is absolutely useless in hemophilia, and, among the French authorities, Labbé proved its inefficacy in cases of purpura, for which it was used, and that the coagulation was unaffected. The work of Addis leads one to believe that the injection of calcium lactate in medicinal doses

increases the quantity of calcium in the blood, but in proportions too small to increase in any appreciable way the time of coagulation.

Of the *artificial sera,* the injection of calcium chlorid solution and isotonic sea water has "cured" isolated cases, but whether this was a coincidence or an actual cure is not easy to say. Pelissard and Bonharnou record a case in a child a few days old, suffering from hemophilia neonatorum, thus cured after other styptics had failed, where, after 10 c. c. of sea water was injected, the hemorrhage ceased in two and one-half hours. Van der Velden employed in these cases:

Sodium chlorid, 5.0 gms.
Sodium bromid, 3.0 gms.

given daily by the mouth.

However, *complex mineralization* was found better than normal saline and recommended by Fleig, because the molecular concentration more nearly approximated to normal blood plasma and was thought, therefore, to be more effectual in increasing the coagulability of the blood and vasomotor constriction. The following prescription was used:

℞		
	Sodii chlor.	6.0 to 8.0 gms.
	Potass. chlorid.	0.2 " 0.5 "
	Calc. chlorid.	0.5 " 2.0 "
	Magn. sulph.	0.2 " 0.5 "
	Sodii bicarb.	0.5 " 1.5 "
	Glycerophosphate of sodium	0.7 " 2.0 "
	Glucose	1.0 " 5.0 "
	Aquæ dist. ad. 1,000.	

This should be oxygenated to saturation.

Reverdin, on the other hand, recommended 0.10 gm. sodium sulphate by mouth every hour.

Substances Which Form Complex Insoluble Colloids.—*Gelatin.*—This was first administered as a coagulant by Dastre and Floresco. The gelatin was mixed with blood *in vitro* and the experiment showed that coagulation was favored, soft clots, such as are produced in normal blood, being formed. The gelatin is used in four different ways:

1. Locally, over a bleeding wound.
2. By mouth, 200 to 250 c. c. per day. It is doubtful if this method is useful, because the gelatin is changed in the alimentary canal to a nonhemostatic form.
3. Subcutaneously, 1 to 5 c. c. are mixed with sodium chlorid 0.7, and distilled water 100; this is sterilized by heat and used for injection.

20 to 100 c. c. are daily employed. Rénard succeeded with rabbits by subcutaneous injection and found, in eleven animals experimented on, that the coagulability was distinctly increased if large enough doses were used, i. e., 0.2 gm. per kilo body weight. He found that the gelatin increased the fibrin ferment. Toussaint, Heymann, and also Babinsky obtained success by this method, though Carnot found his results uncertain; Labbé (2) and Froin found no hemostatic action whatsoever in various forms of hemorrhage (typhoid, tuberculosis, renal, and purpura). They studied the coagulation of the blood before and after the use of the gelatin and found no change. They likewise experimented on healthy rabbits, the results being again negative. Add to this the experiments of Gley and Camus, who found that the gelatin injected subcutaneously was, after all, not even absorbed, and, finally, the experiments of Gley and Richaud, who attributed any coagulating properties, if they existed, not to the gelatin but to the salts contained in it, and the value of the treatment seems to lose much of its certainty. Nolf and Herry attributed any action to the foreign albumin, which excites the formation of thrombozyme secreted by the vascular endothelium and the leukocytes. It would seem, then, that *gelatin injections given subcutaneously are of little value,* because uncertain, slowly absorbed, painful, and liable to cause fever and sometimes even tetanus.

4. Intravenous. Salomoni found the injection of gelatin into the veins of great success where it is borne in large quantities, but without producing coagula in the vessels. It disappears slowly. Blood thus injected coagulates more rapidly than normal blood, but the clot is soft, not permanent, and retractile. He, too, found the subcutaneous method unsatisfactory, because gelatin is absorbed very slowly and then only by the lymphatics.

Serum.—Serum therapy differs from treatment by transfusion or from injection by defibrinated blood. The objects are preventive, curative, and stimulating to the marrow. Among the first to use serum therapy for hemophilia was Bienwald, who employed it for intractable hemorrhage from the scalp in 1897, using the grandmother's blood locally for the child. A cure resulted. Perthes followed in 1905. Fry, in 1898, successfully treated three cases of hereditary hemophilia by subcutaneous injections of horse serum, using 90 to 300 c. c. at an injection. Discos and Giroud (20) stopped six cases of hemorrhage by using an antidiphtheritic serum, and Welch, in 12 cases of hemophilia neonatorum, got successful results when previously 17 out of 18 cases treated with calcium, gelatin, adrenalin, etc., had died. 10 c. c. of normal human blood serum was used three times a day for the first day, and once on each subsequent day. The same success was attained by Bigelow in three cases of hemophilia neonatorum; 5 c. c. of fresh rabbit serum was given subcutaneously with immediate arrest of the hemorrhage.

Weil has perhaps done the best work in connection with this form of treatment. In one patient with severe attacks of spontaneous bleeding since infancy, with intervals between the hemorrhages of not more than three months, treatment during an attack of hematuria resulted in immediate cessation of spontaneous bleeding, while even after cuts into the skin no excessive bleeding occurred. As the intervals between the injections lengthened, however, recurrences took place, but the coagulation time was shortened from four and one-half hours to forty minutes. The same course of events took place with other hemophilics in the same family.

Weil recognizes two types, the one, sporadic hemophilia—that is, accidental with no hereditary tendency, where the blood has no coagulative ferment. In these cases he found that the injection of fresh serum intravenously completely cures the hemorrhagic tendency, and coagulation occurs in the normal time, five minutes, instead of one and one-quarter hours or longer. One can do operations after the injection, such as the removal of teeth, incision for empyema, etc., and this salutatory condition persists for five weeks, after which the serum must be renewed and will produce the same good results. In the other, the hereditary, form the treatment is less effectual, coagulation is merely somewhat accelerated, and the hemorrhagic tendency is reduced. The results, however, are inconstant and merely temporary, for the serum is eliminated in four or five weeks, as is shown by the precipitin test (Marfan and Lemair).

The Kind of Serum to Be Used.—The object of this treatment is to supply to the blood the element that was lacking to cause coagulation. One must therefore use fresh serum, that is, less than two weeks old. Human serum, or that from the horse or rabbit, is best. Leary (24) advises rabbit serum. He aspirates under asepsis, from the left ventricle of the heart, and recommends this for subcutaneous use. One may also use antidiphtheritic serum as being equally efficacious, but beef serum is bad, producing, as it often does, fever, cyanosis, and other signs perhaps attributable to anaphylaxis.

Mode of Administration.—Intravenous.—This is the best method, because most rapid and efficacious. 10 to 20 c. c. of the serum are injected and repeated in four weeks. Some authorities recommend that intravenous injections should be limited only to extreme cases, and then that the human serum alone should be employed. Twenty cases of Leary's so treated were most successful, and toxic symptoms (urticaria) were present only in one case; in most instances only one injection was required.

The Subcutaneous Method.—This is less rapid but simpler. 20 to 40 c. c. are used. Walters and Eaton used horse serum and diphtheria serum every two months hypodermically in doses of 20 c. c. with good results.

Locally.—The local application of serum by plugging, by compress, etc., may be combined usefully with injections and often assists the arrest of hemorrhage.

Transfusion for Hemophilia.—Transfusion is chiefly of use for the posthemorrhagic anemias. The method is not a new one, as in 1874 Boisnot injected some defibrinated blood into the vein of a boy with uncontrollable hemorrhage and recovery was complete. Schelbe employed it in an infant two years old for posthemorrhagic anemia, injecting 15 c. c. subcutaneously of defibrinated blood of the adult. Five injections were given in six weeks, with general amelioration. Schelbe recorded this as a case of cure, because of the specific substance of the serum which acts on hemopoiesis. Hahn also used it for hemophilia and cured cases by the modified Crile operation (arteriovenous anastomosis from the radial artery of the father to the femoral vein of the child, the blood flowing for fifteen minutes).

Organic Extracts (*Thyroid, Ovary, Liver, Etc.*).—These agents doubtless belong rather to the vasoconstrictors and their action is merely transient. *Thyroid* was used by Dejage, by Combemale, and Gaudier with success, and spontaneous hemorrhages, which other methods had failed to prevent, were stopped. But these were in cases of purpura, not hemophilias. Scheffler claims to have stopped epistaxis in morbus maculosis Werlhofii by capsules of thyroid extract, and Royd Jones likewise. Faller speaks of cure of hereditary hemophilia in an infant which was cachectic from cutaneous and renal hemorrhages coming on after a second dose of extract of thyroid gland. *Ovarian* extract has been successfully tried by Lavadier in obstetrics, and *hepatic* extract has been shown by Gilbert and Carnot, by Foa and Pellacani, and also by Heidenhain to accelerate coagulation *in vitro*. All organic extracts have the same properties (Wooldridge Contajean), that is, they sometimes cause coagulation, sometimes anti-coagulation; those most active are derived from the spleen, kidney, and pancreas. While useful in hemorrhagic states other than hemophilia, organotherapy may be said to be useless in the hereditary malady.

Peptones.—Nolf injected propeptone (Witte's) for hemophilia and found that rapid injection intravenously made the blood incoagulable, but when slowly inserted, or when used subcutaneously, it provoked an abundant secretion of thrombozymes and increased coagulability. The following is used:

Peptone (Witte), 5.
Solution Sodii chlor., ½ per cent., 100.

Sterilize by heat for 15 minutes at 120° and inject subcutaneously 10 to 20 c. c. This can be often repeated without any danger of anaphylaxis as a rule, though sometimes rather severe symptoms supervene, with the on-

set of fever, chills, nausea, headache, and general erythema, especially when the larger doses are given. Nolf and Herry regard this treatment as better than the serum method, and Nobecourt and Tixier cured a case of hereditary hemophilia by this means where the serum treatment had failed. They used the subcutaneous method, injecting 38 c. c. of a 5 per cent. solution, giving seven injections in the course of two and one-half months. Their experience, therefore, leads them to believe that rectal injections are quite as good as those which are subcutaneous.

Vasoconstrictors.—Ergot, rathania, adrenalin, pituitary extract, tannin, stypticine, hydrastis canadensis, hamamelis virginica.

Ergot of Rye.—The powder is used, 2.0 to 6.0 gm. daily, in cachets, or by infusion. Or the extract of ergotin is used 1.0 to 4.0 gm. in pills or liquid. For hypodermic use Ergotin Yvon is recommended, 1 to 4 c. c. Ergotinin, that is, the alkaloidal extract of ergot (Tanret), is also used hypodermically, ½ to 2 mg. daily. By itself, ergot is useless, though it helps perhaps the action of other coagulants.

Rathania.—This is even less useful than is the ergot; it is liquid, and the extract is used in doses of 1.0 to 5.0 gm. daily.

Adrenalin.—This is used sometimes locally for a bleeding wound, as, for example, after adenoid vegetations or where the gums are bleeding. Sahli thinks that small hemorrhages result from its use, and maintains that the subcutaneous injections are dangerous. Whether or not this is an exaggeration it is difficult to say, but experience teaches that the indiscriminate use of adrenalin is both dangerous and productive of very serious results. It is certainly contraindicated in chronic nephritis and aortic disease. In purpuras Labbé succeeded with doses of 0.0005 gm. subcutaneously, as did also Renon and Fenwick.

Local Treatment

Local treatment in hemophilia is, of course, useful mainly for wounds. Compression and ligature of vessels, however, seem to be useless. The compresses of Anadon and Pengewar are useless for hemophilia, as are also antipyrin, stypticine, and perchlorid of iron, which, although useful in hemorrhages of healthy people, are utterly ineffectual in hemophilia. Calcium chlorid and gelatin likewise are of very little use when applied locally in this condition.

The best general treatment, namely, the application of serum or organic extracts, is also the best local treatment. Fresh serum saturating the lint and applied to a wound is all-powerful, and may also be used as a plug for the nostrils or for bleeding teeth. Serum has likewise been used with excellent results as a dry powder. Nolf prefers the organic extracts of the lymphoid organs, especially the spleen, the glands, and the thymus, and uses these in the fresh state pulverized. The organ is first

triturated with a little fine sand (washed and sterilized); this is boiled and sterilized and salt solution added (0.9 per cent. sodium chlorid and 0.5 per 1,000 calcium chlorid). Two pounds of the solution are used for one pound of the organ. The liquid is applied sterilized, soaked with cotton wool and used for a few minutes, or hours, as the occasion requires.

The Treatment of the Hereditary Form

Two considerations must be taken into account. First, the treatment from the onset of the first symptom, and, secondly, the treatment during the remissions.

Victims of this disease must be treated soon, and the treatment continued for a long period. One should start either with serum or with peptone, and the agent used should be repeated in four weeks. No anaphylaxis results, and it is well in every case to follow the practice of Netter, who gives at the same time 2 to 4 gms. daily of calcium chlorid. It is well to examine for the coagulation time systematically, in order to direct the treatment properly. This applies equally for the serum treatment and for the peptone treatment.

In hemophilics in successive stages, with remissions of variable duration, one need not continue the serum treatment during the remissions, but recommence at the earliest sign of renewed symptoms; as, for example, the outbreak of petechiæ. Excellent results are shown in numberless cases that have already been reported. Thus, for example, one of Weil's cases, who bled for twelve hours whenever he cut himself shaving, bled for only two minutes after a serum injection; and the same patient, who was subject to hemarthrosis once a month, was freed from symptoms for eleven months. In another instance the hematuria, which had lasted one month, definitely stopped on the third day after the injection.

Local treatment by serum is also given; and 1 c. c. of the defibrinated blood of the rabbit injected locally will stop oozing from the gums which may have lasted previously for weeks.

Sporadic Cases

This is a less severe illness and liable to subside as life goes on, so that, after recoveries from attacks, there is less need of interval treatment. Otherwise the therapeutics are precisely the same as in the hereditary types.

In hemophilic states of secondary or associated types, as, for example, in pernicious anemia, etc., the condition is analogous to that in true hemophilia, though not identical, that is, there are hemorrhage, plasmatic coagulation, retarded coagulation, absence of clot retraction, and absence of exu-

dation of serum. All these anomalies decrease *in vitro* when small amounts of fresh serum or calcium chlorid are added. The same treatment is given as in the other hemophilias. That is to say, for example, if in pernicious anemia one gets petechiæ or hemorrhages with diminished coagulability one should add to the regular treatment of the underlying condition the serum or peptone treatment. Vasoconstrictors, however, should only be used if the hemorrhage is very severe. The same refers to the purpuras, though Labbé did not have the same success here with the serum treatment as did Weil. The coagulability was improved, but the hemorrhages continued as though the serum acted on the hemophilic state without acting on the purpuric. Nobecourt and Tixier found peptones very useful in purpura as well as in hemorrhages from the liver, the kidneys, or those occurring in infective diseases and toxic states.

During the remissions organotherapy should be used first, for two weeks every two months. By this is meant the injection of hepatic or splenic extract, which may help to maintain a reasonable degree of coagulability and keep off a return of accidents.

Vasoconstrictors should be given alternating with opotherapy, that is, for two weeks every two months, to maintain the tonicity of the vascular muscles. Thus, for example:

℞ Tr. hamamelis virginica, 1.0 to 4.0 gm. daily.
Or fluid extract virginica, 1.0 to 20.0 gm.
Or dry extract virginica, 0.10 to 0.20 gm.

daily in pills. Or, again,

Hydrastis canadensis as the tincture, 20.0 to 30.0 c. c.
Or fluid extract canadensis, 1.0 to 4.0 c. c.
Or hydrastin, 0.02 to 0.03 gm. in pills.

This is of use chiefly in uterine hemorrhages.

Ergotin, 0.5 to 1.0 gm., may be also used daily in pills.

Strychnin in various forms has also been recommended.

Nux vomica as a powder, 0.05 to 0.1 gm. daily, or the tincture, 15 to 20 drops daily, or, again,

Sulphate of strychnin, 1 to 2 mgs. in pills, may be recommended.

During all this time the diet should be nourishing in order to regenerate the red cells and hemoglobin, and the yolks of eggs and rare meats are especially efficacious. Vegetarian diet is not to be recommended.

Treatment of Accidents

Hemorrhages.—In addition to general dietetic treatment, one is often called upon to use special therapeutic agents for the accidents in this dis-

ease. In the first place, prophylactically speaking, one should avoid carefully all chances of injury when epistaxis tends to occur; the part should be plugged at once with tampons soaked in serum or extract of spleen, and after teeth extraction an alveolar hemorrhage should be treated locally by plugging in a similar fashion, a ball of cotton being soaked in the serum and gripped between the teeth for half an hour. Superficial oozing of the skin should be treated with compresses of serum or splenic extract. For the intestinal and gastric hemorrhages the patient should be made to swallow fresh serum or powdered liver or spleen extract diluted in artificial serum. Or one may try gelatin serum, or a 0.2 per cent. solution of calcium chlorid. Renal and pulmonary hemorrhages are not accessible to local treatment and require rest, coagulants, and vasoconstrictors.

If all these fail one can then resort to the hypodermic injection of adrenalin, ½ to 1 mg. at a dose. Curiously enough, some authorities advise the use of vasodilators in these conditions, such as amyl nitrate inhalations, but the practice has been shown to be dangerous. For the posthemorrhagic collapse, caffein, oil of camphor, ether, strychnin, and strophanthus may all be used.

Arthropathies.—These are among the most distressing symptoms, and, apart from the general treatment as given above, the joint should be immobilized and covered over with protecting bandages and soothing lotions. For the pain, salicylates or morphin should be used. Later on, the joint should be fixed in order to avoid the recurrence of hemorrhages.

Anemias.—These should be treated by a subcutaneous saline at the time of acute hemorrhage in order to restore the mass of fluid; and arsenical preparations may be given with the hope of stimulating the bone marrow functions, or iron may be given with the hope of restoring the hemoglobin.

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CHAPTER IV

SCURVY

(*Scorbutus*)

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This is an epidemic or endemic disease associated mainly with the ingestion of unsuitable food.

The etiology, while in a general way clear, inasmuch as the disease is definitely associated with food deficiency, is, nevertheless, unsatisfactory, for the particular ingredients lacking in the food of the scorbutic patient are not defined. In some cases the potassium salts seem to be responsible, in other cases, again, lack of fats in the food seems to induce the scurvy, while in a third variety of cases, again, neither of these factors are present, and yet the scurvy will appear.

TREATMENT

Prophylaxis.—The prevention of this disease is particularly easy, for it is well known that where fresh foods are taken scurvy does not occur.

This was well shown by Nansen, whose three years in the Arctic regions demonstrated it in a most satisfactory manner.

Modern methods of preserving foods make the variety of antiscorbutic supplies larger. Fresh meats, for example, and especially scraped raw meat juice, are particularly useful where scurvy threatens. Fresh fruit, especially lemons, oranges, grapes, melons, and gooseberries, are the best antidotes for this disease; and among the vegetables, onions, cabbages, potatoes, spinach, and lettuce are most efficacious. Extracts of meat are of use, perhaps, on account of the lactates. The Russians employ fresh milk, while others praise the French and Italian wines as being antiscorbutic, as is also the infusion of fresh malt. Fats and butter are likewise essentials to prevent the onset of scurvy.

Treatment.—Isolation has been recommended because of the possible infectious nature of the disease, but a study of the various epidemics would not lead one to think that isolation was imperative, it being rather a meta-

bolic than an infectious malady. A good, airy dwelling is important for the patient, who should live as much as possible in the open air and under the influence of the sun.

Daily baths should be assiduously given, and it is found of benefit to sponge over with vinegar.

There is no specific medication, though various drugs have been recommended, such, for example, as arsenic, iron, calcium lactate, phosphorus, chlorate and citrate of potash, sodium lactate, and so on. Some recommend saccharated wheat phosphates, that is the organic phosphates and cerealin (the ferment of bran), combined with milk sugar, this being especially recommended for weak and sickly children; or, where digestion is impaired, one-half to one dram of this is given as sugar in the food.

Diet.—Sometimes the digestion is much impaired and the patients can take but little food. In these cases albumin water, to which a little lemon juice is added, may be all that can be retained for some time; or one may try the efficacy of grape juice. A gradual increase from this to a less and less restricted diet, always considering the essentials of fresh fruits and fruit juices, as well as meat extracts, will favor more rapid convalescence.

Where the digestion is unimpaired, as indeed it often is, one may give a mixed diet in which fresh fruits, vegetables, and meats predominate, and one may add to this, lemonade, wine, beer, or fruit juices.

The Care of the Mouth.—Too much insistence cannot be laid upon the assiduous care of the gums and oral cavity generally. Mere washing and mere gargles are by no means sufficiently efficacious. One must swab frequently with a suitable appliance, avoiding all strong antiseptics, which may do more harm than good. Potassium chlorate is the favorite remedy used (in strength of 1:100) or tannin solution (2 per cent.), or the gums may be painted with a mixture of:

℞ Tincturæ myrrhæ,
Tincturæ ratanhiæ,
Tincturæ gallarum, āā 15.00 gm.

as recommended in the Clinic of Neusser.

More than this, all defective teeth should be removed and all cavities carefully brushed, first with a soft brush, later with one that is stiffer.

Any ulcers that are found may be touched with copper sulphate; whereas, if there be painful bloody infiltrations of the deeper soft tissues, chloroform oil may be rubbed in.

Wherever hemorrhages occur to any extent on the external surfaces serum should be used, as in the case of hemophilia and purpura already described.

Internal medication of any kind seems more or less unsatisfactory. The following prescription has been recommended as a vasoconstrictor:

℞ Ergotin puri ..... 2.0 gm.
Aquæ destillatæ ..... 150.0 gm.
Aquæ laurocerasi ..... 5.0 gm.
Syrupi ..... 20.0 gm.
Sig. One tablespoonful every two hours.

Calcium lactate, however, is a more universal favorite with most physicians.

Constipation is a not uncommon symptom and is best treated by enemata or the mildest of cathartics. Any drastic purgation is dangerous because of the tendency to hemorrhage.

INFANTILE SCURVY

This disease, like the adult type, is one of disturbed metabolism due to defective alimentation.

Absence of fresh milk or fresh foods of any kinds is the main factor. The disease seems to be rare in breast-fed children, except where the mother is ill-nourished or where epidemics occur. It is likewise more common in the better classes, where artificial foods are more used because of convenience and because of their expense. The use of predigested foods and peptonized milks, as well as the so-called humanized milk, is a frequent precursor of the malady. Milk at best, even when fresh, is a feeble antiscorbutic, as, indeed, is also fresh meat juice, and both must be used in large quantities to have any effect.

Treatment

Prophylaxis consists of the avoidance of patent foods as much as possible, as well as in the avoidance of milk that has been sterilized too long. The cure depends on the administration of fresh foods with antiscorbutic properties. Fresh milk should be raised to boiling point only. Vegetable juices are efficacious, especially potato. The potatoes may be steamed, rubbed through a sieve, and the powder beaten up with boiled milk until of the consistence of thin cream; one or two teaspoonfuls of this may be added to the milk of each bottle. Vegetable juices may also be added to the broths, or one may use fruit juices pure, as in the adult cases.

Affected limbs should be wrapped up, put at rest and, if need be, treated with soothing applications.

Drugs are of little use, though sodium lactate in 5-grain doses has been recommended, and during convalescence tonics may be beneficial.

CHAPTER V

BLOOD DISEASES WITH CYANOSIS

C. F. Martin

POLYCYTHEMIA WITH SPLENOMEGALY

Synonyms.—Polycythæmia rubra megalosplenica; Vaquez' Disease; primary myelogenous polycythæmia megalosplenica; true idiopathic polycythemia.

A primary disease of the blood-forming organs, in which a hyperplasia and increased functioning of the bone marrow occur, leading to marked increase in the number of red corpuscles, and frequently to secondary enlargement of the spleen. Characterized clinically by cyanosis, splenic hypertrophy developing progressively and insidiously, and functional troubles dependent on a peripheral or visceral blood plethora, of which vertigo and intermittent albuminuria are the most important. To be distinguished on the one hand from the physiological polycythemias occurring in high altitudes and sea climates, in the newly born, etc., and the secondary pathological polycythemias, such as are present in congenital heart disease, in poisoning by phosphorus, benzine, etc., or in conditions of lessened blood plasma through marked loss of fluids such as occurs in profuse vomiting, diarrhea, or sweating, or in diabetes insipidus.

Historical Note.—This condition was first described by Vaquez (7) in 1892, and then by Rendu and Widal in 1895. Since then some fifty cases have been recorded. In 1903 Osler (2) recorded four new cases in addition to six referred to by him as already reported, and pronounced upon it as a "new clinical entity." Turk (6) followed with seven personal observations added to the fourteen which he was able to collect from the literature. In 1904 Preis (4) reported a typical case, and remarked that the first cases described were not by Osler, Turk, and Rosengart, but by Vaquez in 1892. The subject is brought up to date in a careful review by Senator (5) in 1911.

Symptomatology.—Weakness, vertigo, headache, and other signs of cerebral congestion usually coexist with a chronic cyanosis moderate in degree, which is of long standing and development. The abdomen is en-

larged, corresponding to the degree of splenomegaly, and there may be a history of hemorrhages from the internal organs, while the skin and mucous membranes show a bluish red mottling.

Tachycardia is frequent. The blood changes are characteristic, the erythrocytes being increased to eight, ten, or even thirteen million, and the hemoglobin rising in some cases to 200 per cent. A moderate leukocytosis, ten to twenty thousand, is the rule. The total volume of the blood is increased and its oxygen content, as well as the respiratory interchange of gases, is much raised. Blood pressure is usually not elevated, nor is there cardiac hypertrophy as a rule. The urine may be normal, or may contain urobilin.

Pathogenesis.—Senator ably discusses the various explanations of the polycythemia which have been given. He dismisses the theory of its origin from a lessened destruction of the erythrocytes, by the hyperplasia of bone marrow, which is always, and the increased excretion of iron in the urine, which is frequently, present. Against the possibility of its being a compensatory process in insufficient oxygenation, he points out that the oxygen content of the blood is abnormally high, and the heart's action usually increased. Thus it can only be due to a *primary increased functioning of the bone marrow leading to increased hemopoiesis.* That the spleen does not play a leading part is proved by the fact that splenectomy does not cure the polycythemia, which has been known to set in *after* splenectomy.

Treatment

The treatment is unsatisfactory, and but little can be said of it, for almost no positive results have been obtained; the cases usually progressing slowly downward, through a duration of some six to eight years, to death. *Splenectomy* has been proved ineffectual and has no rational basis, the enlargement of the spleen being evidently not the primary cause. *Venesection* for the relief of the congestive symptoms resulting from the plethora has been found useful, but as a temporary measure only. *Oxygen inhalations and internal administration of potassium iodid* have given only negative results.

Repeated application of the X-rays may be said to be the only measure that has been attended with any degree of success, and one case improved markedly under large doses of *arsenic.*

ENTEROGENOUS CYANOSIS

A rare condition, characterized clinically by a peculiar bluish discoloration of the skin and mucous membranes without dyspnea or any of the other signs of circulatory disturbance usually present in cyanosis, and

unassociated with any lesion of the heart or lungs. The pathological change exists in the blood itself, which is of a dark-colored, venous hue, and presents, on spectroscopic examination, the characteristic absorption bands of methemoglobin or sulphhemoglobin. The blood count may be normal and there is no polycythemia. Digestive disturbances, evidenced by obstinate constipation or protracted diarrhea, are usually present and are looked upon as having an etiological relation, the process being believed to be an *autotoxic enterogenous* cyanosis (Stokvis). This is supposed to be the result of the absorption of poisonous products from the intestinal canal, and analogous to the methemoglobinemia produced by poisoning with the anilin dyes, etc.

Treatment

As the two forms of enterogenous cyanosis appear to differ somewhat in their etiology, the treatment must be considered separately, although, in the present state of our knowledge, little authoritative can be said.

Autotoxic Methemoglobinemia.—This is usually associated with intestinal disorders, chiefly diarrhea, and sometimes with the presence of animal parasites. The patients usually complain of headache and weakness of the limbs. The characteristic cyanosis may persist over years, varying in intensity from time to time, and often leading in the end to slight clubbing of the fingers, although the blood count may remain normal. The urine shows no methemoglobin, but the ethereal sulphates and the indican are increased, while bacteria and putrefactive products abound in the feces and point to the intestinal contents as the source of the disease. The condition may possibly be due to some element in the diet, for in some of the cases marked variations in intensity followed upon alterations in this. Thus, in van der Bergh's (3) case, the cyanosis disappeared completely on an exclusively milk diet, to return with great intensity when a meat diet was resumed.

Thorough intestinal antisepsis, combined with a milk diet, or one poor in proteids and consisting chiefly of milk and milky foods, is thus the only regimen that can be laid down in the present state of our knowledge. This was successful in Gibson and Douglas' (2) case, the blood becoming sterile, and the cyanosis improving.

Sulphhemoglobinemia.—Cyanosis from this cause may last also for years. Wynter's (7) case had a duration of 12 years. The symptoms are identical with those of methemoglobinemia, except that constipation is the rule, the blood is usually sterile, and the urine is normal as regards indican and sulphates. The pathogenesis of these cases is not easy to determine. From the nature of the clinical compound the cyanosis is evidently due to chronic poisoning with SH_2, and yet, in this condition, one does not always find this gas increased in the intestine. It has been sug-

gested that in some unexplained way conditions in the intestine may be favorable to increased absorption of this gas. In this connection, and from the point of view of treatment, van der Bergh's case is again very instructive. The patient, a boy of nine, had had since birth a urethro-rectal fistula following operation for imperforate anus. Through this fistula feces and decomposed urine were mixed in the rectum and were there retained. The free exit of feces and passage of the urine through the normal channel were permitted by dilatation of the rectum and by the retention of a catheter in the urethra, and these measures were immediately followed by improvement. Thus, in this case, cure followed the relief of constipation.

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CHAPTER VI

DISEASES OF THE ADRENALS

FREDERICK FORCHHEIMER

ADDISON'S DISEASE

In 1855 Addison described not only the symptom-complex of this disease but its cause as well: "Disease of the suprarenal capsule." In human beings it may be considered, as far as its pathological basis is concerned, under two headings: I. The primary form, due to atrophy, hypoplasia, or cirrhosis of the adrenals. II. The secondary form, due to tuberculosis, syphilis, or tumors. (Bittdorf.) In by far the greatest number of cases tuberculosis of the adrenals is found. (For pathological physiology see Vol. I, Sec. I, Chapter I.)

In the present state of our knowledge we are forced to the conclusion, notwithstanding pigmentation of the skin is not explained by it, that in all cases of Addison's disease there is a deficit of adrenal tissue. Whether this tissue is medullary or cortical, or both, is not determined as yet.

Under these conditions we would necessarily come to the conclusion that, in order to keep internal secretion normal with insufficient tissue, something might be introduced into the economy, as is done in thyroid gland insufficiency. Organotherapy was probably first employed in this disease by Charrin and Langlois in 1894 by the subcutaneous injection of a glycerin extract of horse or dog adrenals. Since then organotherapy has been sufficiently tested to permit us to come to some conclusions in regard to its therapeutic value. (For pharmacological preparations see Vol. I, Sec. I, Chapter II.)

If we now inquire into therapeutic results they can be grouped under four headings, according to Gilbert and Carnot: 1. Adrenal therapy does harm—intolerance of medication, symptoms made worse, the fatal end hastened. 2. No effects are produced. 3. In some cases improvement is noted. 4. Cure followed.

In Kinnicutt's list 6 cases out of 48 were cured, with improvement in 22 cases. Adams added 49 cases to this list, making 97 cases, of which

16 were cured and 31 were improved, and Sajous adds 23 to Adams' list, 120 cases in all then, of which 25 were cured and 36 improved. It will be seen that, in the short time in which organotherapy has been employed in this disease, the percentage of recoveries has increased from 12½ to 21, and improvement from 22 to 33, per cent. With all due allowance for errors in medical statistical research, we can certainly report good progress in the treatment of Addison's disease with adrenal therapy. The reasons for this are that early diagnosis is made more frequently, that milder cases are treated for what they are, and that our remedies are more efficacious.

As yet we are not sufficiently informed to lay down contraindications for the employment of adrenal products in Addison's disease. The only thing to do is to prescribe them and watch their effects; when the patient develops unpleasant symptoms of any sort which can be connected with adrenal medication it should be immediately withdrawn. In order to achieve success specific medication should be begun early and continued until the symptoms have disappeared or until there is evidence that it does no good or does harm. Relapses should always be looked for and treated.

As to the modus operandi of this treatment, all that can be said positively is that it does not act as organotherapy usually does in other diseases in which we have clinical pictures due to increase of or diminution in internal secretion, as in the thyroid gland. Boinet (4) states that "it seems to act by causing a functional hyperactivity, reëstablishing the double action, pressor and antitoxic, of the portions of the capsule sufficiently healthy. Thus are explained the poor results in classic Addison's disease with its massive destruction of the adrenals. Its action is more favorable in the Addisonian syndrome, often secondary to pulmonary tuberculosis or any other antecedent infection, and in chronic adrenal insufficiency depending upon adrenal scleroses, in that the cells are atrophic, degenerated but not completely destroyed." This view has been expressed by a number of authors. Moreover, it has been shown experimentally that adrenal tissue is very easily regenerated, so that this may help in the restitutio ad integrum, as has been shown by Poll.

Koch's tuberculin has also been employed. If given at all it should be done in the most cautious manner. I know of no good results obtained from its use. Iodid of potassium has been recommended here for the same indications. The principle of nil nocere must be followed in a disease in which a purge has been followed by a fatal issue.

As in the thyroid gland in permanent hypothyroidism, so in Addison's disease the transplantation of a healthy gland has been suggested (vide Diseases of the Thyroid Gland). There is one great difference between hypo- or anthyroidism and hypoadrenalism. In the absence of thyroids we can prevent damage or death by giving thyroid products with great

certainty, not so in the absence of adrenals. We therefore are even more interested in the transplantation of the adrenals than in that of the thyroid gland. In lower animals transplantation has been successfully accomplished, and all the underlying principles necessary to success seem to have been worked out. Jabonlage was the first to transplant adrenals in the human being (1897). He transplanted fresh dogs' adrenal glands in two patients having Addison's disease; both died in twenty-four hours after the operation. As far as my literary research goes, there are only eight transplantations on record in human beings, all of them ending fatally. There is no doubt that surgical methods and technique will overcome the present difficulties so that many of our patients with Addison's disease may be saved, as this seems the most promising treatment.

Heretofore we have considered only the organotherapy of this disease, but it is necessary, in order to prolong life and to relieve and prevent suffering, to look to many other therapeutic measures. The principal therapeutic aim is to relieve adynamia. For this purpose the strength of the patient should be preserved by keeping him in bed, and this should be ordered even before the adynamia makes it necessary. The food is difficult of selection: it must be nutritious, it must be digestible, it must be appetizing, it must not be laxative. It is always best in this disease to consult the patient before laying down absolute dietetic laws. Progressive adynamia is to be feared very much; to prevent this it is necessary to make compromises, always selecting those articles of food and combinations of food which are the patient's choice, the object of this being to keep up and stimulate the patient's appetite. It is not an uncommon occurrence to have the anorexia so great that feeding is practically impossible. Even at best, the question of dieting is a difficult one, and as the disease progresses it grows more and more so. Various remedies have been recommended: iron preparations, arsenic, strychnia, nux vomica. Of these arsenic may be given in ascending doses until large ones are taken. I have seen good results follow its administration; remissions in two cases. Nux vomica is preferable to strychnia, as its effects upon the stomach are more marked and its local action is greater. Iron may be valuable for the anemia, and in this disease should be given as an organic iron compound. Alcohol is very valuable in asthenia; malt liquors, wines, whiskey or brandy should be chosen according to their individual indications.

The gastrointestinal symptoms require great attention. As a rule the stomach is deficient in gastric juice, both qualitatively and quantitatively (v. Achylia). Nausea, vomiting, and pain must be treated. For the dyspepsia strychnia and diluted nitrohydrochloric acid may be given.

℞ Strychniæ sulphatis ..... 0.03 gm.; gr. ss
Acidi nitrohydrochloridi diluti.....15.00 c. c.; ℥ss
Six (6) drops in water after meals.

This dose should be gradually increased to ten drops or more three times daily. When the adynamia is present, diarrhea should be treated by dieting and bismuth preparations, tannic acid compounds, if necessary by opiates. Opium and morphia need not be given in very large doses for checking diarrhea in this disease, the average dose being sufficient. The presence of intestinal autointoxication must always be considered.

Nervous Symptoms.—The nervous symptoms require attention. The psychic changes, which are not uncommon, lack of memory, mental sluggishness, or exaltation, cannot be controlled easily. General treatment, possibly in the direction of removing toxins in the blood, may be of value. Indeed this should be considered in connection with all the nervous symptoms: insomnia, tinnitus aurium, headache and faintness, stupor, and syncope. Moreover, the usual medication which gives relief for symptoms should be applied. Convulsions should be treated as a symptom.

The Circulatory Apparatus.—It is thoroughly understood that blood pressure is low in Addison's disease; it would have been unnatural if, therefore, a routine treatment with vasoconstrictors had not been recommended. Epinephrin at least is no longer used, as it has proven unsatisfactory as a routine method. It is still recommended in cardiac asthma and should always be tried in the cardiac collapse which so frequently marks the beginning of the end. It should be given frequently and in combination with other vasoconstrictors, caffein especially, and with cardiac stimulants: ether, camphor, alcohol.

When authors are mentioned whose names are not in the list which follows, they can be found in the literature collected by Prof. Arthur Biedl in his excellent work on "Die innere Sekretion," 1910.

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CHAPTER VII

DISEASES OF THE SPLEEN

FREDERICK FORCHHEIMER

MOVABLE SPLEEN

Something may be tried in the way of causal therapy when splenoptosis is primarily due to chronic enlargement of the spleen, to be described hereafter. Otherwise the indication is to find a mode or modes of treatment by which the patient gets relief, temporary or permanent. First a well-fitting bandage should be tried; this should be elastic enough not to interfere with respiration, and must be applied so that it has a sufficient bony support by covering the lower part of the thorax. The lower edge of this kind of bandage should hold up the displaced organ. A pad is not necessary as a rule. It may be uncomfortable or even do harm, because, as there is no fixed base of support, the pad itself must necessarily make excursions. If a pad is necessary an abdominal bandage should be applied which does away with this difficulty. The bandage should cover the whole abdomen, be more or less rigid, and have fixed bases of support above and below. This form of treatment may be of some value when the abdominal walls have become weakened by repeated pregnancies, removal of fat, or reduction of the normal and intraabdominal supports from any cause. Massage, electricity, and gymnastics are also recommended. It will be readily seen that they can be of value in very few cases. In enteroptosis due to pregnancy the milder cases may be benefited. The other forms are not affected by mechanical treatment alone. It is more rational to try to recover the intraabdominal fat which has been lost for one reason or another and has acted as the internal support of the spleen. For this purpose rest after meals and superalimentation, especially with the fats and carbohydrates, should be ordered; the results of this simple treatment sometimes are astonishing.

This is one of the most important measures in enteroptosis, of which the floating spleen is usually one feature. In addition, postural treatment should be employed.

Either in general enteroptosis or in that of the spleen alone the pa-

tients' nervous condition must be considered. As long as they do not know their exact condition they may suffer some physical discomfort or even pain; as soon as they become acquainted with the whole state of affairs a nervous state is, as a rule, superadded which varies in intensity, not infrequently developing into neuroses or psychoses. The least that can be expected from the physician, in the circumstances, is that he be careful in the way in which he tells his patient of the nature of the ailment when he decides to tell.

It is especially in the neurotic cases that operation is indicated in enteroptosis. Three operations are performed: splenectomy, fixation of the spleen by suture, and the production of artificial adhesions by replacing the spleen and packing with gauze (Osler-Halsted). As to the results, it goes without saying that splenectomy cures, but there is a certain percentage of mortality. Of the results from the remaining two operations it may be safely said that they are valuable: for their temporary effects to the direct benefits of the operation; for their permanent effects to the operative results either because the organ has been held in place or that it has been reduced in size by having been held in place.

In many cases the cure is probably due to suggestion. I have seen patients operated upon for enteroptosis, I have seen them cured, and have examined them some time after the operation; the enteroptosis had recurred and many of them were not aware of it. It would be a cruel physician who would tell these patients without symptoms that the condition had returned. As yet neither surgical nor medical treatment are thoroughly satisfactory.

When, as is sometimes the case, there is torsion of the pedicle surgical interference should take place as soon as the condition is suspected.

RUPTURE OF THE SPLEEN

In this disease laparotomy should be performed. This is the rule which should be followed, regardless of the causes of the rupture.

INFARCT AND ABSCESS OF THE SPLEEN

In infarct of the spleen little can be done even when it is recognized. It is due either to embolism or thrombosis and the conditions which cause them, as a rule, preclude treatment. When the diagnosis is made and the causal condition is favorable operation should be done. It would be folly to operate for a cachectic infarct; while early operation might be indicated in acute or chronic disease of the left heart or in arteriosclerosis.

Abscess of the spleen should always be treated surgically.

CHRONIC ENLARGEMENT OF THE SPLEEN

The causal treatment of chronic enlargement of the spleen has been considered in connection with the infections, the leukemias, chronic myocardial insufficiency, diseases of the liver (q. v.). There remains the treatment of chronic splenic enlargement as a symptom. It is known positively that remedies exist which directly reduce the size of the spleen. They are ergot, eucalyptus, quinin, and others. Possibly the iodin preparations or thiosinamine might have some influence when there is much adventitious, young connective tissue causing enlargement. As a rule the remedies which are prescribed for the cause also reduce the spleen; they are arsenic, quinin, mercury, and the iodids. But we have procedures which, by stimulating contractility of the spleen, when this is still possible, gradually produce a reduction in its size. Electricity in the form of Faradism, one pole upon the dorsal region of the spine, the other on the spleen itself, is very valuable. In the human being contractility of the spleen can be best demonstrated in intermittent fever during the paroxysm. Hydrotherapy is very valuable: the alternating hot and cold douche over the dorsal region, or over the spine itself, one to two minutes' duration to be given daily. A good masseur can produce diminution in the size of the spleen, but this must not be entrusted to any one except an expert. As will be seen, the spleen can be reduced by physical means both directly by causing its muscular structure to contract (local application) as well as indirectly through its nerve supply. Recent enlargements are influenced by electricity as well as by the other physical means: they, in their turn, affect all stages. When the spleen is large and soft only the milder treatment should be employed. For a time parenchymatous injections into the spleen were given and recommended; their administration is accompanied with too much danger and, therefore, they should never be used.

Enlargement due to echinococcus tumors or cysts should be treated by the surgeon. In another place I have put down the indication for splenectomy as follows: "Any chronically enlarged spleen should be removed when it produces either serious local or general disturbance. For the contraindications, they are found in the general condition of the patient and in the futility of splenectomy on account of the cause of the enlargement."

BANTI'S DISEASE

Banti reports on 50 cases thoroughly studied, with the following results: The disease should be divided into three periods. 1. Enlargement of the spleen. Anemia less constant, slight, or occurring late. 2. Beginning congestion of the portal circulation. 3. Cirrhosis with ascites. Banti

suspects that the disease is due to some infectious agent which lodges in the spleen; the anemia and cirrhosis are secondary to a toxin elaborated in the spleen and therefore he advocates early excising of the spleen as a cure. He thinks that if this be done in the first stage a large percentage of the cases can be cured.

The results of 36 cases operated upon are as follows: Four cases in the first stage, 3 cures after 5, 6, and 15 years, respectively; 22 cases in the second stage: 13 cures some persisting 7, 8, and 14 years; 10 cases in the third stage, 4 cures.

CHAPTER VIII

DISEASES OF THE THYROID AND PARATHYROID GLANDS

FREDERICK FORCHHEIMER

CONGESTION OF THE THYROID GLAND

In that form which follows congestion due to *interference with thyroid circulation,* such as improper use of the voice, screaming, shouting, etc., by mechanical obstruction from tight collars, necklaces or bands, removal of the cause is usually sufficient to give relief. In those cases of *puberty enlargement* nothing need be done until time has shown whether or not the condition has become permanent, then it should be treated according to the ordinary indications for goiter. In the great majority of these cases marked enlargement does not exist, but in some it does, and it is well for the physician to watch further developments. The enlargements due to menstruation require no interference unless they occur in an already enlarged gland, then the treatment of goiter should be instituted.

THYROIDITIS ACUTA AND STRUMA INFLAMMATORIA

In both of these conditions the treatment is the same as is applied to any inflammation of a superficial gland. External applications in the form of the ice bag, then poultices. Mercurials, collargolum, iodin have been applied externally. When there is evidence of pus, incision should be immediately done. It is impossible to overestimate the value of early incisions in glandular suppuration—when the pus discharges the whole clinical picture changes, both local and general. The disease upon which the thyroiditis is implanted should be carefully treated.

GOITER

Goiter is due to hypertrophy of the thyroid gland, but not all its tissues are equally affected, so that a pathological division of the subject is possible. For therapeutic purposes this has not as yet received much at-

tention. As far as the functional activity of this enlarged goiter gland is concerned we are more or less in doubt. It is doubtful if it changes the normal relation of the various internal secretory organs of which the thyroid gland is one, at least no evidences which point in this direction have ever been forthcoming. Under no circumstances can the condition be called one of hyperthyroidism. The tendency to classify diseases of the thyroid gland according to the quantity of its secretion is premature. In the case of the enlarged gland in Graves' disease we are supposed always to have hyperthyroidism; on the other hand, in goiter a large gland does not necessarily produce too much secretion. As Möbius, P. J., says, "all discussions on hyper and hypo are, more or less, music of the future." It is not only the size of the gland that produces change in secretion, but its relation to the other internal secreting organs, as well as its own secretory function. The difference in the symptoms produced by a Graves' disease thyroid and a goiter must of necessity differ, as in the last there is no disturbance of internal secretion and the symptoms are produced by mechanical and not chemical causes.

When the "Kropfherz" (goiter heart of Kraus) develops, I agree with Möbius that this is no longer due to a goiter, but to the presence of Graves' disease. It is by no means uncommon for ordinary goiters to develop into Graves' disease. Indeed, every patient with goiter should be watched and examined for this possible occurrence. In the beginning of the transition it is difficult to be positive, but proper therapy quickly settles the question affirmatively or otherwise. In my own experience this transitional state has developed most commonly when there is some change going on in the ovaries; as occurs in puberty, pregnancy, or menopause.

Goiter occurs sporadically and endemically. In *endemic goiter* we may now speak with a certain amount of hopefulness of *prophylactic treatment.* This and, in a measure, actual treatment are based upon etiological considerations which are accepted; that the cause is found in something that comes from the ground. All observations point to the fact that this is the drinking water. This has been shown time and time again. It is known that the drinking of water from certain springs in goiter regions produces goiter. Those who drink the water get goiter, those who do not remain exempt. In Bozel and Rupperswil, both goiter places, endemic goiter practically no longer exists since they built new water works about twenty years ago. In order to get nearer still to the cause it was necessary to find out what it was the water contained that produced the disease. Bircher showed that goiter exists upon marine deposits of the paleozoic age, especially in the triassic and tertiary periods, and, practically, this is admitted by those who have looked into the subject. Formerly it was contended that the presence or absence of some chemical element, iodin, magnesium, phosphorus, etc., was the cause, but this is no longer taken into consideration. A number of observers have attacked the subject from the

point of view of modern ideas in regard to intoxication and infiltration. Grassi and Muraron claim that there is a miasm due to a microorganism. Kolle, in a most exhaustive, methodical research, can find no lower form of life. M. Wilms (33) has made some experiments upon rats by giving them water from a goiter spring. He found that goiter was produced whether the water fed was unfiltered or filtered (Berkefeld filter). Water was fed after heating respectively to 50° C., 60° C., 70° C., and 80° C. At 50° C. goiters develop normally, between 60°-70° C. goiter production was not complete, and at 80° C. no goiter developed. It is suggested that the causal factor is not a living organism, but rather some "albuminous" toxin. Gouget has shown that in dialysis of water from goiter springs that which remains upon the dialyzer produces goiter. This substance is supposed to be a colloidal substance in as far as surface tension tests show. However this may be these experiments show again that water is the producer of goiter and that it is either a toxin contained within it or an ultramicroscopic lower form of life. The conclusions for our present purposes are: that in order to prevent this form of disease the drinking water should be filtered and boiled wherever goiter is endemic. For treatment removal from goiter territories should be recommended. Thyroid gland products sometimes are beneficial, at others absolutely without effect or producing bad effects. They should therefore be given very carefully, beginning with small doses and increasing gradually until some effects are noticed.

Treatment.—The treatment of sporadic goiter is carried out from various points of view. Medically we possess in iodin and its compounds a remedy which is followed by good results when given early in the disease. It is most useful in vascular and parenchymatous goiters; I have always been disappointed when I employed it in the cystic form, probably because I could not make the diagnosis as early as in the other forms, and, therefore, the treatment was not begun soon enough. I have, therefore, followed the rule never to give it in cystic goiters. How it acts is not certainly established; modern research has demonstrated, however, that iodin has a specific affinity for the thyroid gland when given either as potassium iodid or as iodoform. Clinical experience has shown definitely that goiters can be reduced by iodin administration, and when the treatment is begun early enough the results are excellent. It may be prescribed locally or by the mouth. Iodin is applied externally in various ways. The most common form is painting the enlarged gland with the tincture of iodin, and it is the worst form, as the local effect upon the skin, discoloration and dermatitis, is the dominant one, and very little iodin is absorbed. The unguentum iodi of the U. S. Pharmacopœia is a much more serviceable preparation, a 4 per cent. iodin ointment, which leaves the skin uncolored and is absorbed. It is an unstable combination and has to be used fresh. The best preparation of iodin for external

application is iodopetrogen (5-10 per cent.) or iodovasogen (3-10 per cent.), both identical products, the former made in this country. These should be rubbed in over the gland daily in small quantities, care being taken that no skin irritation follows, and no iodism. That these two products are absorbed is shown by the fact that, in human beings especially sensitive to iodin, one application may be sufficient to produce the classical symptoms of iodism.

When external application is not indicated or does no good iodin should be given internally; and I prefer sodium iodid in a two to five per cent. solution of pepsin three times daily. It is wise to begin with the weaker solution, as no one can foretell how intense its effects may be (acute iodism or cachexia strumipriva). These patients should be watched closely until it is shown that they can take iodin with safety. After that they should be seen occasionally and told to report if any symptoms of iodism develop. When the gland begins to reduce, the dose of iodin may be reduced; relapses are not uncommon, and they should be treated as in the beginning. It is not wise to give iodin for too long a time, as atrophy of the breasts and sometimes of the genital glands may take place.

Thyroid preparations were greeted with great enthusiasm after the first publications had appeared as to their efficacy in goiter. They are not necessary in this disease; their action is not constant; they are accompanied by bad effects which we are not certain of controlling, and, above all, the results are disappointing.

The injection of iodin into enlarged thyroid glands should be discouraged, as the operation is not one in which possible benefit or harm can be calculated or controlled. X-ray treatment sometimes gives good results (v. Graves' Disease).

Gymnastics are very valuable as an adjuvant method of treatment; especially is this the case in the vascular form. "The patient, lying upon the back with the head low, is directed slowly to flex and extend the head, to begin with three minutes' duration of this exercise daily and prolong it to ten minutes daily."

Surgical treatment should be applied when, after medical treatment has been properly tried, there is (I) great and progressive deformity; (II) when there are evidences of malignancy; (III) when the goiter extends into the thorax; (IV) when there are symptoms of pressure from the goiter. Symptoms of hyperthyrea, if there are such, beginning Graves' disease, should not be operated upon until medical treatment has been thoroughly tried. The surgical mortality is very low. Kocher states that, "in the present state of surgery, the operation for goiter can be performed without danger to life." Le Grand Guerry states that the surgical mortality is about 0.5 per cent., and this statement is nearly correct. But it represents statistics of men who are doing these operations

frequently, who have experience, and know how to meet emergencies. This is shown by Kocher's statistics; before the year 1850 there were 70 operations with 40 per cent. mortality; 400 operations between 1850 and 1883, the mortality being decreased to 15 per cent.; and since 1883 the mortality is less than 3 per cent. If we were in the position to collect all the cases operated upon, it would be seen that the mortality is much greater than this. Therefore, for the benefit of the patient, it is best to select a surgeon who has had experience in these cases; the more he has operated the lower his mortality.

EXOPHTHALMIC GOITER

(*Graves', Basedow's, Parry's Disease*)

In the present state of our knowledge of the etiology of this disease it is difficult to draw therapeutic conclusions. The nervous origin, so confidently believed in that resection of the sympathetic nerve was done—and with good results in some instances—is no longer accepted. Yet, on account of accurate work done upon the innervation of the thyroid gland, especially by Brian and Wiener, it would seem that nervous processes are of great importance in this disease. Gautier, and especially Möbius (23), worked out a thyrogenous theory, i. e., that Graves' disease is due to excessive or improper thyroid function. The thyroid gland is the one most amenable to organotherapy, and its laws have been deduced from its study, one of them being that the addition of thyroid substance always increases thyroid secretion. If, then, Graves' disease is due to hypersecretion, administration of thyroid bodies should always be followed by increase in severity and number of symptoms. But in a certain, if not a large, number of cases the opposite holds good, so that we must either conclude that causation of this disease is not the same in all instances, or that the thyroid gland is not alone responsible. In studying the disease it was found that adrenalin occurs in excess in the blood of patients, and a careful study of symptoms shows that there must be irritation of the autonomous system. Eppinger and Hess accept two kinds of Graves' disease, sympathicotonic and vagotonic, which leads to the acceptance of a polyvalent thyroid secretion. Falta (10), Eppinger (8), and Rudinger believe that Graves' disease is the result of combined hypersecretion and nerve irritation, acting simultaneously and independently. In addition the internal secretion of at least the adrenals, the thymus, the hypophysis, and the sexual glands must also be considered for etiology. So that it would seem that in the thyroid gland there is found the final reaction of nervous, internal, secretory, and local (thyroid) processes. The acceptance of this would explain why partial removal of the thyroid frequently

gives relief, as hyperfunction is prevented by reduction in quantity of secretory substance. It also explains why the present surgical phase of therapy must of necessity be a temporary one; whether the treatment of the future will be medical or surgical, or both, it is given to no one to foresee at present.

Two things should be considered when treatment is discussed; ordinarily the prognosis of Graves' disease is favorable when the patient can take care of himself. At the time of writing I have treated 76 cases of Graves' disease without a death. Indeed, in my whole experience I have seen only one death from this disease, and this was due to thyroid feeding. Jackson and Mead saw 85 cases with 3 deaths, only one dying under their own care. A. F. Baker records 50 cases, of which 44 are still alive after an average of 8.7 years when first recorded. None of the six died from Graves' disease or any of its complications. At present the mildest cases are recognized and treated, and this may partly account for our low mortality. Everything, then, is in favor of cure of this disease; therefore, there are many *"post hoc ergo propter hoc"* cures, as is the case in many self-limited diseases, to which class this disease sometimes belongs.

The second thing to be considered is that, as it seems, we are dealing with a circulus vitiosus made up of the goiter, the nervous system, the internal secretory bodies, the toxemia, and frequently external conditions, which, when broken, result in a cure. Because many remedies are recommended in this disease it is not true that none are of value.

Hygienic Treatment.—The psychical condition of the patient should be considered. Unless the physician does this, medical results will not be as favorable as they should be. We should never forget that we are dealing with a disease in which a nervous state is a cardinal feature. First of all, this nervous state should be treated as it is under any condition. Those physicians who do not understand nervous people and who do not sympathize with them should keep their hands off and not treat them medically. It requires sympathy, patience, tenacity, tact, and knowledge to treat these people. Call it psychotherapy or what you will, the fact remains that without these qualities in the physician therapeutic results are not satisfactory in most cases. This retards permanent recovery and produces greater development of undesirable symptoms.

Rest.—Rest is of enormous value in this disease. It should be prescribed as a drug, as to quality and quantity. Besides its influence upon the nervous system, it is a means of producing increase in weight because of diminished metabolic output. When weight and nervousness improve the patient is improving. It is difficult to measure how much the patient should rest; it ranges from an hour after meals to rest in bed the twenty-four. The latter should never be ordered except in the form of the rest cure (v. Hysteria), and never when the patient objects or, after a few

days, becomes restless and dissatisfied. When these conditions are disregarded there is deterioration of the general condition. But there are circumstances when it is absolutely necessary to keep the patient in bed, *nolens volens.* A patient with a pulse of 200 and a dilated heart must be kept in bed. The same may be said of any other indication which makes rest in bed absolutely necessary. On the other hand, most cases require little or no rest. They are the *formes frustes,* under which term I include all the rudimentary cases, and this is the type most frequently found in Graves' disease. In the individual case we may be guided by symptomatic indications. Upon the whole, the importance of rest in this disease seems to be commonly disregarded in cases which otherwise might be cured by medical means.

Diet.—There is no especial diet for this disease. Moreover, patients who hold their own in weight or gain need not be dieted unless there is some other reason for it. At some time or another all severe cases of Graves' disease must be dieted. This may be in the form of superalimentation, increased caloric value being derived from milk and carbohydrates, or for symptomatic purposes, as gastrointestinal or cardiac complications. In the latter especially five or six small meals should be given daily instead of three large ones. This may apply to any form of Graves' disease or to special indications. Moreover, the eating of large quantities of meat should be forbidden, as experimental evidence goes to show that large quantities of meat produce thyroid enlargement due to increased functional activity. Milk, eggs, and vegetable albumin seem harmless. Alcohol should be forbidden; certainly its daily regular use in moderate or large quantities, or its occasional indulgence in large quantities. There can be no objection to coffee or tea when taken in moderation. Tobacco should be forbidden because of its untoward effects upon the heart and the blood vessels.

Exercise.—Exercise should be prescribed or forbidden, as the individual case may require. Aside from the faintness and weakness which may follow it, the condition of the heart may be looked upon as a guide. Functional heart tests are of great value in determining the strength of the myocardium. The nervousness should also be considered, not only on account of the heart, but also because of the bad effects of increased nervousness upon the circulation as a whole. All forms of exercise and of many grades of intensity may be prescribed. Not to indulge in excessive and too violent exercise is a rule that should be followed by all patients with this disease. When the heart is normal exceptions can be made in individual cases. In those who have to remain in bed a competent masseur or masseuse may do good by passive movements, at first without, then with, resistance. After this gymnastics may be prescribed, and finally the patient may take walks, increasing the distance slightly every day. From now on it is the treatment of myocardial insufficiency.

Climate.—The fact cannot be denied that Graves' disease disappears with change of climate. In addition the statement may be made that many patients are made worse with change of climate. There can be no doubt that climate may produce some effect upon Graves' disease. Even Möbius (23), who is very skeptical (l. c., p. 81), admits this. As a rule, we have no precise indications as to places in the climatology of this disease. Patients do well in high, middle, or low altitudes, at the seashore; indeed, in cities and in the country.

One patient in whom I made the diagnosis recovered his health in Rome, and I have known of several who have regained theirs on mountain tops. Why this occurs, or how, is only a matter of speculation; it matters not whether it is due to imagination, or physical and chemical processes. It occurs, and must be considered in the treatment of these patients.

In selecting a place for the patient his own predilection should first be considered. If possible, low mountains (2,000 feet) and warm seashore places should be tried first. The Swiss mountains (3,000 feet and more) have been recommended, especially for winter; others do well in wooded countries, on the lakes, or in small settlements in level country with temperate climate. The heart and the general condition of the patient must always be considered before any place is selected.

Balneology.—Nauheim is recommended, and just as frequently looked upon as contraindicated. When there is chronic myocardial insufficiency Nauheim is valuable in all circumstances; but whether it has any other effect in this disease is still doubtful. Patients have been sent to ferruginous springs, indeed, to drink much and many kinds of mineral waters. Some patients are improved as soon as any one condition is relieved. All authors warn against baths too hot or too cold and baths in the open, especially sea baths.

Hydrotherapy.—Hydrotherapy seems to be very valuable. Judging by the good results obtained by Winternitz, especially in this disease, it should be applied according to his directions when used at all as a curative method. For the symptoms the following may be tried: "For the nervousness lukewarm baths, warm salt baths, the half bath, douche to the spine." The half baths and the douches are especially efficacious. For the enlarged thyroid gland cold applications or the ice bag locally should be tried. For the *tachycardia* the ice bag at the nape of the neck or over the region of the heart may be applied.

Electricity.—This has frequently been applied with curative effects. For this purpose galvanism, faradism, singly or combined, the electric bath, indeed, nearly every form of electricity has been recommended. Good results have been reported following the application of one or more of these methods. Chvostek's mode of application seems the one which has been followed by the greatest number of good results. Chvostek, as

do most, employs the galvanic current, and in the following way: (1) To the sympathetic nerve: anode to the sternal notch, cathode to the angle of the jaw for one minute; (2) to the spinal cord: anode over 5th dorsal vertebra, cathode on the neck; (3) through both mastoid processes, weak currents and daily sittings (Möbius, 23—l. c., p. 83). There are many modifications of this method; all seem to be directed to galvanization of the soft parts of the neck; indeed, this seems to be true of the application of electricity in any form. There is no doubt about the efficacy of electricity in this disease; many cases have been cured and more have been improved. But there are more refractory cases than such as are amenable to this mode of treatment.

Without entering into a discussion of the nature of the effect produced by electricity, I do not hesitate to state that in this disease it is largely due to suggestion, and should be used as any other suggestive measure. Moreover, it is a matter of record that Möbius (23) has noted improvement after psychotherapy, by suggestion in the waking state and in hypnosis. Even one case cured at Lourdes is noted. Electricity then should be applied so as to produce the greatest psychical effect, and other suggestive methods should also be tried by those who know how to employ them.

X-ray Treatment.—Pfahler (1908) has collected 51 cases in which this mode of treatment was employed, with the following results: in 42 cases there was marked improvement, in 9 cases there was little or no improvement, i. e., there was improvement in 75 per cent. of all the cases. All cases which improved have remained well from a few months to three years. Falta (10) (1910) reports six cases, of which five were cured and one benefited. Unfortunately, all observers have not obtained such excellent results as these, but, nevertheless, the Röntgen rays should certainly be tried; when applied by a careful operator no harm follows.

Medicinal Treatment.—In view of the fact that so many drugs have been favorably mentioned, it will be impossible to consider all or even most of them. In this disease medicines may act by suggestion; this should not be forgotten in estimating the effects of a drug in given diseases. It is only by careful and openminded observation that we can eliminate this *modus operandi,* which should always be considered when judging therapeutic measures.

In my own experience the administration of quinin and ergot is followed by the best results, and I have been treating Graves' disease in this manner for nearly thirty years. I give the quinin in the form of the neutral hydrobromate of quinia. Quinin was selected first, on account of its activity in a very neurotic patient in controlling the neurosis, and because the older writers had employed Jesuit's bark in goiters. The hydrobromate or hydrobromid, one or the other, was employed because of the observation that bromids counteract cinchonism. This view is disparaged, but from a long experience I can say that in every instance quinin could be taken in this combination when it was badly tolerated

in any other. The ergotin was prescribed because of its effect upon the blood vessels, causing contraction. In this way many symptoms due to dilatation of blood vessels were controlled. It is difficult to say, as we can for ergot, how the quinin acts in this disease, but it is the more essential of the two remedies in this form of treatment. Huchard, who also recommended it, has claimed that the effect is due to its cardiac tonic and vasoconstrictor properties. In addition, it is possible that it acts by a direct effect upon the toxemia, by slowing the heart or by stimulation of inhibitory centers. At first the quinin given without the ergotin was used for a great many years. When no favorable results followed in two weeks ergotin was added. At present 0.30 gm., gr. v, of quinin hydrobromate and 0.065 gm., gr. i, ergotin are given in gelatin-coated pills four times daily. As the case progresses favorably, three or only two pills a day may be given, but if the patient gets worse the number of pills should again be increased. When cinchonism develops so as to interfere with the comfort of the patient, the number of pills should be reduced, or they may be withdrawn temporarily. One of my failures occurred because the patient would not take the pills on account of nervousness induced by the cinchonism. In all the cases I have seen no permanent damage was produced, either in the ears or otherwise. One of my Graves patients has been taking quinin for nearly five years without any bad effects whatsoever. The good effects under this treatment usually follow in the same sequence; first, the tachycardia improves, the pulse frequently coming down from 130-140 pulse beats to 80 or 90 in forty-eight hours. Secondly, the thyroid gland diminishes in size, by measurement. Thirdly, the tremor and exophthalmos disappear. In by far the greater number of cases the exophthalmos is the last symptom which disappears; indeed, in a goodly number of patients it never disappears. To convince oneself that the treatment is the cause of the changes just noted, it is necessary only to withdraw the pills and, unless the patient is cured, the symptoms recur. If after the withdrawal of the pills the symptoms disappear, such patients, as a rule, may be considered cured. Relapses are not uncommon; these patients have relapses on account of psychic or physical irritations, and these relapses should be treated in the same way as before. It is on account of these relapses that the disease may last so long. The treatment just described is most valuable in the mild attacks, the percentage of complete recoveries being very large, and after a short time. When the fully developed form exists, either primarily or as a relapse, complete recoveries are the rule, but more time is required. When the patient has the foudroyant form the results are excellent, so much so that if one believes only in surgical treatment the quinin and ergotin may be given to get the patient in condition for the operation, as has already been done by Deaver (verbal communication). The treatment has been tested by F. C. Shattuck (30) (1904), and he comes to the conclusion that it is the best. J. M. Jackson and L. Guy Mead (16) have treated 85 patients with quinin in the Out-Patient Department of the Massachusetts General Hospital. Of these, 56 have been under observation long enough so that conclusions may be valuable; 42 (76 per cent.) were cured, 7 were benefited (13 per cent.), and there was failure in 6 (11 per cent.). At the present time (1911) I have treated 71 cases with six failures, i. e., 82 per cent. success. It may be of interest to note that the treatment failed absolutely to make any impression on a negro, the only case in the African race I have ever seen. There was no mortality.

Elimination by the intestines has been employed, with a direct aim and purpose, by W. H. Thomson (31) (1906), who reports excellent re-

sults from intestinal treatment. Kocher has come to the conclusion that phosphate of sodium is the best remedy in Graves' disease, and that its activity is entirely due to its action upon the bowels. I have seen one instance in which a patient with Graves' disease got an attack of sepsis due to tonsillar infection, one of its manifestations being a septic diarrhea. This diarrhea continued for three months; when it was checked by opiates the Graves' disease got worse, so nothing was done for the diarrhea. When this stopped after three months' duration the Graves' disease disappeared and there has been no relapse (1911). When trying this method only my results have not been so favorable as those of Thomson. I employ it, however, in connection with the quinin treatment, and frequently improve my results by the addition of phosphate of soda, the quinin and ergotin combined with it.

In a routine way patients may be divided into three classes for therapeutic purposes in connection with quinin, ergotin, and eliminative treatment. The milder cases get well on quinin and ergotin; elimination is rarely required, and they usually are able to attend to their vocations; in severer cases we must individualize; most of them may continue their work, but in them dietetic and eliminative treatment may be required. The severest forms are put to bed, quinin and ergotin are given, the proper diet is prescribed (v. supra), and if necessary eliminative procedures may be employed, but only the mildest ones. They should have the rest cure, as a rule, as strictly given as it is possible to do.

Other Medicines.—Of the other medicines which should be recommended we only consider those that act symptomatically, although cures have been attributed to all of them. *Belladonna* is valuable on account of its excellent effects upon the bowels and its stimulating effect upon the vasomotor centers. *Arsenic* should be given for the same reasons as it is given elsewhere, to improve nutrition, to counteract anemia. Both act to change metabolism, so that the patient puts on weight and his nervous symptoms are improved. *Strophanthus* should be used as in any other disease; it is nothing more nor less than a cardiac tonic, at times the best. *Digitalis* should be given for the same indications and in the same doses in Graves' disease as in all other heart diseases. When digitalis is administered in functional cardiac troubles, the result, at best, is negative. The *bromids* are valuable and should be prescribed in round doses to give relief to nervousness, thereby improving sleep and counteracting all increased nervous reactions. *Iodin* or its preparations should be used with great care in this disease; it does harm in most cases, but good in some others; we do not know why. At all events, when iodin is given at all, it should be under the careful observation and supervision of a physician whose duty it is to watch for the first bad effects and then to withdraw the drug.

Organotherapy.—The thyroid gland must be considered first as a

remedial agent, because it contains the substances which have the greatest effect upon the physiological and pathological processes of the thyroid gland (*vide* Myxedema for dosage). When used in Graves' disease it is best given as the gland itself or as an extract. Bauman's thyroidin is only a part of the thymus gland and, therefore, has not the same effect as the gland itself, but acts like all other iodin preparations. From a theoretical point of view thyroid gland should never be given in Graves' disease. Biedl says that administration of thyroid in Graves' disease is *always* followed by bad effects, in this way giving direct proof that the disease is not a hypothyreosis. The matter is not so simple as this; the fact remains that a small percentage of Graves' disease patients improve under thyroid or iodin treatment, and some are cured by it. On the other hand, most patients are made worse, and I have seen one patient die as a result of this treatment.

I do not give the thyroid preparations in this disease for the following reasons: there are no precise indications for their administration; they are harmful to the point of danger; and they are unnecessary. Those cases that are helped by thyroid are helped more by the quinin and ergotin treatment.

Thymus gland was first recommended by Mickulicz, who had good results in a few cases, so that an operation became unnecessary. These good results were also verified by Cunningham, Owens, and Möbius. The thymus gland does good because it also contains iodin. It is safer than thyroid medication because of the small quantity of iodin contained within it. It therefore is also unnecessary in the treatment of Graves' disease.

In 1895 Ballet and Enriquez (v. Biedl) suggested a plan of treatment based on the assumption that there is formed in the body a hypothetical poison, which is neutralized by the thyroid secretion, and when the latter is excessive the poison neutralizes it. Therefore, in animals deprived of thyroids, the antagonistic poison must be present in increased quantity in their blood. The serum from thyroidectomized animals was, therefore, applied in Graves' disease. In 1895 they report nine cases with satisfactory results, but in 1903 the end results are disappointing (Buckley). Lanz (Möbius, l. c.) treated three patients successfully by giving them the milk from thyroidectomized goats. In 1901 Möbius had Merck prepare a serum from the blood of thyroidectomized sheep, called Anthyreoidin Möbius, which was first given by injection, then by the mouth, in the dosage of from 10 to 30 drops three times daily for several weeks, and then interrupted and begun again, if necessary. Buckley (l. c.) has tabulated 86 cases in which this treatment was employed with only six failures and 10 relapses. The limited experience I have had of the results of this treatment have not impressed me with it. I have, it is true, seen such cases that have failed; from the point of view

of statistical research it is as valuable as any of the other non-surgical methods of treatment.

The serum of Rogers and Beebe was prepared from the thyroid gland derived from an autopsy of two Graves' disease patients. From their enlarged thyroids there were isolated two proteids, a nucleoproteid and a thyreoglobulin. These were injected into a rabbit, the nucleoproteid to produce the cytolitic effect and the thyreoglobulin an antitoxin. The results in human beings with Graves' disease are: 90 cases treated in all, of which 23 were cured, 52 improved, 11 unimproved, and 4 died (Buckley, l. c.). This mode of treatment has no reason for existence. The results are not as good as they are with surgery, the cures are fewer in number, and the deaths nearly as great; it should, therefore, never be used, and, I believe, is never used now.

Rogers (27) (1910) formulates his new treatment as follows: Eppinger, Falta, and Rüdinger showed the interaction of the thyroid, the pancreas, and the chromaffine system; the thyroid and chromaffine inhibit the pancreas, the pancreas inhibits the thyroid and chromaffine system. Two active principles may be isolated from the thyroid, two from the adrenals, and one from the pancreas (this only for the purpose of internal secretion). In the thyroid the two bodies are a nucleoproteid and thyroglobulin. The first causes increase in heart rate through the accelerator or a sympathetic nerve which is a part of the chromaffine system, which then is stimulated. The greater the hyperthyroidism the greater the irritation and the greater the secretion. The pancreas may also be inhibited through the adrenals. The thyroid globulin seems to have an effect which is not limited to any organ and probably deteriorates in its physiological properties as exophthalmic goiter advances through its various stages. He then assumes that it has a universally activating effect and must consequently activate itself. He next calls attention to the effect of overstrain, of which he states that probably all secretions become deteriorated as its result. In conditions of fatigue there is a great demand for thyroid secretion, which results in large quantities of thyroglobulin being thrown into the circulation accompanied by too much nucleoproteid. The latter overstimulates the sympathetic, and the chromaffine system is thus forced to inhibit the pancreas. Because of this digestion and nutrition suffer, the latter already below par; there comes a demand for increased thyroid secretion, which again is secreted in large quantity but of inferior quality. Thus is established the first vicious circle. The second vicious circle is produced by the excess of thyroid globulin which activates the gland to further activity. On this hypothesis he formulates therapeutic direction.

I. In goiter in fatigue, thyroid preparations should be given. II. In patients without goiter, but with evidences of hyperthyroidism, representing the first stage of exophthalmic goiter, the indications are for sup-

porting the theoretically attempted compensation. III. Operative treatment is successful in fully developed thyroidism, as it breaks through the vicious circle. IV. When the secretion has deteriorated, later on, the operation has a much worse prognosis. In order to determine the course to be pursued in treatment, the following should be done: A dose of specific antithyroid serum is given. If the thyroid is primarily at fault 5 to 10 gr. (0.3 to 0.6 gm.) of the serum will either be followed by negative results or by slight improvement. When there is no change a larger dose should be given. If the chromaffine system is affected the symptoms will be aggravated; these cases should not be operated; those which improve are cured by operation. If antiserum improves the condition, it should be continued as long as improvement continues, and the pancreas should be aided by giving some form of the gland by mouth, by rectum, or subcutaneously. Sometimes more rapid results are obtained by giving thyroid, which counteracts the deterioration in quality of the patient's secretion. He closes with a warning not to push the antithyroid serum to the point of unduly damaging the vitality of the already weakened thyroid epithelium. All this is very suggestive, but it is a hypothesis, with all its weaknesses. It is, however, a distinct progress in therapeutics, and may be found useful to further progress. In therapeutics it is necessary to have demonstrations of results; here especially *"probiren ist besser als studieren."*

The results of medical treatment are very favorable; from 70 to 90 per cent. of all cases are improved and cured by it. They are best in the rudimentary form (*formes frustes*), better in the form which develops gradually than in the one developing suddenly with full force, better in women than in men, and better in the old than in the young. The indications for the operation are as follows: when serious compression exists from the enlarged gland or glands; when the patient gets rapidly worse on medical treatment; when he loses weight continuously; when there is constant fever; when the tachycardia cannot be controlled; when the disease renders him unfit to pursue his usual vocation. Operation is contraindicated by bad general condition, as also in organic heart changes.

The surgical procedures which are accepted in Graves' disease are Jonnesco's sympathectomy and operations upon the thyroid gland itself. In regard to the former, which in the light of the new work in internal secretion again seems a rational operation, it may be said that it will of necessity be again taken up and its indications strictly and precisely worked out. The procedures upon the thyroid gland consist of ligation of several enlarged arteries of the goiter, excision of vascular strumas, and resection or excision of more than one-half of the enlarged gland. The latest results of surgical treatment are expressed by Kocher; he again reports 376 cases, 76 per cent. of which were cured, with a mortality of 3.9 per cent. Mayo has 70 per cent. of cures with a mortality of 4

per cent. Heinecke in his 500 collected cases found the mortality 5.6 per cent. When medical and surgical statistics are compared, it will be immediately seen that the mortality is even smaller in the former than in the latter. The results of medical treatment are about the same as those of surgery, as far as can be seen from the statistical material, which is neither uniform, complete, nor sufficiently precise. As to mortality, it is impossible to express it in figures. In the 424 cases which have been considered for medical treatment in this article, only eight died, less than 1 per cent. (The 23 Beebe and Rogers serum cases are not included, as it was doubtful whether the mortality was due to the remedy or to the disease.) These cases come from various sources, including reports of single cases by men from the ranks of the profession. On the other hand, the surgical reports with the very small death rate come from experts in this operation, men who have operated more frequently than any one else, the Mayos 1,000, Krönlein 2,000, and Kocher 3,000 times and over. It is not necessary to point out again that this alone makes for lower mortality. In order to show the difference in statistical results of various surgeons, Dreyfus' collection of 127 cases operated on by Wolff, Mickulicz, Krönlein, and Kocher (1905) gives a mortality of 7.9 per cent., while that of Rehn's (26) collection of the same year, the result of 37 operators, is 20.1 per cent. So that the physician who recommends operation in Graves' disease should at least have exhausted all other means of treatment before subjecting the patient to a mortality, small as it may be, from surgical intervention. That surgical treatment becomes necessary in certain cases has been stated above. That it is a logical and scientific mode of treatment is fully admitted, as a vicious circle is broken into when it is done. Cures are reported in as high a number as 86 per cent. (Kocher, l. c.). The question that arises is whether all cases of exophthalmic goiter can be cured by removing more or less of the thyroid gland. This has always been answered in the affirmative. When the patient is not cured, or has relapses, and they are not as common with surgical (25 per cent., Mayo) as with medical treatment, it has been taken for granted that not enough or too much of the gland has been removed. This may be true, but in the light of modern investigation it will be seen that there are other reasons for failure not so simple, and that in these cases some procedure such as is recommended by Rogers may have to be employed.

The complications are treated here as elsewhere. Only one requires especial attention. Pregnancy, *per se*, as a rule, has no bad effect upon Graves' disease. If there is a heart condition present which endangers life the pregnancy should be interrupted; if not, this is not necessary unless there is the bad form.

ATHYREA AND HYPOTHYREA

For therapeutic purposes all the various forms are practically the same. When there is absence or great diminution in thyroid secretion this deficit must be supplied. This seems to hold good for all the various forms of hypothyrea and athyrea. In this whole group of cases there is but one form of cretinism which requires special mention: endemic cretinism. As has been stated under endemic goiter, these two forms of disease are found together, the same cause producing both (v. Endemic Goiter). The same prophylactic measures should be employed in the one as in the other. The removal of the cause has done the same for endemic cretinism as it has for endemic goiter; the disease has been prevented.

A great number of symptom-complexes have been grouped under the headings of athyrea or hypothyrea. It is not our present purpose to discuss whether they belong there or not. If the classification has absolute value, i. e., if all cases are athyreas or hypothyreas, the treatment should be the same. If it has only relative value, in so far as combinations of causes are concerned, this will not be the case. The cachexia strumipriva (Kocher) and myxedema are accepted as being due to athyrea. The following are not accepted by all: Dercum's disease, age cachexia, senilismus (Rummo), or progeria (Gilford). Hypothyrea stands on a firmer footing in endemic and sporadic cretinism. Pineles has described a form of disease which he calls thyreoaplasia, also called congenital myxedema. Infantile myxedema is also included in the group, as also a combination of infantilism with myxedema called infantilismus myxedematosus or myxinfantilismus (Brissaud).

If the assumption is correct that these various diseases are due to lack of thyroid secretion, then the introduction of thyroid should cause the symptoms to disappear. Thus we have not only a therapeutic measure, but one which at the same time indicates the cause of the disease in as far as the thyroid gland is concerned. Schiff (1884) first succeeded in transplanting thyroid gland into the peritoneum of dogs whose thyroid gland had been removed, and they lived for some time. Kocher then transplanted thyroid in the human being, but without success. Bircher (1890) was the first to succeed in the human being, but the patient eventually died of the cachexia strumipriva. Lannelongue and Victor Horsley, independently of each other, then showed that implantation was followed by temporary results only, as the implanted gland was ultimately absorbed. In 1891 G. R. Murray advanced thyroid therapy to the point where it could be employed by any one, as he was the first to make an extract with glycerin, which he gave by hypodermic injection. About the same time Hector Mackenzie (1892) and Horvitz showed that when thyroid was given by mouth the same good effects followed that were noted when

given in any other way. Because of this the other modes of administration are discarded, with one exception: transplantation is again coming to the front in the treatment of this condition. At all events, before this is resorted to, the giving of thyroid by the mouth should be tried, not only to find out whether it does good, but as well how much good and for how long a time this may be expected to continue.

Raw thyroid gland was and is still given by mouth. As the same results are obtained from the other preparations, which can be had for less trouble and expense, and which are more readily taken, the use of the raw gland is archaic unless circumstances make it impossible to get anything else.

For pharmacological preparations and standardization see Vol. I, Sec. I, Chapter II.

The ordinary dose which should be prescribed to an adult in the beginning is 0.15 gm.—gr. iiss—three times daily; if no unpleasant results follow then the dose is increased to 0.30 gm.—gr. v. Further increase in dosage is made by adding 0.10 gm.—gr. jss—at first once, then twice, and finally three times a day, then double this amount in the same way until bad effects are produced, which usually occurs when the patient is taking 0.60 gm.—gr. x—*ter in die*. In the adult the following signs and symptoms have been noted: increased pulse rate, palpitation, vomiting or diarrhea, increased temperature, sometimes albuminuria or glycosuria and too great loss of weight. When any untoward symptoms develop it is wise to withdraw the medication and wait until they have disappeared, then to begin with the small dose and, in gradually feeling the way with slow increase in dosage, the limit of greatest efficiency combined with safety will be found.

For children under one year of age the dosage can be found as I have shown elsewhere, by employing a compound fraction, the numerator of which is the age in months, divided by twelve, the denominator being 20; this is multiplied by the normal adult dose, gr. v. If this rule be applied to a child of three months of age the calculation would be as follows:

$$\frac{\frac{3}{12}}{20} = \frac{\frac{1}{4}}{20} = \frac{1}{80} \times 5 \text{ grains} = \frac{1}{16} \text{ grain.}$$

The bad effects in infants can be controlled by watching the pulse rate; this may also be done in older children. In old cretins the adult symptoms of thyroid toxemia may be noticed.

Thyroidin or Iodothyrin.—This was first discovered by Baumann in 1896; he believes that it represents the full physiological activity of the gland. The discussion is going on as to its exact relation to the thyroid gland; whether its action represents its physiological activity in whole or in part; whether it is found in the gland as such, or is due to changes, the

result of condensation, and whether the latter has not destroyed some of the normal physiological reactions which always follow the application of thyroid body. However this may be, the administration of iodothyrin has been followed by good results, as is testified to by a great number of authors. Again there are those who do not consider it reliable and, finally, those like myself, who are thoroughly satisfied with the results of thyroid feeding. Therefore, up to the present there is no reason for giving another remedy which seems to possess no advantages over the one now employed.

In many of the conditions of *Athyrea* or *Hypothyrea* it is necessary for the patient to follow thyroid treatment for years or for his lifetime. This has again given rise to renewed efforts to make transplantation of thyroid gland a success. The problem is not an easy one: the thyroid must be implanted in such a way that it does no harm, that it does good. The difficulty in the problem is not the former, but the latter, for it is necessary to prevent atrophy of the transplanted gland. The good done may be temporary, but gradually the patient gets worse and finally he comes back to the condition before the operation. The problem to be solved is that implantation should be done so that the transplanted thyroid gland will retain its normal function during the life of the patient. When the thyroid has been transplanted in animals the gland first degenerates and atrophies; then, under the most favorable circumstances, it is regenerated and with this functional activity returns. In the great number of cases, however, this does not occur, the remnants of glandular tissue not being increased.

It would seem that the solution of the problem lies in finding tissue or tissues so organized that the transplanted gland may continue to live.

Bramann (5) (1909) mentions Payr, who implanted thyroid into the spleen of a cretin, and that this was followed by improvement for a year and then no further improvement occurred. Christiani succeeded by transplantation into subcutaneous tissue in two cases, one being a cretin and the other myxedematous. Bramann reports three cases of myxedema, two of which also had cretinism. Transplantation was done into the bone marrow and all three cases were very much improved in every respect seven to nine months after the operation.

As far as the results of thyroid therapy are concerned, in the various forms of thyroid deficiency the results differ somewhat. They are best in the *cachexia strumipriva* and in *myxedema*. In both instances they are nothing short of marvelous; there is loss in weight, the color and structure of the skin change, the normal physiognomy returns, digestion improves, the temperature becomes normal, there is sweating again, the hair grows and, in women, normal sexual function returns. But, above all, the psychical state improves, memory, interest in the outer world, the joy of living return. In cretinism of either form thyroid therapy should always

be tried. In 1907 the government treated the cretins (endemic) in Styria with thyroid therapy and V. Kutschera reports as follows: all were improved; in 85, 7 per cent., more than normal growth occurred, in 42, 8 per cent., there was a marked improvement in general symptoms of cretinism, the remaining 48, 6 per cent., showed slight improvement. Eysselt (9) reports in all 75 cases of endemic cretinism. He comes to the conclusions: that only small doses should be used, 0.3 gm. daily; that the earlier the treatment is begun the better the results; that aged cretins are sometimes benefited by treatment; that tuberculosis is a very frequent complication. Among those in whom there was severe disturbance of hearing or speech treatment was not very beneficial, except in very young subjects. Of the total number (75) which were treated 34 have been discharged, 21 cured, 7 improved, 6 unimproved. Eysselt states that it takes from one to many years to effect a cure, but that, in most cases, it is lasting without further thyroid treatment.

In sporadic cretinism the results of treatment are about the same as in the endemic form. All these patients should be treated; there may be no cure, but all are improved by medication.

All the other suspected forms of deficient thyroidism should be treated in the same way; Dercum's disease, senilismus, myxinfantilismus, and many other conditions.

DISEASES OF THE PARATHYROID GLANDS

Tetany [1]

Tetany occurs associated with other diseased conditions. Whether these are the direct or the indirect cause of tetany it is self-evident if these cannot be removed the tetany itself will persist. In children rickets must first be considered, and its removal by proper treatment is of great value. In the gastric form of adults local treatment is indicated; as there is great dilatation of the stomach gastroenterostomy may give relief. Moffett (24) (1911) has seen three cases out of six cured in this way. He says, "in gastric tetany surgery must remedy the underlying conditions that are the cause of stagnation, dilatation, and intoxication." The effect of eating too much meat has already been referred to in connection with diseases of the thyroid (q. v.); in all cases of tetany it is best to withdraw it altogether, substituting for it milk or the vegetable albumins. The food should be adapted to the condition of the stomach and the bowels should be kept open regularly.

For the removal of the intoxication the ordinary modes of treatment are employed, free catharsis, sweats, diuretics, and dilution of the blood

[1] See Vol. I, Sec. I, Chapter II.

by injections of normal saline solutions. The other modes of treatment consist in the administration of calcium chlorid or lactate, organotherapy and the treatment of symptoms. In the severe form calcium lactate should be given intravenously, 3-5 gm. (gr. xlv-lxxv) in 300 to 400 c. c. of normal saline solution (Moffett). Its effects, it is said, are transient and the injection may become necessary again after twenty-four hours. In milder attacks the calcium may be given in normal doses by the mouth.

Organotherapy is applied in the same way as in other diseases in which the ductless glands are involved. The parathyroids are given raw, 0.02-0.04 gm.—gr. 1/3-2/3—in a day; in the form of dried gland, 0.15-0.45 gm. (gr. iiss-viiss) a day; as a parathyroid proteid prepared by Beebe. The thyroid gland has also been, and is still, employed successfully in the treatment of tetany. The statement is made that when it is successfully employed the good results are due to parathyroid substance existing in the thyroid. It seems that this can be rejected, as so careful and competent an observer as Kocher states that he has had tetany disappear after the internal administration of thyroidin as well as of iodothyrin. Moreover, this has been demonstrated by animal experiment, where animals without parathyroids have been kept alive by thyroid feeding. Certainly in chronic cases this might become a very valuable mode of treatment. v. Eiselsberg has successfully transplanted human parathyroids in one case in the human being, the result being a perfect cure.

Symptomatically the spasmodic condition is of prime importance as its persistence and intensity may be a matter of life and death. In milder cases hydrotherapy may be applied in the form of lukewarm baths, the half bath, the cold bath, sponge bath, lukewarm pack. An ice bag to the spine is very useful in some cases. Massage and electricity have seemed valuable in some cases. The faradic current should never be applied, a weak galvanic may be used on the affected muscles or upon the spine. The salicylates in large doses to produce their sudorific effects, antipyrin and their combinations have also been tried. In many cases bromids, chloral, morphin are required to give relief. In the worst forms chloroform may become necessary.

Hyoscin and curare (curarin, 0.0003-0.0006 gm.) have also been employed; the former can hardly be considered valuable in this condition, the latter might be, but, on account of its variability, the remedy has never come into general use. Even curarin cannot be absolutely relied upon to produce a given result with a given dose. Such a situation with such a drug is not conducive to its acceptance in therapy, except in a great emergency.

When pregnancy acts as a predisposing cause either prevention of conception for the future or interruption of the pregnancy for the present should be resorted to. When the thyroid is removed the surgeon should perform that operation in which neither the parathyroids nor their blood

vessels are molested, if it is at all possible. If injury is done or the parathyroids have been removed they should be transplanted immediately (Halsted).

DISEASES OF THE THYMUS GLAND

Status Lymphaticus

The original name given to the symptom-complex first described by Paltauf in 1889 was the lymphatic constitution. The condition is most commonly called the Status Lymphaticus, but also status thymicus, status thymicolymphaticus, and lymphatism. For a further discussion of this subject the reader is referred to Warthin's paper on the Pathology of Thymic Hyperplasia and the Status Lymphaticus (32). As far as the obstructive theory of thymus death is concerned there can be no doubt of its existence because patients have been saved by removing the obstruction; 5 cases of this kind are reported by Rehn. But it must also be admitted, as is done by unprejudiced observers, that a certain number die without any obstructive symptoms. As yet the relative frequency of the two kinds of death has not been determined. Taken all in all we are forced to the conclusion that in the thymus we have a most complicated process of internal secretion, in which the chromaffine system, the sexual glands possibly, and the thymus itself partake—possibly other glands, notably the lymphatics. When sudden changes occur in their process of secretion death may occur. When involution of the thymus occurs the morbid condition disappears.

From a clinical point of view we have the same condition in the status lymphaticus that exists in Graves' disease. When there is a large gland which, with others, seems to form a circulus vitiosus it is most readily broken into by reducing the size of the large gland (v. Graves' disease). Moreover we have the same conditions in other respects; the enlarged thymus gland acts just as does the thyroid in Graves' disease: it does harm by its enlargement, therefore pressure symptoms occur; and also by its hypersecretion. Both of these are removed by diminishing the size of the gland. This, then, is the paramount indication for the treatment of the status lymphaticus. In addition there are precautions which must be carried out in order that the patient does not die of the "mors thymica" while the treatment is going on. For this purpose Jacobi's (17) recommendation should not be forgotten. He says, "from much clinical experience with enlarged thymus glands (lymphatism) occurring during later months I suggest careful attention to the posture of such babies. The thymus will fall backward when the baby is on its back and relieve the trachea when in a less recumbent posture. For many years past I could demonstrate the presence or absence of an extensive dulness behind and

below the manubrium sterni in this connection with the posture of the child." Sudden death occurs most unexpectedly after procedures which, under normal conditions, are harmless, and all precautions should be taken in this direction. We know that minor operations of all sorts may cause sudden death in the status lymphaticus: injections of serum, slight surgical operations, circumcision, tonsillotomy, removal of adenoids, etc. When the children die during operations it is during anesthesia, and it seems to be indifferent whether chloroform or ether is employed. Such children should not be anesthetized until the status lymphaticus has disappeared. Friedlander's (11) case, which was the first one to have been cured by X-ray therapy, has since been anesthetized and operated upon without untoward effects. Fright, even less perturbing causes, should be avoided. The celebrated case in which a noted savant had to give up his child because antitoxin was administered in what subsequently was recognized as the status lymphaticus should warn us to be on the lookout for this condition.

In order to reduce the glandular tissue surgery was first applied. Thymopexy, which was first employed, was a complete failure, except for temporary relief of stenosis. Thymectomy is the operation that is now done. In every way its results are better than those from the older operation (thymopexy). The great objection to it is its relatively great mortality. In a series of cases reported by Lenormant (1909) there were 11 cases in which there were 7 cures, one improvement, and three deaths. Klose (1910), including 5 cases reported by Rehn in 1896, now finds 23 more reported: in these 28 cases there were three which died (about 11 per cent.). In view of the fact that we can obtain better results from another form of treatment the surgical treatment will become less and less necessary. At present there is only one kind of patient who should be operated upon. Within the year I have seen such a case in which operation was refused. An infant had been treated for some time for another disease when, in consultation, I was enabled to make the diagnosis of the status lymphaticus, verified by the X-ray examination. Notwithstanding immediate application of X-rays upon my discovery of the cause of trouble the child died in four days of thymus stenosis. In those cases, then, for the present, in which thymus stenosis exists and in which improvement does not take place as quickly as is necessary to relieve stenosis thymectomy should be done.

When this operation is done it is necessary to bear in mind that all modern and reliable experimental evidence points to the fact that animals cannot live when the whole thymus is removed. It is necessary, therefore, as in Graves' disease, to make not a total, but a partial thymectomy. How much or how little should be left has not been determined. In the 28 cases of Klose only one is reported as improved, which would show that great latitude may be indulged in regard to the quantity of thymus to be

removed. It is certainly a safe procedure not to remove too much, although regeneration seems to go on in the thymus as it does in other glands. No one, however, knows anything about the human thymus in this connection, and when the stenosis has been removed the object of the operation has been fulfilled, and with it life has been saved—the rest of the reduction in size may be accomplished by the next mode of treatment.

In 1903 Heinecke showed that X-rays have a profound influence upon lymphoid tissue in the guinea pig. Changes in the spleen occurred promptly in young animals, marked by increase of pigment, disintegration of cells, reduction of the Malpighian bodies, and rarefaction of cells in the spleen pulp. The same occurred in the follicles of the thymus. Led by these investigations, A. Friedlander first fully applied X-rays to a child for the cure of the status lymphaticus.

As Sidney Lange, radiographer of the Cincinnati Hospital, has treated more cases than any one else in this manner, and is otherwise entitled to speak upon Roentgen ray therapy, I have asked him to give me the technique of the treatment.

"The technique is not difficult. An efficient dose of X-rays must be administered to the thymus without injuring the overlying skin or other tissues of the body.

"A fairly hard X-ray tube must be used, one reading 5 to 6 on the Walter scale. As a safeguard against injury to the skin the rays should be made to pass through a thick piece of leather or through a sheet of aluminium 1-16 inch thick to filter out the soft rays. The skin may be further protected by giving one treatment over the anterior aspect of the gland and the next over the posterior aspect, although of course the action upon the gland is brought about quickest by anterior exposures, since the gland lies nearest the ventral surface of the body. To protect the rest of the body the X-ray tube should be inclosed in a ray-proof shield, with an opening 1 to 2 inches in diameter for the exit of the rays. The distance of the target of the X-ray tube from the skin should be about 8 inches.

"The length of exposure and the frequency of the treatments will depend upon the severity of the symptoms. Where the symptoms are mild two treatments a week of 10 minutes each with a current of 1 to 2 milliampères will suffice. Where the symptoms are urgent treatments may be repeated three times a week or even daily, and the time of exposure may be increased to 12 or 15 minutes, giving one treatment anteriorly and the next posteriorly. Ten treatments will suffice in the average case to improve or dissipate the symptoms.

"However, it should be borne in mind that rapid regeneration of the thymus follows the partial atrophy produced by the X-ray, and there may be a recurrence of symptoms necessitating a repetition of the treatments. Such recurrences have been seen in most of the cases so treated and may be regarded as evidence of the harmlessness of the X-ray treatments, since

none of the possible late effects of complete atrophy of the thymus need be feared. The X-ray treatment is not primarily intended to produce complete atrophy of the thymus and the exposures should not be pushed to that end. An amelioration of symptoms to tide the child over is all that is desired. As the child grows the increase in the size of the chest and the rapidly changing metabolism incident to the child's development may be relied upon to complete the cure. Such rapid regeneration of the thymus after irradiation has been observed experimentally in rabbits and has been especially commented upon by Rudberg.

"With this possibility in mind the patient should be kept under observation for six months to a year, and upon the first evidence of recurrence further X-ray treatments should be given.

"There have been no undesirable accompaniments of the X-ray treatment of thymic enlargements. The skin over the gland has not even shown an erythema. No toxic effects of tissue destruction have been noted nor any late effects upon the growth of the child so far as the cases have been followed."

Aubertin and Bordet (1), 1909, Rudberg (vide Pappenheimer, l. c.), and recently Friedlander (1911) (11) have studied the effects of X-rays upon the thymus gland in lower animals. Practically they agree perfectly, and Friedlander has summarized the situation in regard to this mode of treatment as follows:

"(1) In the X-ray we have an agent which is at the same time safe and efficacious in the treatment of enlarged thymus and status lymphaticus.

"(2) By means of the X-ray it is possible to induce not only an involution of the thymus, but also in cases of status lymphaticus to reduce the size of the spleen, of the lymph nodes, and to change the lymphatic blood picture to the normal one.

"(3) By variation in the number and frequency of X-ray exposures it is possible to bring about the involution with varying degrees of rapidity. Where the symptoms of thymic asthma are urgent the exposures can be given on successive days, thus inducing prompt results.

"(4) Experimentally it has been shown to be possible to induce any degree of fibrosis of the thymus from the very slightest to absolutely complete sclerosis.

"(5) Clinically the dosage of X-ray can therefore be regulated according to the necessities of the case.

"(6) A thymus partially involuted by the X-ray is capable of regeneration. The danger of loss of thymus function (as in the case of complete thymectomy) is thus obviated and the metabolic changes after thymectomy averted.

"(7) The use of the X-ray in these cases is without danger to the individual, as proved by the subsequent normal development of our treated cases."

I have seen seven cases of status lymphaticus. Of these two died, as the effects of the X-ray treatment were not such as to produce sufficient change, quantitatively or qualitatively, in a sufficiently short time to save life. In the other five cases the results were perfect, the symptoms of compression were relieved, the lymphatic glands and tonsils were reduced as well as the spleen. Their age varied from six weeks to two years. In the baby of six weeks of age I saw the child within six hours of the first attack of dyspnea, which lasted for half an hour, and X-ray treatment was begun the next day. The baby has had only three severe attacks in all, then a few milder ones, and then seemed well, the thymus is normal, and she has been otherwise perfectly well up to the time of writing, i. e., for a year. This case illustrates how readily the condition can be controlled when taken early enough. The earlier the treatment is begun the quicker and the better the result.

Tumors, hemorrhages, and inflammations are treated as they would be anywhere else under the same conditions.

DISEASES OF THE PITUITARY BODY

(*Hypophysis*)

Acromegaly

For historical development and pathological physiology see Vol. I, Sec. I, Chapter II.

The combined results of investigation of the pathology and physiology of this disease, of the gross as well as its finer anatomy, the metabolic and other changes which exist, enable us to draw conclusions for treatment. The following should be considered in this connection: Paulesco (1907) and Cushing have established the fact, the latter confirming the views of the former, that the hypophysis is absolutely necessary to life; therefore the surgery of the hypophysis should be limited either to the removal of tumors or when there is hypertrophy to partial hypophysectomy (Cushing). The infundibulum or stalk should not be cut through, as it results fatally almost as quickly as does a nearly complete extirpation of the body itself. The anterior lobe is absolutely necessary to life in animals; not so with the posterior lobe, without which they may exist for months. There are frequently found changes in other glands in acromegaly: enlargement of the thymus, either enlargement or diminution of the thyroid, changes in bones, the adrenals, and especially changes in the genital glands, either degenerative or hypoplastic. Etiologically this disease may again be considered as being caused by some defect in internal secretion. The reasons for this are as follows: the lesion or change is always found in the pituitary body, other internal secretory glands are made to coöperate in order to antagonize the abnormal internal secretion and, lastly, it conforms in its mechanism of action with all the other forms of disease due to improper internal secretion.

The pathology of the disease shows us that in all cases (Cagnetto)

some change is found in the pituitary body. Tumors are the most common, and they frequently consist of hypertrophic and hyperplastic hypophyseal tissue: adenomata, adeno-carcinomata, and other forms are also found. Biedl states that "all those tumors of the hypophysis which are associated with acromegaly always consist of true hypophyseal tissue." Indeed, Benda has shown that the so-called adenomata are in reality nothing more than hypophyseal tissue and not tumors.

The question whether this disease is due to hypo- or hyperpituitarism is still under discussion. Marie and, among others latterly, Cagnetto believe the disease to be due to hypopituitarism. On the other hand, as stated by Hochenegg and Cushing, this question is settled by the results of the operation for removal of the pituitary body in acromegaly. When the tissue is removed there is less secretion, when there is less secretion the acromegaly disappears: therefore it would seem that there is hyper- and not hypopituitarism.

It has been definitely settled that the pituitary body is enlarged during pregnancy; and that this is due to a hypertrophy of the organ. Fichera has produced hyperplasia and hypertrophy in animals by castration. Tandler and Gross and Rössle showed the existence of an enlarged sella turcica in castrated men and in one woman whose uterus had been removed. So that a number of authors—Mayer most recently (1909)—have expressed the opinion that we will find the first cause of the disease in the sexual apparatus. It would be natural, therefore, as a result of pure experimental evidence to try to do something which would introduce the constituents of the ovaries or testicles, as the case would require. Even without this those remedies would suggest themselves, especially in women in whom the sexual symptoms of acromegaly are identical with those of the menopause. This I have done, giving to a patient large doses of ovarian substances, unfortunately without result. This question might be settled experimentally by transplanting sexual glands in lower animals which have been partially deprived of their hypophysis. An encouraging beginning has been made by Fichera, who has succeeded in preventing hypophyseal enlargement in castrated animals by giving internally ovarian or testicular products as were indicated. Sidney Kuh, acting on the basis that acromegaly is due to hypopituitarism, has obtained good results by administering the anterior lobe of the pituitary body. That this proves the hypopituitaristic hypothesis cannot be accepted. It will have to be shown that the pituitary body does not also activate the genital glands, as by an extra stimulant they may also return to partial activity.

At present for cure we must do that which has been found necessary in all those diseases in which one gland seems to be the principal cause of symptoms, viz., to reduce its size. Hypophysectomy was first tried by Caton and Paul in 1893. Horsley, in 1906, reports 13 cases in which the hypophysis was removed in the human being.

Hochenegg (1908) first succeeded in curing a patient with acromegaly by the removal of a hypophyseal tumor. Cushing, as well as Exner, each report a successful case in 1909. In the former instance partial removal was followed by nearly complete cessation of symptoms. Exner published a case from Hochenegg's clinic in which the result was completely successful.

In regard to the general mortality after the operation E. Melchior (22) (1911) reports as follows: There are recorded 41 cases in all. Of these 36 were operated upon by the transsphenoid route with a mortality of 33 1-3 per cent. Three of these died of meningitis. The remaining five cases were operated upon by the older way. In three cases the operation had to be given up, one case died as the result of the operation, and one survived for one and a half years. Individual operators have had better results. In the session of the K. K. Gesellschaft d. Aerzt, Vienna, June 30, 1911, v. Eiselsberg states that he has operated on 13 cases with 4 deaths, and Hochenegg 5 cases with two deaths. At best the mortality is 22 per cent. (Melchior). It should be done as early as possible, especially for the purpose of preventing blindness. As soon as the diagnosis is made by the existence of positive evidences the operation should be done.

Gigantism is also supposed to be due to hyperpituitarism; it seems to be the acromegaly of the period of growth. Here organotherapy seems to have been successful, which would prove that the genital glands, at least in this form, play a causal rôle. Ovarian and testicular products can be obtained without difficulty, but care must be taken to get such as are active. When they are given in sufficient dosage the effects follow very rapidly, i. e., in three or four days. This is the case in connection with ovarian products; I have never had occasion to prescribe testicular products.

Dystrophia Adiposogenitalis

A disease first described by A. Fröhlich in 1901 which, according to Cushing, Archner, and Biedl, is due to hypopituitarism. This may be the result of tumor pressure upon the pituitary body. These patients have pressure symptoms due to the tumor, there is excessive deposit of fat, hypertrichosis, they are small in stature and possess infantile genitalia. In these cases the tumor should be removed by operation. In as far as the other symptoms are concerned it would seem that they do not disappear entirely after the operation. On the other hand, excellent results may now be obtained by pituitary medication. This medication should always be applied in cases in which there is suspicion of hypofunction. The dried gland may be given in the dosage of from 0.1-0.3 gm.—gr. jss—several times a day. The preparation is that of Merck, in which one part equals about 6.5 parts of fresh organ.

PINEAL GLAND

As yet so little is known concerning the pathological physiology of this body that all conclusions in regard to therapy would be premature. It is supposed to have some relation to internal secretion, as it seems to have an accelerating effect upon bodily development, especially that of the sexual glands. With this there is mental development beyond the years of the patient, occurring usually before the eighth year of life. Biedl refers to the antagonism of this gland to the pituitary body. Efforts at removing the diseased pineal gland are not recorded. As there are both hyper- and hypofunction, and the way to the gland is long and through difficult country, it is a difficult surgical problem to solve.

Diseased lymphatic glands will be discussed in connection with those diseases which cause their involvement.

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