sugar (.04 to .07 per cent.) in all cases of hydrops, and Eichhorst (*Zeitschr. f. klin. Med.*, Bd. iii., p. 537) found sugar in ten out of seventeen cases of pleural exudate. Still the copper test alone is not reliable, since boiling of Lion's casein-like substance reduced Fehling's solution.

When sugar amounts to more than .02 per cent. the effusion is chylous. Leydhecker maintains that sugar appears in the transudate only when the lymph vessels of the liver participate in the effusion. As Rotmann suggests, Leydhecker's proposition implies that the lesion of a chylous ascites must be either above the ending of the hepatic vein or that the hepatic lymphatics be assigned as a cause for the appearance of sugar in the ascitic fluid. Rotmann finds that cases in which sugar is found correspond to Leydhecker's hypothesis. Eisenschlitz concludes that the presence of sugar does not make a milky effusion a chylous transudate, since in a case of Moscatelli 0.15 per cent. of sugar was detected in an ascites from liver cirrhosis. A small amount of fat speaks for chyle. Landois estimates the percentage of fat in chyle at nine-tenths of one per cent. Chylous ascites also is rich in solids, especially mineral salts and albumen. Albumen and fat occur conjointly in small punctiform granules susceptible of differentiation by chemical tests. Microscopic examination may differentiate between chylous and adipose fluids by the size of the fat globules or fat and albumen granules.

Adipose or Chyliform Ascites.—Adipose ascites is characterized by the absence of sugar and the higher percentage of fat. The degree of opacity is no index to the amount of fat, since the turbidity may be due to the presence of emulsionized albumin. Fat occurs in most cases; its maximum percentage is 5.25 (Schmidt) and in our case 6.4 per cent., but it may be diluted by venous stasis or inflammation, while concentration of the fluid raises the percentage of fat (Minkowski). Contrary to the older conceptions, milky fluid need not contain fat, as shown by Lion's case in which a proteid, like casein, produced the opacity, as well as in the cases of Quincke, Verdelli, Achard, Sainton, Apert, Ceconi, and Basch. Fat is recognized by the osmic acid, the alkanna stain, and solubility tests. The granules of albumen and fat are much coarser in adipose than in chylous ascites. Hydropic and fatty carcinoma cells may, if numerous, cause a creamy layer, and their microscopic detection favors a diagnosis of hydrops adiposus.

Inflammatory products may obscure the pathogenesis, and hence conclusions cannot be dogmatized from every analysis. Again, the fluid changes with time, the blood absorbing parts of the original fluid—in cachexia, for example. Lymph or chyle may escape into a serous exudate or transudate of earlier origin.

The fluid, of whatever kind, usually clears with ether and caustic potash. It is said to resist decomposition on account of the emulsion of fat and a supernatant fatty layer; to which proposition one of our own cases is an exception. The reaction is usually neutral or alkaline, although it was once recorded as acid. The fluid is opalescent from suspended molecular fat and emulsionized albumen. Some fluids coagulate spontaneously, others do not. Poncy noted the odor of ingested food, while Nickerson pronounced the taste in his case cadaveric. A specimen standing ten days (Quincke, "Ueber Ascites," *Deut. Arch. für klin. Med.*, 1882, pp. 569–587) became acid, due to the formation of fatty acids. Specific gravity varies from 1.007 to 1.026, the average being 1.016. Reaction and specific gravity do not differentiate between the various forms. Macroscopically, nothing is seen except oil globules. Microscopically, fine point-like granules of fat are visible, which often have molecular movement and are soluble in ether. Large fatty cells, lymphoid, endothelial, carcinoma, and sarcoma cells are observable. Red blood discs occur, as do also fibrin (seven times), filaria (Winkel), casein (Straus and Omerod), mucin, sodium alkali albuminate (Oppolzer), bile (Omerod), acetone, hydropsin, peptone (eight times), lecithin (twice), cholesterin (three times), fibrinogen (twice), a diastatic ferment (twice), various inorganic compounds of calcium, sodium, sulphur, phosphorus, potassium, and chlorine. Urea has been recorded three times (Quincke, Remond, Foot). Tubercle bacilli have never been found. The highest percentage of albumen is 6.08 (Ballmann).

Symptomatology and Diagnosis.—The symptoms possible with such a varied etiology are not limited in number or character. The primary disease does not indicate the character of the ascites, for ascites adiposus chylosus is no morbid entity. In conjunction with chyloperitoneum, chylous fluid may be vomited (Sprague, Pellitier, Foot, Nickerson) or discharged per anum (Pellitier, Nickerson). The association of ascites with chylothorax is suggestive, even before abdominal paracentesis. The only conceivable etiological hints relate to diseased lymphatic glands and vessels, affections of the thoracic duct or left subclavian vein (*i.e.*, compression), or chyluria. "The chylous nature of an ascites may be suspected when associated with sudden anorexia, acute anæmia, and emaciation" (?). Rapid recurrence may indicate chyle fistulæ. Temperature is neither frequent nor significant. If transudation through lymph-vessel walls be the cause, the clinical course is less stormy in onset and less rapidly progressive than is observed with antecedent rupture. A diagnosis has never been made prior to puncture, except in the single instance of Morton's early case. The blood varies, of course, with the fundamental disease. Lipæmia was observed once (Popham). The local signs and symptoms do not differ from those of serous ascites. It is probable that many cases diagnosed as the vulgar ascites, healing without treatment, are instances of chylous hydrops, and the increasing frequency of the disease is best explained thereby. It is not easy to differentiate between chylous and adipose effusions as Quincke would have it, and even at necropsy an exact diagnosis is often impossible. Indeed, Senator and Leydhecker have recently spoken of mixed types. In many cases of our classification, even where full details are given, it is often difficult to decide whether the effusion be chylous or chyliform (adipose).

Prognosis.—Reference to the collected cases shows that 81 per cent. died, 8 per cent. were not followed, 11 per cent. recovered. Considering only those in which the ultimate issue is known, 88 per cent. died and 12 per cent. recovered. Bianchi says that the prognosis is better in any rupture than in cases of chylous transudation. Rupture is more likely to heal when it is due to trauma than when caused by mural disease, since thrombosis occurs more readily in trauma. Wiescher ("Zur Casuistik der Verletzung des Duct. Thoracicus," *Deut. Zeits. für klin. Chir.*, Bd. xxxviii., H. 4, 5; also contains account of experimental work upon thoracic duct), reviewing sixteen cases of chylothorax from rupture of the thoracic duct, concludes that rupture is almost invariably fatal. Rupture of the lymph vessels or receptaculum chyli may be compatible with life by the formation of thrombi and establishment of a collateral circulation (experiments of Monro, Lower, Cooper, Dupuytren, Schmidt-Muhlheim, Leichmann, Leuret, Lassaigne, Colin, Flandrin, Magendie, Noeckher, Rogerd, also citation of Wiescher above). Monro stabbed the receptaculum of a pig, but effusion was prevented by thrombosis. If there be no communication left between the blood-vascular and lymph-vascular systems, progressive inanition and death are inevitable. A chylous fistula increases the gravity of the prognosis, as copious and continuous chylous discharge is invariably fatal. I believe the immediate prognosis is better in adipose ascites. Extensive obstruction to the lymph stream is always serious. The prognosis is impressed by concomitant or causative visceral lesions. A close analysis of reported recoveries to determine favorable prognostic characters demonstrates that 3 cases were puerperal and therefore fabulous; 1 was chlorosis; 1 was compression of the thoracic duct by enlarged glands; 1 was filarious disease; 33 were ruptured lymph vessels; 5 were ruptured chyle cysts; 1 was tuberculous peritonitis; 1 was chronic recurrent peritonitis (possibly tuberculous). Only the last 2 cases were adipose, while the first 9 were chylous hydrops. Therefore the ultimate prognosis is better in chylous effusions, the converse being true of adipose accumulations. Chylous ascites is to adipose ascites as $2\frac{1}{4}$ is to 1, while recoveries stand as 5 to 1. Laparotomy improves the prognosis.

Treatment.—Analysis vindicates surgical interference under two restrictions: first, laparotomy is indicated as prophylaxis against possible chylous rupture with consequent constitutional depletion; second, laparotomy for tuberculous peritonitis. Paracentesis should be avoided as far as possible, save, first, as a preliminary diagnostic resort, and, second, as an ultimate resort against compression of the thoracic viscera. Otherwise puncture depletes the organism, especially in the genuine chylous form. The peritoneum should be allowed to resorb all it can of the chylous transudate. A diet readily digestible and absorbable by the stomach is advised (P. J. Murphy), to permit healing by thrombosis of ruptured lymph vessels. The use of water should be restricted. For filariosis, Lancereaux recommends mercurial inunctions and local injections into the diseased lymph glands; Guiteras remarks there is no hope short of the death of the adult worm. Other than mercurial parasiticides are probably useless. The therapy in other directions is absolutely symptomatic. *Arthur R. Edwards.*

References.

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3 Ephemerides Germaniæ, decur. ii., ann. viii.
4 Manson, Lewis, Sonsino, Mastin, Sr. and Jr., Guiteras.
5 Hasebroeck: Zeit. f. physiol. Chemie, 1888, p. 289.

CHYLURIA; GALACTURIA.—Definition and Etiology.—Chyluria signifies the presence of chyle, and consequently of fat in a state of emulsion, and albumin in the urine. Sugar, a constant ingredient of chyle, is so rarely found in chyluric urine that its presence would warrant the suspicion of coincident diabetes mellitus.

There are two varieties of chyluria, the parasitic and the non-parasitic, the former being by far the more common. It has been customary to speak of these two forms as "tropical" and "non-tropical," but since the demonstration of parasitic chyluria in temperate zones this division is no longer appropriate. It is nevertheless true that in the vast majority of cases of parasitic chyluria the patients have become infected in tropical or subtropical countries. Data regarding the etiological influence of age, sex, and occupation are either scanty or absent entirely. According to Senator, chyluria has not been observed in childhood or in the aged. There is, however, no reason, in the nature of things, why it should not occur at any period of life, for its cause is mechanical obstruction of the thoracic duct and this may be seated within the calibre of that tube, in its walls, or outside of it.

Much the most common cause of chyluria is obstruction of the thoracic duct either by adult or embryonic forms of the *Filaria sanguinis hominis nocturna*. In the great majority of cases of chyluria, embryonic filariæ may be readily detected in a drop of blood from any part of the surface of the body, provided the blood be obtained at night. During the day, the embryos of filaria nocturna are very scantily present in the surface capillaries or are absent from them altogether. Manson, observing the embryonic characters of the circulating filariæ and their presence in the surface capillaries chiefly or solely during the night, came to the conclusion that they must reach a further stage of development outside of the body in the interior of some nocturnal blood-sucking animal. He exposed a patient with "*filariasis*" to the bites of mosquitoes, and found the embryos in the bodies of these insects, in which, in the course of from five to seven days, they attained a length of one-fifteenth of an inch. In the blood of man they measure from one-seventieth to one-eightieth of an inch, and are enclosed in a sheath from which they make their escape in the viscid blood of the mosquito. The mosquitoes with the embryonic filariæ in their interior seek water in which to deposit their eggs. This function accomplished, they perish; the embryonic filariæ are liberated, and through the medium of the water in which they exist, gain access to the human system. Manson's latest researches have practically demonstrated that the filaria may be transmitted directly from the infected to the non-infected by the agency of the mosquito (Culex ciliaris or pipiens) in the same manner as the Hæmatozoon malariæ is transmitted by another species of the same insect—Anopheles claviger (*Bulletin de l'Académie de Médecine*, 22 Mai, 1900). Two or more of the ingested parasites attain maturity in the lymphatic system and continue for an indefinite period (sometimes for many years) to produce swarms of embryos. The presence of filaria embryos in the blood does not necessarily give rise to disease, their transverse diameter ($\frac{1}{315}$ inch) being, as a rule, such as to enable them to traverse the narrowest channels of the blood and lymph. Occasionally, however, they occlude these vessels, and this is believed by Manson to be due to the fact that the embryos are prematurely born enclosed in a sac or sheath of globular form, the transverse diameter of which is about $\frac{1}{75}$ inch. Disease in man occasioned by the filaria is therefore the result of disease in the filaria itself. If the adult female filaria produces the young in a physiological manner they are innocuous to their host; if, through disease or irritation, she brings them forth prematurely, they obstruct the lymph channels and cause one or more of the diseases grouped under the title of "*filariasis.*"

The principal diseases to which the filaria gives rise are abscesses, lymphangitis, dermatitis and cellulitis, erysipelas, orchitis, chyluria, chylous dropsy of the peritoneum, chylous dropsy of the tunica vaginalis, varicose groin glands, lymph scrotum, and elephantiasis. Chyluria is not common even in those countries in which filariasis prevails.

As above stated, obstruction of the thoracic duct from any cause may give rise to chyluria. As stated by Manson, the "cause of chyluria is obstruction of the thoracic duct, and this may be brought about in any climate by pressure on the duct, by tumors, by infarcts, by growths, etc.; but in the form of chyluria endemic in the tropics . . . the cause of the obstruction is the parent filaria nocturna."

A case is reported by Mr. Leigh Hunt in which transient chyluria was produced by traumatism, a fall upon a pile of stones (*British Med. Journ.*, February 22d, 1890).

Symptoms and Signs.—The onset of chyiuria may be preceded by no symptoms whatever. In some cases, however, there is a sense of discomfort or pain in the lumbar region or the groins, the perineum or testes, before the chylous urine appears. The first symptom may be retention of urine due to the intravesical formation of coagula which occlude the neck of the bladder or the urethra.

In the great majority of cases chyluria is intermittent, being dependent, for example, upon posture, digestion, bodily exertion, etc. In one of my cases it first appeared during the expulsive pains of labor, gradually ceased after parturition, and did not return until about two years later at the birth of another child. The influence of posture is shown by the fact that in some cases the nocturnal urine is chylous while that of the day has a normal appearance. The general health is, as a rule, well maintained, although if the discharge of chyle is long continued, emaciation, anæmia, and great debility set in and the patient dies from exhaustion.

The appearance of chylous urine is highly characteristic. On careless inspection it might readily be mistaken for milk, but when examined more closely it will usually be found to contain coagula of a delicate pinkish tinge or more deeply colored like ordinary blood clots. The gross appearances, in a case of my own, are thus described: "The urine, after standing for several hours in a narrow cylindrical vessel, separates into two portions, of which the lower is distinctly hemorrhagic; while the upper has the appearance of milk or cream. Floating on the upper chylous layer are numerous coagula of a delicate, pinkish hue, and almost translucent, while at the bottom are a

few small blood clots" (*Medical News*, May 2d, 1896). In some cases, after standing for a short time, the entire mass of the urine coagulates so as to resemble *blanc-mange*.

DIAGNOSIS.—There is no difficulty whatever in making the diagnosis of chyluria. Lipuria, which signifies literally the presence of fat in the urine, should never be confounded with it. In chyluria the fat is in the form of an emulsion so fine as to require the strongest objectives to resolve the droplets of fat. In lipuria, on the other hand, fat globules are seen with comparatively low powers, either free or enclosed in cells or tube casts. It is very seldom that lipuria exists in such degree as to alter the macroscopic appearance of the urine, while in chyluria it commonly resembles milk. The presence of clots is also diagnostic of chyluria. The fat may be separated from chylous urine by shaking it up with ether. The ether, with the dissolved fat, rises to the surface and is then decanted. On its evaporation the fat is deposited. The urine from which the fat has been thus extracted and consequently rendered more or less transparent may now be tested for albumin, which is constantly present in greater or less degree. In addition, chylous urine contains cholesterin and lecithin, and among the albuminous bodies, in addition to serum albumin, it contains fibrinogen, hemialbumose or propeptone, and peptone. It is stated positively by Senator that chylous urine does not contain sugar. This remarkable fact—namely, the absence from chylous urine of a constant ingredient of chyle—has given rise to the opinion that chyluria is not caused by a direct admixture of chyle with the urine. In the opinion of the writer this view is absolutely refuted by the post-mortem appearances observed in cases of fatal chyluria. These consist, for the most part, of a state of varicosity of the lymphatics in immediate relation with the urinary tract. In a case of my own, "the lymphatic vessels, especially those of both renal vessels, were enormously dilated and convoluted, many of them being of the calibre of an ordinary lead pencil. The dilatation was most marked on the right side, and in the pelvis of the corresponding kidney there was a pale lymph clot similar to the coagula passed with the urine during life" (*loc. supra cit.*). In this case the communication between lymphatic and urinary tracts was practically demonstrated. It is possible that the absence of sugar from chylous urine may be due to the presence of some as yet unrecognized glycolitic ferment in the renal secretion.

In all cases of chyluria both the blood and the urine should be examined for the filaria. In the former there is little difficulty in finding it provided the blood be withdrawn (by needle puncture of finger or ear) during the night. In the urine the parasite is apt to escape detection because it is frequently enclosed in coagula. These should therefore be broken up with a glass rod and the urine allowed to stand in a conical glass, at the bottom of which the liberated filariæ may be found.

PROGNOSIS.—The prognosis of chyluria is not unfavorable, but depends largely upon the mode of life of the patient. Manual labor and severe physical exertion of any kind tend both to develop and to perpetuate the disease. In women the pregnant condition is a serious complication.

TREATMENT.—With a view to prophylaxis, a sedentary occupation should be recommended in preference to one demanding physical exertion, and with the same object in view, straining at stool should be avoided by the occasional use of laxatives. As long as the urine is chylous, the strength should be maintained by nutritious food, tonics, and stimulants, and the patient kept at rest. It is doubtful whether any among the numerous remedies employed in chyluria are of the slightest direct benefit. With a view to their supposed efficacy in checking the discharge, astringent preparations of iron, gallic acid in large doses, and various vegetable decoctions containing tannin have been administered. In the parasitic form of the disease attempts have been made to destroy the filaria with thymol and other vermicides, none of which, in the opinion of the writer, has the slightest effect in this direction. I have elsewhere discussed the treatment of filariasis, and will therefore confine myself to the statement that there is no drug that will kill either the adult filaria or its embryos while they circulate in the blood, and that even if such a drug were known it would be wisest to refrain from its employment. When the adult filaria has its seat in one of the extremities and dies, an abscess usually results; or it is perhaps more correct to say that adult filariæ have been found in such abscesses, the presumption being that the latter are caused by the former. If, however, the adult filaria should die in the thoracic duct, with consequent abscess, the result would be of necessity fatal.* *Frederick P. Henry.*

*F. P. Henry, M.D.: Report of a Case of Indigenous Parasitic Chyluria; Med. News, May 2d, 1896. Remarks on Filaria; Proceedings of the Academy of Natural Sciences of Philadelphia, 1896, p. 271.

CHYME.—The term chyme is applied to the contents of the small intestines, or, in a more restricted sense, to the matter ejected from the stomach into the duodenum during the course of digestion. It consists of food in various stages of digestion mixed with the different digestive juices. It is a mixture of extreme complexity and of very variable composition. Its composition at any one time is determined by a number of factors, the most important of which are as follows: (1) The character and composition of the food; (2) the digestive juices—the saliva, gastric, and pancreatic juices, the succus entericus and the bile; (3) the extent to which absorption has occurred; (4) the motility of the stomach and small intestines. Under normal conditions the food ingested is the most important factor in determining the character and composition of the chyme. The food not only contributes its own constituents, which may be extremely complex, but also determines, to a large extent, the amount and nature of the secretions of the glands of the alimentary tract which are added to the chyme; further, one secretion may influence another, and both a third, and all undergo certain chemical reactions with the food and with each other. The movements of the stomach and intestines are influenced largely by the character of the food and the secretions caused by it; the chyme may remain a longer or a shorter time in the intestines, and so offer the digestive juices varying opportunities to act upon it. All these factors—character of food, the secretions, and especially the intestinal movements—influence the absorption of certain constituents by the intestines.

It is obviously impossible, when dealing with such a complex and variable mixture as chyme, to give any account of either the chemical or physical properties which will apply to any but individual cases. In considering these properties it will be necessary to discuss in each case the influences modifying them.

A great many of the facts known concerning the chyme have been obtained from experiments upon the lower animals, but there have been reported a number of cases in man in which the contents of the small intestines have escaped through an artificial anus. Elaborate studies have been made in some of these cases. The case most carefully studied was one reported by Macfayden, Nencki, and Sieber (*Archiv für exper. Path. und Pharmakol.*, xxi., p. 93, 1891). These authors had under investigation a woman in whom, as a result of an operation for strangulated hernia, an *anus præternaturalis* had been established at the lower end of the ileum, and from which the chyme could be collected. Jankowski (*Archives des sciences biologiques publiés par l'institt. de méd. exper. à St. Petersbourg*, i., p. 567, 1892) studied a case very similar to the above. Other cases which may be mentioned are those of Busch (Virchow's *Archiv*, 14, p. 140, 1858), in which the fistula was but a very short distance below the duodenum; of Lossnitzer (Dissert., Leipsic, 1864); of Braune (Virchow's *Archiv*, 19, p. 470, 1860), and of Ewald (*ibid.*, 75, p. 409, 1879). The objection has been made to all such cases as these that the intestine is not in its normal condition; that when an artificial anus is established the part of the intestine immediately above becomes, functionally, the rectum; and it is thought by some that

bacteria normally present in the large intestine may develop here and produce changes not normally occurring. Entirely satisfactory evidence that such objections are valid has not yet been offered, but it is important to remember them and to check the observations on patients with such fistulæ by experiments on normal animals whenever possible.

Chyme, as obtained from a fistula in man or directly from the small intestines in an animal, is a fluid or semi-pasty mass with a yellow or yellowish-brown or orange color. The chyme of the stomach or of the upper part of the duodenum is usually more grayish in appearance, although it may be colored brown from partly digested blood, or green from chlorophyl of the food. The yellow color observed in the lower part of the small intestine is due largely to the admixture of bile.

The odor of chyme is usually not very marked; that which is present resembles that of fatty acids. Occasionally it has a slightly fæcal odor (resembling indol) like that of the large intestine; but this is rare, as very little putrefactive decomposition of proteids (which is the cause of the odor of the contents of the large intestine) occurs in the small intestines.

The consistence of the chyme varies in different parts of the small intestine. When it leaves the stomach, it is a thin fluid holding solid masses of various sizes in suspension. As it passes down the intestine water (and bodies soluble in water) are absorbed; but this loss is about balanced by that added by the secretions of the digestive glands, so that the consistence remains nearly uniform in the upper two-thirds of the small intestine. In the lower third or fourth, however, the water absorbed exceeds that secreted, and the chyme becomes thicker and may be pasty or semi-solid. The nature of the food has, moreover, an important effect upon the consistence of the chyme.

The quantity of chyme which passes from the ileum into the cæcum varies greatly, being dependent largely upon the character of the food. The following figures are taken from the paper of Macfayden, Nencki, and Sieber. The patient was fed upon a diet consisting of 260 gm. of bread, 100 gm. of meat, two eggs, 200 gm. of barley gruel, 20 gm. of peptone, 60 gm. of sugar, 100 gm. of milk, and 1,050 gm. of bouillon; in addition to this she was allowed 200 gm. of water, 200 gm. of wine, and 150 gm. of "grog." The chyme was collected as it escaped from the lower end of the ileum. With the above diet, in which nitrogenous food preponderated, the intestinal contents were of thin consistence and contained on an average 5 per cent. of solids and 95 per cent. of water. At times they had the appearance of diarrhœic stools. When the patient received a vegetable diet the discharge became more consistent and contained on an average 10 per cent. of solids. The maximum amount of the thin discharge in twenty-four hours was 550 gm. with 4.9 per cent. of solids. The maximum amount of the more consistent discharge was 232 gm. with 11.23 per cent. of solids. Very similar figures were obtained by Busch, although in his patient the fistula was above the middle of the small intestine.

The solid constituents of the chyme are derived almost entirely from the food, and hence show great diversity. Before the food reaches the small intestines it has been exposed to the action of the saliva and the gastric juice and undergone marked changes—the character and extent of which are determined by the time during which it has been exposed to the action of these secretions. Foods containing proteids and gelatin are most profoundly modified. Thus, in a fragment of meat the muscle fibres have been usually separated from each other by the solution of the connective tissue binding them together; the fibres themselves are in a partially disintegrated condition, some having been split longitudinally, others transversely, forming the so-called "Bowman's discs." Some of the muscle may be completely dissolved by the gastric juice, but the chyme always contains many more or less altered muscle fibres; these are frequently in the form of a granular mass. The red corpuscles contained in the blood-vessels of the meat are partially digested in the stomach, and the hæmoglobin changed into hæmatin; the latter appears in the chyme and is one of the substances contributing to the brown color which this fluid now assumes. If much milk has been taken, masses of casein, coagulated by the rennin of the gastric juice, are found in the chyme; part of the fat is free while part is enclosed in the coagulum.

The walls of the fat cells of adipose tissue and the connective tissue binding the cells together are also dissolved by the gastric juice; the fat thus freed forms larger or smaller drops and appears in the chyme in this form. A little fat is broken up, in some way, into fatty acid in the stomach.

Pieces of tendon, elastic fibres, bone, and cartilage are not attacked by the gastric juice, and so appear in the chyme almost unaltered. Uncooked vegetable tissues are not much changed by the gastric juice owing to the membrane of cellulose, which is not dissolved in the stomach, protecting the cell contents. If the vegetables have been cooked, however, many of the cell walls have been burst and the proteids, starch, etc., of the contents exposed to the action of the gastric juice; the proteids may be for the most part dissolved, but the starch granules are scarcely altered.

Many gas bubbles are present; these consist largely of nitrogen and carbon dioxide and, to a smaller extent, of hydrogen. The nitrogen comes from the air swallowed with the food; the carbon dioxide is derived from the blood by diffusion, from fermentation of carbohydrates, and from the neutralization of the acid of the gastric juice by the carbonates of the intestinal secretions. Oxygen is not found, or is found in very small amounts; that swallowed with the air is soon absorbed.

While the chyme contains much matter in suspension, there is but very little substance in solution. If the solid parts be filtered off, the filtrate is found to contain salts, hydrochloric acid, and a small amount of peptones and albumoses and usually sugar. A piece of proteid added to this clear filtrate is rapidly dissolved, showing the presence of pepsin.

The above description applies to the chyme of the stomach, or to that which has just reached the duodenum. In the duodenum the chyme undergoes marked changes both in appearance and in chemical composition; these are brought about largely by the admixture with the bile, pancreatic juice, and succus entericus, and the chemical reactions resulting therefrom. Other factors in producing changes in the chyme are bacterial decomposition and the absorption of some of its constituents. The flow of the secretions into the intestines has long been known to be closely dependent upon the presence of the chyme in the duodenum, but the details of this relation have been worked out only in very recent years by Pawlow and his pupils (see the *Archives d. sciences biolog.*, St. Petersburg). These investigations of Pawlow, which form one of the most marked advances in the physiology of digestion of late years, show that not only does the quantity of the pancreatic juice and the bile and their rate of secretion depend upon the presence of food in the digestive tract, but also that there is a wonderful adaptation of the constituents of these secretions to the character of the food to be digested. The experiments were made upon dogs with permanent fistulæ; a few of the more important results which are of interest in this connection will be noted. We will begin with the pancreatic juice.

When the stomach was empty and the dog fasting, there was no flow whatever from the pancreatic duct; the mere sight of food, however, caused some secretion, this being brought about in part by the entrance of the acid gastric juice into the intestines. As soon as food entered the stomach an active secretion of pancreatic juice began; the amount and character of this depended upon the kind of food which had been taken. Thus, in one experiment 600 c.c. of milk caused 45 c.c. of pancreatic juice to be secreted, while 250 gm. of bread caused a secretion of 151 c.c., and 100 gm. of meat a secretion of