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BORDERLINE DISEASES

A STUDY OF MEDICAL DIAGNOSIS WITH ESPECIAL REFERENCE TO ITS SURGICAL BEARINGS

BY

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WITH ONE HUNDRED AND FIFTY ILLUSTRATIONS IN TEXT AND ONE PLATE

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PART II (Continued)

ON THE CLINICAL APPLICATION OF DIAGNOSTIC METHODS

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SECTION IV

DISEASES OF THE DIGESTIVE SYSTEM

1. DISEASES OF THE MOUTH

STOMATITIS

Catarrhal Stomatitis.—The acute catarrhal variety is seen most frequently in children, and is the result of irritation of some kind in the mouth. This may arise from eruption of teeth, from infections about the gums, decayed teeth, deposits of tartar, irritation of highly spiced foods, etc. It is also especially found in debilitated subjects with digestive disorders or chronic Bright's disease. Although many bacteria and fungi are found in the examination of the secretions from the mouth, there is no evidence as yet that any one is specific. The swollen condition of the gums, lips and teeth, the increased secretions and the sensitiveness upon attempting to eat, with slight fever, cause annoyance and, in children, much fretfulness. The possibility that it may be symptomatic of some chronic disease, especially renal or digestive, must be considered.

Follicular Stomatitis (Aphthous Stomatitis).—In this more severe type the inflammation is followed by the appearance of small yellowish-white patches, very sensitive and often painful, surrounded by a red areola and soon becoming vesicular. Upon the rupture of the delicate vesicle a small ulcer is found. Although discrete as a rule these lesions may coalesce and form extensive ulcerations with ragged edges. These appear by preference where the edges of the tongue and the lips and cheeks come in contact. It is perhaps of neurotic origin at times but is common in anemic children with indigestion or acute exanthematous diseases, and while teething. In adults the association with hyperacidity of the stomach should be noted, as the trouble may be most annoying for years and wholly insusceptible to cure by local treatment, although amenable to measures

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directed toward gastric acidity. No specific infectious agent is recognized.

Ulcerative Stomatitis.—This affection is also designated "putrid sore mouth" because of the severity of the process. In children after the age of infancy it is not uncommon as an epidemic in institutions with poor hygienic arrangements, and has been thought to be directly contagious or to be carried by means of the milk. Yet no specific organism has been detected. Some of the old descriptions perhaps apply to epidemic foot-and-mouth disease, which has occasionally occurred in barracks, camps, prisons, etc. It has a superficial resemblance. Ulcerative stomatitis flourishes upon the generally unhygienic conditions of the teeth, gums and mouth, and especially in debilitated individuals. In recent years the finding of spirochetes and Vincent's fusiform bacillus, found in Vincent's angina, has been reported, but always in association with other organisms. Redness and swelling appear at the gum margin, ulceration takes place, a grayish membrane covers the ulcerated areas, and much swelling with bleeding here and there, and finally necrosis, with uncovering of the alveolar processes, is noted. Profuse flow of saliva, foul breath, pain upon attempting to eat, submaxillary adenitis, fever, loss of some of the teeth, and a blotchy eruption are further features. In feeble children death may occur.

Mercurial Stomatitis.—An inflammation quite similar in character to the last described affection is seen after poisoning by mercury. Susceptibility to the poison is the most important feature in the etiology. Since those without teeth commonly escape it is evident that trouble at the gum margin, doubtless because of the ease of infection there, is an important factor. Salivation is the first symptom, and if the mercurial be not suspended ulcerations appear at the edges of the gums, and the teeth may drop out. The submaxillary glands swell, the tongue becomes indented by the teeth, and the breath assumes an almost pathognomonic foul odor. In the worst cases extensive sloughing may occur. The possibility of mercurial poisoning must not be lightly dismissed in these cases, since the patient may not know of having used the drug, or some unusual variety of mercurial poison may be the source. The use of blue oint-

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ment for vermin, hypodermic use of mercury for syphilis, the taking of a calomel and ipecac tablet nightly by mistake for an aloin tablet, the use of bichlorid in surgical dressings or as a douche are some of the common methods of intoxication. Two of the worst cases I have ever seen came from the use of a 7½ grain tablet ignorantly *inserted dry into the vagina* as a preventative of conception, with of course extensive local lesions. I have seen many cases from accidental swallowing of bichlorid solution, two of them in physicians. The patient complains of salivation and a metallic taste and soreness in the mouth.

Parasitic Stomatitis (Thrush).—In the whitish patches seen in the mouth may be found multitudes of the causative fungi, Oidium albicans. The disease occurs only in subjects, both children and adults, whose resistance is lowered by bad surroundings and food, or chronic disease. A foul condition of the mouth predisposes to the infection. It is especially a disease of ill-kept institutions with many artificially-fed infants, and the contagion is carried through the feeding in these cases. The acid mouth of babies, with the fermentation of milk remnants favors the growth of the parasite. The fungus growth appears as a small, pearly, slightly raised point. In the beginning the mucous membrane beneath is not seriously damaged, but finally moderate inflammation and slight erosion occur. The spots spread finally all over the inside of the mouth, favoring those regions traumatized by the action of suction, and eventually reaching the fauces and even the esophagus and the lower digestive tract. A diagnostic feature is the lack of salivation. The diagnosis is readily made by the finding of the yeast-like fungi and filaments under the microscope.

Gangrenous Stomatitis (Noma).—This very serious disease is becoming less frequent with the improvement of conditions in foundling asylums, hospitals, etc. It has always been uncommon in private practice. It shows itself as a localized dark discoloration of the cheeks and lips, the patch becoming black and gangrenous, even within a few hours, and spreading with fearful rapidity. Examination at this time shows an ulceration within the mouth corresponding to the external discoloration which has first attracted attention.

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It occurs in children from the second year to the sixth most frequently, and always when their general condition is depressed by chronic conditions of poverty and poor feeding, or by acute disease. It is most often seen in measles, but I have seen it in typhoid fever and in chicken-pox, and it may occur with other infectious diseases. Much swelling and redness are present, and if the gangrenous process spreads, other parts are involved, with accompanying high fever, prostration and the general manifestations of sepsis. Diarrhea is common. Death occurs from exhaustion, from aspiration pneumonia, or from ulceration into the facial or other arteries. In rare cases the gangrene affects only the mucous membrane, or merely perforates the cheek or lip, and leaves a fistula. Horrible deformity is left if gangrene be extensive, in the few cases which recover. The Vincent organisms are often present, but have not been demonstrated to be the causative agents.

Ulcerative Stomatitis With Angina.—In cases in which a severe and even ulcerative pharyngitis exists, with ulcerative stomatitis, the fusiform bacillus and the spirillum of Vincent have been of late years so often found that the disease is regarded as due to them. There are no especial features clinically excepting the severity, and in some cases the obstinacy, of the ulcerative lesions and the danger of false diagnosis of syphilis which has often been made.

Other Kinds of Stomatitis.—Several minor affections may be mentioned here. In nursing women a variety of ulcerative stomatitis is occasionally seen, ulcers arising from the mucous follicles. It is not especially serious. Italian writers speak of the so-called Riga's disease, in which induration with grayish membranous deposit is found on the frenum in children of the teething period. It is occasionally epidemic and may produce ulceration. In Moeller's glossitis reddish spots appear at the edge of the tongue and the papillæ are swollen.

The dental affection, pyorrhea alveolaris or Rigg's disease, with suppuration beneath the gum margin, loss of teeth and occasionally symptoms of chronic infection, is of interest chiefly because of its frequency in pernicious anemia, and its possible causative relation, as a source of sepsis, to that and other chronic diseases. Upon the

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frenum may be seen a traumatic ulcer in severe whooping-cough, due to the chafing of the tongue by the lower teeth in a majority of cases.

Bednar's aphthæ are small ulcerations upon the hard palate, generally due to traumatism from the impingment here of the nipple of the feeding bottle. The French describe, under the name Perleche, a disease of the corners of the mouth occurring in feeble infants and caused by the constant licking of the parts, with superficial trophic disturbance.

A pemphigoid type of stomatitis is seen occasionally in neurotic individuals. Hutchinson describes the pitting, erosion and staining of the teeth in children with stomatitis, the first permanent molars being especially affected. A line like the "tide line" on the coast may be traced across all the teeth. Mercurial stomatitis may be the cause. Many pediatrists attribute such a line to the depression of the general nutrition from the eruptive or other diseases of childhood. A most unusual and puzzling condition is that known as herpetic stomatitis. It is the manifestation within the mouth and pharynx, which is commonly involved also, of the eruption of the vesicles of herpes of the ninth nerve. The pneumococcus is often present but not specific in any sense. The pain, annoyance, inability to take food, and the chronicity of the affection make it a serious one. One man whom I have seen recently lost one-third of his weight and had not recovered entirely at the end of two years.

Gonorrheal stomatitis is a rare affection in the new-born.

DISEASES OF THE TONGUE

Eczema of the Tongue (Geographical Tongue).—In this affection the superficial epithelium of the tongue desquamates in circular or sinuous patches, healing at one part while spreading at another, and producing the appearance of a geographical map upon the surface. The patient may complain of mild irritation of hot and spiced foods, and of itching and discomfort, but the troubles are generally mental rather than physical. A marked tendency to relapse exists. Smooth atrophy of the tongue, commonly confined to the base, is generally an

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evidence of acquired syphilis, but not necessarily so. The so-called "cobble stone tongue" is a syphilitic lobulation of that organ.

Leukoplakia Buccalis (Smokers' Patch).—This chronic disease of the mucous membrane of the tongue is characterized by the appearance of reddish erythematous patches, which become bluish and then white and opaque, spreading over the tongue and sometimes the lips, cheeks and palate. The papillae of the tongue are concealed by the patch. It may be thick and fissured, and quickly regenerates if stripped off, the denuded surface showing little tendency to bleed. Sixty-five per cent. of the patients have had syphilis, and a considerable number develop cancer of the tongue, yet the exact relationship of the three conditions is still unsettled. It is recognized that smoking is closely related in the etiology, but the disease sometimes occurs in nonsyphilitic women who do not smoke. The disease is generally obstinate, but may disappear spontaneously.

DISTURBANCES OF TASTE

By agusia is meant the loss of taste due either to local conditions within the mouth or to lesions in the lingual nerve, or the glossopharyngeal. Hysterical hyperagusia is rare. Paragusia is more frequently met with, being occasionally present as an hallucination in the insane or an aura in epilepsy.

LABIAL GLANDS

In Baelz's disease there is a chronic inflammation of the mucous glands, with swelling and eventually ulceration. The special agent of infection is not known.

FETOR ORIS

The causes of bad breath are very numerous. Inspection of the mouth and throat may show a local cause, such as the presence of the large foul "plugs" in the tonsillar crypts, with most offensive odor, or ulcerations, either of stomatitis or connected with decayed teeth, syphilis of bone, etc., or more commonly, the presence of pyor-

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rhea alveolaris (already mentioned). Bronchiectasis, gangrene of lung, and other pulmonary conditions, and uremia and diabetes, amongst general conditions, may affect the odor. The heavy breath of a bilious attack is often noted. The expired air may carry an odor peculiar to the blood of the individual. I have seen the idea of the possession of a bad breath, when none existed, as an obsession in a young woman who visited one physician after another for the trouble.

DISEASES OF THE SALIVARY GLANDS

Xerostoma (Dry Mouth).—This is frequent as a purely temporary nervous manifestation, under conditions of nervous excitement, especially public speaking or singing. As a definite disease it is caused by diminution of the secretion of the salivary and buccal glands. The tongue and inside of the mouth are red, dry and cracked, and the ordinary movements of the mouth are much embarrassed. Nervous women are especially affected.

Ptyalism.—In this condition the normal secretion of 30 to 50 ounces of saliva is surpassed. In many inflammatory conditions increase of saliva is noted, and it is not uncommon in early pregnancy. In trigeminal neuralgia it may occur. In small-pox, occasionally in mumps, in diseases of the pancreas and in hysterical women it has been observed. Mercury, jaborandi, tobacco, and many other drugs may increase the flow. Dribbling from lack of control of the lips must not be regarded as ptyalism.

Parotitis.—Inflammation of the parotid glands of the specific infectious type is considered under mumps.

Symptomatic parotitis commonly occurs as a complication of infectious diseases, and especially typhoid. In pneumonia and the septic diseases it is frequently found. In typhoid it is thought that the infection is carried upward to the glands through the salivary duct. In the septic diseases metastases seem more probable. The gland may enlarge suddenly from internal hemorrhage in septic conditions.

Symptomatic parotitis tends to suppurate and the abscess may break externally or through the auditory canal. It is of serious

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omen, but typhoid patients may recover, even after suppuration of both glands. The occurrence of the affection in connection with abdominal and especially pelvic operations is well-recognized, but the exact cause is in dispute. The genital organs are especially prone to give rise to this complication if injured, or if operated upon when diseased. It is of less serious significance than in typhoid. The danger of injury to the facial nerve should be carefully considered if operation becomes necessary. The gland becomes chronically enlarged after epidemic parotitis in rare instances, and in chronic nephritis and syphilis. The submaxillary glands may be affected also. Chronic infection through the duct is found to exist in certain cases, and salivary calculi may be present.

In those occupied as glass-blowers, musicians, etc., Steno's duct may become dilated, and a crepitant gaseous tumor forms over the parotid gland as a result of the dilatation. Salivary calculi occasionally form in the ducts, especially Wharton's duct. They are of the same composition as the tartar precipitated from the saliva on the teeth.

Mikulicz's Disease.—This is a hard chronic painless enlargement of the parotid glands with associated chronic inflammation of the lachrymal glands, of unknown origin. It is definitely not syphilitic. The connective tissue of the gland is greatly increased and the appearance of the parotid may suggest the ordinary mixed tumor of that organ. The mucous glands of the lips may be enlarged.

In a few of Mikulicz's cases the lachrymal glands were not affected, but notable enlargement of the axillary and inguinal glands existed, as in a case recently seen with Dr. F. C. Buchtel. The blood count, Wassermann reaction and the physical examination otherwise were all negative. Leukemia and pseudoleukemia must be carefully excluded.

2. DISEASES OF THE PHARYNX

ACUTE PHARYNGITIS

This simple inflammation of the pharynx may be primary but it is often secondary to acute infectious diseases, as scarlet fever,

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diphtheria, tonsillitis, etc. It is not infrequent as a gouty or rheumatic manifestation. The patient is chilly and feverish, with the usual headache and distress of acute disease. The throat is sore, and has a stiff, uncomfortable feeling, with dryness and a desire to clear the throat by hawking. The extension to the larynx, with cough and hoarseness, is frequent. The mucous membrane is found to be red and dry, but later covered with semipurulent, viscid secretion. The follicles may stand out prominently from the acute swelling. Some soreness exists at the angle of the jaw, and in the cervical glands. The tonsils are commonly inflamed with the pharynx, and the Eustachian tubes may be partially obstructed by the associated inflammation.

Acute hyperemia is an occasional finding in the pharynx; and in nephritis, and occasionally in angioneurotic edema, the soft palate and uvula may be edematous.

CHRONIC PHARYNGITIS

The chronic inflammation of the mucosa of the pharynx is seen after repeated acute attacks, but more commonly after the irritation of the pharynx by excessive smoking, drinking strong liquor, use of highly seasoned food, and especially after overuse of the voice, as by hucksters and even clergymen. The inflammation may assume a hypertrophic form. Nasopharyngeal catarrh is generally co-existent. The mucous membrane may be quite dry, but in most cases a tenacious secretion occurs which is removed with difficulty. It is this condition that causes the constant hawking, coughing and spitting of certain individuals.

RETROPHARYNGEAL ABSCESS

In this affection pus accumulates behind the pharyngeal wall, in the cellular tissue between it and the spinal column. It may come from bony disease of the cervical spine, but is more common after infectious diseases in children. No cause may be found. The swelling may be seen or felt in the back of the throat. Pain, rest-

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lessness, dysphagia and sometimes dyspnea are present. Since aneurism is possible here, it should be considered in the diagnosis. Suppuration may occur in other parts of the pharyngeal wall. Syphilitic and tuberculous ulcerations are not infrequent, and in acute infectious fevers, especially typhoid, ulceration may occur.

ANGINA LUDOVICI

This is an acute phlegmonous inflammation of the floor of the mouth, due to the streptococcus. It is seen more frequently after scarlet fever than in all other conditions combined, but may be found after diphtheria, from trauma, or perhaps idiopathically. Acute swelling starts in the region of one of the submaxillary glands, and rapidly extends, with high fever, and the signs and symptoms of an acute and virulent infection. Edematous infiltration extends to the adjacent parts and may involve the pharynx. There is much danger of death from the local interference with respiration and nutrition or from general infection, unless early drainage is instituted.

3. DISEASES OF THE TONSILS

CHRONIC TONSILLITIS

In connection with chronic inflammation of the tonsils there is generally associated inflammation of all the tissues of the "tonsillar ring," including the adenoid tissues high in the pharynx. The nasal catarrh, and ordinary snuffles in children, of a generation ago, are now known to be due very largely to the chronic congestion and inflammation associated with enlarged tonsils and hypertrophied lymphoid tissue. No definite cause is agreed upon, but all recognize the great frequency of the trouble. By obstruction of the air passages through the nose and pharynx the enlargement of these lymphoid tissues gives rise to the difficulty in breathing, sufficient in severe cases to lead to mouth breathing, at least during sleep. By the extension of the lymphoid growth to the orifice of the Eustachian tube, and along it, the caliber is interfered with mechanically, and a

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chronic inflammatory process is set up within the tube. The hearing is seriously compromised in many cases. On account of the partial vacuum established within the chest because of the obstruction to the ingress of air in inspiration, pigeon-breast or funnel-breast develops. The former shows sharply projecting ribs and sternum, with a groove along the line of attachment of the diaphragm (Harrison's groove). The funnel-breast is much less common, and may originate from other causes as well. If asthmatic attacks are induced, a chest of the emphysematous type may be found. Attacks of night cough and paroxysmal dyspnea are frequent. Fetid breath is often noted. A characteristic modification of the facial expression is soon produced, with open mouth and dull, stupid, staring expression. The children so affected are commonly behind those of the same age in school work, and may even appear exceedingly stupid, being unable to fix the attention normally. Stuttering and impaired pronunciation are frequently present. The entire mental and physical tone is impaired. In case of exposure to scarlet fever and diphtheria, the large area open to throat infection renders the children not only more liable to contract the diseases, but to suffer severely from them. The more exact diagnosis and treatment belong to the specialist.

SUPPURATIVE TONSILLITIS

(*Acute Parenchymatous Tonsillitis: Quinsy*)

In a small percentage of cases of acute tonsillitis suppuration occurs, notably in adults rather than children. The disease follows the course of acute tonsillitis of great severity for two or three days, with a high temperature, severe backache and great prostration. Delirium may be present. After two or three days the inflammation commonly shows decided tendency to affect one tonsil more than the other, although suppuration is occasionally bilateral. The swelling in the tonsillar region increases and the soft palate may be distorted by the unilateral enlargement. Fever, pain, dysphagia, a foul breath, swelling of the neck, and especially of the cervical glands, and a fairly characteristic expression are further features. Dyspnea and even

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suffocation may result from the edematous infiltration. Often the mouth cannot be opened sufficiently for proper examination. Palpation shows the affected tonsil to be hard at first, but softening soon occurs, generally about the fourth or fifth day, and the abscess breaks or is opened by the surgeon, with instant relief. Children occasionally suffocate because of the filling up of the air passages with the thick tenacious pus. The infection is generally streptococcic or staphylococcic. The pus may invade the peritonsillar tissue, and then produces a much more serious condition than is present in ordinary quinsy. I have reported a case of instant death from perforation of a large artery, doubtless the internal carotid, since the man bled to death in my presence in less than a minute. Suppurative tonsillitis has a special tendency to recur, and the patient should therefore be examined after recovery with a view to tonsillectomy.

4. DISEASES OF THE ESOPHAGUS

ACUTE ESOPHAGITIS

This is probably more common than is believed by most practitioners, as many attacks due to irritation of too hot fluids or other cause pass unnoticed. The types which occur in acute infectious disease, notably diphtheria and typhoid, and which may present a false membrane, may be overshadowed by the more serious diseases with which the esophageal inflammation is associated. A pustular eruption may occur in small-pox. The severest forms occur from the violent irritation of poisonous or corrosive liquids. The inflammation may be catarrhal in character, or follicular, ulcerative, phlegmonous, or necrotic in the more severe cases. In the follicular form inflammation of the mucous glands takes place, and they may eventually ulcerate. After violent chemical irritation, as in the common swallowing of lye, large pieces of the mucosa may be vomited. This may occur even in hysterical women.

Symptoms.—Pain of greater or less severity along the course of the gullet, and dysphagia are the leading symptoms. Pain may not be present in the milder cases, but may be very severe and accom-

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panied with a burning feeling in the cases where corrosives have been swallowed. Portions of the mucosa with blood and mucus may be vomited. Tenderness upon pressure over the esophagus and pain upon stretching it by tipping the head backwards are sometimes noted. The "scratchy" effect of rough particles of food swallowed is noticed in the milder cases. Pain has been experienced upon the attempted passage of the stomach tube, but this procedure may perforate the gullet and should not be carried out during the early course of the disease. Thirst is a notable symptom. Perforation into the cavity of the chest is to be feared in the worst cases. There is danger of the production of stricture if recovery takes place.

CHRONIC ESOPHAGITIS

This may follow repeated attacks of the acute form, and it is not uncommon in drunkards. It rarely produces symptoms distinctive enough for recognition, but is found by the pathologist. With it may be associated other conditions of more clinical interest, namely, ulceration, hemorrhage and rupture, which will for convenience be discussed here, although the relationship is not close nor even constant.

ULCERATION

This may occur as a feature of esophagitis, but in other conditions as well. The so-called "decubitus ulcer" is found in persons emaciated by acute exhausting or chronic cachetic diseases, such as typhoid or cancer respectively. The gullet is less well protected than normal because of the emaciation and constant shrinking of the soft tissues which serve to imbed it in health. Pressure ulcer occurs from the anemic type of necrosis induced by pressure of a growth without the tube. Uremic ulceration occurs under the same conditions that give rise to similar ulceration in the colon. More common than any of these mentioned are the peptic ulcers. Tileston has collected 40 such cases from the literature. They occur at the lower end of the esophagus, especially in males, under just such conditions as give rise to gastric and duodenal ulcer. Bassler believes that insufficiency

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of the cardia permits regurgitation of the hyperacid gastric contents, and a cardiospasm secondary to the long-continued irritation of the esophagus tends to hold the fluid in contact with the mucosa and establishes the ulceration. Multiple ulcers may be present. Fifteen per cent. are said to perforate the right pleura, lesser omental cavity or pericardium, even the aorta having been entered. These ulcers are presumably a factor in the origin of cancer of the affected region. Pain and dysphagia have been the usual symptoms, while vomiting and hemorrhage may occur. Pneumothorax or pyothorax may be caused by the perforation.

Prognosis.—Ulceration in the esophagus occurs in grave diseases in most cases and the prognosis is that of the chief affection. The peptic type is decidedly serious, and thus far is hardly amenable to operation.

ESOPHAGEAL HEMORRHAGE

This may occur, as indicated above, from a peptic ulcer. Much more frequently it comes from the rupture of an esophageal varix, especially in cirrhosis of the liver, in chronic cardiac affections and in splenic enlargements.

RUPTURE OF THE ESOPHAGUS

This may more readily occur when the walls of the tube are weakened by chronic degeneration, but in some cases the gullet has shown no disease. The tube ruptures near its lower end in case of severe vomiting, generally in drinking men, and beyond middle age. Choking, dyspnea, cyanosis, collapse, interstitial emphysema of the mediastinum and root of the neck, with a rapidly fatal result, may be expected.

SPASM OF THE ESOPHAGUS

Spasmodic stricture of the esophagus is found chiefly in neurotic and hysterical individuals, especially in females, but also in old men. The globus hystericus is thought by some to be a hysterical esophageal spasm. It is a prominent feature in hydrophobia. In patients

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who have had a fish bone or other foreign body stuck in the tube the spasm may come on later, either on account of some slight lesion which serves as a source of disordered motor stimuli or without any lesion, probably through suggestion. A spasmodic closure may exist at another part of the tube in case of organic stricture. The patient

FIG. 47.—BISMUTH-FILLED DILATATION OF ESOPHAGUS. Simple cardiospasm. (Dr. G. H. Stover.)

complains of inability to swallow food and the same symptoms may indeed appear under excitement, without the attempt at swallowing. Mild pain beneath the sternum is the common accompaniment.

The spasm is made worse by reference to it in the presence of the patient. Thus one neurotic boy could eat breakfast well if he was to remain at home and ride his pony, but any reference to his esophageal spasm, as an inquiry concerning his ability to swallow, brought

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on an immediate attack. On school days the attacks always occurred regardless of such inquiry.

Because of the spasm food may be retained long in the esophagus, and when finally regurgitated shows no chemical evidence of having entered the stomach.

In general the trouble is annoying rather than dangerous to the patient, but severe emaciation may occur. In a man nearly 70 with a spasm so severe and accompanied by so much pain that the attendant dared not force the passage of the bougie, after the usual safe degree of pressure, the attempt was abandoned and the diagnosis of cancer of the esophagus was made. The man gradually emaciated to a skeleton and died of starvation. At the post mortem the only lesion disclosed was a slight degree of interstitial nephritis, the esophagus being absolutely normal. The use of modern Röntgen ray methods might have prevented the error.

Diagnosis.—This has been settled at once in every other case which I have seen by the passage of the stomach-tube or bougie. One can feel the assurance of safety in the use of these instruments in the young, and if assured of the absence of cancer and of aneurism and a history pointing toward a cause for organic stricture, in older patients as well. Steady, gradual pressure is rarely dangerous, but I have known the esophagus to be ruptured, with death as a result, when an organic lesion existed; and the knowledge of this possibility leads to caution in applying force. The grasping of the bougie because of the spasm may be felt. In certain cases cure results from the first demonstration to the patient of the patency of the gullet. In others of neurotic constitution, the obstruction recurs with any nervous upset, even over a period of many years.

Paralysis of the esophagus exists in bulbar paralysis and some other conditions, and causes dysphagia, but calls for no detailed and separate study.

STRICTURE OF THE ESOPHAGUS

The obstruction of the tube by malignant growth will be considered in a separate section. Stricture is sometimes congenital, a rare

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condition and often not consistent with the continuance of life. The esophagus is an undeveloped cord, or opens into the air passages.

The tube is blocked more or less completely in certain cases by the pressure of aneurism, bronchial glands, mediastinal tumor, goitre, or the dilated sac in pericarditis with effusion. A rare source is found in the contracting bands in fibroid phthisis. In these cases the obstruction is entirely secondary to the more serious condition.

The type of obstruction which demands our chief attention is that which follows the healing of an ulceration, produced generally by the swallowing of caustic fluids (especially lye) or other chemical irritants, or by such ulcerations as have been considered in a previous chapter, or occasionally by syphilis. Most of the strictures coming under observation are of the type due to corrosive fluids. These are delayed slightly in the act of swallowing at the three narrowings of the gullet, and hence stricture is most likely to be produced at these points, namely—at the level of the cricoid cartilage, at the bifurcation of the trachea, and at the diaphragmatic opening.

Symptoms.—The first complaint is likely to be of the inability to swallow coarse particles of food, although at this time liquids and soft foods pass normally. Soon, in the progressive stricture, even fluids cannot pass, and, after being held in the dilated tube above the stricture for a varying interval, are regurgitated. They show an absence of hydrochloric acid and the stomach enzymes. In these cases the second swallowing sound is delayed even for a whole minute. If the stricture be high in the esophagus, the retention interval may be but a fraction of a minute, while if low in the esophagus it may be an hour or more. In this type of stricture emaciation occurs, although in that permitting the passage of fluids the nutrition may be good. By the giving of bismuth in the mucilage of acacia, and the use of the X-ray the stricture may not only be located, but the degree of dilatation above it estimated. This bismuth preparation adheres well, yet may be readily washed off the esophageal wall, and works better in every way than the bismuth capsule, the bag filled with bismuth or the heavier bismuth meal, according to Plummer. The tightness of the stricture is to be ascertained by the use successively of varying sizes of the bougies, and the degree of yielding may be

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ascertained. The X-ray plate may show to the trained eye something of the degree of cicatricial development around the stricture. The possibility of a second narrowing lower down must be borne in mind. The technique developed by Dr. H. S. Plummer of the Mayo clinic for the examination of stricture of the esophagus depends largely upon having a guide to keep the bougie in line so that it may not be directed away from the passage. Silk thread is swallowed, two to three yards at first, in such a way as to make a snarl in the stomach. This is allowed to pass down into the bowel with the stomach contents. Several yards more are swallowed at the rate of a foot an hour the next day, so that in the afternoon the patient has sufficient length of the thread in the bowel to offer a fairly firm hold. Upon the free end a bougie with a drilled tip is now threaded. It follows the guide easily, but may be pulled back out of a diverticulum, or guided into the hiatus esophagi in cases with cardiospasm and diffuse dilatation, if it has left the narrow path, by traction upon the thread. In two cases Plummer injected the thread through a long, narrow stricture with a special syringe, under the guidance of the esophagoscope. He finds that benign cicatricial strictures are passed with difficulty but rarely bleed unless dilatation is attempted, while cancerous strictures are easily passed but bleed afterwards. The dilatation in case of the benign stricture gives much relief, but not in the malignant variety. In certain difficult cases he has used a fine piano wire to follow the thread and passed the bougie upon this as a guide.

It is even possible to feel very high stricture with the finger in the throat, as the bougie is guided into the gullet. The operator must have in mind the normal narrowing at the level of the cricoid, the possibility of partial obstruction by diverticulum partially filled, and the danger of aneurism, cancer, or other growth. As mentioned in the diseases of the mediastinum, I have known the bougie to pass into the right pleura with so little evidence of trouble that when I saw the patient the next day, that cavity had rapidly filled with fluid, which I diagnosed as milk swallowed and escaped through a probable perforation. The milk was aspirated from the pleural cavity, but the damage was so serious that the child died. The esophagoscope in

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skilled hands lessens the danger of damage in the attempt to dilate stricture of the esophagus by furnishing a better knowledge of all the conditions and possible complications. The prognosis depends upon the degree of the stricture, and the skill and persistence of the surgeon.

CANCER OF THE ESOPHAGUS

Eighty-five per cent. of all the obstructions seen clinically are of this type. Reflection upon the figures will cause the physician to lean strongly to the diagnosis of cancer, and to use very moderate pressure in attempting the passage of a bougie. Only the uterus, breast, and stomach furnish more instances of cancer than the esophagus. Cancer starts from the mucosa, and probably frequently from an esophageal ulcer, this being in part an inference from the preference of cancer for the lower parts of the esophagus, where ulcer commonly occurs, and in part from the recognized frequency of cancer as a late development of ulcer of the stomach. Males after the fortieth year are more often affected. The irritation from the use of strong alcoholic liquors, known to cause chronic esophagitis, is thought to be of some moment. Doubtless the irritation in the region of diverticula may be the cause in certain cases. With the increase in the growth the lumen of the tube is narrowed and the thickening and infiltration without interfere still further with expansion of the tube, so that obstruction results. The attempt of the esophagus to empty itself through the obstruction leads to hypertrophy of the muscle walls above, and the retention and decomposition of food in the esophagus above the growth lead to dilatation.

Symptoms.—Dysphagia is the first manifestation of the presence of cancer of the esophagus, and may induce considerable loss of flesh before actual obstruction occurs, although this latter is the prime feature in inducing the emaciation in most cases. Pain is not uncommon, and a feeling of pressure beneath the sternum may be complained of. Regurgitation of food soon occurs, being postponed longer after eating in proportion to the distance of the obstruction from the pharynx, and being generally more profuse in the late cases. A mixture of blood and pus may be noted, and the odor may

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suggest necrosis. Enlargement of the cervical lymph glands is generally present. In some cases the growth may be latent, and obscure lung symptoms may first suggest its development. Perforation into the pleura, lung, or pericardium, exhaustion, starvation, or aspiration—or bronchopneumonia may be noted in the final stages. The recurrent laryngeal nerve may be involved, and the diagnosis may

FIG. 48.—CARCINOMA OF THE ESOPHAGUS AND A MEDIASTINAL GLAND. Above, esophageal carcinoma, irregular bismuth outline. Below, carcinomatous mediastinal gland.

be suggested by the report of the laryngologist. Disturbances of the sympathetic, similar to those mentioned under aneurism, are rarely present. As in cancer of the stomach the more or less persistent slight bleeding from the growth gives a frequent positive blood reaction in the examination of the feces.

Diagnosis.—This may be regarded as probable when a man in middle age has real obstruction in the esophagus, with distress and

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loss of weight, since the great majority of such patients suffer from cancer. The bismuth mixture and the X-ray plate, the esophagoscope and the Plummer method of passing the bougie should be resorted to in case of doubt. In most cases the emaciation, obstruction to the soft rubber tube, presence of blood upon the tube, character of regurgitated contents, enlargement of glands, and lack of evidence

FIG. 49.—BISMUTH-FILLED OBSTRUCTED ESOPHAGUS. (Dr. G. H. Stover.)

of obstruction by pericardial effusion, goiter, etc., leave no doubt as to the diagnosis. Yet a certain number of patients starve to death in non-malignant troubles, and in case of any doubt, it is imperative to make certain of the diagnosis by the means suggested. Fragments of the tumor may be ejected and obtained for examination, or even obtained through the use of the esophagoscope.

Prognosis.—This is fatal, as surgical procedures have thus far

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been of little or no avail, so far as cure is concerned, and there is nothing to be expected through our present means of treatment. The patients generally die in the course of a few months after the diagnosis becomes possible.

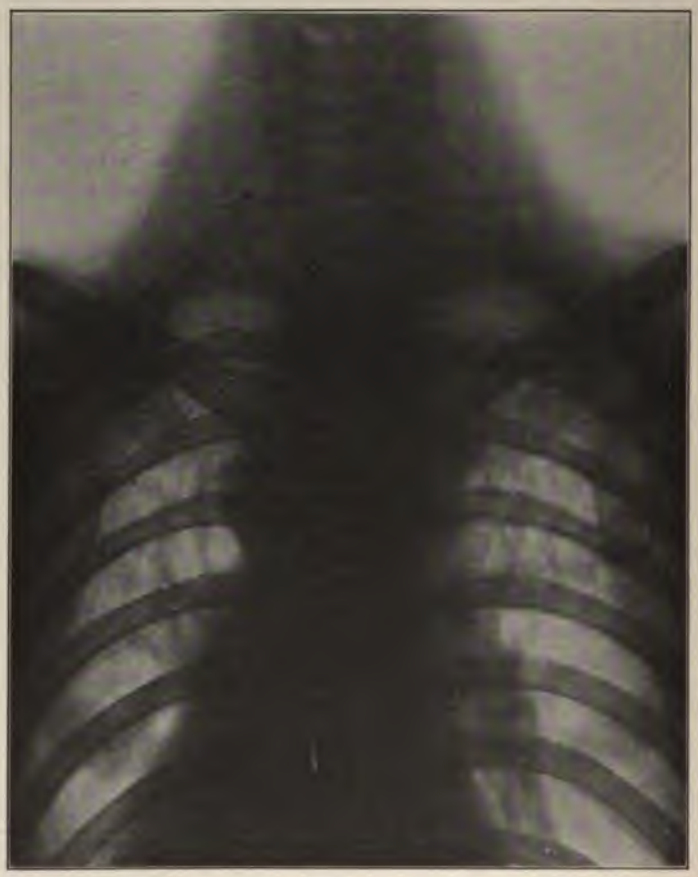

FIG. 50.—OBSTRUCTED AND DILATED ESOPHAGUS FILLED WITH BISMUTH. Stricture caused by drinking lye. (Dr. G. H. Stover.)

DILATATION OF THE ESOPHAGUS

This follows stricture, cancer, or compression from without, but in these cases it is an incident only in a more serious condition. The important type, clinically, since it is common and capable of cure, is that without anatomical stenosis, and frequently following cardio-

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spasm or spasmodic stricture of the lower portion of the esophagus. The cause of the cardiospasm and spasm of the gullet just above the cardia may be local disease, especially ulcer, or gross disease in the stomach, either cancer, ulcer, or syphilis. In many cases no definite cause can be assigned for the dilatation, but muscular atony, asthenia, or paralysis are amongst the causes suggested. In several of Plummer's cases where spasm was considered, the cause of the dilatation was found to be deformity at the hiatus esophagi or cardia, or a condition which he believed to be analogous to congenital pyloric stenosis. The absence of dilatation in certain of the cases of cardiospasm should be noted. Plummer groups his cases as follows:

"One hundred and thirty cases that have come under my observation have been grouped as follows:

"1. Diffuse dilatation of the esophagus without anatomic stenosis, ninety-one cases. No gross gastric lesions were found in this group and only five of the patients were of a neurotic type.

"2. Severe cardiospasm without diffuse dilatation of the esophagus, two cases. Both patients had periodic attacks continuing from three to fourteen days, during which they were not able to swallow either liquid or solid food. I think that in these cases diffuse dilatation of the esophagus would have ultimately developed.

"3. Cardiospasm without diffuse dilatation but with gross lesions in the stomach, twelve cases. Of these, two patients had ulcer, two syphilis, five carcinoma, and three suspected, but not absolutely demonstrated, ulcer.

"4. Mild cardiospasm without diffuse dilatation of the esophagus or gastric lesions, twenty-four cases. Almost without exception these patients were of a neurotic type and many were distinctly hysterical.

"That relatively few individuals of a neurotic type and none with gross gastric lesions were noted in the group having diffuse dilatation of the esophagus, that diffuse dilatation had not followed the cardiospasm in any of the patients with gastric lesions, and that almost constant evidence of an acquired or congenital asthenia was present in the patients with mild spasm without dilatation or gastric lesions seems to indicate that these groups are of different origin and not very definitely related."

Symptoms.—Disturbances of deglutition and regurgitation of food, occasionally pain under the sternum, are the main symptoms of dilatation of the esophagus. Respiration may be disturbed. The diagnosis should be made by the means suggested under stricture of the esophagus, the bismuth plate, the sound, and if necessary the use of the bougie with the silk thread.

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Prognosis.—The cases are curable by surgical means, if only the diagnosis be made.

DIVERTICULA OF THE ESOPHAGUS

These may be congenital and due to lack of obliteration of the branchial clefts. High in the posterior wall are found the pressure diverticula, apparently due to separation or rupture of the muscular coats, "pouching" resulting. These diverticula may be pharyngeal, rather than esophageal, and may be purely congenital, even the posterior variety. The hernial protrusion of the mucous and submucous coats may have only a narrow slit-like opening from the gullet. The accumulation of food, its decomposition, and the weakening effect resulting finally cause so much enlargement as to produce definite symptoms.

FIG. 51.—REMARKABLE OBSTRUCTIVE DILATATION OF ESOPHAGUS. The organ retained 30 ounces of bismuth milk suspension for over 2 hours. It would empty into stomach only after ingestion of an additional quart of fluid. (This is one of a series of röntgenograms Dr. G. H. Stover.)

The so-called traction diverticula are situated

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in the anterior wall near the tracheal bifurcation, and are due to the retraction of the scar tissue resulting from some inflammatory disease of the bronchial glands or other tissues in this region. The constant drag on the wall pulls it out into a pouch. This type rarely gives symptoms. Diverticula are most commonly found in males of middle age and but few are recognized clinically.

Symptoms.—These are present in probably only a minority of cases. It is not until the diverticulum is of sufficient depth to retain food that the pain, burning, and local irritation, feeling of a foreign body in the throat, obstruction in swallowing, regurgitation of retained contents, and interference with respiration in extreme cases are noted. With great retention putrefaction of the food, a bad breath, ulceration of the mucosa, and perforation and death may result. Empyema and gangrene of the lung may occur from the perforation. The largest diverticula may even hold a pint. The stomach tube may pass by a small diverticulum and may enter and be checked by a larger one. A second tube may then pass by the stopped orifice and enter the stomach. The tube may be obstructed to some extent in its passage by the swollen diverticulum filled with food.

Diagnosis.—At the Mayo clinic the diagnosis has been made many times by means of the radiograph, after filling the esophagus with the bismuth-liquid. With the use of the silk thread guide, the bougie may perhaps enter the diverticulum, but by the use of traction upon the thread it may be withdrawn and the depth of the diverticulum ascertained. The esophagoscope in skilled hands enables the nature of the diverticulum to be still further studied.

Prognosis.—Since diverticula occur in the upper part of the esophagus generally, the diagnosis may be followed by surgical extirpation. In the hands of the Mayos ten cases have been operated with perfect results and without a death.

5. DISEASES OF THE STOMACH

A. GASTRITIS

Acute Gastritis (Acute Indigestion).—This is an acute catarrhal inflammation of the gastric mucous membrane accompanied by epithe-

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lial desquamation, secretion of mucus, and the symptoms of an acute indigestion.

It is usually traceable to errors of diet, and very slight indiscretions may cause the attack in susceptible individuals, notably those of gouty predisposition. The eating of too much rich food, partially decomposed food, or too highly seasoned dishes, and especially in connection with alcoholic liquors, is at the foundation of most attacks. The use of irritating medicines may cause it. At the beginning of many acute diseases the first notable symptoms may be those of acute indigestion. Men suffer more frequently, doubtless because more exposed to the usual causes. The greater frequency of the disease in the hot months is accounted for by the use of foods easily decomposed in a warm temperature, and the increased use of iced drinks and foods.

Pathology.—The gastric mucosa is found reddened and swollen, with submucous hemorrhages in the severe cases, and a thick layer of mucus. In the pyloric region may be found slight erosions. Swelling of the gastric cells and other microscopic changes have been demonstrated. The secretion of hydrochloric acid is checked and undigested particles of food may be adherent to the surface.

Symptoms.—In the milder cases the complaint is of gastric distress rather than pain, and of fullness and headache, nausea, and perhaps vomiting. Belching and especially vomiting give some relief and the attack may then subside in the mildest cases. In the severer types the nausea and vomiting are much more common, with eructations of foul taste, and pain radiating through the general region of the stomach. Diarrhea is frequent in children, and may be present in the adult, though constipation is the rule. The temperature rises slightly. A concentrated urine, with excess of indican, and dark with urates, is passed, and herpes labialis appears. In the course of one to three days the coated tongue and foul breath clear up and recovery ensues. In children and the aged a fatal result is possible.

Diagnosis.—This is easy in most cases, when the tendency to the attack is known, and the symptoms are mild. In severer types, with some febrile movement, there is danger of mistaking the attack

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for the beginning of some acute disease, and even typhoid may be suspected. Gall-stone colic and acute appendicitis are suggested by the pain. In general if the attack does not show signs of sharp decline in two or three days further examination should be instituted for some acute infectious disease. As in every case of abdominal pain it is imperative to consider the possibility of the gastric crises of locomotor ataxia.

Acute Suppurative Gastritis (Phlegmonous Gastritis).—This may occur as a localized gastric abscess or as a diffuse infiltrating type of inflammation. It is a rare affection, chiefly of the male sex. It is due to the entrance into the submucosa, commonly through an abrasion, of a virulent infection, generally streptococcic, although probably idiopathic in certain cases. Suppurative gastritis is ordinarily a complication of cancer of the stomach or some septic disease.

Symptoms.—The disease is of acute onset with intense pain in the region of the stomach. Thirst, dry tongue, high fever, rapid, irregular pulse, and all the signs of a violent and acute septic infection are present. Vomiting may occur and pus cells and bacteria are present in the vomitus, but rarely a gross purulent appearance. Jaundice may be noted.

Diagnosis.—This has rarely been made ante-mortem. The vomiting of the pus from a localized abscess breaking into the stomach, or the feeling of a tumor might suggest it. The outcome is practically always fatal.

Infectious Gastritis.—This is occasionally reported, being due to such varying organisms as the anthrax bacillus, diphtheria bacillus, yeast fungus, moulds, favus and thrush organisms, and even the larvæ of flies. The diagnosis is made by the microscopic examination of the stomach contents.

Diphtheritic Gastritis.—In this rare affection a false membrane forms over the gastric mucosa, occasionally due to Klebs-Löffler bacilli, but generally of the type seen in the colon in pneumonia, small-pox, pyemia, etc. The membranes may be vomited and point the way to the diagnosis.

Toxic Gastritis.—This follows the ingestion of irritating and corrosive poisons,—lye, strong acids, phenol, bichlorid of mercury, etc.

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The more corrosive poisons lead to the necrosis and perforation of the walls, the less severe to an acute glandular inflammation and infiltration of the connective tissue.

Symptoms.—Intense pain in the upper digestive tract follows the swallowing of poison. Vomiting occurs and, in case of the corrosive poisons, blood and perhaps bits of mucous membrane are ejected. Thirst and incessant burning in the esophagus and stomach with tenderness, distension of the abdomen, and diarrhea are prominent symptoms. Collapse and death may quickly follow. In the milder type of cases the poison has time for absorption, and jaundice, acute nephritis, and subcutaneous hemorrhages, delirium, and high fever may be noted. Death may occur from collapse or from exhaustion after separation of extensive sloughs and secondary hemorrhage. Stenosis of the esophagus is likely to develop in the patients that recover.

Diagnosis.—This is made by the character of the stains and burns upon the mouth, tongue, clothing, etc., and the appearance of the vomitus. The odor of phosphorus, phenol, and other poisons may be characteristic, or the color, as in Paris green.

Chronic Gastritis (Chronic Dyspepsia).—This is an affection in which there is a chronic catarrhal inflammation of the gastric mucosa, frequently an increase in the quantity of the mucus, an increase or decrease of the normal acidity, interference with the normal motility, frequently atrophy of the gastric glands, and serious interference with the nutrition.

Pathology.—In the simple type the stomach is somewhat dilated, the mucosa pale, or reddish in places, with adherent mucus. The pyloric end is more pigmented and rough and the term "gastritis polyposa" may be appropriate in view of the prominence of the elevated sections. Both parenchymatous and interstitial inflammation of the glandularis and atrophic and hypertrophic changes in the muscular coats are noted. The veins may be prominent. The atrophic type may represent the terminal stages of the last form, or it may have been of this variety from the beginning. The stomach wall is "thinned out," all the coats being atrophied. The glandular atrophy is conspicuous, the mucous membrane being less smooth

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and grayish in color. Small catarrhal ulcerations are not infrequent, and Einhorn's hemorrhagic erosions may be present. Various intermediate conditions of the gastric mucosa may be found.

Etiology.—*Primary Form.*—The disease is very common, and is especially an American disease. Men are more often affected. The cause in general may be said to be the summation of the dietetic crimes of the careless eater. The man who eats too rapidly and too much, too irregularly, chews his food too little, eats too many condiments and desserts, drinks too much ice water, and eats too much ice cream, drinks too much strong alcohol on an empty stomach, smokes too much, drinks tea and coffee too freely, and works too soon and too violently after eating may not contract chronic gastritis, but should expect it. Repeated attacks of acute gastritis predispose to the chronic form. As a secondary affection, chronic gastritis is often found in connection with the chronic diseases which lower the general resistance, as anemia, pulmonary tuberculosis, chronic dysentery, chronic nephritis, etc. Chronic disease of the stomach, especially ulcer and cancer, those conditions which interfere with the proper circulation through its walls, notably valvular heart disease and cirrhosis of the liver, and those which prevent proper free circulation of the normal blood through the gastric vessels predispose to a chronic gastric catarrh.

Symptoms.—These develop so gradually that the patient may not be able to state within a year the time when he ceased to have good digestion. He complains of distress after eating, a coated tongue, poor appetite, poor sleep, lack of natural energy and buoyancy, especially on waking. Distress may be present with the stomach empty, and nausea is not infrequent. Dizziness, palpitation, and dyspnea are common. Belching, heart-burn and even considerable pain may be prominent. A fickle appetite and desire for unusual foods, especially highly spiced ones, are often mentioned. In the flatulent type the belching is especially prolonged and troublesome, and much distension of the abdomen with gas is present. In the chronic gastritis of hard drinkers an almost pathognomonic symptom is the vomiting of ropy mucus before breakfast. Even in women one may not hesitate to rely upon this symptom rather than upon

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the patient's statements. The urine is generally scanty and concentrated. A pharyngeal type of cough (stomach cough) is often troublesome. The pulse may be slow, and is often weak from the general debility. Constipation, perhaps alternating with diarrhea, is common.

Gastric Analysis.—The vomitus frequently contains a moderate amount of mucus and entangled in it are food remnants, which were perhaps taken 12 hours before. The great quantity of mucus in the alcoholic type has been mentioned, and butyric, lactic, and acetic acids are frequently present with scarcely a trace of hydrochloric acid. After an Ewald test-meal in ordinary simple gastritis the acidity is commonly low, and may be absent, and the enzymes are decreased. An excess of mucus and poor digestion of the contents are to be noted macroscopically.

In the so-called gastritis acida, although the mucus is increased, there is also an increase in the hydrochloric acid. This type probably represents an ordinary hyperchlorhydria in which a secondary gastritis has been excited, but has not advanced to the point of weakening the secreting power of the gastric glands. In the gastritis mucipara of Boas, the acids and ferments are decreased, but the quantity of mucus is very great. In atrophic gastritis all evidences of gastric digestion are wanting, and the bread of the test-meal looks as if soaked in water. Leukocytes and bacteria are abundant. The putridity of the stomach contents of cancer is wanting.

The Blood.—A secondary anemia of very moderate degree may be present. In the severe atrophic cases an anemia practically indistinguishable from pernicious anemia is a rare finding.

Physical Examination.—The patient is commonly moderately emaciated, but many sparely built patients look fairly well. Moderate pallor is occasionally present. A coated tongue and flatulent abdomen with epigastric tenderness and an increased percussion area over the stomach, with splashing, are the usual findings.

Diagnosis.—This is fairly evident from the conditions mentioned. In cancer and ulcer the chronic gastritis plays an entirely secondary rôle, as a rule, yet the diagnosis from cancer is occasionally

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difficult. Pain, emaciation, and cachexia, with tumor and glandular involvement are to be expected in cancer. The study of the bismuth plate shows a dilated and perhaps abnormally shaped stomach in chronic gastritis, but it fails to show the irregularities and perhaps definite tumor formation of cancer. The differentiation is so important that prolonged study of the physical signs, the chemistry and the X-ray appearance of the stomach are demanded, and the diagnosis may be made, in probably all cases, by these means.

Prognosis.—In all cases associated with cancer and ulcer the prognosis depends upon the more prominent factor. In mild cases, under skillful treatment, much improvement and practical recovery in many instances are to be hoped for. In the severe mucous forms and in chronic alcoholic gastritis persistent treatment is likely to be of great help if the patient will avoid a repetition of the excesses which have led to the trouble. In the severe atrophic forms the outlook is serious.

B. CIRRHOSIS OF THE STOMACH

This is a rare condition of diffuse sclerosis of the walls of the stomach, with great thickening and much reduction of the size of the cavity, and without any evidence, upon most careful search, of scirrhus cancer. The latter is to be assumed until proven absent. The submucosa and the muscular layer are enormously thickened, the glandular elements atrophied. The total thickness of the wall is so great and the size of the stomach so small that in one of Osler's cases no gastro-enterostomy could be made. Vomiting, occasionally of blood, decreased capacity of the stomach, and the hard sausage-shaped tumor are important features. The X-ray should be of great help in the diagnosis. Gastrectomy has been resorted to successfully.

C. DILATATION OF THE STOMACH: GASTRECTASIS

Acute Dilatation.—This is now recognized as a not infrequent complication in surgical cases, especially those that have been sub-

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jected to general anesthesia. The type of operation is of less importance than the time required for anesthesia and operation. Less important causes are injuries of the head and spine, while a few cases develop in connection with severe febrile illnesses (typhoid, pneumonia, etc.). Volvulus of the stomach is a rare cause.

PATHOLOGY.—Many hypotheses have been advanced, and one is known to apply in many of the post-operative cases. We refer to the theory of Albrecht, that acute dilatation of the stomach is due to mechanical obstruction of the duodenum by the root of the mesentery and the superior mesenteric vessels because of the drag from the falling down of the empty small intestines into the true pelvis. As a result, partial distension of the stomach occurs, and the intestines are prevented from returning and relieving the duodenal compression. In many cases this condition has been found post-mortem. In favor of it clinically is the rapid recovery in many cases by turning the patient partially upon the abdomen. The effects have been miraculous in several cases which I have seen. Less frequently accepted is the view that a primary disturbance in the nervous control of the stomach permits it to distend and force the small bowel downward, and thus set up a drag upon the root of the mesentery. Whether a primary or secondary phenomenon, the blocking of the duodenum by this mechanism, a gastromesenteric ileus, is recognized as a frequent finding, and, occasionally, upon the operating table, as a cause of chronic dilatation of the stomach. I have seen not infrequently the upper portion of the duodenum chronically dilated, and the portion below the point mentioned much smaller; and in one case, in which the examination led me to expect pyloric obstruction, probably from an ulcer, Dr. Freeman found the stomach and pylorus entirely normal, excepting for dilatation, with so pronounced a narrowing at the root of the mesentery that a duodeno-duodenostomy was necessary. Without further discussion of the cause we may state that at this time the best view seems to be that operations of any kind, but especially abdominal ones, under general anesthesia which is considerably prolonged, in patients of nervous constitution, much shocked and depressed by the anesthetic and operation, are occasionally followed by acute dilatation of the stomach, and that a

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paretic or paralytic condition of the musculature of the stomach and bowel may supplement the mechanical causes mentioned in medical as well as surgical cases.

SYMPTOMS.—Continuous vomiting of an unusually large amount of bile-stained watery fluid attracts the attention at any time during the convalescence, and the pain, collapse, and pronounced distension of the upper abdomen are soon evident. Fever is absent. The contrast between the thirst which induces the patient to drink continually and the scantiness of the urine is striking, the latter being due to the non-absorption of fluids from the stomach and their inability to pass on into the intestine, although bile evidently escapes back past the pylorus. The greatly dilated stomach is commonly tympanitic above and flat below, since it contains much fluid and gas; yet there is no such rigidity and acute tenderness as to suggest peritonitis. It would seem that the cardia must be blocked by a valvular change or kink in some cases, as the stomach tube relieves the distension if it can be passed; yet further distension occurs. In one case the giving without orders of an effervescent drink was followed by almost instantaneous aggravation of the symptoms. A succussion splash may be present, and rarely peristaltic waves may be seen. Although constipation is the rule the gastric contents have no fecal odor, an important point in the exclusion of intestinal obstruction, which is frequently suggested by the severity and suddenness of the symptoms, the vomiting and the distension. In the most dangerous cases the vomiting and distension are less prominent, yet the patient does not progress properly, being troubled with gas and anorexia. Without any recognizable cause, the abdomen begins to distend moderately, the pulse fails, the facial expression indicates danger, the extremities become cold, and the temperature falls. Passage of a stomach tube withdraws several pints of bile-stained or slightly blood-stained fluid, with some transient relief. Yet many of of the cases are fatal. The absence of hydrochloric acid from the gastric fluids in most cases of acute dilatation of the stomach, the almost constant staining with bile, the occasional brownish discoloration with blood, and the frequent presence of lactic or other organic acids should be noted. The absence of food remnants is practically

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constant, since the anorexia prevents the taking of anything but liquids to relieve the intolerable thirst.

Diagnosis.—The best commentary upon this is that the majority of cases have been unrecognized until within the past two or three years. Of 60 cases quoted by Martin, but 13 were diagnosed during life. There can be no question of the considerable frequency of this condition and a considerable percentage of the deaths after operation is due to it.

It should be considered in cases that fail to progress well. In any case, post-operative or otherwise, the distension of the abdomen with flatness over a considerable area suggests the retention of ingesta, and this is so prominent a feature of acute dilatation of the stomach that, regardless of the location, this trouble should be considered. The dilatation is so extreme in certain instances that the stomach reaches the pelvis. If the pain, collapse, and continual vomiting of fluid, with thirst leading to its constant replacement, be present, the diagnosis ought to be made at once. In case of doubt, the stomach tube should be passed repeatedly and in this way the overlooking of the condition should be obviated in every case. The absence of distension of the stomach and the presence of fecal vomiting suggest intestinal obstruction.

Prognosis.—This has heretofore been bad, about 70 per cent. of the cases ending fatally in a few hours to five days. The outlook is materially better with the more prompt recognition and more appropriate treatment of the past few years. Thus I saw two desperate post-operative cases, with different surgeons, of different hospitals, but within 48 hours, cease vomiting within an hour and start upon convalescence as the result of adopting a lateral abdominal position. Thus far the prognosis has been rendered worse by resort to operation in most cases.

Chronic Dilatation.—The cases are divided into two classes:

(a) Those due to insufficiency of the muscular power, the walls having been repeatedly stretched by overeating, the use of effervescent drinks, milk in large quantities, as in milk-cure establishments, by the fermentation of food and accumulation of gas in the stomach, with its tendency to stretch and weaken the wall, etc. Much discus-

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sion would be possible on this subject, but it will be sufficient here to say that many more cases of the second class are seen, and the tendency is now toward the idea that the recognized causes of the second type perhaps apply more frequently than we have heretofore believed in the variety we are now discussing. The frequency of dilatation of the stomach in connection with chronic gastritis, with its associated weakening of the walls, should be noted. In heavy

FIG. 52.—POSTERO-ANTERIOR VIEW OF STOMACH GREATLY DILATED AND PTOSED. Clinical diagnosis: inoperable carcinoma. Röntgenographic diagnosis: stenosis of pylorus due to adhesions to gall-bladder—proved by operation. (Dr. G. H. Stover.)

eaters and drinkers, in excessive beer drinkers, and in the insane this type of dilatation is common.

(b) Those due to pyloric obstruction. Heretofore the causes commonly given have been especially cancer, gastric ulcer, scar from ulcer, and adhesions of various types. Less frequently given causes have been foreign bodies within the stomach, floating kidney, through kinking of the duodenum, pressure of tumors from without upon the

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pylorus and duodenum, and hypertrophic pyloric stenosis. From the operating room standpoint rather than that of the consulting room we may make the following statements: Chronic dilatation of the stomach presupposes in the great majority of cases some cause of pyloric obstruction. The overwhelming proportion of these cases presents obstruction from gastric ulcer or gastric cancer. Next in frequency may be placed obstruction from adhesions, and many less commonly found causes follow. Peptic ulcer may produce obstruction by mechanical interference with the lumen of the pylorus or duodenum; by the spasm of the pylorus set up by the lesion, although the latter may not be immediately at the pylorus; by distortion induced by the swelling which is present around the ulcer, gastric or duodenal, or the adhesions formed, or by the puckered scar left upon the healing of the ulcer. In cases of long standing I believe this latter is the most common of all causes. Cancer produces obstruction in a purely mechanical way in many cases involving the pylorus. Distortion in other types may be responsible, or glandular enlargement close to the pylorus. In cases of pyloric cancer entirely surrounding the outlet, yet without obstruction and chronic dilatation, the growth is commonly "channelled" by the ulceration. The adhesions producing the obstruction have been those about ulcer and cancer as mentioned, those with the liver, pancreas, and neighboring parts, especially in cases where gastric ulcer has perforated at some previous time. Perforation of a cholecystitis into the stomach or elsewhere, chronic distorting adhesions about the gall-bladder, the drag upon the omentum by appendiceal adhesions, the adhesions left after pancreatitis, after hernia, trauma, perigastric abscess, or any other process capable of leaving adhesions, may distort the stomach and duodenum or cause shrinking in their walls. The drag upon the duodenum in floating right kidney is probably not a frequent cause, but I consider it a perfectly definite one, as I have repeatedly seen dilatation of the stomach relieved by anchoring the kidney. The duodenum may be pinched, or narrowed by the root of the mesentery as in acute obstruction, with chronic dilatation of the stomach as a result. There is a variety of acutely developing pyloric obstruction of which I have seen several examples, coming on in the first few

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weeks after operation for appendicitis, and due to the drag of omental adhesions upon the pylorus and duodenum.

One of my operated cases had had a chronic obstruction and a ten-year history of ulcer. The scar of an old ulcer a hand's breadth from the pylorus was found, but the chronic obstruction with dilata-

FIG. 53.—PTOSIS; DILATATION AND PYLORIC OBSTRUCTION FROM ULCER SCAR, PROBABLY CARCINOMATOUS, IN PYLORUS AND LESSER CURVATURE. (Dr. G. H. Stover.)

tion was due to intermittent pinching of the pylorus and first part of the duodenum in a Treitz's hernia. Although sufficient pressure existed to cause hematemesis repeatedly, the pylorus at times evidently escaped incarceration of such a degree as to prevent it from carrying on its functions reasonably well.

The dilatation of the stomach from congenital pyloric stenosis

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is well recognized, but quite rare. It was well marked in one of my cases operated upon by Dr. C. B. Lyman upon the fourth day of life. An extremely frequent cause of dilatation of the stomach which has not heretofore been given its due weight is the chronic pyloric spasm due to the long-continued irritation of abdominal lesions, chiefly of the appendix and gall-bladder. Because of the frequent predominence of the gastric symptoms and the secondarily induced irritative hyperacidity with vomiting and delay in emptying the stomach, the diagnosis of pyloric ulcer is commonly made. I have seen cases of this type relieved by operation upon the appendix or gall-bladder, which had been treated for periods of ten to twenty-five years for the stomach condition without a suspicion that the conditions were simply reflex.

Pathology.—The stomach is found dilated, sometimes enormously so. Thickening of the pylorus from spasm may be associated with hypertrophy of the muscular coat at this point, with perhaps increase in the fibrous tissue. More commonly some of the lesions mentioned above will be noted,—ulcer, cancer, adhesions, etc. The stomach wall is thinned in many cases, with glandular changes of a chronic gastritis; in others the hypertrophy secondary to the obstruction has led to thickening of the walls. A diverticulum in the stomach wall may have been formed.

Symptoms.—In the atonic type the stomach may be silent, the symptoms being those due to poor nutrition—neurasthenia, debility, and lack of endurance. In certain individuals the condition is found accidentally and no symptoms can be attributed to it. In others the symptoms of chronic dyspepsia are common, probably when chronic gastritic changes are pronounced. In the obstructive cases the symptoms are well marked. Distress in the stomach is constant. The depressed state of the patient's nutrition leads to the taking of food and drink freely; yet they are frequently accumulated in the stomach and evacuated periodically in enormous quantities. I have repeatedly withdrawn from a quart to a gallon in cases of gastric ulcer, when the symptoms pointed much more strongly to the ulcer than to the obstruction with dilatation, and several times the quantities mentioned are not uncommon in severe chronic ob-

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structions. Thirst is a common symptom in spite of the amount of fluid found in the stomach, since water is not absorbed from this organ. The usual concentration of the urine is thus accounted for. Constipation is present in most cases. Emaciation is the rule. The distress may come from the dilatation and stretching of the stomach and its great weight, but more acute pain may be due to the disease causing the obstruction. The vomitus is a dark sour-smelling liquid, containing remnants of undigested food, mucus in case of ulcer, occasionally blood. I have often practically made the diagnosis of cancer from the offensiveness of the contents, entirely different from the sour smell in ordinary retention. Bacteria, sarcinæ, yeast fungi, etc., are often present in profusion. The urine often shows indican in excess. The blood may show secondary anemia. The skin is often dry and harsh.

Physical Examination.—The large dilated stomach causes prominence of the abdomen. From its weight it is always a dropped stomach, and therefore in the standing position the enlargement of the abdomen chiefly affects the lower portion. In chronic cases with well-dilated stomach and thin abdominal walls, the curves of the organ may be traced by the eye, and the peristaltic waves may be noted, generally passing in the normal direction toward the pylorus. Upon palpation the stomach may be felt, and frequently the obstructing tumor at the pylorus. If distended with fluid and air, splashing is readily produced by the examining hand, or by sudden contraction of the diaphragm on the part of the patient. In case of doubt it is best to distend the stomach, as may readily be done by giving the two parts of a Seidlitz powder dissolved separately, when the sizzling of the fluid may be heard readily with the stethoscope, and the enlargement readily outlined by inspection and percussion. In many years' extensive use of this method of dilatation by Dr. T. R. Love and myself in a great variety of gastric conditions, including hundreds of cases of ulcer, the worst result we have noted has been vomiting, and this in but two or three cases. We have of course not used the method in ulcer complicated by recent hemorrhage. The movements of the stomach may be readily followed by percussion, made in the upright, recumbent, and lateral positions, and its bor-

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ders may be traced more particularly by the use of distension with gases mentioned, by drinking water, or by evacuating the stomach by vomiting or by the tube. The stomach may yield to the stethoscope a sizzling sound from the fermentative process going on, but

FIG. 54.—MEGALOGASTRIUM. Postero-anterior view of a greatly dilated, thick-walled stomach. The patient weighed 83 lbs. at time of examination, having lost 45 lbs. within the past year. The röntgenogram shows the residue in the stomach at the end of 6 hours after a one-pint bismuth meal. Diagnosis: stenosis of the pylorus, caused by cicatrization following an old ulcer. Six months after a gastro-enterostomy, the patient had gained 50 lbs. in weight, and was restored to reasonably good health and strength. (Dr. S. B. Childs.)

much less pronounced than that induced by the distension method mentioned. Gastroscopy is but little used in this type of stomach disease. The sound may pass to a distance of 70 cm. from the teeth instead of the normal 60 cm.

The most striking of all methods of examination is that by the

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bismuth plate. The size and shape of the stomach are readily appreciated and frequently the presence of tumor or adhesions at the pylorus may be detected. In general the presence of food remnants after six to eight hours suggests some retention. The finding in the morning examination of bits of raisins or other such easily identified food particles eaten at night is to be regarded as indicating a definite surgical type of obstruction. After extensive use of various methods we conclude that no chemical test for rapidity of absorption is to be compared for reliability with this rough clinical test, which fortunately is so easy of application.

Diagnosis.—This can scarcely be missed if the case be examined in the manner outlined, and with experience most cases may be certainly placed by inspection alone. Gastroptosis has none of the retention signs of gastrectasis, and the stomach does not dilate with gas to any considerable extent. The bismuth plate shows its size and abnormal location. In distinguishing between the idiopathic form and that due to pyloric obstruction the history must be the guide. There is a slower course, not marked by history of ulcer, cancer, gall-stone disease, appendicitis, etc., with less pain, less vomiting, less emaciation, with absence of tumor and of visible peristalsis. Pylorospasm may be suspected if the history of appendicitis or gall-stone disease is obtained, and especially if tenderness and rigidity be found over the regions indicated. It is pitiful that so many cases of dilated stomach go from one physician to another, and even from one specialist in digestive diseases to another, as occasionally happens, when rigidity and tenderness at the region of the appendix may give the clue to the diagnosis in one minute. In the case of a physician who had practiced medicine for 25 years with a marked example of this type of dilatation, who had suffered from many physicians and had finally given up practice and contracted the morphia habit on account of the pain, the removal of a chronically inflamed appendix and a course of treatment for the drug habit restored him to the profession in better health than he had ever enjoyed. I have seen many comparable cases, and can not speak too strongly of the need of such examination.

The stenosis from compression of the duodenum may be sug-

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gested by the occurrence of bile in the vomitus. This is not common in duodenal ulcer, since the obstruction is above the papilla.

The so-called hypertrophic stenosis of adults should be investigated with the suspicion in mind that it may arise from the pylorospasm of appendicitis. I have seen many of the latter, but none of

FIG. 55.—POSTERO-ANTERIOR VIEW OF A TYPICAL WATER-TRAP STOMACH. The stomach is held in this position by extensive adhesions to the large intestine and left ovary. (Dr. S. B. Childs.)

the former in the operating room. Recognition of a separate variety of stenosis of this type seems to be wanting.

PROGNOSIS.—Cases of definite surgical obstruction, which are by far the most frequent, are remediable by operation. In order to obtain a good result, however, the damage to the musculature and glandulature of the stomach must not be allowed to progress to the

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point of atrophy. If a diagnosis be made early and proper measures be taken, the prognosis will offer no difficulties. In the idiopathic cases we are dealing with chronic gastritis with gastrectasis in most cases, and the prognosis is that of the gastritis. Operation is probably of little value in any instance without mechanical obstruction, but this will be found in many cases which were formerly thought to be of idiopathic type. Even in cancer of the stomach with obstruction, pylorectomy or resection of the stomach saves a few lives, while the let-alone policy loses every one.

D. NEUROSES OF THE STOMACH

(*Nervous Dyspepsia*)

Those disturbances of gastric digestion in which no anatomical foundation for the trouble is discoverable, during life or post-mortem, are looked upon as of nervous origin. The neurosis may affect the sensory, the motor, or the secretory functions of the organ, and in most weird combinations. There is commonly a neuropathic basis, and in many cases the stomach symptoms are merely the ones which are temporarily on top. The patient is likely to be in the hands of the neurologist next year and of the gynecologist the year after, as other features become more prominent in reality or in the mind of the patient. Many of the gastric symptoms, as is the case with the neurological and gynecological ones, are reflex disturbances from distant regions. The very great frequency with which they originate in a slightly diseased appendix or some pelvic organ is too often lost sight of. Females are naturally more often the victims of nervous dyspepsia, and the same causes which tend to the production of neurasthenia or hysteria are operative here. The well-to-do are much more frequently affected. Not all suffer seriously from these diseases. It is common to see the highly strung neurasthenic type of individual who complains persistently of the belching of gas, of distress, distension and consciousness of his stomach's action, yet who is able to do a fair amount of work and, what is more important, holds his weight from year to year. At the other extreme are the half-

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starved, wretched-looking women who cannot eat and digest enough food to keep them from the very borders of starvation.

A most extensive and fantastic nomenclature has grown up about the gastric neuroses. As many of these are being eliminated by the discovery of their dependency upon organic disease, it is to be hoped that a similar atrophic process will affect the classification of the remainder.

Neuroses of Secretion.—HYPERCHLORHYDRIA (Hyperacidity).—This is one of the most common neuroses of the stomach. An abnormally acid gastric juice is called out by the digestive process in these subjects, the increased acidity being attributable to hydrochloric acid. It is common in both sexes, but in neurotic girls it is very frequently present. The patient complains of distress from the acidity during the first few hours after eating. It should be noted here that in a majority of all cases with this diagnosis a definite digestive lesion, most commonly ulcer or chronic appendicitis, is present in the abdomen, but we must describe the symptoms as they occur, since the lesion is not always to be detected. Further, the symptoms of hyperacidity depend not so much upon the absolute acidity as upon the sensitiveness of the mucosa to the irritation of the acid. Oversensitiveness is probably more common as the cause of distress than marked increase in the hydrochloric acid. The patient complains of a distress in the stomach, often of heart-burn, and the eructations are notably sour. The trouble is commonly more pronounced after a carbohydrate meal, because of the lack of the albuminous elements with which the acid may combine. In most patients the acidity is present only at occasional meals or for a few days at a time, especially at periods of stress, usually emotional or mental. Relief is obtained either by taking an alkali and neutralizing the excess of hydrochloric acid, or by drinking water and diluting the over-strong gastric juice. In some cases the drinking of milk, rich in albumin, completely relieves the distress by combining with the acid. The long continuance of the acidity is almost certain to produce chronic headache, and I regard this variety as next in frequency after those due to visual defects and the migrainous types. Irritability and general nervousness are frequently present. The patient is consti-

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pated, doubtless in part because of the over-complete digestion of certain elements of his diet by the over-strong gastric juice. The urine and blood show no characteristic changes. The test-meal shows hyperacidity in many cases, yet in my experience a hydrochloric acidity of 50 is not often reached. Certain cases far surpass these figures. At other times, and perhaps most of the time, a normal or subnormal acidity is present. In the pure cases blood is absent. In the continuous hyperacidity of Reichmann, and the chronic hypersecretion of certain writers, the hydrochloric acid is increased, not only in time of digestion, but even in the fasting stomach, with much gastric distress as a result. This type may occur in tabes as well as in the generally neurotic type amongst whom hyperchlorhydria is found.

The interference with carbohydrate digestion leads to sour stomach and acid eructations, followed by vomiting and occasionally by dilatation of the stomach from pyloric spasm. There is danger of development of ulcer in all cases of hyperacidity.

Physical Examination.—This shows little but tenderness over the epigastrium and perhaps slight dilatation of the stomach with splashing.

Subacidity and Anacidity.—This type of nervous disturbance of the secretory function of the stomach is distinguished by the small amount of hydrochloric acid or its absence in the gastric juice. It should be noted that the name applies only in case of absence of gross cause for the low acidity, especially chronic gastritis, atrophy of the mucous membranes, and cancer. Excitement, depression, worry, and chronic cachectic disease, not directly connected with the stomach (neurasthenia, exophthalmic goiter, pulmonary tuberculosis) are often causative. Advanced age is a reason for some decrease of the usual hydrochloric acidity of middle age. It is not unusual to find persons in perfect health with low acidity. In many subjects with practically total loss of hydrochloric acid the intestine may take on extra work in such a way as to preserve fair or even normal nutrition, and the same fact is noticed even after extirpation of the stomach. If hydrochloric acid and all the ferments are absent, the name achylia gastrica applies.

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Symptoms.—There may be none and the general health may be excellent. Marked symptoms of nervous dyspepsia may be present. The stomach may empty itself in normal time, and serious nutritional disturbances may be entirely absent so long as this is the case. With failure to empty itself, however, the stomach contents tend to ferment, intestinal digestion is interfered with, and flatulence and even diarrhea may be present. The improvement in health or at least partial restoration of the gastric secretion in certain cases gives ground for the belief that Stockton's explanation of achylia gastrica in certain cases is correct, namely, that it is a matter of simple functional depression, in association commonly with neurasthenia.

GASTROMYXORRHEA.—In this condition an excessive secretion of mucus is found. In typical cases the stomach contents are deficient in hydrochloric acidity. The condition may be intermittent. The frequent presence of much mucus in cases of hyperacidity is well recognized. The symptoms are not definite enough for diagnosis. The condition is generally discovered in routine examination, and little is to be gained by separating it from the chronic forms of gastritis. It must be borne in mind that the secretory neuroses are commonly combined with other disturbances of gastric function.

DIAGNOSIS.—*Hyperacidity.*—No symptom-complex must be approached with greater scepticism, unless it be that known under the name of gastralgia. While functional hyperacidity does exist and must be recognized, a fair experience in examination upon the operating table of cases which have been treated as hyperacidity for periods of one to twenty-five years leads me to say that if those due to the reflex irritation of chronic appendicitis and peptic ulcer were eliminated a majority of all the cases would easily be included. If we add those in which surgical lesions in the pelvis and gall-bladder are responsible, a very moderate number will be left. *No diagnosis of functional hyperacidity should stand for a moment until the case has been examined for evidence of the history of appendicitis, gall-stones, or peptic ulcer, and until the absence of rigidity and tenderness in the regions indicated has been established by repeated examinations.* Even after such a course one may occasionally learn that patients have had an attack of acute appendicitis, have been operated,

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and are well. The diagnosis of nervous hyperacidity should always be held subject to revision for cause, and the physician who sees many abdominal cases operated by surgeons familiar with these matters will appreciate this and act accordingly.

PROGNOSIS.—This is good as to life. Many of the patients are well nourished, in part at least, on account of the over-action of the digestive organs. Gastric ulcer is to be feared if the trouble continues indefinitely.

Subacidity and Achylia Gastrica.—The prognosis as to life is fair excepting when the trouble is based upon an organic cause, which fact may not be recognized at the time of making the prognosis. Many of the patients are of low vitality because of lack of sufficient digestive ability, and this constitutional tendency cannot be cured.

Neuroses of Motion.—HYPERMOTILITY.—This may occur as a purely nervous phenomenon, although more commonly as an accompaniment of ulcer or other organic disease. The stomach is found to empty itself in part within a few minutes of the bismuth meal. The test-meal after 60 or even 45 minutes may yield no result, as the stomach has completely emptied itself. It is most common as an accompaniment of hyperacidity. No definite symptoms are recognized clinically.

NERVOUS ERUCTATIONS.—These commonly follow swallowing of air, as in "cribbing" horses, the proof of which is that the belched gas is atmospheric air. In many cases the swallowing may be easily recognized, but it should not be excluded because not quickly detected. The trouble occurs in attacks perhaps lasting for hours, and often under mental excitement. Neurotic patients, especially hysterical women, are sufferers. It may be imitated by children.

NERVOUS HICCOUGH.—Apart from the type of hiccough occurring in organic disease of the organs below the diaphragm, there is a type of singultus occurring in subjects with hyperesthetic stomachs.

NERVOUS VOMITING.—This occurs in hysterical women chiefly, and like other hysterical manifestations, especially in brunettes. The functions and structure of the stomach are otherwise perfect. It is frequently called nervous regurgitation, because of the lack of nausea and retching. It may occur after eating or at other times,

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and may last an indefinite time, even many weeks. Males are by no means exempt. I have recently seen a case in a young athletic German who had been disappointed politically. Nothing was of any avail until he was placed in a hospital under a strict regimen. The cases occasionally prove fatal. The rare cases, of which I have mentioned one elsewhere, of vomiting by the husband during the early months of his wife's pregnancy, are of this nature.

Edsall's suggestion that possibly some of these cases may be a manifestation of acid intoxication should be acted upon in case of any serious developments.

Peristaltic Unrest.—In neurasthenic subjects excessive peristalsis occurs soon after taking food, and cramplike and even visible contractions of the musculature are noted. Rumbling, which may come from the intestines in part, is noted, and gurgling may be felt by the examiner's hand. Examination with the fluoroscope proves the overactivity of the stomach, and it often empties itself too quickly. The usual amenability to the influence of emotion, as in other neurasthenic manifestations, is to be noted. Reversed peristalsis may be present, and this may apply to the bowel in many cases, so that the intestinal contents may be vomited.

Rumination (Merycism).—In this affection the patients seem to derive some satisfaction or pleasure from the regurgitation of the food and remastication of it, as in ruminating animals. It is distinctly of neurotic or hysterical origin, and may be of hereditary or family type. It is not very rare in asylums for the idiotic and insane. It is of no especial clinical importance. Insufficiency of the cardiac orifice is a part of the trouble, and is thought by some to be the essential causative feature.

Cardiospasm.—This has been considered in connection with dilatation of the esophagus, of which it is a frequent accompaniment, if not the direct cause. The researches of Plummer have established it as the cause of many of the esophageal troubles which have heretofore been but little understood. It may occur in connection with pylorospasm and give rise to distension of the stomach with air—"pneumatosis."

Pyloric Atony.—As a nervous affection it is rare, and asso-

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ciated with the hypermotility described, of which it may well be a part. Gas pumped into the stomach passes into the bowel directly. It is of no especial clinical importance.

PYLORIC SPASM.—This is rare excepting as the result of organic gastric disease, or from reflex irritation from the appendix or other organs. It is fully discussed elsewhere.

GASTRIC ATONY.—This is discussed in connection with gastrectasia.

Neuroses of Sensation.—HYPERESTHESIA.—This condition is found in hysterical and neurasthenic patients. The stomach is over-sensitive and feels uncomfortable from contact with ordinary articles of food, a normal gastric secretion, or even one in which hydrochloric acid is deficient. The symptomatology is closely related in extent to the vocabulary of the patient, but burning, heaviness, and fullness are perhaps the most common complaints. All the causes operative in producing the neurasthenia are frequently to be found. The idiosyncrasies which certain persons have to certain foods, which produce no symptoms in others, are closely related. In the worst cases the disability as to the taking of food may reduce the patient in much the same way as is the case in hysterical vomiting.

BULIMIA.—This is a condition of abnormal hunger and may be purely nervous in origin. Excitement of the "hunger center" has been suggested. Those cases due to definite hyperchlorhydria, diabetes, etc., must be differentiated. The nervous form is more common in women, and in the neurotic type of which we have been speaking in connection with other functional neuroses. It may occur in epilepsy and brain tumor. The attacks are periodical, and the feeling of intense hunger must be satisfied, a peculiar fear and anxiety impelling the patient to this course. Various chronic gastric diseases may result from the over-distension and abuse of the stomach. By the term akoria is meant the lack of a normal feeling of satiety, a condition often associated with bulimia.

PAROREXIA.—Parorexia is a general term signifying such perversion of the appetite as leads to the desire for strange articles,—earth, chalk, spices, or even disgusting articles.

GASTRALGIA NERVOSA (Gastrodynia).—The actual pains of rec-

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ognized organic origin, as in malignant diseases and ulcer of the stomach, and those due to the interference with the posterior nerve roots in spinal disease (crises of ataxia) are discussed elsewhere.

Functional gastralgia is found in the neurotic and hysterical type of individuals, generally of the female sex, who furnish most of the cases of functional diseases of the digestive tract. Anxiety, grief, worry, menstrual disturbances, hyperacidity, nervous disturbances of the menopause, and debilitating chronic conditions associated with secondary anemia are looked upon as causative. The close association with some type of nervous dyspepsia is frequently noted.

Symptoms.—The patient is seized with sudden pain in the epigastrium, often of great severity, radiating to the back, and often of a girdling character. There is no definite relation to the taking of food. After a period of a few minutes to an hour, eructation of gas takes place, with relief in many cases. Others are relieved by pressure.

Diagnosis.—If the physician will carefully and intelligently rule out the gastric crises in tabes, the cases of ulcer of the stomach and duodenum, and of chronic appendicitis, of hernia in the linea alba or elsewhere, the diagnosis will offer few difficulties, for few cases will remain. There is no better gauge of the ignorance on the part of the physician of the modern surgical pathology of the painful digestive disorders than the frequency of the diagnosis of gastralgia in his practice. One of the few cases in which I have had occasion to make the diagnosis in a decade was in the case of a physician who apparently had a vagus neuritis in association with a peripheral neuritis arising from the therapeutic use of arsenic. In every case in which the diagnosis has been made by others, and in which I was able to explore the abdomen, when opened by the surgeon, a perfectly definite surgical lesion was found, and this is the universal experience in clinics where digestive diseases are treated by modern methods. In my opinion, based upon my own experience, no one can study the living pathology as seen in the operating room in 1,000 cases of digestive disease and hold any other opinion. Nevertheless, the diagnosis of gastralgia is justified when the general neurotic condition of the subject and utter absence of any of the signs of structural alteration suggested above are associated.

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E. HEMATEMESIS

(*Hemorrhage from the Stomach*)

Strictly speaking, hematemesis signifies the mere vomiting of blood, while the term gastrorrhagia signifies that the hemorrhage has been originally from the stomach. In hematemesis the source of the blood may have been a nosebleed, blood having been first swallowed, or it may have been coughed up from the lungs and been swallowed, or it may have come from other extragastric source. Rarely an aortic aneurism is the source of the blood. Amongst local causes of gastric hemorrhage peptic ulcer should be placed first, much more commonly gastric than duodenal. Ulcerations from infectious processes (typhoid, tuberculosis, sepsis, etc.) may be the source of the hematemesis. Simple erosions, the congested mucous membrane of gastritis, small aneurism or varices of the vessels of the stomach wall, and, more frequent and important, gastric cancer, should be mentioned. In appendicitis with well-developed peritonitis a black vomitus is not infrequent, and fresh hemorrhage may occur. Injury to the omentum in abdominal operations is an occasional cause of erosions of the gastric mucous membrane from which much bleeding occurs, not infrequently lethal. Bleeding from the mucosa without visible lesion (gastrostaxis) may be found in young women.

Direct injury is not a very infrequent cause, as from collisions, horse-kicks, etc. The trauma may be produced within the stomach, as by a foreign body, even by the stomach-tube. Severe vomiting not infrequently produces streaks of blood in the ejected material. Hemorrhage has been reported from stretching the cardiac orifice in case of cardiospasm, and over-distension of the stomach may cause it. A not unusual cause is the damage to the gastric wall produced by violent chemical irritants, as the mineral acids. The source may be a local lesion produced indirectly, notably in obstructive difficulties of the portal vein. Cirrhosis of the liver is by far the most common cause of the obstruction, and more cases of hematemesis arise from this source and from gastric ulcer than

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perhaps all others combined. Syphilitic hepatitis and portal thrombosis are occasional causes. In chronic cardiac disease with passive congestion of the liver and other abdominal organs, in emphysema and fibrosis of the lung, and in splenic diseases, notably splenic anemia, gastrorrhagia is often noted. I have seen the hematemesis so severe in thrombosis of the superior mesenteric vessels as to lead to the erroneous diagnosis of peptic ulcer. Amongst the general causes should be placed the various specific fevers, especially the exanthemata, hemophilia, scurvy, leukemia, splenic anemia, uremia and cholemia, and certain nervous diseases, particularly hysteria, tabes, paresis, and epilepsy.

Pathology.—It is not at all the rule that the source of the hemorrhage is to be demonstrated at the post mortem examination, since hemorrhage by diapedesis may be fatal. In ulcer, cancer, rupture of aneurism or of a varicose vein, in case of trauma, and in cases due to chemical irritants and acute toxic conditions, the lesion is generally to be found with little difficulty. Hemorrhages into the mucous membranes are more prominent features in the last-mentioned class. General pallor of the tissues is noticeable after death from hemorrhage of the stomach. The lower end of the esophagus should always be examined if a source for the bleeding is not apparent in the stomach.

Symptoms.—In acute cases they are the symptoms of loss of blood from any region—pallor, exhaustion, dizziness, and perhaps syncope and death. It is possible for a fatal result to occur, as in typhoidal hemorrhage, and that from duodenal ulcer, without any appearance of blood outside the body. In cases with repeated hemorrhage a secondary anemia develops, not infrequently with very noticeable pallor. The blood is fresh and red in case of a large hemorrhage if it be vomited soon, dark and clotted in case it is retained in the stomach, especially in case of hyperacidity, the oxyhemoglobin being changed to hematin. The reaction of the ejected blood is commonly acid from the admixture of gastric juice in these cases. The stools practically always contain blood, at least in small amounts, since a portion passes the pylorus. Chemical examination may be necessary for its detection. The circulating

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blood in cases of chronic bleeding shows the usual changes of secondary anemia. Fever is not infrequent. In the acute cases delirium and convulsions, blindness from circulatory disturbances in the optic territory, thrombosis of cerebral vessels or other vascular accident may be present. The splenic artery is the most frequent source of severe gastric hemorrhages.

Diagnosis.—It is first necessary to establish the actual presence of blood or blood pigment. In case of doubt this is easily done microscopically or chemically. Various articles ingested may give rise to a vomitus grossly resembling blood (tomatoes, red fruit juices, etc.), but reasonable care serves to eliminate these false cases. Brick dust and other colored substances are used by malingerers, "dummy chuckers," hysterics, etc., to give the impression of the occurrence of hematemesis. The black vomit of peritonitis may be closely imitated by bismuth salts or iron preparations which have become discolored in the stomach, but chemical tests serve to differentiate these substances from blood.

Hemoptysis is the most frequent source of confusion in diagnosis, and unless a reliable observer has seen the hemorrhage there may be much difficulty in differentiation. There are signs and symptoms of disease of the chest rather than of the abdomen, the blood is raised by coughing and not by vomiting (excepting where it has been swallowed), it is pink and frothy rather than dark and coagulated, as in hematemesis, and alkaline rather than acid, as in the latter condition. Evidence of the presence of blood in the air cells or bronchi exists in hemoptysis, with blood-stained sputum following the attack, while the features of abdominal disease and melena characterize the cases of hematemesis.

Prognosis.—It is said that 3 per cent. or 4 per cent. of gastric hemorrhages are fatal, less frequently from ulcer and cancer than from hepatic cirrhosis and those diseases associated with great enlargement of the spleen. In case of peptic ulcer the danger from gastric hemorrhage is much less than that from the duodenal form, in which the blood commonly passes from the bowel.

Indications for Surgical Intervention.—This procedure is called for more frequently in peptic ulcer than in all other conditions

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together. The matter has received attention in the section upon gastric ulcer.

F. HYPERTROPHIC PYLORIC STENOSIS

(a) Congenital.—The cause is not definitely known, but it seems probable that the hypertrophy, chiefly of the circular fibers of the pylorus, which is demonstrable upon opening the abdomen, is secondary to muscular spasm, although the cause of the spasm is not apparent. The frequency of spasm in adults as a result of hyperacidity suggests the same origin in infants, but it has not been proven. Further, the hypertrophy may be well marked at birth, and the symptoms may begin with the first feeding. In one of my cases, operated on the fourth day, the thickening from hypertrophy of the muscle fibers of the pylorus was very marked. That a spasm of hypertrophied muscle is the essential feature of the causation of the symptoms is apparently proven by the fact that the condition may spontaneously recover even when the pyloric tumor has been palpable through the abdominal wall, and the tumor is said to be palpable in certain cases after recovery. Males are more often affected.

Symptoms.—These not infrequently begin with the first feeding, but generally a week or two after birth. Expulsive vomiting is the rule, occurring several times during the day. The vomitus consists of the food taken, little or none of it having passed the pylorus. The occasional presence of blood and mucus and the constant absence of bile are worthy of note. Marked constipation is the rule, there being no intestinal contents to evacuate in the severer cases. Weakness and marked wasting follow, with death in many cases from asthenia. The urine is scanty. Diarrhea has been reported.

Upon physical examination the pyloric tumor may be felt in most cases, but its presence is not essential to the diagnosis. We could not feel it in one case, although it was evident upon opening the abdomen. A peristaltic hardening of the tumor may be noted. The dilated stomach is often evident to inspection, subsiding with emesis. Visible peristalsis is present, especially in cases of long standing, the waves passing toward the pylorus. The use of the Röntgen ray

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after a bismuth meal is advisable, often giving information of much value as to the size, shape and position of the stomach, and especially as to the permeability of the pylorus. It is also of assistance in the exclusion of intestinal causes of partial obstruction with continued vomiting. Simple pylorospasm may cause somewhat similar symptoms in milder degree, but hardly of sufficient severity to demand the operative intervention occasionally found necessary in the true hypertrophic cases.

Prognosis.—In the cases with true hypertrophic stenosis the outlook is very grave, although better with early surgical aid than otherwise. Many of the cases of recovery under medical treatment were probably instances of pylorospasm rather than hypertrophic stenosis.

(b) Acquired Stenosis.—In adults a condition similar to that just described is said to occur, especially in connection with chronic gastritis. Very much more frequently met with are the cases of hypertrophy with greater or less obstruction resulting from reflex spasm, notably from chronic appendicitis, and more especially from the type in which concretions are present in the appendix. I have observed many of these cases, and noted their recovery after operation. The pylorus may be felt to be much firmer and thicker than normal, the stomach is dilated, and food retention is a feature. Many of the cases show a pronounced hyperacidity, and the false diagnosis of pyloric ulcer is frequently made, as I know from experience. In chronic gall-bladder disease a similar pyloric complication may be present. The gastric signs and symptoms all vanish upon operative cure of the original condition. There may be tenderness over the pyloric region, and increased tonicity of the stomach wall may be appreciable through the abdominal parietes. The very frequent dependence of this type of pyloric disturbance upon appendiceal and gall-bladder disease should be emphasized.

Perhaps next in frequency may be placed the type of stenosis due to the scar of a healed ulcer. In 16 of my first 50 cases of operation for the results of gastric ulcer the stenosis was due to this cause, there being but 14 from active ulcer. Adhesions took some part in causing the obstruction in both classes of cases. The frequency of stenosis

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from malignant growth has been discussed under gastric cancer. Adhesions about the pylorus resulting from ulcer, gall-stone disease or other nearby inflammatory disease, are frequently responsible for pyloric obstruction. One type, of which I have seen several instances, not very rarely follows the contraction of adhesions set up after abdominal operation, especially upon the appendix and pelvic organs. The omentum is commonly involved, the kinking and narrowing of the pylorus resulting from the pull of shrinking cicatricial tissue. A markedly dilated stomach developing within a few months after an abdominal operation is commonly, in my experience, due to this cause.

In connection with pyloric stenosis should be mentioned the type of obstruction of the duodenum due to adhesions, infiltration of an extensive ulcer, scar of such an ulcer, gall-stone disease, benign or, rarely, malignant tumor, or localized peritonitis. If the obstruction be below the papilla, bile may constantly regurgitate into the stomach and be vomited. I have seen several instances of marked chronic dilatation of the upper portion of the duodenum, in connection with narrowing below, from the pressure of the superior mesenteric vessels, and in one such case the trouble was corrected by an anastomotic operation. One case of pyloric obstruction with gastrectasia was due to the pinching of the pylorus and upper duodenum in a Treitz's hernia.

The symptoms of pyloric stenosis have been considered in the sections upon ulcer and cancer of the stomach. Hemorrhage is not to be regarded as diagnostic of pyloric ulcer or cancer, since it may occur in obstruction by adhesions.

G. PEPTIC ULCER

Ulceration of the mucosa of the stomach and that portion of the duodenum lying above the entrance of the common bile duct is spoken of as peptic ulcer. A division is made into gastric and duodenal ulcers. In the post mortem room the former has been regarded as much the more common, and it has been much more frequently diagnosed in the past. Statistics from the Mayo clinic and elsewhere

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show that in reality duodenal ulcer is about three times as common as the gastric, that 80 per cent. of all peptic ulcers occur in males, and that in 8 per cent. of the cases multiple ulcers are present.

Etiology.—The essential elements in the development of a peptic ulcer are diminished resistance upon the part of the mucosa, and such activity of the digestive fluids as to lead to destruction of the tissue. Undoubtedly in certain cases thrombosis in the vessels of the stomach wall is the immediate cause of the lowered resistance. In anemia the resistance of the tissues is lowered, and if gastric hyperacidity coexists, an ulcer is likely to develop. We shall not discuss the various theories of origin, but merely mention traumatism, injury from swallowing caustic substances, infection by the colon bacillus with destruction of the mucosa, development from simple erosions, or from nervous lesions analogous to those of herpes zoster. Ulcer of the duodenum is recognized as a not infrequent finding after extensive burns, and thrombosis has been considered the probable cause. In one of my cases the symptoms developed with an attack of confluent small-pox of extreme virulence, suggesting that a cause similar to that in the case of burns may have been operative. Hansmann calls attention to the fact that syphilis is probably a more frequent cause of calloused and perforating ulcer than we have hitherto believed.

Sex.—Whatever the statements from medical clinics and post mortem rooms, of the cases coming to operation about four-fifths are males.

Age.—Ulcer is most frequently met with before the age of 30 in females and 40 in males, but with great variations in individual cases. The average age of females suffering with ulcer is probably at least 10 years less than that of males. Cases may develop at birth. I have reported such a case in which repeated hematemesis occurred with excessive gastric acidity, marked melena, and abdominal rigidity. Even in the eighth decade peptic ulcer is occasionally found clinically and pathologically.

Occupation.—No especial influence has been proven. My own cases seem to have come indiscriminately from every walk of life.

Circulatory Influences.—Chlorosis and other types of anemia, arteriosclerosis and endocarditis are of some influence, the first

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perhaps by lowering the resistance of the mucosa through poor nutrition, the latter two by bringing about mechanical failure of circulation.

Heredity, trauma, syphilis, tuberculosis, abuse of alcohol, use of highly spiced foods, and various infections are thought to be of occasional importance. The recognized association of gastric and duodenal ulcerations, generally of slight degree, with chronic Bright's disease and uremia, may be noted. In a general way it may be stated that ulcer is reported to be much less common in America than in England and in central Europe, but there is much disagreement between post mortem statistics and those from the clinic and operating room.

As to the frequency of cases of such severity as to demand surgical help, the most important factor is the recognition by the clinician of the cases not presenting the classical symptoms. In clinics in which many cases are classed as acid dyspepsia, hyperacidity, nervous dyspepsia, erosions, gastralgia, dilatation of the stomach, etc., but few cases of ulcer may be diagnosed, while one with experience in the operating room pathology of ulcer would probably make a totally different classification, finding ulcer to be much more frequent. I have seen reports of great hospitals, with very large out-patient departments, which recorded fewer cases of gastric ulcer in a year than I have seen in private practice in that time, and even in some cases fewer than I have had demonstrated by operation. Perhaps another hospital in the same city reports very much larger numbers of cases of gastric ulcer. The obvious inference is that the cases do not vary so much in frequency as in the manner of classification. Those who see many operative cases of the diseases of the digestive tract make more diagnoses of ulcer and fewer of functional disturbances.

Pathogenesis.—The presence of hydrochloric acid is probably essential to the development of ulcer, and ulcer may occur wherever the acid is found. Yet hyperacidity is by no means the rule in ulcer. The failure of the ulcer to heal is probably closely related to the presence of hydrochloric acid, especially if in excess. It should be recognized that hyperacidity is common in the absence of ulcer. Jejunal ulcer after gastro-enterostomy is probably almost directly depend-

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ent upon high acidity, the mucosa of this region being less able to resist it than that of the stomach and upper duodenum. The failure of the production of an antibody antagonizing digestion of the mucosa has been suggested as possible.

Pathology.—A distinction is made between acute and chronic ulcer. The former is little more than an erosion of the mucosa with sharp edges and smooth base. The chronic ulcer is larger, with thickened edges and a calloused base. The floor may be the submucosa, the muscular or the peritoneal layer, or not infrequently the liver, pancreas or other neighboring organ to which the stomach has become adherent. A considerable excavation into the liver is not unusual, and I have seen the larger part of the pancreas inside the stomach through a large adherent ulcer. In size the chronic ulcer may approach even that of the extended hand, covering perhaps much of the anterior or posterior walls. If in the pylorus or duodenum, or on the lesser curve, such an indurated ulcer with its surrounding adenitis may so strongly suggest cancer that many mistakes have been made. Yet the actual ulcer is commonly only from a few millimeters up to a centimeter or two across. Mayo states that most of the large ulcers are undergoing malignant changes. The slow deepening of the ulcer leads to the formation of a dense barrier of connective tissue to protect against the possibility of perforation. Healing takes place in certain superficial ulcers without puckering of the gastric wall, only a smooth scar being found when the stomach is laid open. If the ulcer extends below the mucosa, the cicatricial contraction may be very extensive. The ulcer may heal at one edge and extend at another, and such an extending serpiginous ulcer may distort the stomach, and especially the pylorus, with disastrous results. Hourglass stomach not infrequently develops from such contraction in girdling ulcers. The thick-based ulcer may last for many years without healing, and even apparently without an attempt at healing, and as will be noted later, malignant degeneration is especially to be feared in such cases.

In the duodenum the ulcer never reaches so great a size, and is frequently so small as to be easily overlooked. The thickening about a chronic duodenal ulcer may make a mass palpable through the ab-

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dominal wall, and may produce material obstruction. The location in the stomach is commonly in that portion in which the more active work of digestion is carried on, where the chemical and mechanical irritation are greatest. Hence the pyloric end is most often affected —the pyloric antrum. Martin gives the following table*: lesser

FIG. 56.—ULCER OF THE LESSER CURVATURE OF THE STOMACH. Note pseudo-hour-glass contraction of greater curvature. (Dr. G. H. Stover.)

curvature, 35 per cent.; posterior wall, 28 per cent.; pylorus, 14 per cent.; anterior wall, 9 per cent.; cardia, 6.5 per cent.; fundus, 3 per cent.; greater curvature, 3.6 per cent.; anterior walls and posterior walls together, 0.67 per cent. The saddle ulcer at the pylorus, astride the lesser curvature, is a type frequently found in the oper-

*Osler: "Modern Medicine."

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ating room. Tileston reported from the literature 40 cases in which peptic ulcer was found in the esophagus. In the duodenum 90 per cent. to 95 per cent. are in the first portion, about half of these reaching very nearly to the pylorus. The anterior wall is most affected at the point where the acid chyme from the stomach strikes the duodenal wall. The remainder are chiefly in the second portion of the duodenum.

Wilkie states that so-called "silent" ulcers are most frequently met with in the subjects of arteriosclerosis, and are generally located upon the posterior wall of the duodenum. Some toxic or irritative factor connected with the appendix or the colon is found in many of the cases.

Multiple ulcers are not uncommon, while the association of duodenal with gastric ulcer is very frequently met with. There may be two points of stenosis from two different ulcers in the duodenum (hour-glass duodenum). Much confusion has heretofore existed as to the distinction between gastric, pyloric and duodenal ulcers. The pyloric vein is recognized by Mayo, Moynihan and other surgeons as an approximate land-mark, and perhaps the best classification is into gastric ulcer, above the vein, and duodenal ulcer, below it.

Gruber found 170 cases of peptic ulceration or erosions in 4,208 necropsies. In only 18 out of 115 actual ulcer cases had the affection been diagnosed during life.

Progress of the Ulcer.—Cicatrization without deformity occurs in superficial ulcers. The extensive changes noted in the deeper chronic ulcers, with very marked deformity (hour-glass stomach, stenosed pylorus, hour-glass duodenum), have been mentioned. The most frequent cause of pyloric stenosis is found in peptic ulcer and its complications and sequelæ. In the process of cicatrization adhesions to neighboring organs take place, and great deformity may result. Posterior ulcers are prone to become adherent to the pancreas, while anterior ones adhere to the left lobe of the liver, the omentum or the abdominal wall. The spleen, colon or other viscera may be implicated. The duodenal ulcer may be adherent to the liver or posterior abdominal wall so that it cannot be brought forward at operation. Because of the intimate relationship between the duodenum and the

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common duct and the pancreatic duct, the cicatrization may produce grave symptoms. Stenosis of either duct may occur with jaundice, fatty stools, inanition and other features, leading to the suspicion of cancer of the pancreas. The portal vein has been compressed with resulting thrombosis.

As an acute, subacute or chronic process perforation probably occurs in about one-fourth of all cases, gastric or duodenal, the

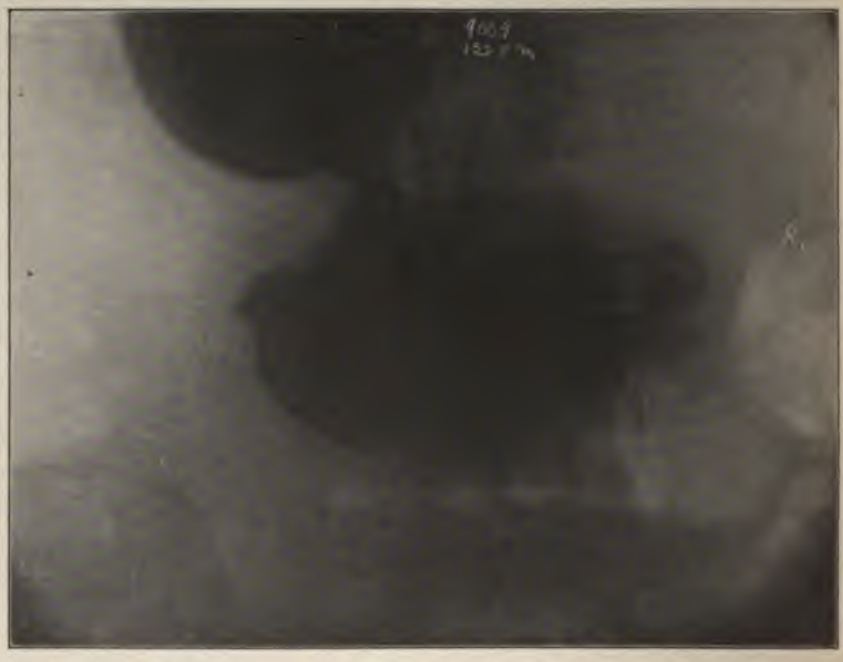

FIG. 57.—TRUE HOUR-GLASS STOMACH, CICATRICIAL. (Dr. G. H. Stover.)

chronic type with firm adhesions outnumbering the acute and subacute varieties together. Women are relatively more frequently affected than men. Multiple and even multiple and simultaneous perforations may take place. Brinton states that 70 per cent. of perforations occur on the anterior wall, 21 per cent. at the lesser curvature and 9 per cent. posteriorly. Chronic ulcers, either gastric or duodenal, furnish nearly all the instances of perforation, acute ulcers being rarely involved.

The frequency of perforation of the anterior wall of the stomach is

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due to the great mobility of this portion of the organ, and the relative difficulty of forming adhesions. Hence acute perforation into the peritoneal cavity is common here. Posteriorly the communication is into the lesser peritoneal cavity, or into the cellular tissue behind the duodenum, with extravasation toward the kidney or down along the ascending colon. Acute perforation with extravasation of stomach or duodenal contents leads at once to a general peritonitis, if the peritoneal cavity be involved. In subacute perforation but little leakage takes place since adhesions rapidly form, and the peritonitis remains a local process. In the chronic form extensive adhesions have been present before the perforation took place. Extension of the process may give rise to subphrenic abscess, emphysema of the subcutaneous tissues, or to fistulous communication with the stomach, pericardium, cavities of the heart, pleura, bile passages, portal vein, kidney, vagina, or to perforation through the skin. It is thought that acute ulcer of the stomach, commonly found in poorly nourished females, often multiple and often fatal in a few weeks through perforation, is very much less frequent than it was a generation ago.

Vascular Involvement.—The gastric ulcer most frequently erodes the splenic artery or that of the lesser curvature, while the duodenal ulcer may open the portal vein, hepatic artery, or more frequently the pancreatico-duodenal artery. The aorta has been eroded, and almost any vessel in the region may be involved. Thrombosis of and embolism from the vessels affected, especially the veins, are not very unusual.

Carcinoma.—The most serious aspect of peptic ulcer, in which curiously the duodenal ulcer takes practically no part, relates to the liability to the development of cancer upon the ulcerous base. Wilson and McCarty found that 71 per cent. of the cases of cancer showed, in the examination of the resected specimen, origin from an ulcer, while, conversely, 68 per cent. of the specimens resected for gastric ulcer showed beginning development of cancer. The fact that both ulcer and cancer tend to develop close to the pylorus is very suggestive. In ulcers at the pylorus, if cancer develops, it is upon the gastric edge of the ulcer. The escape from this complication of duodenal ulcers is remarkable.

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Symptoms.—In general the symptoms of gastric ulcer are those of an acid dyspepsia, but with great variability in different cases. The symptomatology of the small ulceration not interfering with the outlet of the stomach differs widely from that of the indurated chronic ulcer obstructing the pylorus. We may be sure of the diagnosis only in cases coming to operation or autopsy, and these are necessarily the severe cases presenting marked symptoms. This reasoning, in connection with the recognized fact that ulcer is not an uncommon finding at operation and at autopsy when there have been no very definite symptoms, convinces us that the symptomatology in many mild cases does not suffice for the diagnosis.

Latent Ulcer.—Symptoms are stated to have been absent in approximately one-fourth of the cases coming to autopsy, according to Stall and other authors. The reason for this is probably the same as in the case of gall-stones "without symptoms," namely, that they are not sought for in the great majority of cases with sufficient care. When the profession realizes that a large proportion of the cases of chronic dyspepsia, acid dyspepsia and nervous dyspepsia are really cases of ulcer of the stomach, the figures will doubtless be modified. Many physicians hesitate to make the diagnosis without hemorrhage, which occurs only once in three or four cases. There are latent cases of peptic ulcer, but the number appears from statistics vastly greater than it really is. The symptoms of indigestion may not attract the patient's attention very strongly, and I have repeatedly known hemorrhage or perforation to be the first symptom leading the patient to recognize that he had a serious illness. In practically every case, however, symptoms of acid dyspepsia were to be traced. In 50 cases of peptic ulcer of such severity as to demand operation, and in which the diagnosis was therefore absolutely certain, I found the leading signs and symptoms present as follows: pain in 82 per cent.; persistent sour stomach in 80 per cent.; epigastric tenderness in 70 per cent.; vomiting, 66 per cent.; rigidity, 60 per cent.; hematemesis, 34 per cent.; melena, 8 per cent.; 74 per cent. had lost from 10 to 55 pounds in weight.*

Pain.—This is rarely absent at some period in peptic ulcer. It

*Amer. Journal Med. Science, May, 1909.

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is characteristically a burning pain, felt in the epigastrium, frequently reflected upward under the sternum or into the back. A characteristic of this type of pain is that it may commonly be relieved by either of three measures—the taking of water, which dilutes the hyperacid gastric juice; the taking of an alkali, which neutralizes the acidity; or the taking of food, especially albuminous in nature, which combines with the acid. The pain is most frequently felt on an empty stomach, but in many cases comes on at a more or less definite interval after eating. It is very common to find it most marked in the middle of the forenoon, or of the afternoon, after the stomach has begun to empty itself, or at night after evacuation has presumably occurred. Although the pain in duodenal ulcer is generally later in appearance after the taking of food than in the case of gastric ulcer, but little dependence can be placed upon the time of its appearance in the attempt to localize a gastric ulcer. In general a pyloric ulcer as regards the time of pain approaches that noted in duodenal ulcer. In certain cases the irritable stomach rebels upon the introduction of food, pain appearing almost immediately. The reason is said by Mayo to lie in the localization of the ulcer in the body of the stomach. In a general way, the location of the pain on the left of the epigastrium suggests the location of the ulcer well to the left of the pylorus, while to the right it suggests involvement of the pylorus or lesser curvature. In duodenal ulcer the pain is much more severe in character, generally in the center or to the right, radiates over the abdomen, and is often neuralgic in nature. Thus a hunger pain plus neuralgic radiation suggests duodenal rather than gastric ulcer. Perhaps a majority of all the cases of so-called gastralgia are in reality cases of duodenal ulcer.

A variety of pain seen in duodenal ulcer, but never in gastric, and not generally recognized, is that caused by obstruction of the common duct by the encroachment of the infiltration about the ulcer. The attacks of pain being due to biliary obstruction exactly resemble biliary colic, which I have confidently diagnosed in several instances. In each one the gall-bladder was absolutely normal, but the edge of a large thick ulcer reached the papilla, which it evidently compromised. In no case has the pain recurred to my knowledge after a gastro-

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enterostomy was performed. The occasional jaundice noted in duodenal ulcer may be due either to the temporary mechanical blocking or to a catarrhal inflammation extending into the duct. The attacks of pain recurring nightly, often soon after midnight, and which lead the patient to take a glass of milk or other food to his bedroom in order to obtain the relief which it gives, are especially characteristic of duodenal ulcer. The pain is sometimes relieved by pressure or by change of position. In some cases, for example, of ulcer on the anterior wall, the patient is more comfortable when lying down, as if the stomach contents came less closely in contact with the ulcer in that position. The pain may not infrequently be increased by a dose of dilute hydrochloric acid, and is generally relieved by emesis. The late appearance of the pain after an especially hearty meal is very striking in certain cases. Tenderness is a fairly constant symptom, and many patients wear loose clothing or refrain from wearing a belt on account of it. It may be central, or to the right or left of the median line. If definitely and constantly to the right or left, it suggests roughly the position of the ulcer. At the region of the tenth rib, to the left of the spine, local tenderness is very often found, and the upper dorsal spine is frequently sensitive to a light tap with the percussing finger. A combination of very acute pain and tenderness developing upon a well-marked history of ulcer, but without definite signs of perforation, suggests peritonitic involvement over an attempted perforation. I have found congestion, with flakes of lymph, upon the peritoneum, over the ulcer under these circumstances, and thus by early surgical intervention prevented the perforation. Adhesions about an ulcer and a subserous lymphangitis may be the source of marked tenderness. In examining for tenderness, care should be used, as perforation has been caused by rough manipulation. A marked hyperesthesia may be present over the site of the ulcer.

Persistent sour stomach was noted in the history in 80 per cent. of the cases. In others it was spoken of as only occasionally present. Care should be taken that the patient has a chance to grasp fully the question, since many will admit the belching of hot burning liquid, perhaps, who deny either sour stomach or heart-burn. A feeling of

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heat beneath the sternum is often mentioned. Persistent hiccough for years was present in one of my cases. The observation of Mayo that the incisor teeth are often eroded by the particularly acrid eructations of duodenal ulcer is of interest.

With the acid dyspepsia there is commonly found much belching of gas or distressing rumbling of gas in the bowels. The occasional relief of acidity by the swallowing of the alkaline saliva at times provoked by the acid dyspepsia should be mentioned.

Vomiting.—In 66 per cent. of my cases vomiting was noted, but higher figures are commonly given. It may be preceded by nausea, or by pain, or by neither of the two. It is likely to occur at the height of digestion, and to give relief from the dyspeptic pain. It may be provoked in order to obtain such relief. The vomitus is generally highly acid, and not infrequently the food has been so thoroughly digested by the over-acid gastric juice as to be indeterminable from the character of the vomitus. In case the pylorus be blocked by ulcer or scar, food remnants from previous meals may appear. Even a gallon of stomach contents may be vomited at once in such cases. In duodenal ulcer vomiting is rarely present, excepting in those cases in which a virtual pyloric stenosis is found, when it may be of the character mentioned. Blood may be demonstrated macroscopically or chemically in the vomitus in many cases.

Rigidity.—Rigidity was present in 60 per cent. of my series. It is commonly found over the upper portion of the right rectus muscle, but may be to the left of the epigastrium, probably especially if the gastric ulcer be upon the greater curvature. In duodenal ulcer it is found in the former location. An exaggerated epigastric reflex may be present on the side of the rigidity.

The exaggerated tonicity of the abdominal muscles may be present in cases in which, by operation, the absence of an active ulcer is demonstrated. It is probably due, in these cases, to the irritation of the adhesions so frequently present. Too little attention has been given to rigidity in the diagnosis of digestive diseases. If unilateral and definitely demonstrable I consider it of more importance than almost any other sign of gastric ulcer, or other organic disease of the digestive tract. No case should be diagnosed as one of hyperacidity,

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nervous dyspepsia, etc., if it be present; for I think it invariably marks the presence of some definite lesion, although by no means pathognomonic of any one lesion. An educated and delicate touch will demonstrate its presence in many cases when a casual examination would fail to do so. In ulcers of the posterior wall, as in retrocecal appendicitis, it is frequently absent, since the parietal peritoneum is not irritated by the lesion.

HEMORRHAGE.—This was present in 34 per cent. as hematemesis, while melena was noted in 8 per cent. of the cases. Careful examination of the stools in all cases for occult blood would doubtless raise the latter figure materially. Twenty per cent. of the deaths from ulcer result from hemorrhage.

The vomiting of blood is a very striking symptom, but too much weight has been given it in diagnosis, since in a majority of cases it is wanting. The amount of blood may be anything from traces to such an amount as to cause almost immediate collapse and death. The bleeding from duodenal ulcer is even more ominous than that from the stomach, but hemorrhage of such a degree is found only in old infiltrated ulcers. Moynihan is probably correct in regarding this type of hemorrhage as a complication occurring in cases which should have been diagnosed and operated much earlier rather than as a symptom.

The blood from a duodenal ulcer may regurgitate into the stomach and be vomited in a fresh condition, but more commonly it is passed by the bowel, generally tarry, but not infrequently as bright red blood. In hemorrhage from gastric ulcer, vomiting of the blood is the rule, but the stools are frequently darkened for a day or two afterward. The usual symptoms of loss of blood are noted in these cases—dizziness, small, feeble, rapid pulse, pallor, collapse and even death. Convulsions or amaurosis may be noted. A chronic anemia may result from long-continued and unrecognized hemorrhage. Cerebral thrombosis or other vascular accident may result. The red cells may fall to less than a million, but such extreme anemia is unusual. Polycythemia may be noted from concentration of the blood mass even after hemorrhage. In certain cases of obstinate hemorrhage the vessel at fault is found to be so atheromatous that it cannot

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readily collapse. In old calloused ulcers, the same end is brought about by the infiltration of the tissues through which the artery passes.

The usual tests for blood are to be applied in case of doubt. The ingenious test of Einhorn, in which staining of a swallowed thread is produced by contact with the ulcer, may be mentioned. Intermittent occult hemorrhage is characteristic of ulcer, while the continuous presence of blood in the stool is extremely suggestive of cancer.

Loss of Weight.—Seventy-four per cent. had lost from 10 to 55 pounds in weight. The interference with nutrition in most cases arises from the distress in the taking of food, in others from pyloric stenosis. A loss of 20 per cent. to 40 per cent. in the body weight is not uncommon in the latter condition.

In the urine, albumin, diacetic acid, acetone and increase in indican are occasionally noted, but no characteristic features are found. The blood commonly shows a moderate secondary anemia. Leukocytosis signifies a complication such as perforation or subphrenic abscess. Hiccough is occasionally a very troublesome symptom. In one of my cases it had recurred periodically over a period of 11 years with alarming prostration at times. A saddle ulcer at the pylorus was found at operation, and the patient completely recovered as a result of performance of gastro-enterostomy by Dr. I. B. Perkins.

Complications.—These are many and serious. In the depleted patient thrombosis of the veins of the leg is not very unusual. After perforation or hemorrhage parotitis may occur. I have seen it upon both sides, with suppuration, operation and complete recovery, but it may be a sign of much gravity. Interstitial emphysema has been mentioned. Tetany may be noted in gastrectasis following ulcer. Multiple neuritis is occasionally seen. The most serious complications relate to the perforation of the ulcer or the effects of the cicatricial adhesions and contractions due to the ulcerative process.

Perforation.—This probably occurs in about 25 per cent. of cases, nearly always in chronic ulcer. The regions involved are discussed under the pathology of ulcer. The acute perforation is much less common than the subacute or chronic, with formation of localized abscess, adhesions, etc. The discrepancy as to frequency as

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stated in different reports is based upon the fact that most perforations are of the subacute or chronic type and are unrecognized during life unless the case comes to operation. Statistics derived from the operating room and the autopsy room agree fairly well, the surgeons'

FIG. 58.—PENETRATING ULCER HIGH UP ON BODY OF THE STOMACH. Bismuth is seen filling niche at the side of the upper segment. Hour-glass stomach. (Dr. G. H. Stover.)

statistics being probably higher because only the severer cases come to operation.

Women are relatively oftener affected, and at an earlier age. Multiple perforations are stated to be present in 20 per cent. of the cases. In the acute cases, with emptying of digestive contents into the free peritoneal cavity, general peritonitis results—the larger cavity being affected if the anterior gastric wall be involved; the lesser

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cavity, if the perforation be posterior or on the lesser curvature. Perforation of the posterior duodenal wall permits the extravasation to reach the region of the right kidney or to descend along the ascending colon toward the appendix, which is frequently supposed to be at fault. In the subacute cases local adhesions or abscess formation may limit the spread of the process for a time, but it may later break through.

In the chronic form the adhesions have become so firm in advance of the perforative process that no general infection occurs, or the resulting suppuration is diverted in such a way as to form a subphrenic abscess, or lead to eventual emptying into the pleura, pericardium or elsewhere.

Acute perforation is characterized by sudden agonizing pain, and death may follow almost immediately from the intensity of the shock. Following the pain there are commonly faintness and prostration, inability to move without increase of pain, pallor, sweating, collapse and occasional vomiting. The respirations are quickened, since the diaphragm cannot be depressed. The pulse soon becomes rapid and wiry, and the pulse tension rises. The abdomen is retracted and characteristically rigid. In no condition is the rigidity of the abdominal muscles more marked and constant. Tenderness is at first more extreme over the seat of the ulcer than elsewhere in most cases. As the peritoneal cavity is more and more invaded, and distension comes on, the liver is pushed upward or even backward, perhaps by free gas in the peritoneal cavity, the pulse rises rapidly, and the temperature, which may have been subnormal, begins to rise. Death is the rule in untreated cases, generally within two or three days. A most remarkable remission of symptoms may result from the early use of morphin, and I have known patients to refuse operation and die, because of their failure to recognize the gravity of the situation under these conditions. More patients would be saved, because more would be operated early, if no anodynes were given.

For the course of the suppurative process after the subphrenic space has been invaded, see the section upon subphrenic abscess. Almost any course is open to such an abscess after the subdiaphragmatic space has been reached.

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As a result of the adhesions produced about the ulcer, either with or without suppuration, the stomach, pylorus or duodenum may be bound down, deformed, or become adherent to various other organs. The adhesions are most frequently found about the pylorus, less frequently at the cardia. The liver, gall-bladder, pancreas and spleen are the organs most frequently involved. An hour-glass stomach may result from the pull or compression of adhesions, apart from the presence of an actual cicatrix in the gastric wall. The gall passages, duodenum or pylorus may be obstructed, and the pancreatic duct is oc-

FIG. 59.—DILATED AND PTOSED STOMACH FROM OCCLUDING ULCER AT THE PYLORUS. Operation. Recovery. (The stomach has been inflated.)

casionally occluded. Pain, tenderness, rigidity, tumor, dilatation of the stomach, jaundice or fatty stools may be noted.

Cicatricial contraction at the site of the healed or partially healed ulcer is of extreme importance. In 16 of 50 cases operated for pyloric obstruction we found only the scar of a healed ulcer, pyloric or duodenal, as the cause. The puckering of the external wall readily indicates the site of a cicatrix, and the examining finger cannot pass the pyloric ring after inverting the gastric or duodenal wall, and pushing it before the finger.

Above the pylorus various deformities of the stomach may be caused, the girdling ulcer producing the not infrequent cicatricial hour-glass stomach. In one patient this was so complete as to require

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a gastrogastrostomy as well as a gastro-enterostomy. In one case Moynihan found four separate compartments. Hour-glass contraction of the duodenum is less common, but almost complete stenosis may result.

Cancer as a Sequence of Ulcer.—The frequency has been discussed in the section upon pathology. It should be stated forcibly that one of the most urgent reasons for surgical cure of chronic ulcer is the hope of avoiding malignant degeneration. Gradual increase in

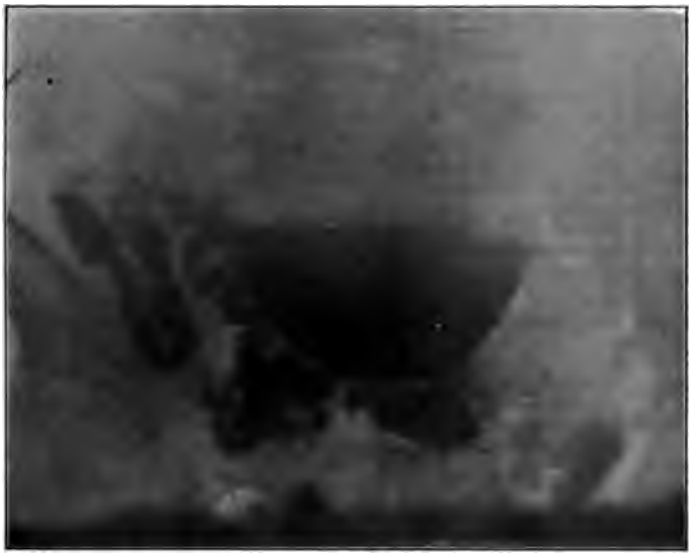

Fig. 60.—Six-hour Residue in Pyloric Obstruction from Ulcer. (Dr. G. H. Stover.)

the digestive difficulties, increasing pyloric obstruction, decreasing acidity, and the accession of the signs and symptoms of cancer in a case previously presenting those of ulcer are to be noted. But in several cases with entirely characteristic ulcer histories in comparatively young individuals we have found cancer already far advanced. Hyperacidity is no guarantee against such a finding.

The not very infrequent association with ulcer of small omental hernias in the central line above the navel should be mentioned. I have seen several so sensitive that the lightest pressure gave rise to

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instant eructations of gas. In at least two instances the hernia seemed of as much importance in producing distress as the ulcer itself. Ury states that "there seems to be an unmistakable connection between the disturbance resulting from an epigastric hernia and the development of an ulcer of the stomach." He warns us further that "the symptoms may be referred to the evident hernia, when in reality they are due to an unsuspected gastric ulcer." On the other hand it is possible that symptoms ascribed to assumed gastric ulcer may in reality be the work of an insignificant and overworked hernia. In view of the frequent association of peptic ulcer with chronic appendicitis due in part at least to pylorospasm and prolonged retention of the often hyperacid gastric contents, it seems especially reasonable to suggest that the epigastric hernia may act through the irritation of the omentum, so commonly caught in the opening, to produce similar conditions favorable to the development of ulcer.

FIG. 61.—HOUR-GLASS STOMACH, SHOWING ALMOST COMPLETE SEGMENTATION BY THE SCAR OF AN ULCER. (Dr. G. H. Stover.)

Course and Duration.—The history of the disease is found to extend over a period of many years in a large proportion of the

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cases, if the anamnesis be carefully developed. In 11 out of my first 50 operated cases the duration had been from 18 to 30 years. Recovery takes place even without treatment in many cases, as witness the frequency of scars of healed ulcers at autopsy. In a great number of cases eventually coming to the surgeon the supposed recovery has been merely a remission, and such remission is the rule. Many patients are comparatively well through certain portions of the year, probably when a different diet or occupation influences the situation. In the late summer and fall I have noted that the more extensive use of sweet and starchy fruits and vegetables causes an exaggeration of the symptoms, while the use of more fatty and nitrogenous diet during the winter is favorable to remission. The strawberry season is especially favorable to the development of acute symptoms. Moynihan mentions the occurrence of attacks in duodenal ulcer in the cold and wet seasons of the year. It is probable that habits as to exposure, exercise and especially diet vary so much in different countries that variations as to the period of recurrence may be considered. The fanciful remark of W. J. Mayo that operation should be considered "only after 9 complete and permanent medical cures" deserves a place in the memory of every practitioner who treats peptic ulcer, for it forcibly suggests the periodicity of the symptoms of the disease and the tendency to recurrence.

Diagnosis.—In the case of acute ulcer, acid dyspepsia with pain and hyperacidity may be suggestive, but frequently the diagnosis is not confirmed until hemorrhage occurs. No tumor nor gastrectasis, and but little tenderness and rigidity may be found. Even post mortem the ulcer may be difficult of detection, although fatal hemorrhage may have occurred. These are distinctly the medical ulcers in which permanent cure results from medical treatment. Chronic ulcer is readily diagnosed if pain, vomiting, hyperacidity and hemorrhage be present, even in the lack of physical signs. At the other extreme are the cases in which only an acid indigestion is complained of. If unilateral rigidity and tenderness coexist with a high hydrochloric acidity, even in the absence of notable pain, hemorrhage, vomiting or gastrectasis, the diagnosis becomes a probable one. A vast number of cases go from one clinic to another begging

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for a diagnosis, generally under the guise of some type of functional indigestion.

In a considerable number of cases, both gastric and duodenal, a tumor may be palpated, and may strongly suggest cancer. In one operative case of ulcer involving the pylorus the mass was so large and the adenitis so extreme that a gastro-enterostomy was performed to avert starvation, and an absolutely bad prognosis given. No gland was removed for histological examination because the patient was in a very poor condition and it was not considered necessary. After four years the patient is still teaching the same school in perfect health! The size of the tumor alone is not to be regarded as of decisive importance in the diagnosis. In many cases the patient's nutrition is excellent despite the dyspepsia; in fact, patients with duodenal ulcer are often especially well nourished, robust, active men. Because of their powerful digestive juice, and because they feel more comfortable after a full meal, they are likely to be hearty eaters, and thus keep fat. The constant constipation in this type of patients results from the digestion and absorption of all available food material in the digestive canal.

Persistence over a long period of acid dyspepsia, with pain, vomiting and eructation of acid fluids, even in the absence of physical signs, establishes a presumption of ulcer. Relief from food is a feature of no little value, especially when taken in connection with regularity of the onset of the pain and seasonal variations in the severity of the digestive symptoms.

Especial Features of Duodenal Ulcer.—It more commonly occurs in middle-aged men, often well nourished and with a history of recurrent attacks over many years. "Hunger pain" is more notable than in gastric ulcer, and a gastralgic type of pain associated with gaseous distension is more frequently present. Severe hemorrhage from the bowels is suggestive of duodenal involvement. A biliary type of colic is not infrequent, due presumably to temporary blocking of the common duct, and jaundice may rarely supervene. The occurrence of the pain at fixed hours—late in the forenoon, late in the afternoon, and after midnight, the taking of food to the bedroom in anticipation of pain and food relief, the practical ab-

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sence of vomiting, the late appearance of gastric dilatation, and the especial acridity of the eructated fluids are further characteristics of duodenal ulcer. Moynihan's remark that "recurrent severe hyperchlorhydria *is* duodenal ulcer" will be substantially accepted by almost every clinician with extensive operating-room experience.

JEJUNAL ULCER.—This is a rare condition following gastro-enterostomy, and occurs just beyond the point of anastomosis, especially in the anterior gastrojejunostomy. The diagnosis depends upon the knowledge of the previous ulcer, the operation, and a recurrence of symptoms suggesting ulcer.

FIG. 62.—ULCER IN THE FIRST PORTION OF DUODENUM. (Dr. G. H. Stover.)

LABORATORY FINDINGS.—The test-meal showed a hyperacidity in three-fourths of the cases of peptic ulcer operated upon and it is probable that an increase of hydrochloric acid is present at some time in all cases of peptic ulcer. The absence of this finding is of little value against the diagnosis. The finding of blood in the test-meal, if no hemorrhages have been caused by the passage of the tube or by straining, is of considerable value. The particles of bread in the test-meal are commonly unrecognizable, a watery pap being extracted if there be high acidity. Mucus and lactic acid are commonly absent. The motility of the stomach is good unless pyloric obstruction is present. The chemical analysis is of value in a

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general way, but no definite opinion may be formed by the report considered apart from the history and general examination. Sarcinæ and yeast cells are often present if the outlet be blocked, but lactic acid is found only in event of stagnation with absence of hydrochloric acid. Its presence distinctly suggests cancer. In gen-

FIG. 63.—SIX-HOUR RESIDUE IN DEFORMED DUODENUM FROM SCAR CONTRACTION. (Dr. G. H. Stover.)

eral, the finding of low acidity with excess of mucus is against the diagnosis of ulcer, while low acidity with food remnants suggests pyloric obstruction.

X-ray Diagnosis.—"Deformities in the stomach and duodenum, either from the ulcer or the contracting scar, or from the pull of adhesions, are well shown upon the bismuth plate. The failure of normal emptying of the stomach is easily recognized. The shadows

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supposed to indicate the position of the ulcer because of the adhesion of the bismuth administered are probably not as dependable as they have been believed to be, at least not as indicating the size of the ulcer. The use of the fluoroscope combined with manipulation of the stomach through the abdominal wall may be of value in certain cases in the recognition of movable tumor. If skillfully taken and interpreted the bismuth plate is of much value in certain cases, especially those in which operation is to be considered. Confirmatory evidence is always necessary for a safe diagnosis.

"A florid ulcer upon the lesser curvature causes a spasm of the muscle and an indrawing of the wall at a point opposite; this must not be mistaken for the deep notch of hyperperistalsis.

"An ulcer upon the lesser curvature or about the pars pylorica causes pylorospasm, manifested by a full rounded outline of the antrum and pars pylorica during expulsive efforts, and later leading to dilatation, atony, and dropping of the greater curvature, with great delay in emptying time.

"Chronic penetrating ulcer leads to excavation into the neighboring tissues or organs; this excavation may fill with bismuth and appear upon the plate as a small sacculation.

"Duodenal ulcer leads to deformities of the duodenum which mould the Röntgenographic outline of the duodenum correspondingly; in the presence of duodenal ulcer, the stomach is apt to empty rapidly. The plate may show a curvature of the spine concave to the right, owing to the habitual position of the trunk caused by the pull of adhesions." (Stover.)

The gastroscope has been used, but is probably more dangerous than the ulcer in many cases. Einhorn's duodenal bucket and various other paraphernalia are of much interest, but have small place in the clinics where the most advanced work upon digestive diseases is done. Attempts at minute diagnosis are of little real value in this field as compared with the recognition of those features which indicate the need of surgical intervention.

Hour-Glass Stomach and Duodenum.—The condition is most easily diagnosed by the use of the bismuth plate. In the stomach it is recognizable in many cases by the observance of the following

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points, as given by Moynihan: "A portion of the fluid introduced by gastric lavage fails to return, being held in the second compartment; a foul fluid appears from the lower compartment, after the stomach has been supposedly washed clean; splashing is found, originating in the lower compartment after the stomach has supposedly been emptied by the stomach tube; irregularities in outline of the stomach are detected after inflation, due to differing amounts of gas in the two cavities."

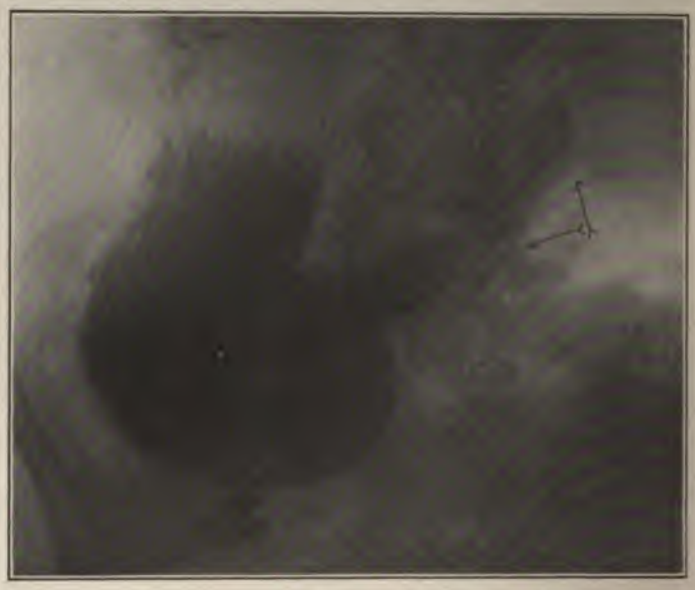

FIG. 64.—DEFORMITY OF DUODENUM, DUE TO ULCER, AT POINT INDICATED BY ARROWS. (Dr. G. H. Stover.)

Differential Diagnosis.—Cancer of the stomach so frequently develops that it is to be suspected when the features of ulcer are gradually replaced by those of cancer. The latter condition may well be developed, as I have seen in many cases upon the operating table, before any such change has occurred in the symptoms due to ulcer as would lead to a suspicion of the malignant development. The exact diagnosis is less important than the realization of the necessity of speedy exploration when any serious doubt arises as to the diagnosis. The differentiation from gastralgia and hyperacidity has per-

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haps been sufficiently considered. We may reiterate that gastralgia is an almost unknown quantity in the modern study of digestive diseases, and that severe continuous hyperacidity generally signifies peptic ulcer, or results from the long continued reflex irritation of chronic appendicitis or gall-bladder disease. I have seen dozens

FIG. 65.—DUODENAL ULCER. (Dr. G. H. Stover.)

of cases in which this was proven at operation after years of medical treatment for supposed functional hyperacidity.

The most difficult diagnosis is that between ulcer on the one hand and chronic appendicitis or cholelithiasis on the other. Many cases are admitted to hospitals and treated by various well-known methods for ulcer without a recognition of the fact that the chronic hyperacidity, vomiting, pain, pylorospasm, dilatation of the stomach

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and even trivial hemorrhages may all be due to the reflex irritation of the stomach. I give credence to such a statement not so much because of having seen cases wrongly diagnosed by others, but because, after seeing many of them operated and learning the ease of committing such an error, I have been repeatedly mistaken myself. A most careful inquiry for attacks of inflammation of the appendix or gall-bladder and very thorough examination for rigidity and tenderness over the two organs mentioned is absolutely necessary.

The frequency with which, in the past, the appendix has been removed without finding it sufficiently at fault to account for the symptoms; in which the gall-bladder has later been drained, but without adequate excuse; and in which finally exploration of the pylorus and duodenum has resulted in the finding of ulcer, deserves very careful consideration by the diagnostician.

Prognosis.—The mortality of all cases of peptic ulcer is given by many authors at 8 per cent. to 10 per cent. About 20 per cent. of the fatalities are due to hemorrhage, and a lesser proportion to perforation. A very grave feature in prognosis is the liability to stenosis of the pylorus, with such inanition following as to lead to the development of tuberculosis or other intercurrent disease. In acute simple ulcer the prognosis is good under medical treatment. In chronic calloused ulcer the prospect of temporary relief is good, but relapse is to be expected. The frequency of malignant degeneration is to be considered. The mortality from surgical treatment may be stated as in the neighborhood of 2 per cent. under favorable circumstances.

Indications for Surgical Intervention.—Operation is indicated for:

(a) Perforation, the most important prerequisite of which is early diagnosis. In so-called threatened perforation Leube and others have advised against operation. The day for such advice has certainly passed by, for in skilled hands such operation as is called for is practically as safe as that for chronic appendicitis, and advantage may be taken of the opportunity to have a gastro-enterostomy done if called for. Threatened perforation is likely to end, without surgical measures, either in acute or chronic perforation, or serious adhesions. As we have learned in the case of the ap-

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pendix, the time for operation is before extensive pathological changes have developed.

(b) Recurrent small hemorrhages, not otherwise controllable, in certain cases only. In a single profuse hemorrhage operation is inadvisable, since it may come from an erosion of slight degree curable by medical treatment, and not from chronic ulcer. If hemorrhage tends to recur, operation should be undertaken.

(c) In chronic calloused ulcer. The dangers of hemorrhage, perforation, inanition from stenosis, and of cancer, so far outweigh the slight operative risk, as to render the indication imperative.

(d) In pyloric or duodenal obstruction and in hour-glass stomach, with serious nutritional disturbance. The important features in establishing the degree of stenosis are the chronic dilatation of the stomach, and the retention of the food remnants in the stomach over night. In the face of these findings, the tests for chemical and motile derangements are of little importance.

(e) In subphrenic, perigastric and other abscesses originating from perforation of the ulcer.

(f) In perigastric adhesions causing serious pain, interfering with motility, compromising the patency of the gall-duct or pancreatic duct, or otherwise making serious digestive disturbance.

(g) When a fair trial of medical treatment has failed to give the patient relief.

(h) When gradual change in the chemistry of the stomach contents, emaciation, pain and general failure suggest the possible development of carcinoma. *No case of chronic gastric disease whether diagnosed as ulcer or not should be permitted to go on month after month without exploration,* unless cancer can be excluded.

Prognosis.—The prognosis of ulcer with operation. The mortality in 1,000 operations of all kinds, for chronic indurated ulcer, at the Mayo clinic was 2.4 per cent. and this in spite of the fact that in the earlier cases the technique had not been perfected. At present the mortality rate is well under 2 per cent. (Mayo). In 98 per cent. cure or great improvement resulted. Even in so grave a condition as acute perforation of duodenal ulcer, Mitchell of Belfast reported 16 successive operative recoveries. The lack of early diag-

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nosis and immediate operation is all that prevents a most favorable outcome in the great majority of cases of acute perforation of peptic ulcer.

H. CANCER OF THE STOMACH

Incidence.—Probably one-third to one-half of all cancers originate in the stomach. The uterus is the only organ more frequently affected, and this organ does not by any means hold first place in all statistical tables. Variations in frequency of gastric cancer in different countries are very marked, and hence local statistics are more or less unreliable. There is very little doubt that the disease is becoming more common, though the effect of the greater number living at the cancer age as compared with the number living at all ages should receive consideration.

The disease is less frequent in the negro and in the inhabitants of tropical countries. About three-fourths of all cases occur between the ages of 40 and 70, and about 2 per cent. under 30 years of age. Rare instances are observed in childhood and even in infancy. The fiftieth year marks the middle of the decade in which nearly one-half of all cases of gastric cancer are found. Heredity is regarded as of less importance than formerly, yet the disease undoubtedly occurs in many individuals of a single family. In one of my cases the deaths of five members of the immediate family were attributable to cancer of the stomach. Males are affected in nearly 60 per cent. of all cases.

Etiology.—All other alleged causes of cancer of the stomach are overshadowed by that of the chronic irritation resulting from gastric ulcer. In this matter, as in so many others, the pathology as seen upon the operating table is to be considered rather than that of the dead room. So strong a statement requires further elaboration.

The post mortem examination is naturally made in the great majority of cases only after the main disease, gastric cancer, has proceeded to a lethal issue. Any evidence of the origin of the malignancy from gastric ulcer is naturally entirely obliterated by this time. In an analogous manner pathologists for a century

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missed the importance of the appendix as a cause of disease and death, the general peritonitis covering up all the evidence that the process had originated from gangrene of this organ. We should never have known the relationship existing between gastric ulcer and cancer from pathological study, but it is easy to recognize it when the stomach is examined at operation, early in the course of the latter disease.

In no department of medicine have the pathologists and the internists lingered behind the surgeons to such an extent as in the diseases of the stomach. In the case of ulcer this situation has been bad enough; in that of cancer it is even worse. Unfortunately, it seems at times almost a case of not being willing to be taught a medical truth by a non-medical man. Happily this ultra-conservative position is becoming wholly untenable.

The widely quoted statistics of the Mayo clinic need a further repetition. In 153 cases of cancer of the stomach, of the specimens removed at operation, "71 per cent. presented sufficient gross and microscopic evidence of previous ulcer to warrant placing them in a group labelled 'carcinoma developing on preceding ulcer.' In 7 per cent. the evidence of such origin was suggestive but not conclusive, while in 22 per cent. only was there no evidence of precedent ulcer."

Such figures are looked upon askance by clinicians who wait for months to make sure of the diagnosis of gastric cancer, and then give condurango and a fatal prognosis. Those who, on the other hand, bearing in mind that no case of gastric cancer has ever been cured by medical means, call in the surgeon for exploration of the abdomen in every case of chronic disease of the stomach which does not improve under medical treatment, and who personally investigate the living pathology as shown upon the operating table give full credence to the statements offered. It is not going too far to state that no one is entitled to offer an opinion upon this subject to the profession who has not investigated this aspect thoroughly. The day of waiting for the diagnosis of cancer in the consulting room has passed away, and with it the time for offering as final the conclusions derived from dead-room pathology, where only end results

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are seen, as evidence against those of the operating-room pathology, for here alone the earlier causative relationships may be studied.

The fact that ulcer and cancer of the stomach affect the same region predominantly is ground for very careful consideration of their intimate relationship. It is very striking that about 60 per cent. of cancer of the stomach occurs in the male, while Mayo found 58 per cent. of true gastric ulcers in the male. The frequency of ulcer of the stomach without recognizable symptoms should be given proper consideration in estimating the frequency of cancer supervening upon ulcer.

Trauma, chronic gastritis, alcoholism, a vegetarian diet and various other factors are mentioned, but with little evidence in their support.

Pathology.—Kemp states that the cylindrical celled adenocarcinoma is most frequently met with, encephaloid or medullary following, with scirrhus third in order of frequency, and colloid cancer last. Brinton, however, states that 72 times in 180 cases the scirrhus type was present, and there is much evidence to show that it is perhaps the most common variety in most series of cases.

The location of the malignant growth was as given below in 1,300 cases analysed by W. H. Welch:—pyloric region, 791; lesser curvature, 148; cardiac, 104; posterior wall, 68; whole or greater part of the stomach, 61; multiple tumors, 45; greater curvature, 34; anterior wall, 30; fundus, 19.

In considering these figures one should give due weight to the fact that they came from the autopsy room, after extensive growth had occurred. Extensive surgical statistics will probably throw much light upon the point of origin of the growth, but the unenviable ascendency of the pyloric region is not likely to be overthrown.

In perhaps 1 per cent. of cases cancer of the stomach is secondary to malignant disease elsewhere, most commonly from the breast. In a few cases multiple growths are present. In case the pylorus is involved the outlet is often narrowed and dilatation of the stomach supervenes in many cases. Occasionally this obstruction is relieved after a time by ulceration occurring in such a way as to open a passage through the growth.

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If the cardia be affected the esophagus is often dilated, while the stomach may be shrunken. In cirrhosis ventriculi the whole organ is contracted. Deformity of the stomach is very commonly present from accentuation of the lesser curvature if the growth be situated there, or indentation of the greater curvature in other cases. Puckering of the organ is very pronounced in many cancers of the scirrhus type.

In many cases the organ is displaced, in part because of the weight of the retained contents, as in pyloric obstruction, in part because of the sagging of the pyloric end or because of adhesions, as when the growth has involved neighboring parts. A descent of the organ is a very common finding. If no adhesions prevent, the pyloric tumor may be extremely movable, being found in certain instances in almost any part of the abdomen. Next to ulcer, cancer ranks highest as the cause of hour-glass contraction of the stomach.

The disease is at first confined to the stomach, and in many cases most extensive involvement may not prevent free mobility of the organ, a most important point in the consideration of the advisability of recommending operation. Of 1,404 lymphatic glands obtained from 200 specimens of cancer of the stomach removed by operation at the Mayo clinic, McCarty found 52 per cent. to be carcinomatous. Unless the glandular involvement be very marked only the microscopical examination may decide between inflammatory and cancerous adenitis.

In pyloric cancer the lymphatics and glands, as shown by Cuneo, become involved so far as the point of union of the coronary artery with the stomach, the lymphatics passing from the lesser curvature. The glandular involvement from the greater curvature does not commonly pass the median line. The Mayos have emphasized the scanty lymphatic supply of the fundus. The degree of lymphatic involvement is closely dependent upon the age of the patient, being greater during the earlier decades, but less in later life, as progressive atrophy of the lymphatic system develops (C. H. Mayo).

Through the lymphatics metastases occur in the neighboring glands in 44 per cent. of the cases; in the liver in 33.2 per cent.; peritoneum and intestines in 27.6 per cent.; pleura and lung in

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7.3 per cent.; and pancreas in 7.6 per cent. (Cuneo). Metastases to the nervous system, spine, spleen, etc., are not uncommon. Secondary growths at the navel are occasionally noted, and may be due to infection by the blood or lymph stream, or by direct contiguity. The inguinal glands are occasionally affected. The involvement of the cervical and mediastinal glands in cancer of the cardiac end of the stomach is very marked in certain instances.

Perforation of the cancerous growth occurs in perhaps 3 per cent. to 6 per cent. of the cases, rarely as compared with ulcer, into the free peritoneal cavity. The infiltration of the tissues in advance of the perforative process is the explanation of this rarity; most frequently the perforation is into the colon or small bowel, but occasionally the pleura, pericardium, subphrenic space or external abdominal wall may be perforated.

Ulceration is present at the post mortem examination in a very large proportion of cases of cancer. At operation the proportion is naturally much less.

Extensive ascites is common as the result of peritoneal involvement, but may also occur from cancerous glandular obstruction of the portal vein, by pressure, or by direct cancerous invasion. The effusion is often bloody in character, and may be chylous.

In a small proportion of cases the malignant disease is entirely latent so far as the presentation of symptoms relating to the stomach is concerned. The patient is anemic, fails in strength and weight, and dies of asthenia. Perhaps secondary growths may attract attention to the exclusion of the scirrhus cancer of the stomach from which they originate. A majority of supposedly primary cancers of the liver, as diagnosed clinically, are found to be secondary to gastric cancer.

Symptoms.—In a majority of cases a carefully taken history will demonstrate the presence of previous digestive disease. Graham found that 59 per cent. of operated cases gave a clear history of chronic ulcer. Moynihan and Rodman give somewhat similar figures. In many cases a history of chronic gastritis precedes the development of the malignant growth for a year or two. Not very infrequent are the cases in which cancer develops suddenly. Within

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two or three months a previously robust man shows the usual signs and symptoms of advanced cancer. In not a few, metastases in the liver, spine, or elsewhere may be thought to be the original disease, the growth in the stomach having been practically without symptoms. This is more common in the scirrhus form.

Pain is the earliest symptom in probably half the cases. Many of these patients speak of it as a discomfort or distress rather than a pain, especially during the first few weeks, and others speak of a dull ache. Acute pain is not common. The area of distribution is definitely gastric in most instances, but radiation to the back is common. The pain is often described as gnawing in character, and is frequently aggravated by the ingestion of food.

Tenderness over the epigastrium is the rule in advanced cases, and unilateral muscular rigidity is often found. The rigidity may be universal if the involvement be extensive. The dorsal spine may be tender to percussion, and areas of tenderness exist upon either side in many cases. Ten per cent. to 20 per cent. of cases run a practically painless course.

Flatulent indigestion, with moderate distaste for food or complete anorexia in the severer cases, is a very common symptom. The belching of gas from the stomach is a frequent feature, but differs from that in gastric ulcer in that no acidity is noted. In cancer developing upon ulcer this rule does not hold. A distaste for meat is decidedly suggestive of cancer, as is the loss of desire for the use of tobacco. Dysphagia is very common if the cardiac end of the stomach be involved. The tongue is often coated. If food retention exists, thirst is a troublesome symptom because of the non-absorption of fluids from the stomach.

In approximately three-fourths of the cases vomiting appears, but commonly late in the disease, and very frequently associated with pyloric obstruction. The contents of the stomach are ejected, often unchanged, but in later stages putrid from decomposition which occurs so rapidly in a stomach devoid of digestive juice and frequently ulcerated. The diagnosis of cancer may practically be decided by the putrid vomit in certain cases.

Hematemesis is a frequent finding, often in association with the

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vomiting of the retained stomach contents. Blood is ejected in approximately one-fourth of the cases, generally dark in color from partial digestion. Yet bright blood does not at all exclude gastric carcinoma. In a majority of the cases the finding of occult blood in the feces is decisive for cancer as against other stomach affections, since the ulcerating surface bleeds more or less continuously.

Loss of Weight.—This is one of the most suggestive signs, so much so that any patient of middle age who presents it in marked form in association with pain in the epigastrium and indigestion is to be suspected of having gastric cancer. The loss may amount to from 10 per cent. to 50 per cent. of the patient's weight during the course of the disease. While progressive loss is the rule, increase of weight may occur, as mentioned by Osler, as a result of proper treatment of the associated gastritis, through the use of lavage after pyloric obstruction, and even from profound mental impression, as from exploratory incision. I have seen such temporary gain in several cases where the condition found was entirely hopeless. After relief of obstruction by gastro-enterostomy the gain is not infrequently 20 to 40 pounds, even though the malignant growth increases meanwhile. A certain type of increase in weight which has a most evil significance is not commonly mentioned in the text-books, namely, that which arises from the accumulation of ascitic fluid after the peritoneal involvement. This occurs especially in cases of general scirrhus cancer, with marked contraction of the stomach and especial involvement of the lymph glands about the pyloric region. The actual accumulation of fluid is so rapid, perhaps often from involvement of the portal vein, that the patient may gain five to ten pounds at a time when every other sign and symptom points to the most rapid progress of the disease.

In perhaps 2 per cent. of the cases of gastric cancer the disease is of the sclerotic type, contracting the entire organ. The symptoms are almost pathognomonic here, but are not well recognized. The patient complains, in addition to his indigestion, that he cannot take even a very moderate quantity of food without a feeling of being uncomfortably full, since the stomach capacity is so greatly decreased. If ascites, so common in these cases, now appears, and

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hydrochloric acid be decreased in the test-meal, the diagnosis is practically certain.

Marked general weakness is a very important feature, and is especially notable in cases of pyloric obstruction. It may be long

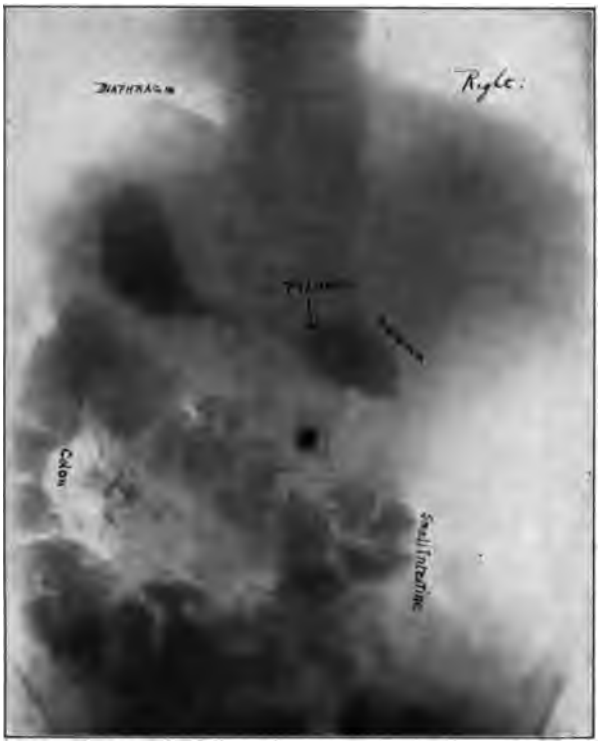

FIG. 66.—"SCHRUMPFMAGEN." Carcinoma of the entire stomach, with dilated first portion of the duodenum. Plate made 20 minutes after administration of 1 pt. of buttermilk and 2 oz. of bismuth. Note very small size of stomach and absence of peristalsis. The bismuth meal passed rapidly through the stomach and is shown in the small intestine. The bismuth in the colon was the result of a meal administered 24 hours prior. Conditions shown were verified at operation. Postero-anterior view. (Dr. S. B. Childs.)

delayed if only the orifices of the stomach escape the malignant process. Vertigo and mental dulness are features of some importance in certain cases. The secondary anemia of the disease is largely responsible for the symptoms. The hemoglobin is com-

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monly reduced to half the normal, and the red cells somewhat in proportion. Osler found the average count to be 3,712, 186 per cubic millimeter. In those cases with marked concentration of the blood, owing to non-absorption of fluids from the dilated stomach, secondary to obstruction of the pylorus, the count may be as much as six millions. The white cells are not commonly especially changed in number or character excepting as complications may influence them. The occurrence of certain cases believed for a time to be pernicious anemia when the real pathology is gastric cancer should be mentioned.

Constipation is the rule in the disease, largely because of the diminished intake of food. Diarrhea is of occasional occurrence.

Urine.—No characteristic features are noted. It is often very scanty in case of pyloric obstruction. The presence of albumin and casts and of sugar, of acetone, of albumose, and of increase of indican have no especial diagnostic value, but are of some importance in prognosis. Coma may be noted in association with glycosuria or acid intoxication.

Fever.—This is not at all uncommon, and is often a striking feature if the liver be secondarily involved. I have known such a case to be treated for a month for typhoid fever. Chills and sweats may occur.

Edema of the legs is common in advanced cases in which anemia is marked. Ascites has been mentioned. Trousseau noted the frequency of femoral thrombosis, and himself suffered from it. A marked mental hebetude is not infrequent in cancer of the stomach. In the hospital or consulting room the patient with digestive disease who is thoroughly apathetic may be suspected of having malignant disease. The cachexia of cancer is very marked in most advanced cases. An unhealthy yellowish or yellowish-gray color is often to be noted, and after secondary liver involvement a tinge of jaundice is not infrequent.

Physical Examination. — Inspection. — The sallow, anemic, or cachectic appearance may be marked, and an apathetic expression is common. Emaciation in some degree is the rule. When the abdomen is uncovered, a crop of red nevi is very frequently noted

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in this as in other cases of malignant disease within the abdomen. The actual tumor may be seen through the abdominal wall in many cases, frequently low in the abdomen, the dilated stomach being also visible in many instances. Peristaltic waves may pass from left to right over the dilated stomach, and occasionally in the reverse direction. The region of the navel should be carefully examined, since metastatic nodules are frequently found here. In a few cases affecting the cardiac end marked adenitis is visible at the left side of the neck above the clavicle. Because of the emaciation the pulsations of the abdominal aorta are often quite evident. The tumor may be seen to move with the changes of respiration. If the patient be requested to stand erect, it may at times be seen when invisible in the recumbent position. Only in cases of well-advanced cancer does inspection show any considerable number of the signs mentioned.

Fig. 67.—Cancer of Anterior Wall of Stomach. Explored, inoperable. Tumor visible.

Percussion.—Upon percussion the most frequent finding is the tympany of the dilated stomach. Only in case a very large tumor exist can its dulness be demonstrated by this method of examination. In the scirrhus type mentioned, flatness may be noted, due to the ascites present. Boas "emphasizes the importance of dulness in the semilunar space, the 'rib phenomenon.' He has always found this dulness when a cancer of the fundus of the stomach had involved

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large extents of the organ, and thus offered great technical difficulties to its removal, but this sign requires further study to determine its connection with inoperability."

AUSCULTATION.—Auscultation is commonly of little value. Splashing in the dilated stomach may be detected and occasionally the gurgling of fluid through the narrowed cancerous pylorus. A cancerous peritonitis may give rise to audible friction-sounds if little fluid be present.

PALPATION.—The visible tumor of the pylorus may naturally be easily palpated, but many tumors not visible are demonstrable by this method. The proportion of the cases with palpable growth depends almost entirely upon the stage in which the disease comes under observation. Thus Osler found such tumors in 115 out of 150 cases, 48 being epigastric in location, 25 umbilical, 18 left hypochondriac, 17 right hypochondriac, while in 7 cases the mass could be felt to descend from under the ribs on the left upon deep inspiration. If cases of chronic digestive disease could be properly followed up, the proportion with palpable tumor should be much lessened, since many could be operated upon before this stage was reached. The tumor is movable in the early stages of pyloric cancer, less so in other locations. If the stomach be much dilated the pyloric tumor may be pushed almost anywhere in the abdomen in certain cases. Distension of the stomach with gas or even with food may cause marked displacement of the tumor. The growths upon the greater and lesser curvatures, before adhesions occur, move more freely with respiratory movements than those at the pylorus. The movement of the malignant mass as the result of peristalsis may be palpable, as well as the "heaving" imparted to it by the aortic pulsation. Smithies states that at the Mayo clinic 80 per cent. of the cases present a palpable tumor, about two-thirds of these being movable. He states that 90 per cent. of epigastric tumors pertain to the stomach, and 90 per cent. of these are malignant. In case of massive cancer at or near the lesser curvature, a solid mass, flat upon percussion and movable only upon respiration, may fill the epigastrium and may even protrude in extreme cases. Only in rare cases may tumors of the posterior wall be palpated,

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and those of the cardiac end are completely hidden behind the ribs and sternum.

The mass is commonly tender to touch and not infrequently nodular. The feeling of gas as it gurgles through the obstructed pylorus is very suggestive of this type of pyloric narrowing. Occasionally large lymph glands are palpable. The navel, groins, and supraclavicular spaces, especially the left, should be carefully examined, and the abdominal surface palpated lightly for superficial metastatic growths. The hepatic border should be carefully investigated during deep inspiration with a view to detecting any malignant metastases in that organ—important as a sign that operative intervention is out of the question. Rigidity may be detected in the epigastric region and over the recti muscles in many cases in which no tumor is palpable. It should be sought with extreme care, being much more important with reference to early diagnosis of cancer than detection of a tumor. The mild peritoneal irritation over a malignant growth announces itself first by pain, but most significantly by muscular rigidity. Deep tenderness commonly accompanies it. The intermitting rigidity of the walls of the stomach caused by severe contractions of its musculature may be noted in case the pylorus be obstructed.

Inflation.—By giving the usual Seidlitz powder in separate glasses or by pumping air into the stomach, the size and shape of the organ and the presence of tumor, especially on the anterior wall, may be demonstrated. In case of recent hemorrhage the method should be used with caution, but I have never seen harm from it. The movement away from the liver of a doubtful tumor may decide its gastric origin, and also give valuable information as to the absence of such extensive adhesions as would indicate inoperability. In certain cases, inflation of the colon may serve to mark out the location of the gastric tumor more definitely.

The use of the bismuth meal and the X-ray is of much service in the diagnosis of cancer of the stomach. The irregular outline of the stomach wall, the presence of tumor, adhesions, hour-glass contraction, dilatation, general contraction, glandular involvement, etc., may be detected. Dr. G. H. Stover has been very successful in

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my cases, in demonstrating the mediastinal glandular metastases in cancer of the cardiac end, otherwise difficult of diagnosis.

"A medullary carcinoma of the pars pylorica prevents that part of the organ from filling with the meal, producing a marked "filling defect" in the röntgenographic outline.

"A scirrhus of the stomach wall produces raggedness and irregularity of the outline, in which peristaltic waves are absent. If the

FIG. 68.—POSTERO-ANTERIOR VIEW OF "SCHRUMPFMAGEN," INOPERABLE SCIRRHUS OF STOMACH WALL, SHOWN IN UPPER LEFT QUADRANT. (Dr. G. H. Stover.)

scirrhus involves the pylorus the stomach will empty rapidly, because the rigid tube formed by the scirrhus cannot close. If the deformity caused by a scirrhus is moderate, the case is operable (roughly speaking), but when the röntgenogram shows that a large part of the stomach wall is involved, and especially if it is fixed, operation is useless.

"Neighboring tumors encroach upon the bismuth outline of the

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stomach, but do not give the ragged outline of the scirrhus defects of the wall.

"In general, the absence of change of form of the stomach in a series of bismuth plates signifies fixation by inoperable cancer." (Stover.)

The use of the gastroscope in the diagnosis of gastric cancer seems inadvisable in most instances, since the information acquirable

FIG. 69A.—COMPLETE PYLORIC OBSTRUCTION FROM CANCER DEVELOPED ON ULCER OF THE PYLORUS AND LESSER CURVATURE. (Dr. G. H. Stover.) Note apparent absence of pylorus and duodenal bulb.

may be obtained by safer methods. Transillumination offers no advantages over the bismuth plate method.

Laboratory Diagnosis.—The vomitus is frequently foul in character because of the decomposition of the food, and blood is frequently demonstrable chemically, if not macroscopically. The test-meal commonly shows a low hydrochloric acidity, but by no means always. I have repeatedly seen the hydrochloric acid content so

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high, perhaps above normal, in case of cancer developing upon ulcer, that no suspicion of malignancy was entertained. Lactic acid is found only in case the hydrochloric acid is very low. The sour smell of the contents is frequently due to butyric acid. Under the microscope the Oppler-Boas bacillus is not infrequently found, but is to be regarded as suggestive rather than diagnostic. Food remnants, especially meat fibers, blood cells and blood pigment, pus cells, bits of necrotic tissue, sarcinæ and fungi are frequently detected. In one case the diagnosis was established by the finding by Dr. T. R. Love of a cancerous fragment in the eye of the stomach tube. Hydrochloric acid and the ferments gradually disappear in about 90 per cent. of the cases of gastric cancer. In the operable stage the proportion of cases with such disappearance will be much less.

Graham and Guthrie report as follows regarding the gastric analysis in 150 cases of gastric cancer:

CANCER OF THE STOMACH

150 cases

Free hydrochloric acid present in	70 cases
Average age	48 years
Duration of symptoms	4½ years
Absent in	80 cases
Average age	54 years
Duration of symptoms	9 years

Free hydrochloric acid present without blood, lactic acid, or food remnants in 24 cases.

Free hydrochloric acid present without blood, lactic acid, or food remnants in 46 cases: in 37 of these cases no palpable tumor present; 33 of these cases had palpable tumor present (blood alone 15 cases).

Blood present in 80 cases: Blood and lactic acid, 20 cases; blood and food remnants, 15 cases; blood, lactic acid, and food remnants, 30 cases.

Lactic acid present in 64 cases; lactic acid alone, 11 cases; lactic acid and food, 3 cases.

Food remnants present in 63 cases.

Food remnants present without blood or lactic acid in 15 cases.

Their conclusions are of great interest:

From this summary it will be noted that a large number of cases of gastric cancer must be diagnosticated independently of the test-meal findings,

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yet, on the other hand, there are a few cases in which the subjective symptoms are indefinite, and where the test-meal throws the first light upon the real pathological condition present.

The large percentage of free hydrochloric acid in this class of cases is explained by the fact that cancers of the stomach are diagnosticated earlier and with less hesitation than in former years. We have been impressed with the frequency with which cancer develops upon old ulcer. The latest statistics from our laboratory show that seventy-one per cent. of the cancers of the stomach developed on an old ulcer base.

FIG. 69B.—MEDULLARY CARCINOMA OF PARS PYLORICA, LATERAL VIEW. Filling defect shows a light oval shadow in the lower right quadrant of picture. (Dr. G. H. Stover.)

The motor power of the stomach is commonly much decreased, especially if parts other than the cardia be involved. Complete stagnation is found in pyloric obstruction. The glycyltryptophan test in our laboratory has furnished no evidence of especial value, not better obtainable otherwise. The antitryptic reaction of the blood serum, the skin reaction, and the study of hemolysis have not yet demonstrated their value.

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Stools.—The frequent occurrence of occult blood over long periods has been mentioned, and is of much significance. Brown emphasized the importance of Schmidt's finding of the Oppler-Boas bacillus in the stools.

Schmidt showed the following fact: The bacterial examination of the stools by Gram's stain under normal conditions gave a picture of very few

Fig. 69c.—Inoperable Carcinoma of Transverse Portion of Stomach. Fundus filled with bismuth on the left, and filling defect in the center. Postero-anterior view. (Dr. G. H. Stover.)

organisms, the Gram-negative colon group vastly outnumbering any Gram-positive organisms. The normal stool Schmidt called Gram-negative. A stool that with Gram's method showed uniform-sized bacilli far outnumering all other organisms he regarded as Gram-positive. Occasionally a stool was found in which Gram-staining organisms in great varieties outnumbered other organisms; these organisms were chiefly cocci and non-uniform bacilli which he differentiated in a manner to be referred to later. They are not

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Gram-positive in the sense that the predominating organism is a well-staining uniform bacillus. Schmidt takes the ground that Boas-Oppler bacilli are vastly more easily found in the stools than in the gastric contents, which is quite true, and he believes that if the morphologic characteristics of the Boas-Oppler bacilli are determined in differentiating them, their relation to cancer becomes of great significance.

FIG. 69D.—POSTERO-ANTERIOR VIEW OF OPERABLE MEDULLARY CARCINOMA OF PARS PYLORICA. Patient living and well 1½ years after resection. Prepyloric filling defect is shown just above the center of the picture. (Dr. G. H. Stover.)

Schmidt's technic is as follows:

Make thin smears.
Dry and fix five minutes in methyl alcohol (thus dissolving also fat).
Stain five minutes in anilin-oil gentian-violet; wash.
Iodin-potassium-iodid solution till deep purple; wash.
Decolorize in 95 per cent. alcohol till nearly colorless; wash.
Stain in weak aqueous solution of fuchsin; wash; dry; mount.

COMPLICATIONS.—The most frequent and important relate to metastatic growths. The glandular involvement has been mentioned

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in the section on pathology. The most frequent region of metastasis next to lymph glands is the liver, this occurring in more than half the cases. The neighboring organs are often affected by direct contiguity, notably the pancreas, spleen, and kidney. The peritoneum is frequently involved. Not rarely the growth perforates upward, and the organs above the diaphragm are implicated. Gas-containing abscesses may thus be originated. Metastasis to distant portions of the body is not unusual. Rectal examination may show metastases in the pelvis—important because forbidding operation. Boas states that in twenty to thirty per cent. metastasis occurs, generally in the anterior wall of the rectum, two to four centimeters above the prostate, and not involving the rectal muscles as does local disease. This feature should warn the surgeon not to operate under the diagnosis of local rectal cancer. The sloughing carcinoma may perforate into the neighboring hollow viscera of the abdomen, so that fecal vomiting, for example, may suddenly occur without intestinal obstruction, signifying communication with the bowel. Direct perforation into the peritoneal cavity is unusual, since alhesions in advance of the growth commonly prevent it. The involvement of the peritoneum commonly gives rise to a bloody fluid in which characteristic mitotic cells may be found. The occasional occurrence of femoral thrombosis has been mentioned. It is regarded by Boas as significant of the passage of cancer cells into the blood.

Course.—The disease progresses steadily, as a rule, reaching a fatal termination in six to eighteen months in average cases. Scirrhus cancer not involving the orifices offers the best prognosis, and the duration may exceed two years after the diagnosis has been reasonably established. The mechanical obstructive features, so notable in other portions of the digestive tract, do more toward hastening the end than the influence of the malignant growth, apart from obstruction. In certain cases the growth is very rapid, and the total recognizable duration may be but a few months. Metastases in the liver may grow so rapidly as wholly to overshadow the original lesion. Remissions are not very unusual. They are thought to be due to the mental influence of exploration in certain cases. They are certainly due to relief from obstruction at the pylorus from the per-

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formance of gastro-enterostomy in many instances, and the suggestion is obvious that in certain cases ulceration of the central canal through the obstructing mass may, by offering better opportunity for food to reach the bowel, lead to a gain in weight. Termination in general carcinosis is not very frequent.

The important fact for the physician to bear in mind regarding the course of carcinoma is its inevitable lethal termination under medical treatment. Dr. Love has analyzed the last one hundred cases, diagnosed clinically as cancer of the stomach, as they appear in my private records. The figures given below offer a sad commentary on the neglect of early symptoms in this disease, generally by the patient, but frequently by the physician as well, for most of the cases seen early enough to offer a good chance of recovery through surgical intervention were discovered in operations for gastric ulcer.

Of the one hundred cases ninety-one were seen too late to offer any especial encouragement as to cure by operation. Thirty-seven were explored, always with a most definite understanding that the operation was to be regarded by the patient as a means of exact diagnosis and probably of help, either as to prolongation of life or cure. In six cases gastric ulcer was present, and in one a gastro-enterostomy had been done five years before for obstructing ulcer at the pylorus. In eight cases the pyloric obstruction was so great as to justify a gastro-enterostomy, and in another case a gastro-enterostomy was done connecting the upper compartment of an hour-glass stomach with the bowel. In another hour-glass stomach nothing could be done. In three cases only could pylorectomy be carried out. One remained well after fifty-two months, one was still well ten months after operation, when last heard from, and another passed through an attack of acute pneumonia thirteen months after operation, but has not since reported. One hopeless case, in which gastro-enterostomy was done to avert starvation, gained thirty-five pounds, another twenty pounds, and a third lived and worked as a mail carrier for a year, dying some months later. Bloody ascitic fluid is mentioned in one case explored, and serous effusion in three, all in such amount as to escape detection, or no exploration would have been recommended.

One case I regarded as chronic gastritis. She went to another

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State and died of cancer of the stomach within a year. An exploration at the time of my examination might have saved her life. The statistics in my public hospital service are not available, but would be, I am confident, even more gloomy than those quoted. Fortunately, the whole situation is improving, as physicians and laity recognize the hopefulness of early intervention.

Diagnosis.—This may generally be made if sufficient time be taken, for signs and symptoms eventually develop which are unmistakable. If scientific diagnosis be the end to be attained, the application of the various means enumerated with a sufficient lapse of time for the development of the destructive processes of the malignant growth, suffice for its attainment. If the matter of the restoration of the patient to health be given any weight, which unfortunately seems not to be the case in certain clinics, the waiting for the exact diagnosis is almost criminal. The only possibility of cure lies in such early diagnosis that complete surgical extirpation of the growth is still possible, and such early diagnosis may be made only by exploration. As soon as we find pain, loss of weight, anorexia, decrease of hydrochloric acid, tenderness, muscular rigidity and irregularity in the outline of the gastric wall, such as is attributed to cancer by those expert in the use of the X-ray, unless other explanation be at hand, the patient's abdomen should be explored. The mortality of the simple exploration is almost nothing, if it only be done early enough, and every effort should be made to have the laity, and especially the more conservative section of the profession realize the facts of the case. The complacency with which an enthusiastic diagnostician dilates upon the beauties of various methods of diagnosis in gastric cancer and the certainty with which the post mortem appearances are predicted are anomalous in an age when cure is attainable by early surgical intervention. The fact that most men in middle age who develop symptoms of indigestion with loss of weight, and in whom hydrochloric acid is deficient, are eventually found to have gastric cancer, should never be lost sight of. Further, marked loss of weight with severe secondary anemia in the middle-aged is extremely suggestive.

Differential Diagnosis.—That from ulcer is most important, and it

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cannot be made early enough in certain cases by any means short of exploration to save the patient. One of the most potent arguments for operation in gastric ulcer lies in the fact that enough patients may be saved from death by cancer, by finding and removing unexpected malignant growths to much more than balance the total mortality of the operation! The proper plan is to spend less effort and time in the differential diagnosis between ulcer and cancer, but rather to explore early enough to save the patient. In occasional instances, the resemblance of ulcer, with extensive thickening about the pylorus and adenitis, to carcinoma is so great that only histological examination is decisive. These are the cases which unexpectedly recover after gastro-enterostomy has relieved the pyloric obstruction. I have mentioned such a case in which permanent recovery ensued after an erroneous grave prognosis when even the excision of a gland for histological examination seemed to us unjustifiable because of the gravity of the case. Syphilitic tumors of the gastric wall and especially the pylorus may be deceptive. The history, the Wassermann reaction, and the response to treatment are commonly decisive. The finding of scars upon the liver upon exploration is very suggestive. Regardless of the exact diagnosis these patients should not die of pyloric obstruction since exploration and gastro-enterostomy or other operation should afford relief, if specific treatment fail.

In chronic gastritis the chemical findings may be practically those of cancer, excepting that blood is usually absent. The chronic course, often with remissions, is the most decisive feature. The history of abuse of alcohol is often present. The advent of signs of marked motor insufficiency or of decided gastrectasis should lead to exploration. Non-malignant pyloric obstruction suggests pyloric cancer, but the course is more chronic, glandular involvement is absent, tumor is often absent, blood is absent from the stomach contents, and the history often suggests previous ulcer, of which the scar remains as the cause of the stenosis.

Location of the Growth.—The absence of difficulty of swallowing and retention of food in the stomach suggests the absence of involvement of the orifices. The glandular enlargement near the insertion of the left sternomastoid with enlarged mediastinal glands,

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as shown by the X-ray, is fairly conclusive as to affection of the cardiac end. Obstruction to the passage of the stomach tube at the cardiac orifice, with bleeding after the attempt, is common in these cases. Gastrectasis with marked food retention signifies pyloric involvement with obstruction, and a tumor may generally be palpated. Affection of the greater and lesser curvatures and the walls causes less severe symptoms and loss of weight than orificial involvement.

Prognosis.—This is absolutely bad excepting under surgical treatment. In this event the proportion of complete recoveries is as yet small, but chiefly because of the delay in making the attempt rather than from lack of a sufficiently good technique to meet the situation.

Operation is indicated even when a chronic indigestion has continued, without other explanation than probable cancer, for a sufficient time to produce a material and continued loss of weight. Progressive pyloric stenosis, or a pyloric tumor not sufficiently adherent to prevent its free movement under the hand, calls for exploration. Such marked interference with the motility of the stomach as to produce increasing inanition calls for exploration, since if not produced by carcinoma, some other and more remediable cause is likely to be found. In general a definite suspicion of cancer on the part of an experienced clinician, this being not removable by the results of treatment, demands the assistance of the surgeon. In case of definite history of ulcer this is even more imperative.

Even the presence of an extensive growth with many hemorrhages does not forbid an attempt at surgical cure. One patient with a pyloric tumor of the size of an orange, with marked adenitis, who had six severe hemorrhages on the day preceding operation, and in whose case two-thirds of the stomach was removed, was alive and engaged in his usual occupation over four years afterwards. It is not the size of the tumor but the degree of lymphatic involvement that decides the possibility of successful intervention. Marked fixation of the tumor ordinarily warrants a hopeless prognosis. In general it should be stated that the operative mortality is steadily lessening, and the percentage of cures is steadily growing. If earlier intervention could be secured still further improvement in the figures could be obtained. There is much encouragement in the steady im-

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provement as to both operative mortality and final results. Under favorable conditions, probably a third of the cases may be permanently cured. The operative mortality at the Mayo clinic was thirteen per cent. some years ago, and is gradually lessening, as it is in other hospitals.

In a considerable number of cases of gastric cancer the serious result after operation is due to a post operative acute pneumonia.

Other Tumors of the Stomach.—Sarcomata, fibromata, lipomata, polypi, and cystic growths are occasionally met with. Within the stomach may be found foreign bodies, especially the hair tumors mentioned elsewhere.

6. DISEASES OF THE INTESTINE

A. DIARRHEA

(*Catarrhal Enteritis*)

Etiology.—In general diarrhea results from the hurrying of the liquid contents of the upper intestinal tract through the cecum and colon, where normally the liquid is taken up. The effect of increased secretion from the intestine must be considered. Diarrhea may be caused by the over-use of water alone, and if it contain small amounts of laxative substances, as is the case with the "alkali waters" found in many parts of the country, the laxative effect is very pronounced. Foods which contain irritating substances, such as seeds of fruits, etc., or over-abundance of cellulose or of fat, or which are indigestible because of over-ripeness or beginning decomposition, oftentimes associated with marked bacterial action and production of irritating toxins, are common causes of looseness of the bowels. Changes in the weather, especially in the warm season, are frequently accompanied by diarrhea. The extensive use of the abdominal band in the tropics testifies to the belief in the influence of chill upon the action of the digestive organs. Nervous influences are of great importance, and perhaps most persons have suffered from occasional looseness of the bowels from this cause. It is not uncommon in

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hysterics. Changes in the amount and character of the bile and the pancreatic juice are important in certain cases.

The secondary diarrhea associated with typhoid, dysentery, many septic diseases and in conditions where anemia or congestion and inflammation of the intestinal mucosa are present as the result of chronic heart disease, cirrhosis of the liver, chronic nephritis, pernicious anemia, cancer, tuberculosis, etc., will be discussed in other sections.

Bacteriology.—In some cases the B. coli is apparently responsible for the diarrhea, having apparently undergone an increase in virulence, or having found conditions under which it becomes more active than usual. Shiga's bacillus dysenteriæ and the various subsidiary forms are active, not only in dysentery but in various diarrheas, especially in children. The B. enteritiditis, the B. botulinus, and the specific organisms of typhoid, tuberculosis, etc., should be mentioned.

Pathology.—The whole intestinal tract is likely to be involved to a greater or less extent, with softening and infiltration of the mucosa, pallor, and slight injection and shedding of the epithelial cells. The intestinal follicles may be swollen and eroded in the severer cases.

Symptoms.—The usual history is that of having eaten something which disagreed, or of exposure to some of the causes mentioned, followed by slightly disagreeable sensations in the abdomen or by mild colicky pain. Loose dejections soon appear and commonly show recognizable food elements, since the contents have been hurried through too fast for the usual digestive changes. Mucus is present in excess, and the stools are colored in various shades, greenish, yellowish, brownish, largely from the unaltered bile. The old term lienteric diarrhea was applied to the type in which undigested food was a prominent feature. In the more severe cases, the abdominal symptoms preceding and accompanying the diarrhea are more pronounced. Vomiting, colic, and tenesmus may be present, the latter signifying the participation of the colon in the process. The accumulation of gas in the bowel is more marked, and the rumbling and gurgling is accompanied by griping pains. Thirst is distressing owing to the loss of fluid from the system. In certain choleriform attacks,

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"summer cholera," very free watery passages, probably always associated with bacterial infection of some type, may occur. Cramps in the calves, faintness, and even collapse may result from the profuse discharge of fluid from the body. Fever of moderate grade may be present. A mere staining of the stools with blood may at times be noted, but it is not common nor characteristic, but accidental. After a day or two the attack commonly subsides unless injudicious eating and drinking prolong it. The prognosis is excellent, although chronic diarrhea may follow.

Chronic Diarrhea

This may follow the acute form, or supervene upon repeated attacks of it. The type found in connection with cancer of the bowel or other structural diseases will be considered elsewhere. The symptoms are those of the acute form, but they persist, with intervals of perhaps normal fecal discharge, or even of constipation. The stools are commonly yellowish or brownish, and are frequently quite offensive. Distension of the abdomen with local tenderness is frequently present. In severe cases emaciation and gradual reduction of strength are to be noted, though many of the soldiers of the Civil War suffered little permanent weakening, even after years of trouble. Mucous colitis and chronic dysentery are to be differentiated.

Prognosis.—This is fairly good as to life, but the attacks may recur, especially in the warm season, over half a life time.

Intestinal Ulceration

Croupous Enteritis.—A false membrane is not infrequently found in the bowel post mortem as the result of poisoning by mercury. It is an incident only in the severe toxic disturbance. It has also been found in intoxication by lead and arsenic.

In acute diseases, notable pneumonia and pyemia, and as a terminal process in cirrhosis of the liver, etc., a similar condition is found. A greater or less degree of ulceration and of necrosis of the mucosa is present, and bloody mucus and shreds of membrane may

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be passed in the stools. The conditions are overshadowed, clinically, by the important affections with which they are connected.

Phlegmonous Enteritis.—Phlegmonous enteritis is the name given by pathologists to suppuration in connection with various intestinal troubles, generally some form of obstruction. An abscess forms in the intestinal wall. It is but an incident in the course of the main affection. Stercoral ulcers result from the contact, over long periods of time, of scybalous masses with the mucous membrane of the large bowel. They are especially found in the sigmoid, cecum, and at the colonic flexures. The sacculi of the colon may harbor dry masses of fecal matter for years, lime salts being eventually deposited in them. They are of interest from their relationship to diverticulitis, because of the gradual atrophic yielding of the sac, and to cancer of the colon, from the ulceration and hence long-continued irritation which may lead to the malignant change. Many errors have been made in the past as to the relationship between decubital ulcers, diverticulitis, and cancer, both as to their diagnostic and their pathological relationship.

Duodenal Ulcer from Burns.—This condition is not infrequently found at post mortem examination in case of death from extensive burns (6.2 per cent). Multiple ulcerations may be present, different from the usual peptic type. The exact cause is not yet determined. In a man who was one of thirteen to survive an outbreak of virulent confluent small-pox in Mexico, the symptoms of duodenal ulcer, for which he was operated later, began before he was discharged. The case is interesting from the similarity to the cases resulting from extensive burns.

Other Forms of Ulceration.—Uremic ulcers occur in the ileum and large bowel in conection with the uremia of chronic nephritis, especially the interstitial form.

Follicular ulceration occurs as mentioned in enteritis, but is found also in chronic cachectic diseases. It is an advanced stage of the catarrhal ulceration of some writers. It is of little importance clinically.

New growths may ulcerate their way into the bowel and abscesses may break into it, leaving an ulcer. Cancer, tuberculosis, syphilis,

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typhoid, and dysentery of different types present special forms of intestinal ulceration. A solitary ulcer is recognized, which may lead to perforation of the large bowel. The so-called simple ulcerative colitis resembles dysentery, but is classified separately by some authors, in view of the lack of any definite bacterial causation.

Symptoms of Intestinal Ulceration.—In the types mentioned the most frequent manifestation is diarrhea, with the passage of blood, pus, and shreds of tissue. Free hemorrhage may occur, but abundant passage of pus suggests the rupture of an abscess through the bowel. Perforation is a not infrequent incident.

B. INFANTILE DIARRHEA

Because of the greater susceptibility and less resistance in childhood, the diarrheal diseases of this period acquire an importance entirely out of proportion to that of similar troubles in adult age.

Etiology.—Recent work upon the bacteriology of summer diarrhea has shown the astonishing frequency of the presence of Shiga's dysentery bacillus, or of several types differing from the original organism in minor particulars. It is well established, however, that outbreaks of diarrhea occur in which the identical investigators who have found the Shiga bacillus in previous epidemics are unable to demonstrate its presence, so that its supposed position as the usual cause of summer diarrhea is not at all established. The Bacillus coli, B. lactis ærogenes, and B. proteus are very commonly present. It is thought that the Streptococcus pyogenes is responsible for the ulcerative intestinal lesions, even though other organisms start the diarrheal process. The intensely acute symptoms of cholera infantum suggests the action of some perfectly definite and very active bacterial cause, but none has been discovered. In many epidemics the carrying of the infection is through the milk supply, but by no means in all. Further study will probably clear up this matter. Extensive investigations are in progress.

Food.—Probably the most important feature in the causation of summer diarrhea of childhood is the food supply. The digestive system is so sensitive that even though the food be above suspicion,

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an excess in the amount may cause the trouble by furnishing an undigested residue, which offers opportunity for the growth of harmful bacteria and for fermentation. Many a diarrhea starts from a single feeding of food which has become slightly spoiled. In many cases the giving of fruit or other improper food to nurslings is the source of the diarrhea. The well-recognized fact that breast-fed children do not suffer seriously from summer diarrheal troubles points the way to the best method of prevention. Fortunately, the recent immense improvement in the character of the milk furnished to babies in large cities is having a marked beneficial influence upon the whole situation.

TEMPERATURE.—The influence of temperature conditions has been thoroughly established. Every degree of excess over the mean temperature of the summer months means additional cases of the disease in large cities. The effect is less evident in the country, but still well marked. The lessened frequency of diarrheal diseases of children in mountain climates is well recognized, and is due largely to the lack of the depressing effects of the heat by day, and to the recuperative influence of the normal sleep which the babies obtain during the cool nights.

Pathology.—The changes vary from a slight catarrhal inflammation in the mildest cases, with the swelling of the follicles, to the congested mucosa with swelling and infiltration and even slight ulceration of Peyer's patches of the usual enterocolitis. In the severest forms, extensive ulceration is present, with a false membrane in the lower bowel. The mesenteric glands show an acute adenitis.

In the simple dyspeptic type of diarrhea, the improper feeding excites nausea and vomiting, followed shortly by loose fecal movements. These are sour and ill smelling, and contain food remnants, mucus, and especially curds of undigested milk. Colicky pains and abdominal distension, moderate fever, elevation of pulse, prostration, and the signs of exhaustion in severe cases are noted. The stools have perhaps doubled or quadrupled in frequency. In mild cases, the symptoms all subside, but in many instances they tend to recur. A severer form may follow this recurrence, or the attack may assume this character from the beginning. The temperature becomes higher,

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even to 105°. After the emptying out of the fecal contents the diarrhea continues with frequent liquid or mucous stools. Fretfulness, drowsiness, or even convulsions may be noted. The attack may subside, may go on to coma and death, or lead to a definite enterocolitis.

In this latter type all the symptoms are yet more severe. It may originate without any conspicuous appearance of the preceding varieties. The temperature is high, the stools frequent and watery; and mucus, blood, and pus, which have been inconspicuous in other diarrheas, may appear. Tenesmus and abundant mucus in the stools signify a special colonic involvement. The irritating discharges cause inflammation of the skin about the anus and buttocks, and the rectum may prolapse and add to the distress. If the frequent stools continue, the signs of exhaustion become marked, and the pinched face, hollow eyes, cold and cyanotic extremities, distended abdomen, dry mouth and feeble cry testify to the approaching danger. Collapse, coma and death too frequently follow, yet the child may gradually recover or eventually die of exhaustion after the diarrhea has practically ceased. Bronchopneumonia and other complications are to be feared in all severe cases.

Cholera Infantum.—This is a diarrhea of extreme virulence, seen in young babies, of unknown cause bacteriologically, and marked by the choleraic character of the stools and of the general symptoms. It is fortunately much less common than the preceding types of summer diarrhea. It often starts suddenly with vomiting followed quickly by profuse and frequent diarrheal stools. The bowel is quickly emptied, but serous odorless stools are yet passed in quick succession. The rapidity of the shrinking of the tissues, hollowing of the eyes, depression of the fontanelles, and loss of weight are startling. The rectal temperature is moderately elevated, though the skin feels cool. As the disease advances, extreme dryness of the mouth and tongue and a corresponding thirst are notable features. Failing pulse, stupor, collapse, and death may terminate the disease, even within the first twenty-four hours. In other cases the child shows the appearance of the "spurious hydrocephalus" of the older writers—semi-coma, retracted head, and Cheyne-Stokes respiration.

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This may last for several days. The diarrheal symptoms frequently disappear before its development.

PROGNOSIS.—About 90 per cent. of the cases die.

C. CONSTIPATION

The failure to void feces properly is due to many causes. In the absence of definite obstructive symptoms the term constipation is applied. The word obstipation is sometimes used to signify severe constipation. An unusual dryness and hardness of the fecal matter is present. Normal habit of body varies so much that we can merely state that daily defecation is the rule in healthy persons, although many are somewhat less regular. At the other extreme are patients with megacolon in whom a few defecations a year suffice. One such patient of mine passed two or three months at a time without defecation, with some inconvenience, but with no serious results.

Etiology.—Probably the most important point in the etiology is the character of the diet. Those who habitually eat food from which every removable bit of indigestible matter has been taken have so little residue in the bowel that the organ is unable to handle it properly, as the hand fails of a secure hold upon a wire as compared with that upon a walking stick. If one should live on sugar, for instance, in just such amount as was needed to support life, but little intestinal residue would be left, and constipation would almost necessarily result. On the other hand, the savage who obtains his starchy food by eating raw roots, his sugar by eating berries and fruits, who has abundant cellulose in his diet from tender inside barks and aromatic leaves, and who eats meat in addition has, with the vigorous appetite of an outdoor life and abundant exercise, a bulky intestinal residue, which remains soft and easily handled by the peristalsis. His natural squatting position in defecation is a still further advantage.

Constipation from a coarse diet is always mentioned in textbooks, but it must be unusual. Insufficient use of water should be mentioned as a frequent cause of constipation.

Next in importance comes the constitutional tendency to constipation seen not infrequently in the dark-complexioned type of peo-

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ple, who are subject to sluggish action of the liver as well. The same class of persons also suffer from "bilious spells."

An active life favors intestinal peristalsis, and the converse of it, so often incident to city life, and in fact any type of indoor life, is a common cause of constipation.

FIG. 70.—MARKED COLOPTOSIS. (Dr. G. H. Stover.)

Lack of regular habit of defecation is of much importance. In wasting diseases in which the secretions of the digestive glands are decreased and little food is taken, and in many acute diseases, torpidity of the bowels is present. Morphin habitués are obstinately constipated.

Locally many causes operate to prevent free movement of the bowels. One of the most common is the interference with peristalsis, due to a chronic or subacute inflammation about the appendix. Ad-

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hesions from any cause, often as the result of conditions for which operation has been postponed until serious damage has been done in the abdomen, are causative. The use of the bismuth plate shows us that many of the cases are due to angulation or other trouble along the course of the colon, so that it works at a disadvantage. The con-

FIG. 71.—SPASTIC CONDITION OF DESCENDING COLON, FUNCTIONAL. The enema given later showed a normal caliber. (G. H. Stover.)

stipation dependent upon local conditions in the rectum belongs in the department of the specialist.

It was a great surprise to physiologists, as well as clinicians, to learn by the use of the Röntgen ray how few abdomens presented the classical position of the large intestine. The duodenum in its third part and the ileum are often kinked, though the fluid feces here are

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less delayed than the desiccated mass farther along in the canal. Many of the angulations and kinks are the result of pelvic or other types of peritonitis. It is imperative in obstinate cases to watch the course of the bismuth meal through the digestive tract by a series of X-ray plates. Much progress is already being made in treatment as a result, as well as in diagnosis. Visceroptosis affecting other organs comes in the same class.

Atony of the abdominal wall and of the coats of the colon interferes with the exertion of the natural force which propels the contents of the bowel. A spasmodic type of constipation is described, in which the bowel remains contracted after dysentery and other affections. A similar spasm gives the small contracted bowel of lead poisoning with its obstinate constipation.

The acute type of constipation is better dealt with under intestinal obstruction, as it is the result of this cause in some form.

Symptoms.—In most cases there are no symptoms aside from the infrequency of the bowel movements, and the disturbance because of the necessity of forcing them. Patients whose bowels move perhaps but once a week continue to do their life's work indefinitely in some cases. Many patients, however, suffer from headache, bad taste in the morning, lassitude, and mental depression. If the rectum, normally only a passage-way for feces, not a warehouse as is the colon, is permitted to fill and remain unemptied, the unsatisfied desire to empty the bowel is a source of trouble. Meanwhile the rectum is being rendered insensitive, so that it does not demand evacuation as it normally should.

The pouches in the wall of the colon tend in these cases to gather scybala, and the hardening, and even calcification of these leads to still further trouble, since stercoral ulcers, and even diverticulitis may result. The interference with the venous circulation in the rectum causes hemorrhoids, and the passage of the hardened mass accumulated may cause a fissure. In drug habitués it is not uncommon for the insensitive rectum to become filled with desiccated feces which the patient removes manually or the physician instrumentally. Neuralgia in the sciatic distribution may result from the pressure of this mass as from the pressure of a fetal head in pregnancy.

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Recurring attacks of diarrhea may be noted, although with every attack hardened fecal masses are passed. The colon in these cases may be lined with fecaliths in the saccules, and the diarrhea arises from the irritation of the retained contents. Examination of the abdomen may show the visible cecum and colon, and the hardened masses may be felt if the walls be lax. They are occasionally mistaken for tumors.

In women the presence of "liver spots" upon the face is attributed to the intestinal toxemia of chronic constipation, and probably with much reason. Certainly the muddy complexion and sallow conjunctivæ may be greatly benefited by correcting such a trouble. The close association between constipation and chlorosis has been mentioned elsewhere.

There is a well-defined perverted mental state in constipated persons who have worried long with the disease. Every imaginable symptom is attributed to the condition, even though under treatment the bowels are moving daily.

In case of fissure of the rectum in children, the dread of the pain which follows tearing open the fissure as a result of hard fecal movement leads to postponement of defecation, with the result that so large a mass accumulates as to make certain of material damage on its passage.

Congenital causes may be operative in children. I have reported a case of such huge distention of the bowel that my diagnosis was that of megacolon. Post mortem examination showed a dilatation of the entire small bowel, though the colon was normal. The small intestine was as large in this infant as the adult colon, and three great folds practically filled the center of the abdomen. Enlargement of the colon is much more frequent. Probably deficiency in milk fat is the most common dietetic cause in nurslings. Hernia may result from straining at stool.

Diagnosis.—There is usually no difficulty. Local examination is imperative in chronic cases, since fissure, hemorrhoids, cancer, retroflexion of the womb, pressure of a fibroid tumor or of an enlarged prostate or other local conditions may be operative. A very careful

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examination should always be made for tenderness and rigidity in the region of the appendix, for the relief in such cases by appendectomy is often most gratifying. The bismuth plate is essential in very serious cases.

Prognosis.—This is good, although much skill and patience are often requisite.

D. ENTEROPTOSIS

(*Glenard's Disease*)

In this condition the abdominal contents have a tendency to fall because of the looseness of the attachments by which they are normally held in place. The right kidney, the colon, the stomach, the left kidney, the liver, and the spleen are affected in order of frequency in some such general succession as they are named here, there being especially no question of the position of the right kidney at the head of the list. The left kidney is rarely very low unless all of the other organs are displaced downward. There can be no doubt that the majority of patients with marked visceroptosis present the bodily conformation insisted upon by so many writers. The slender figure, long thorax, thin abdominal wall, generally relaxed muscles, and floating tenth rib are commonly present. The figure impresses one as not being well "set up." So far as endurance of physical strain goes, this is the very type which stands the least. In fact, the patients are generally neurasthenic.

Falling of the viscera is common also as an acquired condition, when the abdominal walls have been stretched out of form by distention, as by tumors, pregnancies, or ascites. Symptoms may not be present in this type. Ptosis of the kidney not infrequently follows strain, injury, or exhausting disease in which abdominal fat is wasted away.

In the neurasthenic type first mentioned, the patients are young women in a majority of cases, of the slender build mentioned. The complaints are of distress, indigestion, backache, vague pain in the abdomen, easy exhaustion, a movable tumor in the right abdomen,

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frequently obviously the kidney, and inability to stand the strain of work. The young housewife cannot sweep, and the nurse cannot stand the work which involves standing, stooping, and lifting. Pronounced neurasthenic symptoms are noted, and some of the vasomotor instabilities of that condition are likely to be found in the examination,—flushing, abdominal pulsation, etc. Examination shows the right kidney prolapsed, not infrequently the left in less degree, and the stomach and colon are also low. The latter feature may be better demonstrated by the bismuth plate, though percussion after distention is quite satisfactory. The frequent uterine retroversion should be mentioned. It is reasonable to suppose that visceroptosis, uterine retroversion of this type, and neurasthenia may all be different manifestations of lack of strength and ability to stand the strain for which they were designed on the part of the various structures at fault. The displacement of the kidney may be of the first, second, or third degree, as described under movable kidney. The results of obstruction of a ureter (Dietl's crisis, etc.) are there considered. The frequency of appendiceal symptoms in this condition is discussed under appendicitis. Sciatica may be attributed to the pressure of the displaced kidney. Pyelitis is definitely more common in the floating kidney than in the normal one, and Kelly found that the pelvis contains on an average 12 or 13 c. c. of fluid as against 7 or 8 c. c. normally. The displaced kidney is often congested and tender, and it is this finding that formerly too often hastened the surgeon to believe that anchorage of this organ in place would prove curative. The rigidity of the muscles over the organ lends credence to the conception that the kidney is definitely diseased, at least in the way of a chronic congestion from interference with its circulation from the displacement, and the examination of the urine drawn from the kidney, showing a trace of albumin and hyaline and granular casts, is confirmatory. The stomach may be simply of the dropped type, or, as found by X-ray examination, of the vertical type, and extending below the umbilicus. The duodenum is not infrequently kinked with resulting stasis. Splashing is generally present in the stomach, and the motor functions of the organ are notably interfered with, in part because of the general lack of nervous and muscular

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tone, and in part because of the bad mechanical condition under which it must do its work.

The sagging of the transverse colon is the most notable intestinal feature, and kinking at the hepatic and splenic flexures is extremely frequent. This more than any other one feature may account for the usual constipation of the condition. Mucous colitis is very common. The duodenum is dragged upon by the displaced colon. Serious kinking of the sigmoid is frequently the cause of marked symptoms. The liver shows displacement less than do the other organs, but next to the kidney it is probably the one most influenced by tight lacing. In these cases it is tilted forward, so much that it presents a greater area of surface to the abdominal wall than normal, and may be thought to be enlarged. In one woman with such a displaced liver, in whom I had confidently diagnosed gall-stones from the repeated attacks of colic and jaundice, the gall-bladder and ducts were entirely negative, but the duct could be seen to be kinked in the low position of the liver. She has remained entirely well since the liver was anchored in proper position. The spleen may be so loose as to be felt in the abdomen and may even become strangulated. I have seen it in the right abdomen. The best opinion seems to be that the pancreas does not prolapse.

In ptosis of the liver and spleen we are practically limited to the manual examination of the abdomen, which commonly suffices. The stomach and small and large intestines should be examined in important cases by the bismuth plate method, which reveals so much more than any other mode of examination that there can be no possible comparison as to efficiency. The X-ray examination of the kidney, after the passage of the ureteral catheter, or after distention of the ureter and pelvis with collargol, gives information not only as to the size and shape of the kidney, but as to the size of the pelvis, presence of possible kinks, or distention of the ureter, stone, etc. It should be practiced before any operative procedures are decided upon.

Prognosis.—This depends more upon the associated neurasthenic condition than upon the mechanical features within the abdomen. Much relief can be given in certain cases by judicious surgical intervention, in some by the use of an abdominal support. The prognosis

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depends largely upon the skill and judgment used in the application of the means of relief.

E. IDIOPATHIC DILATION OF THE COLON

(*Hirschsprung's Disease*)

This is a congenital malformation, or the result of congenital weakening of the wall, in which the large bowel becomes enormously enlarged and loses its function to such an extent that it becomes al-

FIG. 72.—MEGACOLON. Operation by Dr. A. H. Williams. Recovery.

most incapable of expelling its contents, which therefore tend to accumulate. The bowel may increase to the size of even ten inches in diameter, and a patient of mine lost over 30 pounds in weight as a result of successful purgation, the bulk of stool passed being almost incredible. The sigmoid may be alone in the involvement and may practically fill the abdomen. A narrowing in some part of the colon or a valve effect or kinking may be operative in the causation. The coats, and especially the muscular coats of the colon, are thickened.

Symptoms.—These are enlargement of the abdomen and constipation. The former may be due as much or even more to accumulation

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of gas as to feces ("balloon man"). The peristaltic waves of the hypertrophied colon may be visible. Dyspnea is common as the result of the crowding up of the diaphragm. The mechanical interference is so great that many patients cannot work, but the patient mentioned went out regularly for a two or three months' period, returning to get relief by medical assistance. He was finally operated upon, with great improvement in his condition as a result and was doing well when last heard from.

Death may occur from gradual interference with nutrition, or from perforation of the bowel from ulceration. The patients do not commonly reach middle life.

Diagnosis.—This is commonly easy if the possibility of the condition be only given consideration. In a child, mentioned elsewhere, who never had a natural movement during its life, post mortem showed a condition exactly similar affecting the small bowel. The distinction could have been made now by modern means of diagnosis (bismuth plate), but I had at the time of examination no doubt of its being a case of megacolon.

Prognosis.—This is bad excepting with the assistance of the surgeon, which should be invoked if the condition becomes serious. It commonly progresses until this stage is reached.

F. APPENDICITIS

Inflammation of the vermiform appendix is now recognized to be the most frequent and important of the diseases of the abdominal organs. Some explanation is in order as to the relatively enormous frequency of a disease practically unknown to the last generation.

The explanation is a simple one. Before the days of modern abdominal surgery the patient with appendicitis either recovered, in which case no pathology was discoverable, or died with general peritonitis. The early pathology, in which the appendix played the chief or even the entire rôle, was therefore unknown. The "iliac phlegmon" was not recognized as of appendicular origin. In the usual post mortem examinations the changes about the appendix of one who had recovered from the disease were so slight as to attract little attention.

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It is probable also that the disease has become absolutely more frequent during recent decades.

The appendix may be looked upon as an organ practically without function in man and, being a retrogressive structure, less able than other organs to withstand disease, especially when its lymphatic tissues are affected.

Etiology.—Although a bacterial infection is an essential element in appendicitis, other features deserve mention before this is considered. Most inflamed appendices present structural peculiarities to which the readiness to infection are in part attributable. One may generally find in an inflamed appendix a stricture, kink, angulation, enlargement at the distal end, or other structural feature interfering with the exit of any material which has found its way in. It is likely that in a majority of all cases mechanical difficulties are at the basis of the acute or chronic inflammation. In others, acute infectious disease is probably responsible. The well-recognized frequency of involvement of the appendix in typhoid, of which I have seen many examples both upon the operating table and in the autopsy room, should be noted. The equally frequent involvement in tuberculosis is of interest. Tonsilitis and influenza are associated with acute appendicitis in certain cases. A nurse was operated upon in St. Joseph's Hospital for what appeared to be a typical attack of appendicitis associated with a sharp coryza. The appendix and neighboring ileum were covered with a blotchy eruption, and acute catarrhal inflammation of the organ was present. As the patient came out of the ether, an abundant and typical eruption of measles appeared, and the disease ran its normal course. A similar association with other acute diseases has been observed. Yet in a majority of the cases, an inflammation of the mucosa, a congestive or ulcerative process, has resulted from retained fecal matter, foreign body, stricture, etc. In rare instances parasites, especially pin worms, have been present. The cases attributable to trauma have invariably, in my experience, had a structural basis, as indicated above. Severe use of the psoas and iliacus muscles, as in long wheel rides, is a frequent source of the trauma from which the acute attack arises. The bruising and pressure to which the organ is subjected in the muscu-

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lar exertion of childbirth is a not infrequent cause of acute inflammation.

Concretions are of much importance in the etiology, since they frequently cause a decubital ulceration. Gall-stones, pins, shot, or other foreign bodies may enter, especially if the valve of Gerlach be relaxed. Mitchell states that such foreign bodies are present in 7 per cent. to 30 per cent. of the cases. In nearly half of all cases containing foreign bodies they are of fecal origin, often merely inspissated fecal matter, which has originally entered through the narrow valve in liquid form, but definite coproliths may form. Bacteria,

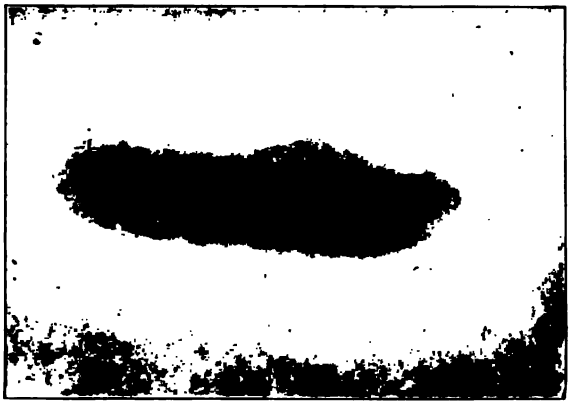

FIG. 73A.—SHOT IN THE APPENDIX. (Hitchings and Sloan, *Jour. Am. Med. Assn.*, April 25, 1914.)

epithelial cells, mucus, and lime salts are frequently important in the makeup of the concretion. The great frequency of gangrene and perforation at the site of the concretion is evidence of its etiological influence.

Cecil and Bulkley have reported instances of the finding of the Oxyuris vermicularis and the Trichocephalus trichiuria in the appendix, with catarrhal inflammation, and, in their opinion, punctures and ulceration of the mucosa caused by parasites.

In many cases the distention of the cecum produces a kink or twist which partially shuts off the caliber of the appendix, and predisposes to an acute inflammation within it. In the absence of free drainage an increase in the number of the bacteria within takes place,

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and, what is vastly more important, an increase in their virulence. Catarrhal inflammation with, frequently, gangrene and perforation, results. Even though no such acute process ensues, the long continued chronic inflammation produces serious symptoms, and prepares the way for an acute outbreak.

The disease is notably one of youth, largely, no doubt, because of the abundance of lymphoid tissue present. An added factor is found in the congenital structural anomalies, which are likely to produce acute inflammation because of the reasons mentioned. Yet acute cases in the seventh and eighth decades are not excessively rare.

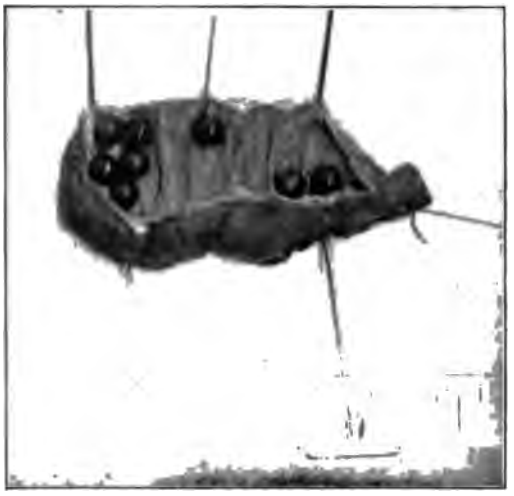

FIG. 73B.—SHOT IN THE APPENDIX. (Hitchings and Sloan, *Jour. Am. Med. Assn.*, April 25, 1914.)

Males are affected somewhat more often than females, 3 or 4 times as often in many tables. The family tendency to the disease, which is undoubted, probably depends upon the inheritance of such anomalies of structure as we have indicated. I have known of 3, 4, and even 5 cases in a family where the pathology was so perfectly definite as to satisfy the most skeptical. Occasionally outbreaks of the disease occur in schools, several cases occurring in close association. This seems most frequently to be due to a coincident influenzal infection.

The association of the disease with indigestion seems attributable to an extension of an acute catarrhal inflammation from the bowel into the appendix, probably in association with some of the features mentioned which favor an intense infection. Occupation seems of relatively slight importance in the etiology, although severe lifting

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and trauma are to be considered. The disease is very common in nurses soon after entering training. Possibly the change to a more active life, with the influence of stooping and lifting, may be operative. I reported 18 operative cases occurring in Denver training schools during a short period. Perhaps relatively more physicians are operated upon than members of any other profession, but chiefly because they recognize the greater safety of early operation as compared with a policy of delay.

Bacteriology.—No one organism is to be regarded as causative, although the B. coli is present in a great majority of cases. The Streptococcus pyogenes is very commonly present in acute and virulent suppurations. The typhoid bacillus, tubercle bacillus, ray fungus, and many other organisms are occasionally present.

Pathology.—McCarty's classification, based upon a study of 5,000 appendices removed at St. Mary's Hospital, Rochester, Minnesota, is probably the best one. He classifies the varieties as follows: (1) *Acute catarrhal appendicitis,* with congestion of the mucosa, infiltration with leukocytes, and inflammation of the lymph follicles and submucosal lymphatic tissues. (2) *Chronic catarrhal appendicitis,* resulting from repeated acute attacks, with increased formation of connective tissue, distortion of the normal structures of the appendix, and deposit of blood pigment in the mucosa. (3) *Purulent appendicitis with necrosis.* Intramural abscess formation, and even complete sloughing are present. Perforation commonly results. (4) *Acute peri-appendicitis.* The peritoneum becomes involved in the extension of the processes mentioned. If recovery ensue the scar tissue found gives rise to a chronic peri-appendicitis. (5) *Obliteration,* the appendicitis obliterans of other authors. In some degree it is present in about one-fourth of the specimens removed. McCarthy found carcinoma in nearly one-half per cent. of the 5,000 appendices upon which he reported, generally in the obliterative type, and often not recognizable macroscopically. If the acute inflammation of the mucosa be associated with such stricture or swelling or both as to cut off the lumen from the cecum, the inflammatory contents may accumulate in such a manner as to fill the entire organ, which may become so tense as to stand erect from the wound. Gangrene of the

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mucosa is commonly present under these conditions. Blood is frequently effused and submucous hemorrhages are the rule. As the gangrenous process extends to the peritoneal coat, a grayish, greenish, or blackish color results. The development of flakes of fibrin precedes this process, and not infrequently pus surrounds an appendix before gross perforation is perceptible. In the most virulent cases no walling off of the inflammation occurs, the perforation being into the free peritoneal cavity. Under more favorable circumstances adhesions between neighboring intestinal coils prevent such general infection. The neighboring ileum and cecum most frequently take part in such walling off of the abscess. General peritonitis results from a rupture of the appendix or the resulting abscess into the free peritoneal cavity. In the chronic form of appendicitis the mechanical changes in the organ may overshadow those of infection. The appendix is very commonly club-shaped or presents stricture in its lumen. Sharp kinks with distal dilatation of the organ are found. In many cases the slow obliterative process mentioned elsewhere has transformed the extremity of the appendix into a fibrous cord, while a chronic inflammation exists in the proximal portion. The twisted, kinked, clubbed, strictured, or atrophied organ is often buried in a mass of adhesions, or is in part subperitoneal. Concretions of various kinds are often present. Ileocecal kink and membranous pericolitis are often found. The pathological changes involved in the frequent complications of appendicitis will be sufficiently considered under the respective headings.

FIG. 74.—CYSTIC APPENDIX. Operation, recovery. (Case of Drs. Bagot and Freeman. Compare with size of silver dollar.)

Acute Appendicitis.—SYMPTOMS.—The attack may be of the fulminant variety, coming on with violent, acute pain, nausea, vomiting, abdominal distension, high fever, rapid pulse, and utter pros-

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tration. In this type perforation may occur even during the first few hours.

The pain is colicky in character and generally first felt in the epigastrium. Later it is more prominent in the region of the affected organ. The retrocecal appendix may produce pain strongly suggestive of renal colic, but distinguishable by the lack of ureteral radiation. This is the type in which pain down the course of the sciatic nerve is frequently present. In women the adhesions which form between the appendix and the right ovary and tube may account for a variety of pain suggesting tubal disease. If recurrence take place adnexal involvement may be suspected from the exaggeration of pain and tenderness at the time of the pelvic congestion which marks the menstrual period.

Nausea and vomiting are practically constant in severe acute appendicitis. The stomach is emptied of its contents, and bile soon appears under the influence of the severe retching. After general peritonitis appears, as after perforation, a black peritonitic type of emesis is often noted. I have occasionally seen small quantities of fresh blood appear with beginning peritoneal involvement. Marked tympanites is the rule.

The temperature may be almost anything from normal up to 105°. In general it is a moderate rather than a high fever. No absolute dependence is to be placed upon the thermometer in estimating the gravity of the attack, since fever may be absent or practically so in intense gangrenous invasion. A sharp fall of temperature may occur after perforation.

The pulse in general offers a much more reliable guide to the true condition of the patient. It is scarcely accelerated in certain acute gangrenous forms of appendicitis, but it is most often increased in frequency up to 90 or 100 or to 120 per minute, with less direct relationship to the temperature curve than in most febrile disorders. Full and bounding at first, it later becomes smaller and harder. After perforation it is commonly wiry, and the blood tension is increased.

The prostration shows no especial features different from those of other severe infections. Loose movements of the bowels are not

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unusual at the onset, but constipation is more often present. If the appendix approaches the urinary bladder retention of the urine is very common because of the peritoneal involvement with the beginning of the appendiceal inflammation. After general peritonitis appears, retention is the rule.

The blood.—A definite increase in the polymorphonuclear leukocytes is the rule, and a white count of 10—30,000 may be expected. A peritonitis of the ordinary grade gives the highest count as a rule. Unfortunately the worst types of general peritonitis may show a falling white count, or even leukopenia. Arnette has mentioned a relative increase of the mononuclear neutrophiles with a low absolute count or even a leukopenia, and it is regarded as significant of a very virulent peritoneal involvement.

Urine.—A few red cells are frequently found in the urine, and a trace of albumin is very commonly present, with a few hyaline and granular casts. Acute nephritis is an occasional complication. The presence of pus from rupture of an abscess into the bladder should be mentioned as a rare complication.

Physical Examination.—Inspection shows more or less immobility of the lower right abdominal quadrant. A flushed face is not uncommon, but later a pale, anxious countenance is the rule. Pallor and profuse sweating may accompany a severe onset.

Palpation shows intense tenderness over the region of the appendix, and frequently a superficial hyperesthesia. The latter may disappear upon the occurrence of perforation. Deep pressure is intolerable. In order to lessen the intra-abdominal tension the right leg is frequently drawn up. Early and marked rigidity appears over the appendiceal region, but not infrequently extending far to the right and even to the left side of the abdomen. The gall-bladder and the right kidney are commonly inaccessible to direct examination because of the extent of this rigidity. This symptom is more dependable than tenderness, which is more subject to exaggeration by neurotic patients. After perforation occurs, general rigidity is present over the whole abdomen, frequently of great intensity. The patient is utterly unable to relax the affected muscles. Percussion is of value chiefly in ascertaining the size of the liver, and possibly dis-

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tention of the stomach with gas, and of the bladder with urine. Pelvic examination by rectum or vagina may be wholly negative, but frequently the intense tenderness of an accessible appendix is of much value in the diagnosis.

PERFORATION.—The danger of this fulminant type lies in the possibility of early gangrene, with perforation before limiting adhesions have had a chance to form. As the diseased tissues weaken, any slight effort, as in vomiting, may produce the rupture. In a surgeon under my care, who had refused early operation, the rupture took place upon his lifting the telephone to answer a call. A pain as violent and sudden as that of a bullet wound in the abdomen is not unusual. Collapse, sweating, fall of temperature and increase of pulse rate quickly follow, and the tenderness and rigidity quickly spread over the abdomen. Vomiting occurs, frequently dark colored from capillary hemorrhage. The pulse becomes more wiry, and retention of the urine, abdominal distention and hiccough occur. If relief be not afforded by operation, general peritonitis with facies hippocratica and death closes the scene, within a day or two, in most cases. If adhesions have limited the process so as to save the general peritoneal cavity from invasion, or if the perforation has occurred in the retrocecal region, or to the outside of the cecum, an abscess may occur, which may be later opened surgically, or may rupture in the most varied localities. Different patients of mine have suffered rupture externally, or into the bowel, bladder, vagina, navel, subphrenic space, and thence into the pleura or through the lung, or downward along the rectum or the psoas muscles to an opening in the ischiorectal space, or even over the region of the ischium. More serious than rupture in most of the regions mentioned is the burrowing upward of a retrocecal abscess until the perinephric tissues are involved, or the region about the liver. In many of these cases septic emboli pass into the liver through the portal vein, and single or multiple abscesses occur, with consequences of the utmost gravity. (*See* Subphrenic Abscess.)

No type of appendicitis is so dangerous to deal with as this retrocecal variety and none more easily overlooked. The abscess may point in the lumbar region. The appendix may be entirely within

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the connective tissue posterior to the cecum, and without any real peritoneal covering. Following the necrotic and ulcerative processes associated with perforation into the bowel, repeated intestinal hemorrhages may take place. I have known the false diagnosis of typhoid fever to be made in this type even after the appendiceal abscess had been drained, from a lack of proper appreciation of the possibility of hemorrhage in appendicitis.

If perforation of the bladder by an appendiceal abscess take place, foul pus is evacuated in considerable quantity, with relief of the abdominal pain and tension. The urine continues to show pus in lesser amount afterwards. A similar evacuation of an abscess through the rectum may lead to prompt healing. If the appendix has come away entirely in the sloughing process, this constitutes the happiest termination of suppurative appendicitis which nature affords.

Ordinary Form.—This comes on much less acutely than the fulminant variety. Pain of less severity, nausea and vomiting of moderate degree, an increase of temperature to 101°–103° a pulse rate of 90–110, with comparatively little prostration are to be expected.

Upon physical examination we may have the same findings noted in the severer forms, but generally in lesser degree. If abstention from food be practiced the attack commonly subsides in the course of five to ten days, leaving little but moderate rigidity and tenderness as the evidences of its occurrence.

In a small proportion of cases, abscess occurs, generally well walled off and indicated by a continuance of the moderate rise of temperature and pulse, leukocytosis, and persistent tenderness in the affected region. Redness and edema may signify the approach of the abscess to the surface, especially to the outer side of the cecum. In many cases not forming abscess a persistent induration may be felt in the abdomen, the result of the infiltration about the inflamed appendix. It may persist for months, with recurrence of the pain, rigidity and tenderness. In rare cases the condition well described as "wooden abscess" is found. The infective process and the resistance to it are so well balanced that neither frank suppuration nor

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healing can occur, and the inflammatory thickening progresses to such a degree that the whole lower right abdominal wall is involved. The tissues are so thickened that the false diagnosis of sarcoma of the wall is occasionally made. Tenderness is not a common feature, but the hard brawny deep infiltration may be well appreciated upon

FIG. 75.—ABSCESS FOLLOWING APPENDICITIS. Bismuth injection. (Dr. G. H. Stover.)

fairly firm palpation. Deep and thorough dissection finally reveals an abscess at the site of the appendix, often so minute as to appear completely out of proportion to the inflammatory mass to which it has given rise. It is a chronic granulomatous process of similar nature that occasionally leads to the diagnosis of inoperable sarcoma

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about the appendix, when the wall of the abdomen is not involved. It is merely a tumor-like growth of inflammatory tissue.

Chronic Appendicitis.—In the great majority of attacks the acute inflammation in the appendix subsides before advancing to gangrene and perforation. The organ remains distorted or strictured, or bound down by adhesions. A chronic congestion of its mucosa persists. Irritation and perhaps ulceration are found as a result of the presence of concretions. The cecum is often distended as a result of the irritative interference with its peristaltic function, and its veins may become dilated and varicose. In many cases a loose kidney upon the right side confuses the situation.

Symptoms.—These are of two classes, those dependent upon the local disease, and those reflected elsewhere from the appendix. In average cases the patient suffers recurring attacks of inflammation of the appendix, the severity varying from a degree sufficient to confine the patient to bed for a week or two to that mild type which causes only a feeling of soreness and some added digestive symptoms. In other cases a dozen attacks may occur in a year, but they are generally less frequent. An exaggeration of chronic constipation is a common manifestation of the attack. In many instances the diagnosis of chronic appendicitis fails because the symptoms so closely mimic the course of some other abdominal affection as to deceive even those of much experience. Amongst these conditions we may describe the following:

(a) The symptomatology resembles that of gastric ulcer. The patient has for even 10 to 30 years sharp hyperacidity, occasionally nausea and vomiting, pain relieved by food, by alkalies, or by diluting the hyperacid contents with water or other fluid. There may be exaggeration of the distress by the use of sweet and starchy foods, tenderness, and possibly rigidity over the epigastrium, accumulation of gas, sour belching, constipation, or other evidences of an acid dyspepsia. After some years the stomach frequently becomes dilated, and food retention is found upon washing out the stomach. Loss of weight, irritability, and nervous instability ensue. Upon operation the stomach is found to be normal excepting for the spasmodic thickening of the pylorus and the consequent gastric dilatation.

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The symptoms have all arisen from the reflex irritation of the pylorus and stomach. These reflex symptoms have so focussed attention upon the gastric features that the patients have, in many instances coming under my observation, been treated for stomach disease for half a life time without any suspicion of the true character of the disease.

(b) The symptoms are those of "nervous dyspepsia" described in detail elsewhere. No feature of this multiform, and of late somewhat discredited affection is wanting if only one investigates a sufficient number of cases. It suffices to state that no diagnosis of any type of nervous dyspepsia can have any standing with the clinician without a very clear statement that no evidence of appendiceal disease was to be found upon skillful examination. It is not necessary that the appendix should show extreme pathological changes to justify the belief that it has been the cause of the trouble. Crile speaks of "the extraordinary improvement in the digestive functions and general health following the removal of the appendix so slightly altered physically that only the clinical results in many cases could persuade one that this change could be an adequate cause for such far-reaching and important symptoms." No truer statement could be presented.

(c) Obstinate constipation, with the "liver spots," "bilious attacks," etc., often associated with this condition, is the chief or even the only complaint. The mechanical interference with the functions of the terminal ileum, the cecum and the colon, with the addition of the interference with peristalsis from irritative spasm, sufficiently accounts for the intestinal inaction. Pyloric spasm with splashing stomach may be present.

In other cases the symptoms are less definite. The patient complains that he does not have his normal vigor, of digestive distress, and of a variety of the symptoms enumerated above, with frequent periods of soreness in the abdomen, but without any very definite clinical picture.

Physical Examination.—The usual findings are tenderness and rigidity in the region of the appendix, naturally more marked at the time of the exacerbations of the disease. The tenderness

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may be very manifest, but may require skill for its demonstration. If not found upon ordinary pressure at McBurney's point, deeper and more constant pressure must be exerted. If the appendix be retrocecal, the pressure is "cushioned" by the distended cecum, and pressure in the loin by the fingers of the other hand may be necessary to elicit tenderness. If the appendix be more centrally placed, the

Fig. 76.—Appendix; Distal and Proximal Portions Contain Bismuth. At operation the lumen was found much narrowed in the middle. (Dr. G. H. Stover.)

tender point may be just below the navel, and the chief complaint may be referred even to the left of the central line. In a considerable percentage of cases the appendix lies so far to the outside of the cecum that the careless examination of McBurney's point shows nothing, while more careful examination above the iliac crest is rewarded by the finding of marked tenderness and rigidity. The rectal or vaginal examination should not be neglected, since the pelvic location

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of the organ is not unusual. In certain cases the appendix points upwards toward the gall-bladder territory.

Rigidity is even more dependable than tenderness in the diagnosis of chronic appendicitis, since it is less subject to those elements of uncertainty so often apparent in examining for pain and tenderness in sensitive patients. The supposedly sound side should be first tested to obtain a standard of comparison. In very nervous or, especially, ticklish individuals patience and tact are requisite. The lightest palpation should be first employed. Even with the first touch upon the skin of the right lower quadrant the navel may be seen to "duck" to the right, the over-irritable transversalis being thrown into contraction. The sign deserves more consideration than it commonly receives. The rectus may show more rigidity than any other part of the abdominal wall. In general the whole right side is affected, and this distribution may be so marked that the sign is of little value in distinguishing between appendiceal, gall-bladder and pyloric affections. If the muscular rigidity be confined, as it frequently is, to the extreme right of the abdomen, it signifies not only that the appendix is probably affected, but that it is retrocecal in location, or that it lies to the right of the cecum. If the right kidney be prolapsed and engorged, it produces muscular rigidity, but the tenderness is found only upon direct pressure upon the organ. Upon the first examination no rigidity may be found, but pressure over the "slumbering" appendix causes it to appear. Thus upon a second examination, by another physician an hour later, the sign may be detected, as I have many times noted. In many cases tenderness over the lymphatic glands to the right of the lumbar spine may be found, as described by Morris. The chronically thickened appendix may be palpable in individuals with thin abdominal walls. In one case at St. Joseph's hospital a cystic appendix was removed of such size that it had been regarded as cancer of the cecum by two or three of the most eminent authorities in the country. It measured 6¾ inches in circumference and 9 inches in length, and weighed 11 ounces.

The "air cushion" phenomenon, due to paretic distension of the cecum is present in many cases. In this type especially we see the

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chronic dark pigmentation of the skin due to continual and almost unconscious efforts of the patient to obtain relief, by pressing over the cecum to dislodge the accumulated gas. The right leg cannot be extended fully without discomfort in certain cases. The rectal examination is of importance, chiefly in those cases in which the appendix hangs downward. Its tip may be distended as by a concretion, and give exquisite tenderness upon digital examination, and even upon the passage of a firm stool, which induces pressure upon

Fig 77.—Shadow Resembling Large Appendix. It is due to a streak of bismuth remaining in the rectum immediately after defecation. (Dr. G. H. Stover.)

it. In women bimanual examination commonly suffices to distinguish between disease of the adnexa and of the appendix, owing to the difference in their location, but if, as is not infrequent, the appendix is adherent in the region of the ovary or tube, the distinction may be impossible. The occurrence of pain, not upon gentle pressure, but upon relief of the pressure over the appendix, is very suggestive of chronic inflammation. In many cases, the pressure over the appendix produces nausea and distress in the epigastrium, rather than at the point of application. Patients with chronic appendicitis occasionally complain bitterly of pain in the hollow of the iliac bone,

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and tenderness may be found there upon examination. Not infrequently there are isolated attacks of right-sided sciatica or long continued and indefinite pain down the course of the nerve mentioned. The explanation, of course, lies in irritation of the roots of the plexus. The retrocecal appendix is more likely to give these symptoms.

Course.—The acute form tends to subside, especially if the intestinal tract be placed at rest, and abstinence from food be observed. The great majority of cases follow such a course. Unfortunately recovery from the attack does not mean recovery from the disease, as other acute attacks follow, or chronic appendicitis, with various digestive symptoms, supervenes. If the process be more virulent, gangrene of the wall occurs, infection spreads to the peritoneal cavity, and in the less severe cases a localized abscess results. This is the result to be hoped for in this variety in the event of suppuration when operation is for any reason impossible. Rest, absence of catharsis, and abstinence from food greatly contribute to this end. In the worst cases, the perforation occurs before walling off is established, and general peritonitis results. In some cases a small abscess is localized at the beginning, but subsequently the adhesions break and the general infection follows.

In the first class mentioned the fever, pain, tenderness and rigidity tend to subside after two or three days, and recovery ensues. The patient is up and about during the second week. Relapse is not infrequent within a few days or weeks.

In local abscess formation the course follows that of ordinary acute appendicitis for the first few days. Then instead of subsidance of the fever and of the symptoms, the fever continues moderately elevated, the pulse rate is suspiciously high, perhaps from 90–100 or 110 as a rule, and pain, and especially tenderness at the region of McBurney's point are notable. Chilliness and vomiting may recur. Leukocytosis is most marked. The induration in the right iliac region is very definite, and pressure with the finger is exquisitely painful if the exact point of suppuration be found.

The local signs may be far to the right when the appendix is placed to the outer side of the cecum, and the right loin may

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present the only definite signs, if it be entirely retrocecal. The abscess may be detected by pelvic examination in other cases. Walling off of the abscess is least likely to occur if the gangrenous appendix lies anteriorly, or to the left of the cecum. If neglected, the abscess may burrow in many different directions, and obscure pocketing of pus presents one of the serious difficulties of the condition. Rupture in various directions has been mentioned. I have known rupture to occur several times upon the anesthetic table as the result of the struggling and consequent increased abdominal tension.

In the third class the local peritonitis which originates at the site of the acute inflammation spreads rapidly, with death as a result after 36 or 48 hours, in too many cases. The avoidance of general peritonitis is one of the chief objects to be attained in the treatment of appendicitis and the possibility of its occurrence is a strong argument for early intervention.

Complications.—The complications and more remote effects of suppurative appendicitis are so numerous and of such grave character in many cases that they deserve extended consideration. I have reported * some of these occurring in a series of 500 cases of appendicitis. These cases were very largely of the serious type and it is not to be inferred that any such number of complications would occur in 500 ordinary cases, receiving early and proper treatment. Amongst the complications the more serious were—extension of the suppuration to the liver, nine times; subphrenic space, eight times; right pleura, once; perforation of the right lung, once; perforation of the pericardium, once; perforation through the stomach, once; into the right kidney, once; through the navel, once; through the bowel, seven times; once involving the transverse colon. Through the bladder the rupture occurred once, through the vagina once, and into the ischiorectal space twice. Pulmonary embolism was noted twice, and right hemiplegia from embolism once. The right thigh was amputated in one case, following long after lung abscess, for embolism of the popliteal artery. Curvature of the spine, concave to the right, I have noted twice, as the result of the contraction about

* *Surgery, Gynæcology and Obstetrics*, October, 1911.

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a lung involvement after perforation of an appendiceal subphrenic abscess upward through the lung. In one case obstruction of the descending colon, from contracting adhesions occurred 30 years after the acute attack, with operation and recovery. Another case was operated upon four times in five years following the original operation for recurring intestinal obstruction due to a general adhesive type of peritonitis. In two cases operation was demanded for relief of a dilated stomach, from distortion of the pylorus by the pull of adhesions from below, and I have recently seen a third case of similar nature. Serious hemorrhage from the gangrenous stump was present in one case, and I have also noted it from the bowel after operation. Postoperative lobar pneumonia occurred ten times. Suppurative pylephlebitis, hemorrhage from ulceration of large vessels, perforation of the appendix into the sac of a hernia, after severe taxis, acute dilatation of the stomach, during the first days after operation, and a great number of other complications of the most varied character may be noted. Suppurative infection of the iliopsoas muscle is occasionally noted, naturally in connection with a retrocecal appendix. Femoral thrombosis is a fairly frequent complication, and is often the source of pulmonary emboli. It occurs as in other conditions more frequently upon the left side. Recurrence of appendiceal abscess after opening of the first one formed, is common. I have known several such attacks, in the same individual, before he would consent to the operation for the removal of the appendiceal stump. Tyrode mentions the frequency of chronic colitis as the explanation of failure of complete recovery of certain operative cases of appendicitis. In one case the extraperitoneal portion of an acutely inflamed appendix was removed by a surgeon of limited experience. In a subsequent attack, so typical that I suspected that a portion of the organ remained, there was removed an inch of the stump which was subperitoneal in location. It is in this type of case that a two or three hours' search is occasionally made without finding the appendix.

Hernia of the wound is not infrequent, especially after drainage. The development of right inguinal hernia, due to weakening of the muscular structure of the right abdomen from severance of

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nerves and muscles is occasionally noted, and I have seen both types of hernia at different times in the same individual. He had had three appendiceal abscesses opened previously. In certain cases the appendix becomes pinched in a peritoneal pouch, so that very sharp recurrent attacks occur. In one such a young woman described her attacks as coming on almost instantly, and the severe pain prevented any movement of the body for a short interval. As soon as possible she got over on her hands and knees, having learned that she soon got relief in this position. We found the chronically inflamed appendix loosely engaged in a peritoneal pouch, in which it had apparently been pinched many times. I have seen other cases more or less resembling it.

Appendicitis With Left-Sided Symptoms.—This is of such comparatively frequent occurrence that the possibility of it must never be overlooked. The explanation may lie in the fact that the appendix is actually in the left abdomen, or the pain or other symptoms may be of the referred type. I have twice found the appendix in the left abdomen from failure of the colon to rotate, the cecum being thus left in or near its original fetal position. In one case the enlarged appendix was felt by pelvic examination just above the position of the left tube, for which it was mistaken. In the other, extensive adhesions, from previous attacks, had bound the appendix down in its lower left abdominal position. The Mayos have reported two instances in connection with six cases of complete transposition of the viscera, which have come to their notice. In five cases of situs inversus which I have seen, congenital heart disease led to the discovery of the abnormality twice, but I have found no appendicitis or other abdominal complication.

There is a much larger group of cases, of which I have seen several, in which the appendix has been attached by adhesions—perhaps congenitally, to the spine, in the center line, or to other tissues there. The complaint of pain, gurgling, tenderness, feeling of obstruction in the bowel in chronic cases, with perceptible and painful passage of gas, are all referred so definitely to the left abdomen, that the thought of appendicitis scarcely occurs to the physician. A brief synopsis of one case will suffice. Mrs. A was seen with her

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physician in another city. For several years she had the usual history of chronic appendicitis, with many acute attacks, excepting that every symptom and sign was reported by her physician to have been upon the left side. She had been confined to bed for a week or two at a time on six or eight occasions, so that there had been abundant opportunity for observation. I thought I could detect fully as much rigidity over the right rectus as over the left. Diverticulitis and other left-sided possibilities were discussed, but both physicians stated unequivocally that the history was similar to that of the ordinary type of appendicitis. My own statement was that in such a case the mere fact that the signs were on the wrong side should not prevent the diagnosis. The condition outlined above was found by a prominent surgeon who had never encountered such a case before. After removing the badly diseased appendix he stated that in his opinion that could not possibly be the cause of the left-sided symptoms, and the entire intestine was drawn out and examined critically, as one might do for an obscure acute obstruction. Not satisfied, he examined the bowel a second time, and the whole abdominal contents as well, and then closed up the abdomen unsatisfied with my statement that he had remedied the trouble. She has remained perfectly well for two years.

I think that pain may perhaps be reflected to the left side in certain cases, when the appendix does not reach toward the center, but the physical signs will prevent error in diagnosis. In differentiating these cases from diverticulitis, the history is of chief importance. The bismuth plate in cases permitting of the necessary delay ought to settle absolutely the location of the cecum and thus of the appendix. The usual findings in transposition of the viscera would suffice in that class of cases.

Appendicitis in Childhood.—Deaver emphasizes the insidious onset, rapid progress and obscure symptomatology. In his 500 cases in childhood, 8 per cent. occurred in the first five years of life, 38 per cent. in the second five years, and 56 per cent. in the third. Males were affected in the proportion of 315 to 185 females.

Deaver expresses his opinion in the epigram, "All cases of abdominal trouble in children are appendicitis until proved otherwise."

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The location of the appendix deep in the pelvis renders the bladder symptoms very common and they should be viewed with suspicion as to the appendix. Pelvic localization is especially frequent and rectal examination of especial importance. In girls salpingitis and gonorrheal peritonitis must be considered.

Pregnancy and appendicitis are not infrequently associated and the danger of abscess formation during the first few days after labor is considerable. I have repeatedly seen this mistaken for puerperal sepsis. The acute attack is doubtless associated with the trauma inflicted by the severe abdominal muscular contractions. If a well-marked acute attack occurs during pregnancy, operation should be recommended before gangrene and perforation with abscess formation and general peritonitis develop. The mortality is so high in the latter type of cases that early operation with the view of avoiding the graver later consequence should be the rule. We have never seen a miscarriage result.

Diagnosis.—The diagnosis of appendicitis is often made by the laity in the characteristic acute cases and frequently missed by the profession for a time in the obscure chronic ones. In acute cases the more or less colicky pain, near the umbilicus at first, but generally localized in the region of the appendix later; the nausea and frequent vomiting; the rise of temperature and pulse rate, generally moderate in degree, and the localized tenderness and rigidity, are sufficiently characteristic. No one of these phenomena is indispensable to the diagnosis. An uneasy feeling may replace the pain, a retrocecal appendix, or one pointing down into the pelvis may give little or no rigidity or tenderness, although this view should not be accepted without a rectal or vaginal examination. A nearly normal temperature and a pulse rate of 60 are occasionally seen when operation shows beginning gangrene of the appendix, while gastric symptoms may be wholly wanting. The tenderness and rigidity may be in the region of the right kidney, the gall-bladder, or entirely on the left side, for a long appendix may be attached to the kidney, gall-bladder, stomach, bladder, uterus, ovary, descending colon or elsewhere. Further the entire cecum and appendix may not very rarely be displaced to the left side. The symptoms of intestinal obstruction may obscure

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those of the primary appendicitis upon which they depend and such confusion is frequent.

The diagnosis depends upon no pathognomonic feature, but must be based upon the general picture, with the vivid realization of its extreme diversity; still it is easy and dependable in the great majority of cases.

The diagnosis in chronic appendicitis is much more difficult. If the examination be made during one of the patient's free intervals it is frequently impossible unless the history is characteristic. We should suspect the appendix, however, in any case presenting digestive trouble of any kind if accompanied at any single examination by pain, tenderness or rigidity at or near the region of the appendix, distension of the cecum with gas, dilatation of the stomach from reflex spasm of the pylorus, recurring attacks of constipation with discomfort in the right iliac region; pain in this locality with each menstruation, often shooting down the posterior aspect of the right thigh; brownish pigmentation over the cecum from continual manipulation of that portion of the abdomen with a view of relieving the discomfort; chloasma of the face in constipated women, often with loss of flesh; attacks of the "blues;" frequent "bilious attacks;" a history of attacks diagnosed as gastric fever, colic, peritonitis, inflammation of the bowels, etc.—any of these should lead to a searching examination for further evidence of chronic appendicitis. As the most frequent offender in the abdomen the appendix must be under suspicion in most cases not presenting clear evidence that the trouble belongs elsewhere. An acute attack may be wholly absent from the history of chronic appendicitis; we should accept no diagnosis of chronic dyspepsia or other digestive trouble without careful consideration of the possibility that the appendix may be the origin of the trouble. A history of being abed a day or two after any acute digestive attack is extremely suggestive, the abdomen being tender after appendicitis, but not notably so after a simple colic or diarrhea.

Bastedo dilates the lower bowel with air, and depends upon the finding of tenderness at McBurney's point as an indication of chronic latent appendicitis. He states that the results have been reliable.

The chronic obliterative type of inflammation is particularly

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prone to give rise to the symptoms of indigestion, and local pain is a prominent feature. The danger of perforation is practically absent so far as the obliterated portion of the appendix is concerned, but not infrequently the proximal end is in a state of chronic or subacute inflammation. In case of fairly acute symptoms the only safe course lies in operation.

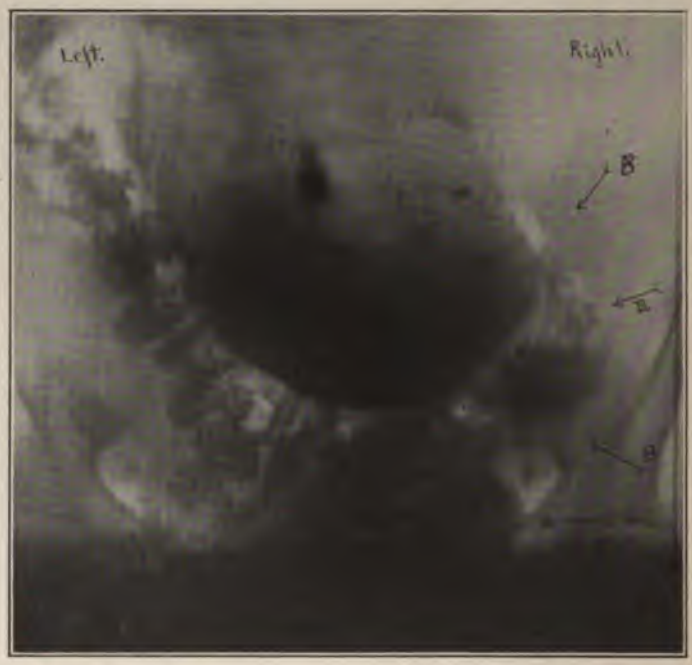

FIG. 78.—A CASE PRESENTING JACKSON'S MEMBRANE. General deformity of cecum indicated by arrows "B"; rolling up and stasis of terminal ileum, indicated by arrow "A." (Dr. G. H. Stover.)

"Chronic appendicitis is attended by spasms of the muscle at the ileo-coecal junction, with consequent delay and accumulation of the opaque food in the terminal ileum.

"Adhesions about the cecum cause local deformities.

"Jackson's membrane causes a general abnormality in form, position and arrangement of cecum and small intestine in the right flank, different from the more localized deformities due to simple adhesions." (Stover.)

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Differential Diagnosis.—This fails more frequently because of the sins of omission in neglecting to consider various possibilities, than because of great inherent difficulties. A thorough and well-ordered physical examination is our only safeguard against the humiliating mistakes which have occurred too often in the past. So long as we err only between affections which demand operative intervention, error is not extremely serious, but it is criminal to recommend operation without taking every precaution to assure ourselves that a definate surgical condition exists.

Pneumonia is frequently mistaken for appendicitis, usually because not looked for. The right lower lobe is of course most often involved in these cases, but I have seen cases in which the right upper lobe and the left lower lobe were affected, and in which the reflected pain led to a plausible diagnosis of appendicitis. I believe the diaphragmatic pleura is always involved in these cases. A central pneumonia of the lower right lobe may exist with no discoverable physical signs in the chest for a day or two, but rarely without cough, expectoration, rapid respiration or other manifestations of its presence, to be given credence even in the face of pain, rigidity and tenderness over the appendix. The diagnosis is rarely long in doubt if we realize the possibility that pneumonia or pleurisy, especially diaphragmatic in type, may cause these symptoms. In many cases the fixation of the diaphragm upon the right side by the peritonitis about the appendix prevents the movement of the lung during respiration and suppressed breathing may be noted at the right base. Slight dulness is not infrequently present, presumably from congestion of similar origin. I have seen the condition many times and Dr. John B. Roberts has called especial attention to it. No case of supposed appendicitis should be subjected to operation without the most critical examination into the condition of the lungs, and especially of the right base.

If one carries in mind the possibility of lead colic, of gastric crises of locomotor ataxia and of visceral manifestations of erythema multiforme, they may be excluded. In every case of chronic appendicitis the pupillary reactions and the knee-jerks should be tested, and the blue line upon the gums sought for. Erythematous, urti-

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carial and purpuric lesions may be found in the last mentioned affection.

Extra-uterine pregnancy, biliary colic, renal colic, Dietl's crises, perinephritic abscess, intermittent hydronephrosis, acute pancreatitis, the pains of gastric and duodenal ulcer, salpingitis, ovarian cyst with twisted pedicle, tuberculosis and actinomycosis of the cecum, psoas abscess and tuberculosis of the mesenteric glands, all present fairly characteristic symptoms.

The latter condition is common enough to suggest a very careful examination for its presence in case the appendix appears but little diseased when the abdomen, especially in the child, is opened.

In obscure cases, after excluding the extra-abdominal troubles mentioned and others that are comparatively easy to dispose of, we finally narrow the field until we have left for consideration, in most cases, the following conditions: appendicitis, gastric ulcer, duodenal ulcer, gall-bladder disease, intestinal obstruction from other causes than appendicitis, typhoid fever, perinephritic abscess, disease of the right ovary and tube, and tuberculosis of the cecum. Amongst these we should state frankly that diagnosis is not always possible, but a high degree of certainty may generally be obtained. Practically every symptom of gastric ulcer may be present, as I have many times noted in chronic appendicitis. Hyperacidity, pain, vomiting, tenderness, rigidity, and finally great dilatation of the stomach led me in one case to the diagnosis of ulcer, in a physician whose history was given me with utmost exactness. A large swollen appendix, thickened from years of chronic inflammation, was found, and the most searching investigation of the gastric walls showed absolutely nothing excepting a pylorus slightly thickened by spasm, and the consequent dilatation. The hematemesis occasionally noted in such cases raises a presumption that ulcer is present, but the rapid restoration to health after years of invalidism leads one to believe that a congested mucous membrane must have been sole cause of the bleeding.

Dilatation of the stomach is a comparatively frequent sequel to the long continued irritation and consequent spasm of the pylorus in chronic appendicitis. I have several times inferred from the

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rather indefinite history that the scar of an ulcer was the cause of a dilated stomach believed to require gastro-enterostomy, but have found in the operating room only the chronic appendicitis as the cause.

Duodenal ulcers are even more difficult to exclude than gastric, since the pain, tenderness, and rigidity are oftentimes in the very region of the appendix, especially when the stomach is dilated. The pain late after eating, frequent sour stomach and vomiting, possibly hematemesis or melena, the greater complaint of gaseous indigestion, and generally the absence of recurring attacks of pain with subsequent soreness in the appendix region suffice for the diagnosis.

From perforation of gastric or duodenal ulcer the diagnosis may commonly be made if attention be given to the previous history, the location of the pain, rigidity and tenderness, and the great severity of the affection with rapid progress, and termination in collapse. In many cases of rupture of a duodenal ulcer the inflammatory process creeps downward along the ascending colon until it involves the cecum, and appendicitis is closely simulated. In case of operation, if the pathology of the appendix does not abundantly account for the abdominal symptoms and signs, the possibility of a perforated duodenal ulcer must be considered, as in a case just operated by Dr. W. B. Craig at St. Luke's Hospital.

The appendix may be attached to the gall-bladder, as I have several times seen. In such a case, as in many others, we must base our diagnosis upon the preponderance of evidence. The pain of gall-stone colic is much more severe than that in the usual case of appendicitis, comes on and ceases more suddenly, generally radiates to the right shoulder or the epigastric space, is oftener accompanied by chilly feelings, but less often by vomiting. Jaundice is fairly conclusive. The resumption of normal health and especially normal digestion almost immediately after the subsidence of the attack, with absence of continued soreness in the right side, are almost positively in favor of gall-stone disease. In one case where the evidence was apparently equally divided, and in which jaundice and retention of urine had occurred during different attacks, it seemed to me that the latter, in an otherwise healthy young man,

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was less likely to be an extraneous accident than the jaundice, which might well be of the ordinary catarrhal variety; appendicitis was diagnosed and proved by operation.

Appendicitis and gall-stone disease frequently co-exist. The inflammatory paresis of the bowel from extension of the inflammation of the appendix oftentimes gives rise to the fear of intestinal obstruction for a time. Excepting in those few cases in which actual mechanical occlusion occurs owing to the presence of bands of adhesions which exaggerate the effects of the paresis, this does not go so far as to produce fecal vomiting. The absence of hernia, of bloody stools, of movable tumor, great loss of weight, glandular involvement, and other characteristic features of different varieties of obstruction, and the presence of the signs of a localized inflammation involving the peritoneum, should suffice for a correct diagnosis in most instances.

The chronic constipation amounting in certain cases to partial obstruction resulting from Lane's kink, from chronic membranous pericolitis, or from contracting adhesions about the appendix, should be mentioned. The differentiation of these conditions is not commonly made before operation. An extension of the signs in the abdomen, well upward, along the ascending colon, suggests the membranous pericolitis mentioned. The diagnosis of a chronic peri-appendicular condition interfering with digestion and the general health is the essential thing, and fortunately this is attainable in practically every case.

It is in a sense begging the question to try to differentiate between appendicitis and typhoid fever, since the only cases in which such differentiation is needed are those in which the appendix is involved in the typhoidal inflammation, and usually in those in which this trouble arises in the first few days of the illness. It is not possible to be always correct in these cases. Thus a girl of eighteen had typhoid with well-marked Widal reaction and other absolutely characteristic features, and two years later, while a sister was suffering from typhoid fever, our patient was suddenly attacked with a sharp pain over the appendix. She was operated, in part upon my advice, on the second day, and we found a sharply inflamed

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appendix. About it was a characteristic typhoid adenitis, and the usual course of the disease followed. It was a case of appendicitis, but due to the presence, as we determined, of typhoid ulcer of the appendix. I have seen several such cases operated upon in the first two or three days of the fever and do not believe a differential diagnosis is possible.

Operation should not be advised without a definite history of pain, nausea and vomiting, followed by the local rigidity and tenderness and by fever, unless under exceptional circumstances. The presence of fever before the other features mentioned raises a presumption against appendicitis. In case of doubt, however, safety lies upon the side of intervention, for perforation of the appendix by a typhoidal ulceration is too common to permit delay if the symptoms be urgent.

Perinephritic abscess may follow previous disease of the urinary tract, but it is not uncommon as the result of extension upward of a periappendiceal abscess. Pus may discharge through the urinary tract. The bulging and tenderness in the region of the kidney suggest the diagnosis and demand exploration. Acute hemorrhagic pancreatitis presents a sharper onset, with more severe and deep-seated pain, higher in the abdomen, and with severe shock. The left-sided dry pleurisy above the splenic region, described elsewhere, may appear in a day or two, and may be of value if the decision has not already been possible.

Disease of the right ovary and tube may simulate appendicitis, but many errors of the opposite nature, attributing true appendiceal symptoms to the ovary and tube, occur for every error of this nature. The history of uterine or tubal disease, especially gonorrhea or septic abortion, the fixation of the uterus upon the right side, the lower situation of the mass, if one be palpable, the menstrual accentuation of the symptoms, and the comparative mildness of the digestive disturbances should generally suffice for the differentiation. The frequent association of chronic appendicitis and right tubal disease must be borne in mind, and the diagnosis of the associated conditions may be made by a consideration of the especial features of each in many cases. It is in these cases that tenderness

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of the right group of lumbar glands is decisive in favor of appendiceal involvement, according to Morris.

Tuberculosis of the cecum resembles subacute or chronic appendicitis after the peritoneum is involved. A larger mass may usually be felt than in chronic appendicitis of a similar degree of severity. I have seen chronic obstruction present before peritoneal effusion developed. A well-marked tuberculous history in many cases is of value. Nevertheless, I have observed a considerable number of cases of ordinary acute appendicitis in patients with well-marked chronic pulmonary tuberculosis, and perhaps an equal number of cases of tuberculosis of the cecum and appendix in apparently healthy people in whom its tuberculous character was not suspected. The presence of miliary tubercles over the peritoneum, which lies over a chronic tuberculous ulceration in the appendix or cecum, may establish the diagnosis at once upon exposure of the parts at operation.

As a result of a chronic appendiceal inflammation of the very mildest degree, and even when no signs nor symptoms of appendicitis exist, a well-defined appendiceal hypochondriacal condition is not infrequent. The subjects are generally young men or women of spare physique, often with a floating right kidney. They have everlasting complaints and fears of trouble in the right iliac fossa. Exquisite tenderness is often spoken of, yet when the patient's attention is drawn away, no tumor, rigidity, nor soreness is to be found. These unfortunate individuals usually find some one to operate upon them. Even after removal of the appendix the obsession may continue. One young woman, when she applied to me, had already five laparotomy scars, but still believed the long-departed appendix the cause of her ill health, and wished to be operated upon once more. I saw her again later with a young surgeon to whom she had applied for operation. It is doubtful in this case if even the first operation was justifiable. In neurotic and hysterical patients, especially females, the diagnosis is extremely difficult at times. It is a safe rule not to operate unless definite signs are present, since the symptomatology may be exactly imitated. Hysterical rigidity and tenderness are present, but even if decided in

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character must be considered carefully. Leukocytosis is of much more significance in this variety of the disease. Serious difficulty is rarely found in case of acute suppurative appendicitis, and in the mild chronic forms immediate diagnosis is not imperative. In case mucous colitis be accompanied with much intestinal pain, it may resemble appendicitis.

Summary of Diagnosis.—In most acute cases there are, in order of occurrence, abdominal pain, at first epigastric, but soon becoming localized to the appendiceal region, vomiting, rigidity, and tenderness. The vomiting is generally present, while increased temperature and pulse rate are less dependable. The occasional absence of fever in the most virulent cases may be very deceptive. Increased pulse rate is less often wanting. Leukocytosis is of much value if present, but in the very cases offering most difficulty it may be absent. It is possible for rigidity to be absent in gangrenous appendicitis, but such an occurrence must be extremely unusual. Difficulty in urination is very suggestive.

Prognosis.—This practically lies entirely in the hands of the practitioner, if he sees the case at the start, since death is of very unusual occurrence if skillful intervention be possible as soon as the diagnosis is clear. The mortality practically all occurs in cases which have been allowed to go on to perforation, abscess formation, or to peritonitis. The outlook in the graver class of complications outlined above is grave. Even though recurring attacks be mild and the danger of acute inflammation with perforation may seem remote, a most virulent attack may occur at any time. The chronic indigestion of the disease is serious enough to make an invalid of the sufferer in many cases, and this must be taken into consideration. The possibility of cancer (22 times in 5,000 cases, McCarty) must be given due weight.

The prognosis in children is excellent if operation be done within the first twenty-four hours, but is serious in suppurative cases. The mortality in the 500 cases was 23, or 4.6 per cent. Theoretically there should be no mortality in operations for chronic appendicitis excepting as accident influences the situation. More than 1,000 cases have been operated upon successively without a

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death from any cause. In acute cases the death rate is extremely low if operated before the development of a general peritonitis—a fraction of 1 per cent. in some series.

In many cases thought to be chronic appendicitis, the condition found at operation is chiefly one of membranous pericolitis. The appendix may be pathologic, but in these cases its removal is not followed by a cure, unless the condition mentioned is taken into account by the surgeon. The condition is believed by various authorities to be congenital (Jackson: *Annals of Surgery*, March, 1913; Mayo, Keiller, and others). Lane regards the membrane as "accessory ligaments formed to antagonize the downward train with tendency to prolapse of these segments of the intestinal tube." By still others the condition is thought to be inflammatory (Gerster, Pilcher).

The typical condition as described by Jackson in his first case "looked like a complete new layer of peritoneum, perfectly transparent, investing the colon from above the cecum into the hepatic flexure." Various degrees and varieties of the condition are now recognized by every abdominal surgeon. The symptoms attributed to the pathological conditions by Jackson are: (1) pain over the right abdomen, from the cecum to the hepatic flexure, often paroxysmal; (2) diffuse tenderness, without rigidity and often with marked superficial hyperesthesia; (3) very obstinate constipation; (4) gaseous distension; (5) mucous diarrhea, alternating with the constipation; (6) gastric disturbances often leading to a diagnosis of chronic gastritis or gastric ulcer; (7) loss of weight and tone; and (8) neurasthenia. Jackson emphasizes the statement that no definite symptoms are found unless the membrane interferes with the intestinal peristalsis. Local stagnation of the bismuth meal in the cecum is found by the use of the bismuth plate, the cecum being often dilated and prolapsed. The signs in Lane's kink are much more sharply local than in pericolitis, but the second condition may be associated.

Stierlin believes * that an abnormally mobile cecum is the cause in many cases of symptoms commonly mistaken for those of chronic

* *Deut. Ztschr. f. Chir.*, 1910.

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appendicitis. Although his claims are not generally recognized, his description of that affection is worthy of consideration.

He bases his extensive study of this subject upon 61 cases upon which Wilms did the operation of cecopexy. Twenty-five per cent. were in males and 75 per cent. in females. Sixty-seven per cent. were between the ages of fifteen and twenty-five years. In most of the cases the diagnosis of a mobile cecum was based upon the following symptoms: (1) Periodic attacks of colicky pain, localized chiefly in the region of the cecum and ascending colon, generally without fever, often associated with long-continued pain in this region, and not rarely in the region of the stomach. The attacks of colic occurred in 86 per cent. of the cases. (2) Chronic, usually severe, constipation, occasionally alternating with brief periods of diarrhea, and particularly at the conclusion of an attack of colic. Severe constipation occurred in 77 per cent. of the cases. (3) In the region of the cecum is a distended tumor, which is distended by gas, and on palpation is soft and gurgling, is painless or somewhat tender, and shows considerable mobility. In all cases the diagnosis was established by the X-rays, which determined the abnormal mobility of the cecum, its size and atony, and the diminished motor function. The permanent results in 43 cases were: 75 per cent. cured, 16 per cent. improved, and 9 per cent. unimproved. In 10 cases of long mobile cecum with the typical symptom-complex, appendectomy without cecopexy gave the following results: 2 cured (with persisting constipation), 3 improved, and 5 unimproved. An abnormally long cecum, in rare cases, kinking and rotation, may lead to severe clinical disturbances. The clinical picture of a mobile cecum develops when, besides a long cecum, there is also a primary or a secondary atony of the colon, or other cause of stoppage in the large intestine, as at the splenic flexure. Atony of the colon or cecum may be congenital, it may be due to a chronic colonic constipation, to an abnormal situation of the colon, or to a combination of these factors. The chronic constipation is most frequently due to a mobile cecum. The colicky attacks of pain and the continued pain in the intervals are due to the pull on the mesentery of the overdistended cecum and, in consequence of the constipation and probably also antiperistalsis, the outward displacement of the cecum. It is probably also due to the effect of the distension on the sensitive nerves in the cecal wall.

Classed heretofore under the general term "adhesions" should be placed certain conditions found at operation but often impossible of diagnosis before operation. Most prominent is the "Lane's kink," so distorting the ileum in its entrance to the cecum as to make serious difficulty in the passage of the contents. The parietocolic fold of Jonnesco arises from the peritoneum at the left side of the

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ascending colon, and passes over its anterior aspect in an upward slanting direction.

The bloodless fold of Treves is described as "passing from the mesenteric border of the appendicular cecum and from the non-mesenteric border of the last part of the ileum to the posterior and lateral abdominal wall" and "forms the anterior wall of a fossa completely closed save below." (Reid.) The appendix may be found in this pocket, as in one of my cases quoted. The symptoms arising from these conditions are not to be distinguished clinically from those of the usual chronic appendicitis, but they are of much surgical interest.

G. DIVERTICULITIS

In the colon, preferably in the sigmoid flexure, less frequently in the descending portion, but occasionally as well in the rectum, diverticula form, commonly near the site of the epiploical appendices. The rectum seems to be less frequently involved than the sigmoid, in part at least because of the fact that "it is protected by firmer surrounding tissues, that the musculature is stronger, that internal pressure from accumulated feces is less constant, and peristalsis less active." (Giffin.)

Etiology.—The origin of the diverticulitis, according to most authorities, is the hernial protrusion of the mucous coat through the muscular and fibrous coats. Stagnation of fecal contents occurs, which eventually sets up an inflammation which may become a peridiverticular process, and an abscess, a chronic infiltrating type of inflammation, perforation into the free cavity, or into the bladder, or other structure to which the diverticulum has become adherent by inflammation or metastatic abscess, may follow. In the chronic type, carcinoma not infrequently develops, with perfectly obvious evidence of its origin from the diverticulitis (5 in 22 cases of sigmoid diverticulitis, Giffin). Diverticulitis, according to this authority, is much less frequent than carcinoma of the sigmoid.

Symptoms.—Giffin found that the time of greatest frequency was between 45 and 60 years. More than twice as many males as

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females were affected. The patients were generally obese, and in an excellent state of nutrition. But little loss of weight was noted. Abdominal pain, often localized in the region indicated, was generally complained of, and pelvic pain not infrequently. Colic was common. The duration was anywhere from 20 days to 12 years. Many months or a year was a common duration. Constipation was generally present; diarrhea was mentioned in a few cases; chronic obstructive symptoms of mild degree were not uncommon, but no acute obstruction was noted. A moderate degree of fever and a moderate polynuclear leukocytosis were frequently present. Passage of gas and feces from the bladder signified perforation of the viscus in one case. A previous appearance and disappearance of a mass in the rectum was once noted. The rectal examination was of little significance excepting in the presence of an inflamed mass, and rectal bleeding was infrequent, contrasting sharply with cancer. Narrowing of the bowel is found in the pathological specimen or post mortem, but it is not easily recognizable during life.

Diagnosis.—In cancer the loss of flesh and the obstructive phenomena are most striking, and bleeding is almost always noted. The most frequent difficulty is the differentiation from left-sided appendicitis, but with the bismuth plate, transposition of the viscera or failure of rotation of the cecum could be detected. The diagnosis is impossible without exploration in many cases. The danger of cancerous degeneration must be borne in mind.

H. MUCOUS COLITIS: MEMBRANOUS COLITIS

Etiology.—This affection is commonly found in neurasthenic young adults, more frequently in the female sex. Hysterical and hypochondriacal manifestations are frequently associated. Mucous colitis, or membranous colitis, as it is called when the mucus forms a membrane, adherent to the surface, and which is passed either as a membranous cast or in shreds, is a secretion neurosis of the bowel, mucus being secreted in much greater quantities than normal. No bacterial agency has been demonstrated. Prolonged constipation is the most common precedent condition, aside from the

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neurasthenia mentioned. The patients are commonly thin and distinctly of a nervous type.

Symptoms.—The main complaint is of the passage of strings or casts of mucus from the bowel. This may occur only with occa-

FIG. 79.—POSTERO-ANTERIOR VIEW OF THE LARGE INTESTINE IN A CASE OF MUCOUS COLITIS. Note the position of the hepatic flexure and the pulling forward and to the right of the proximal part of the transverse colon which overlaps the ascending colon and is fixed in position by a Jackson's membrane. Note also the dilated and distended sigmoid which is attached to the cecum by adhesions —also the double loop in the descending colon proximal to the sigmoid. From a plate made of the ileum the diagnosis of a Lane's kink was also made. All conditions mentioned were verified at operation. (Dr. S. B. Childs.)

sional constipated bowel movements, or the patient may have an attack of mucous colic, especially on rising, in which several stools made up of a small quantity of mucus are passed with griping and

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tenesmus. The attacks are frequently periodical, but generally preceded by obstinate constipation. This may alternate more or less regularly with the mucous colic. The close association of the attacks with emotional upsets should be noted. The physician may have shreds of mucus brought to him on the suspicion that they are intestinal worms. The colic may be of such severity as to lead to the suspicion of some acute abdominal inflammatory lesion. The patient commonly makes the condition still worse by eating only the blandest articles of diet leaving no great residue, thus exaggerating the constipation and in this way the colitis. The dependence of the desire for defecation upon emotional disturbances was well illustrated in one of my patients, a physician, who was always compelled to evacuate the bowel before he could possibly respond to a night call.

Upon examination of the bowel little is found but diffuse tenderness and possibly distension. The colon may be felt as a hard tube, presumably from a spastic condition. Occasionally an especially tender spot may be found, more often on the left, which has seemed to the patient to be the center of the painful manifestations. In some cases the passage of intestinal sand is a prominent feature. In a recent case a beautiful red sand, looking like small garnets under the microscope, was passed in such quantities that the patient noticed it, and large deposits could be obtained by diluting the stool with water and centrifuging it. The patient ate many bananas, a common history in these cases, since the concretions of this type are said to come from the dark streaks found in that fruit.

Certain of the patients gradually lose weight and evidently suffer not only much pain and distress, but a serious nutritional disturbance. The frequency of the false diagnosis of appendicitis should be noted and the error guarded against.

Diagnosis.—This is commonly easy. The important thing is to remember the possibility that the trouble may not be a primary neurosis, but a condition secondary to appendicitis, diverticulitis, stricture of the bowel, etc. With these possibilities in view, a careful physical examination and examination of the stool for blood should be made in any doubtful case.

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Prognosis.—Probably half the cases may be materially improved and some of them practically cured by persistent treatment, but in some the primary neurotic condition is incurable and the complicating colitis persists.*

7. DISEASES OF THE MESENTERY

EMBOLISM AND THROMBOSIS

These are not very infrequent. Embolism is more often found than thrombosis, and the obstruction of the arteries is more frequent than that of the veins. Endocarditis and atheroma are thus commonly preceding conditions. Thrombosis occurs occasionally in cases in which severe enteritis has existed, with opportunity for infection in the vessels. Syphilitic endarteritis is a not uncommon cause. I have seen syphilitic thrombosis of the superior mesenteric artery in a patient already hemiplegic from a similar cerebral condition. Hepatic cirrhosis and septic phlebitis are common causes of venous thrombosis.

Pathology.—The pathology is practically that of infarction, the bowel of the affected region being engorged and black with hemorrhagic extravasation, and a bloody fluid is found in the peritoneum in severe cases. Since the superior mesenteric vessels are the ones commonly involved, the small bowel supplied by them is generally affected.

In the acute cases, in connection with some recognizable cause of embolism, or in cirrhosis of the liver, serious and often neglected appendicitis, or other septic digestive disorder, abdominal symptoms appear suddenly. There are pain, nausea, and vomiting, and generally hemorrhagic diarrhea. Severe backache was a notable feature in one case. The vomiting of blood may be so profuse as to suggest hemorrhage from gastric ulcer, as in one case proved to be dependent upon thrombosis in connection with cirrhosis of the liver.

* Since the above was written one of our cases of 8 years duration, with extreme kinking distortion of the large bowel, has been cured by operation designed to correct the obstruction. (See Figure 79.)

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The superior mesenteric vein was involved. Twice I have seen the signs of intestinal obstruction with no hematemesis nor melena, and this is not infrequently the case. Local tenderness suggests the involvement of the peritoneum, which always eventually occurs. The abdomen is enlarged by the swelling of the intestine, in which a paralytic distension has occurred. A definite abdominal tumor may be suspected, for the mass caused by the infiltrated mesentery and bowel may be felt through the abdominal wall.

The progress is generally rapid and death may ensue during or soon after the first twenty-four hours. In the chronic type the symptoms may be spread over a period of weeks or months, with cramps and constipation, but commonly no symptoms sufficing for a diagnosis. In rare cases the blood in the thrombosed vessels becomes infected, as in septic pylephlebitis, giving the appearance of an abscess within the mesentery. Recovery has occurred in mesenteric thrombosis through the development of a sufficient collateral circulation (Gobiet).

Diagnosis.—Symptoms of obstruction, less sharply defined than usual, and without the history of hernia or previous operation, or gradual failure suggesting cancer of the bowel, and commonly without fecal vomiting, suggest obstruction from mesenteric vascular occlusion. I have been correct in the diagnosis, but have failed in most cases. The only safe plan to follow in this, as in all other acute abdominal affections, is that of opening the abdomen when in doubt in every serious case not so far gone as to be hopeless. As soon as it appears that a grave abdominal lesion exists, immediate surgical consultation should be advised. Most of my cases have been individuals so hopelessly damaged by syphilis, hepatic cirrhosis, and sepsis that operation was out of the question. In one following a violent enteritis from fish-poisoning, in which part of the "embalmed" fish was vomited unchanged on the ninth day after it was eaten, 32 inches of the small bowel were resected, but the patient died of exhaustion. Only in exceptionally favorable cases can recovery be hoped for (four only out of Porter and Quimby's 47 operated cases recovered; eleven out of 67 in Gobiet's series).

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HEMATOMA OF THE MESENTERY

This is rare and when found may be in association with hemorrhage into neighboring structures. It may occur in malignant infections.

CYSTS OF THE MESENTERY, MESOCOLON AND OMENTUM

These may be of hydatid origin. In a case of recognized hydatid disease of the liver the occurrence of round tumors in the abdomen may suggest the diagnosis. I have noted easily recognized multiple cysts in the omentum in hydatid disease. Dermoid cysts are rare in this region. In some cases cysts filled with serous or blood-stained fluid or with chyle have been found, and chylangiomata are occasionally described. Dilated lymph vessels filled with clear fluid have also been reported. In one case a man gave a history of sudden abdominal pain after lifting a heavy piece of machinery. An abdominal tumor immediately appeared, but we could make no definite diagnosis when we saw him some months later. It proved to be a collection of serous fluid of the size of one's head in the layers of the mesentery. Recovery resulted from drainage. It was apparently either a collection of lymph from rupture of a lymph vessel or hematoma with absorption of most of the blood coloring matter.

Diagnosis.—This is not usually possible. The mobility of the tumor is suggestive, and the median location as well. Floating kidney, cyst of floating spleen (Powers), ovarian cyst, and pancreatic cyst may be considered. The exploration of the abdomen is the safest measure.

Torsion of the Omentum.—Seventy cases have been reported. The twist commonly occurs after a portion of the omentum has slid down into a hernial sac. The circulation becomes embarassed and local peritonitis and even gangrene may supervene. Although the onset is acute the patient often recalls vague abdominal discomfort, particularly about the site of a hernia. (W. W. Grant's case recovered with operation.)

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Retroperitoneal cysts may occur, and retroperitoneal hematoma has been found rarely. Cystic dilatation of the urachus has been reported, sometimes connected with the bladder. The cyst is usually adherent to the umbilicus. The common discharge of fluid from the navel at intervals, with redness and irritation of the skin, so common in young women, is not generally associated with cystic dilatation, but with mere patency of the umbilical end of the urachus.

8. INTESTINAL OBSTRUCTION

Intestinal obstruction is defined as interference with the passage of feces by mechanical obstruction. It may be complete or incomplete, acute or chronic.

Etiology.—(a) Causes Within the Bowel.—Foreign bodies of various kinds may be present. A large gall-stone may ulcerate through from the gall-bladder into the adherent small intestine. Occasionally the stone has passed through the common duct by an ulcerating process. The blocking is naturally in the small bowel in most cases. The condition is found in women more frequently than in men, and generally in the sixth or seventh decade.

Foreign bodies swallowed, or concretions which have formed in the stomach—hair balls, bismuth concretions, etc.—or even the Murphy button used in gastro-enterostomy may enter the bowel and cause obstruction. In the intestine masses of round worms or other parasites, fecal concretions or inspissated masses of fecal matter, possibly infiltrated with lime salts, are the usual factors. The accumulation of firm fecal matter about a foreign body may cause a considerable tumor. The accumulation of hardened feces may be so great as to make an easily palpable mass. The explanation of the frequently partial character of the obstruction lies in the fact that the mass may be channelled, and softer fecal matter passes through. If low in the intestinal tract, serious symptoms may be long delayed, perhaps not occurring until a detached hardened mass blocks the lumen.

(b) Causes Without the Bowel.—Pressure upon the bowel may be the cause of obstruction, notably the pressure of pelvic tumors

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upon the rectum. Fibroids and cancer of the womb are not infrequent causes. Even the retroverted uterus may partially obstruct the rectum. Abscesses, tumors, hydatid cysts or other growths may obstruct almost any portion of the intestine.

The different varieties of hernia, especially the internal forms, demand consideration. The ordinary external types are among the most frequent causes of obstruction, but their consideration belongs rather to the surgeon. The physician should always examine the navel, and the inguinal and femoral regions in every case of suspected obstruction, and the possibility of reduction of hernia *en bloc* should be considered.

The bowel may be pinched in a retrocecal pouch, diaphragmatic hernia, a Treitz's hernia, hernia into Douglas' pouch, into the broad ligament, etc. In certain of these varieties the stoppage may be recurrent, relief being obtained by spontaneous reduction a number of times before the final complete and permanent blocking. Diaphragmatic hernia may be congenital or traumatic. Occasionally the bowel protrudes through a slit in the mesentery or omentum and becomes incarcerated. Obstruction from bands of adhesions is becoming increasingly common as abdominal surgery is more extensively employed. Adhesions between neighboring loops of intestine or bowel give opportunity for a loop to become incarcerated. Meckel's diverticulum offers an opportunity for the bowel to slip through a foramen formed by the attachment of its free end to the bowel, mesentery or other structure within the abdomen. The appendix may act in a similar manner. Owing to the more fixed character of the large intestine as compared with the small bowel, it is less frequently involved in this variety of obstruction. As in other forms, the bowel may be in the place of danger for a considerable time, actual obstruction not occurring until accumulation of gas or solid or fluid contents or distension of the vessels with blood as the result of pinching of the gut increases the size of the incarcerated loop and causes the definite incarceration. Strangulation from the iliohypogastric vessels is unusual. Adhesions about a peritonitic or ulcerative process in the abdomen or at the site of a surgical operation frequently so distort or tie down the loop of the bowel as to obstruct it. The drag of such

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adhesions about the site of suppurative appendicitis is not infrequently the cause of obstruction. Certain portions of the bowel are prone to be obstructed by traction-kinks, namely, the last part of the duodenum, the terminal portion of the ileum, and the sigmoid flexure. In many cases the so-called acute dilatation of the stomach is, in fact, caused by obstruction of the duodenum where it crosses beneath the superior mesenteric vessels (gastromesenteric ileus). I have seen chronic partial obstruction from the same cause. Congenital stenosis of the bowel is especially to be found at the lower end of the rectum, but is occasionally present elsewhere. Acquired stricture is a much more common cause of obstruction. It is ordinarily due to the cicatricial contraction following an ulcerative process due to syphilis, tuberculosis, dysentery, typhoid fever, duodenal ulcer, diverticulitis, etc. Stercoral ulcerations in the large bowel are not infrequent causes of obstruction, especially at the hepatic and splenic flexures, and in the cecum and rectum. Volvulus, a rotation or twisting of a segment of the bowel, is an occasional cause. The sigmoid flexure is most frequently involved, the cecal region next and the small bowel less frequently. A mesenteric attachment naturally very lax, or which has become so through the drag resulting from inclusion of the loop affected in a hernial sac, or in old people in connection with chronic constipation, is very frequently of importance in the etiology. In poorly developed, flabby children, volvulus may occur after such exercise as jumping rope, gymnasium practice involving contortions ("skinning the cat"), etc. As in the case of intussusception, beginning tuberculous peritonitis or other pathological conditions of the bowel may predispose to the development of the obstruction. I have seen volvulus of the cecum and ascending colon in association with a subacute appendicitis. Intussusception is common as a cause of acute obstruction, but often escapes consideration as a cause of the chronic variety. In most cases the intussusception comes down from above into the intussuscipiens, but the reverse condition is occasionally found. Many of the intussusceptions found upon the post mortem table are of agonal form, no adhesions having formed. Violent peristalsis, as around an acutely inflamed focus, may result in intussusception, a constriction of the bowel resulting from peristaltic spasm,

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and favoring the entrance of this portion into the normally relaxed segment below.

The region most frequently involved is that of the ileocecal junction, the ileum and the valve being received into the cecum and ascending colon (ileocecal intussusception). Less common is the ileo-

FIG. 80.—CARCINOMA OF THE ASCENDING AND TRANSVERSE COLON. (Area enclosed by arrows.) Note the conical shape of the bismuth shadow in the ascending colon, and the unfilled area in the transverse colon. Verified at operation. (Dr. S. B. Childs.)

colic form in which the ileum prolapses through the valve, and still less common are the forms limited to the colon or ileum. Intussusception is the most frequent form of obstruction in young children.

Obstruction by Tumor of the Bowel.—This is ordinarily the result of malignant disease, although benign tumors may rarely produce it. The gradual growth of a cancer of the colon narrows the caliber of the gut until finally, often without preliminary symptoms,

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the acute obstruction occurs because a firm fecal mass cannot pass the small orifice remaining. Although most frequent after middle age, cancer of the colon with obstruction is not rare in the third decade. Cancer of the mesentery was the cause of the obstruction in two out of fifty-two cases of intestinal obstruction reported by me.* The obstruction in these cases as in those caused by embolism and thrombosis of the mesenteric vessels arises from the paralysis of the musculature of the bowel—paralytic ileus. In various chronic diseases and after abdominal operations a similar intestinal paralysis may develop and become the direct cause of death. A hysterical ileus is described, the essential elements in the diagnosis being the hysterical features and the paralytic type of obstruction. In four cases constrictions and adhesions caused by tuberculous peritonitis were found at operation. Simple fecal impaction without discoverable origin was the cause in one case. Congenital dilatation of the colon was the cause of fecal obstruction in two cases, and similar dilatation of the small bowel in another case. A motor paralysis from overdistension was the final cause in the last three quoted.

Occasionally two distinct causes for obstruction may be found at operation. In one case the acute obstruction was due, as diagnosed, to a band of adhesions about an old chronic appendicitis, while a cancer of the colon produced a partial obstruction below. In another, four partial obstructions of the small bowel existed from contraction about healed tuberculous ulcerations, the case being brought to operation by a band at the site of a previous appendicitis. The tuberculous process had entirely escaped us. Several other more or less similar conditions have come under my observation.

Pathology —The bowel above the point of obstruction is widely distended, but empty below. If a chronic cause has long been operative, as in cancer of the colon, hypertrophy of the muscular walls of the bowel is noted. Acute inflammation, ulceration or gangrene may be present. The distension of the gut is probably the chief factor in the circulatory failure responsible for some of these changes. If the strangulation be fairly complete, gangrene quickly follows. The distended and hyperemic loop of the bowel becomes dark red or

* *Amer. Jour. Med. Sc.*, Nov., 1910.

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purple in color, petechiæ appear, and complete gangrenous destruction takes place. Peritonitis results from the escape of bacteria through the damaged bowel wall. Although at first local, it commonly becomes general unless relief be afforded by operation. In the case of obstruction by foreign body, ulceration occurs and the object may escape into an abscess cavity formed about the site of the obstruction, or into the peritoneal cavity. The obstruction may be relieved by such escape from the bowel, the lumen being restored. In intussusception the neck may become so constricted as to bring about gangrene of the intussuscepted portion, the peritoneal surfaces may unite, and recovery ensues. Stricture may later develop at the site of the healing. Peritonitis is a frequent complication of acute intussusception. In the chronic form obstruction is not complete, and the large tumor may remain for a long period.

In volvulus the blood vessels are generally so constricted as to lead to gangrene if relief be not afforded. The changes in general resemble those seen in the gut incarcerated in a hernial opening—peritonitis, gangrene, and rupture of the bowel.

Symptoms.—The general symptomatology will first be considered and then the peculiarities of the different types.

Pain.—This is the first symptom in a majority of cases of the acute form. It is severe, colicky in character and generally diffused over the abdomen. If the large bowel be involved, it is possible for the patient to localize the pain more definitely, since the bowel is more fixed in its position. It continues, with partial remissions, until the patient obtains relief or becomes too exhausted and septic to notice it acutely. As peritonitis and distension occur, it changes somewhat in character. In chronic obstruction the acute pain of onset is absent. The peristaltic efforts increase in intensity until finally discomfort, colicky pain, or agonizing paroxysmal pain results. Nausea and vomiting are early symptoms of obstruction, even though it be not complete. The close association of these symptoms with the degree of pain, shock, prostration, and collapse suggest that they are often reflex in character. The stomach contents are first evacuated, then greenish bitter matter containing bile, and finally the intestinal contents, after some hours of complete obstruction, with yellow or brown-

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ish vomitus of most offensive character. If the stomach be washed out in a suspected case of obstruction, the offensive odor of the fluid obtained may suggest obstruction before any vomiting has occurred, or at least before it has become offensive in character. If the obstruction be high up, fecal vomiting is absent, but violent retching and early collapse are present. Obstruction lower in the bowel or in the upper portion of the large bowel leads to typical fecal vomiting. If the lower portion of the colon or the sigmoid be affected, absorption of the intestinal contents may be so complete that no vomiting occurs. Hiccough is a common late symptom in severe cases. The obstruction may be so complete that after the bowel below is emptied nothing passes, though in many cases gas in small quantities is evacuated with much pain.

Distension.—This occurs sooner or later in all cases, being an earlier sign in the more acute and a later one in the chronic forms. In certain cases individual loops of bowel may be visible, and violent peristaltic waves may be seen sweeping across the abdomen. The bowel may be felt to harden beneath the hand.

Symptoms of the Acute Form.—In the acute form the constitutional symptoms early become serious. Fever is commonly absent, but the pulse increases greatly in frequency and becomes thin and thready. The anxious pale face, pinched expression, cold sweat, dry tongue, incessant thirst, and collapse indicate the severity of the affection. If the obstruction be high up, the urine is not infrequently practically suppressed, but little fluid being retained, and absorption being greatly interfered with. Blocking low in the colon may merely cause a moderate decrease in quantity of urine. Albumin may be present and indican increased. In severe cases a local inflammation is accompanied by marked leukocytosis.

Symptoms of the Chronic Form.—In the chronic form, the symptoms are rather those of obstinate constipation, and constitutional symptoms may be absent for weeks after the obstipation is established. It may be even a month before fecal vomiting occurs. In cancer of the colon the symptoms may be practically latent, the patient supposing that he suffers only from severe constipation. With increasing obstruction from the growth, more and more diffi-

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culty is felt in obtaining a movement, and finally acute obstruction occurs. The colicky pain may then be very severe, and the case may assume the characteristics of the acute form. The accumulation of inspissated fecal matter above the cancerous or other stricture may be mistaken for a large malignant growth.

The site of the intestinal obstruction may oftentimes be quite accurately localized. If the occlusion be in the first part of the

FIG. 81.—CLYSMA ARRESTED BY ORGANIC OBSTRUCTION. (Dr. G. H. Stover.)

duodenum, the symptoms are practically those of pyloric obstruction —loss of weight with retention of food, fermentation and periodic emptying by emesis. At the region of the orifice of the common duct the cause of the obstruction commonly produces persistent jaundice from compression of the papilla. Attacks of biliary colic are common. If the obstruction be below the biliary papilla, bile regurgitates into the stomach and is vomited. If the obstruction be complete, fecal vomiting does not occur. If the duodenal obstruction be

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chronic and incomplete, the symptoms in general resemble those of pyloric stenosis, but with attacks of pain distinctly intestinal in type. Obstruction in the small bowel below the duodenum gives less and less suggestion of gastric symptoms according as it is farther from the pylorus. The decomposition of the food remnants, imperfectly digested in the stomach, gives rise to an offensive vomitus, but for

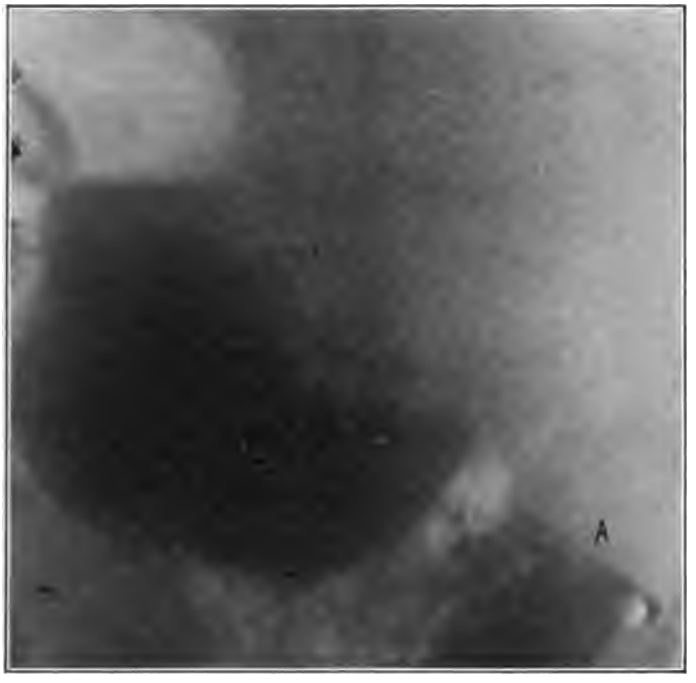

FIG. 82.—POSTERO-ANTERIOR VIEW OF DEFORMITY OF CECUM, CAUSED BY STRAP-LIKE FIBROUS BAND REACHING FROM "A" DIAGONALLY DOWN AND ACROSS PELVIS TO OPPOSITE GROIN. Röntgenologically diagnosed chronic appendicitis (with absence of clinical signs). Confirmed by operation. (Dr. G. H. Stover.)

the production of true fecal vomiting the obstruction must be well down in the ileum or below it. Tympanites is marked in this case and perhaps distinguishable in the affected loop of the gut (Wahl's sign). Palpable peristaltic waves and hardening of the wall of the bowel under the hand are to be noted. In obstruction of the upper part of the small intestine the loops of the empty bowel sink into the

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pelvis and may be detected by palpation in certain cases. A rectal examination is imperative.

Partial obstruction is not uncommon in the ileocecal region from the distortion of the small bowel as it enters the cecum (Lane's kink). The mesentery becomes thickened and the ileum in its terminal few inches is angulated and distorted. Prolapse of the cecum and colon are often present. The distortion of the affected parts

FIG. 83.—ORGANIC OBSTRUCTION OF THE SIGMOID. Food held here 128 hours. (Dr. G. H. Stover.)

has sufficed for the probable diagnosis by means of the bismuth plate in certain of my cases.

If the cecum or ascending colon be the seat of chronic obstruction, a fecal tumor is to be felt in the right side of the abdomen and the frequently cancerous or tuberculous tumor causing the obstruction may be distinguished. If low in the large bowel, peristaltic movements are not sufficiently violent to be painful unless the obstruction becomes suddenly complete. In general obstruction of the small bowel causes distension of the center of the abdomen rather than at the sides, above if the obstruction be high, and below if it

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be near the ileocecal valve. In the child mentioned as dying from chronic obstruction with enormous congenital dilatation of the small bowel, a "ladder" of three steps was visible in the central part of the abdomen.

If the large bowel be blocked the accumulation of gas is in the portion above the occlusion. The colon may offer the "horse shoe" type of distension if the blocking be in the sigmoid. Tapelike stools are significant of cancerous or other stricture in the rectum. Early occurrence of fecal vomiting suggests an obstruction high up, as does anuria. Great distension, slow course, and tenesmus signify that the blocking is below the cecum.

Special Symptoms of Different Varieties of Obstruction.—In volvulus the blocking is often sudden, vomiting occurring even in a few minutes, and fever may be present. But little fluid can be injected into the rectum if the sigmoid be involved, as is so often the case. Volvulus and some type of internal hernia are especially to be considered if obstruction follow violent exercise. The twisting of the gut in a hernial sac is occasionally noted. In aged individuals who have suffered from obstinate constipation, volvulus is to be considered before other causes if obstruction should arise. Spasokukozky believes that the empty intestine of partial starvation is especially prone to volvulus. The condition is not common and the diagnosis is not often made before operation.

Diagnosis.—Intussusception.—The occurrence of obstruction in childhood suggests the diagnosis. The tumor, perhaps curved in form because of the deformity arising from the pull of the invaginated mesentery, the early vomiting, the bloody mucous discharge from the bowel, and the tenesmus are distinctive. I have seen the invaginated loop project from the anus and it may slough off and pass in the stool. The hemorrhage from the bowel may appear even in the first hour and before the vomiting, as in a recent case of ileocecal intussusception. The intussusception may not infrequently be detected by rectal examination. The importance of this procedure in every case of intestinal obstruction cannot be too strongly insisted upon. Fecal vomiting is less frequent than in other types of acute obstruction. Sudden recovery, especially after rectal in-

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jection, suggests intussusception as the cause of the occlusion. Goodall has collected a series of cases of chronic intussusception, characterized by digestive symptoms, thirst, early and progressive exhaustion, pain, insomnia, chills, emaciation, distension and palpable tumor, or even two separate tumors, due to different invaginations. The symptoms are oftentimes intermittent in character.

Repeated attacks of obstruction with sudden relief suggest the possibility of some variety of internal hernial opening into which a loop of intestine, oftentimes the same one, may occasionally slip, and become partially incarcerated. We found the duodenum incarcerated in a Treitz's hernia in one of my cases, and the symptoms offered every evidence that it had been repeatedly caught there, with spontaneous relief. If the patient has undergone an abdominal section, the possibility of obstruction from a band or loop will be suggested. Overt tuberculosis with slowly developing symptoms followed by obstruction suggests that tuberculous peritonitis is the cause.

Obstruction from mesenteric thrombosis is characterized by a slow development, with lack of sharp symptomatology. In the absence of features of other types of obstruction, and in the presence of signs of hepatic cirrhosis, syphilis, arteriosclerosis, source of possible embolus or thrombosis, with bloody vomitus or stools, involvement of the mesenteric vessels should be considered. The occasional severe pain in the back has been mentioned. History of chronic gall-bladder disease might suggest the possibility of obstruction from a gall-stone, but in few of the recorded cases had the presence of the stone been suspected. In chronic fecal obstruction the masses of fecal matter may commonly be felt by the rectum and through the abdomen, and the history of the case is convincing. In acute pancreatitis, acute appendiceal and tubal infection, the peritonitis may bring about such a degree of obstipation as to lead to the belief that a mechanical obstruction exists. The fever, local tenderness and rigidity, the violence of the symptoms, peritonitic countenance and pulse, and possibly the history of previous attacks, are commonly decisive. Fecal vomiting is very unusual. Absence of peristalsis is a common feature.

The insidious character of the obstruction resulting from cancer

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of the colon, even in young adults, should be mentioned. The actual obstruction may be the first symptom.

Summary of Diagnosis.—The essential features in acute obstruction are pain, obstipation, vomiting becoming fecal in character, distension, absence of fever, rising pulse rate and rapid progress toward collapse. Clubbe lays great stress upon sudden, paroxysmal, colicky pain in the abdomen with drawing up of the legs and vomiting, in the diagnosis of intussusception, for delay until the typical signs of intestinal obstruction appear renders operation almost hopeless. In chronic obstruction the picture is less sharp, but increased difficulty in obtaining a fecal movement, colicky pain, tumor, perhaps fecal in character, intermitting attacks of diarrhea in certain cases, with slow development or absence of vomiting, and especially of fecal vomiting, are to be noted.

The bismuth plate is of much value in certain cases, as of kinking of the ileum at the cecum, or sagging and angulation of the colon. Stover and Pfahler especially have shown the distortion of the bowel with symptoms of mild partial obstruction, caused by adhesions about the gall-bladder and pylorus.

Prognosis.—In complete obstruction unoperated, death occurs in from a few hours to a few days, generally several days. Recovery may occur through spontaneous cure of the condition in certain varieties, as in intestinal hernia and intussusception. Clubbe lost but four out of fifty cases of intussusception operated, evidently because the cases are seen early. If the patient's condition be sufficiently favorable to justify abdominal exploration, it should be done as soon as the diagnosis of complete obstruction is made, and in case of partial obstruction, if the severity of the symptoms warrants it. The conditions which should guide us in making the decision relate to the degree of the obstruction, the frequency, and the general character of the pulse, degree of exhaustion, character, and severity of the vomiting, distension of the abdomen, the degree of cyanosis, the character of the surgical assistance available, and the facilities for operation. Early diagnosis and early operation are the most important factors in lowering the mortality rate.

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9. DISEASES OF THE PERITONEUM

A. ACUTE GENERAL PERITONITIS

The acute inflammation of the peritoneum may be (1) circumscribed, the cause producing a local effect only, and the inflammation spreading but moderately; or (2) diffuse or general, the whole peritoneal cavity becoming involved. The latter is the type commonly seen after flooding of the peritoneum with the gastric or intestinal contents which escape through a perforation. The former is typically seen in those cases in which the peritoneum is irritated by some inflammatory process within one of the viscera, but in which complete perforation is wanting, or occurs only after the inflammation has been circumscribed by adhesions.

Etiology.—Peritonitis may be idiopathic or secondary, the latter being very much more frequently met with. Primary peritonitis is to be regarded as of infectious origin, the variety arising after cold and exposure, and known as rheumatic, being probably always infectious. The infection reaches the peritoneum through the lymph or blood vessels and this fact implies a focus of infection elsewhere. The pneumococcic variety may complicate pneumonia, and the so-called rheumatic variety may be found in association with rheumatism, although as yet no agreement has been reached as to the character of the infectious agent. It is necessary to exclude even the minutest focus of suppuration before deciding upon the primary nature of a case of peritonitis. In the great majority of cases the peritonitis is secondary to some local process within the abdomen, the appendix being the most frequent seat of the causative inflammation. In young women inflammatory processes connected especially with the fallopian tubes, and to a less extent with the ovaries and the womb, are an extremely frequent source of peritonitis. Next to these two chief causes should be placed complete perforation of peptic ulcer, of the bowel, gall-bladder, abscess of the liver, of the pancreas, etc. Perforating wounds from without are not infrequently noted as the cause. Included under this head are the not unusual cases of perforation of the uterus by a sound or other instrument.

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Bacteriology.—The B. coli is found in a very large proportion of cases of peritonitis, but is not regarded as the most active agent of infection in all of them. The streptococcus, staphylococcus, B. pyocyaneus, the gonococcus, the typhoid bacillus, and various other organisms are frequently present, with or without the colon bacillus. The pneumococcus is less frequently found than in the primary type, but is not rare in perforation of the stomach and bowel. It is especially found in cases affecting children, particularly girls. The role of the tubercle bacillus in peritonitis is discussed elsewhere. In general, the severe types of general peritonitis are due to the streptococcus and the B. pyocyaneus, the former being the usual agent in the severe forms associated with puerperal infection and perforation of the appendix.

Pathology.—If the peritonitis be localized the omentum is frequently found adherent over the seat of the inflammation. The coils of the intestine are distended with gas because of the interference with peristalsis, and the loops are glued together with exudate in the affected region. Here may be seen the dilatation of the blood vessels of the peritoneum characteristic of the violent inflammation. The visceral peritoneum is more affected than the parietal layer. Yellowish masses of fibrin are present, and in the case of a well-localized peritonitis it is to the presence of this fibrin that the adhesions of neighboring intestinal loops and the consequent walling off of the inflammation are due. A sero-fibrinous fluid, sometimes frankly purulent, is found free in the peritoneal cavity, and in this may be found substances indicating the place of perforation which has caused the peritonitis, as partially digested food, bile, pus from a liver abscess, gall-stones, etc. Perforation of a cancerous growth, especially one of the hollow viscera, gives rise to a putrid, greenish exudate, while a reddish color may indicate a hemorrhagic variety. Free gas in the peritoneal cavity suggests the presence of the B. aërogenes capsulatus, if no perforative lesion be present to account for it. The pus is generally found in the pelvis post mortem, but may be encapsulated. Local abscesses are not uncommon and may be found in any region of the abdomen.

Symptoms.—These vary widely in accordance with the character

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of the attack. If the appendix becomes gangrenous rapidly and suddenly perforates, the onset is extremely sudden and severe, while a localized peritonitis about an inflamed tube or a deep ulceration in the stomach or intestinal wall, gives rise at first to little beyond localized pain and tenderness.

In the former type the pain is sudden and agonizing, localized more or less accurately in accordance with the place of the lesion in some cases, but generally diffuse through the abdomen. The patient often mentions the feeling that something has burst in the abdomen. Chill and collapse are not unusual, and vomiting is generally noted. The abdomen soon becomes distended in most cases, and excessively tender, the thighs are drawn up to relieve the abdominal tension, the respiration becomes thoracic in type, and every effort is made to avoid any movement of the abdominal muscles. The rigidity of these muscles becomes so pronounced in muscular individuals that even in the absence of many of the leading symptoms the diagnosis may be suggested by it. In perforation of ulcer of the stomach and duodenum I believe it is earlier and more pronounced than in any other condition. Rigidity may be absent in peritonitis, especially in women with flaccid abdominal walls. It disappears under complete anesthesia.

Hiccough frequently occurs, perhaps between the attacks of vomiting. The temperature is generally depressed at first, but later rises in most instances. In typhoid fever the initial shock may induce a subnormal temperature. Rarely the fever reaches 103° or 104°, generally in patients of good resisting powers. In general the thermometric record is of little value in the diagnosis or prognosis of peritonitis.

The respiratory movements are increased, and are notably shallow, because of the non-participation of the diaphragm in the function.

The vomitus is at first the contents of the stomach, followed by bile-stained fluid, and finally by the contents of the upper bowel. It is not infrequently dark in color from admixture of blood from capillary hemorrhage into the stomach. A faint fecal odor may be present. The pulse is rapid and thready, and of increased tension

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in the earlier stages, but later running and eventually imperceptible. Thirst, dry tongue, cold sweat, and, finally, facies Hippocratica and death are features of the severer type.

The pain may indicate something of the location of the point of origin of the peritoneal inflammation, as when it is felt at McBurney's point in appendicitis, or at the epigastrium in perforation of a gastric ulcer. Yet the pain may be of the variety typical of appendicitis in perforation of a gastric ulcer. It is not to be depended upon too closely in the diagnosis of the point of origin. General tenderness over the abdomen is commonly present and often most marked in the especial areas corresponding to the viscus chiefly affected. The tenderness and muscular rigidity are notably more marked in appendicitis if the organ lie anteriorly than if it be retrocecal in location, because of the involvement of the parietal peritoneum in the former case.

Because of the intestinal paresis and the decomposition of the intestinal contents gas accumulates, the diaphragm with the heart is elevated, and the liver is pushed upward in such a way as to lessen the area in contact with the abdominal wall. Thus a change in the hepatic area of dulness by no means signifies free gas in the peritoneal cavity. Early in the disease the friction rub caused by movement of the inflamed coils of intestine over each other may be heard, but this sound, and even the ordinary gurgling of the bowel, is suppressed as the process advances. The bowels become constipated as the result of the absence of peristalsis in the majority of cases, but diarrhea is an occasional occurrence, especially in pneumococcic peritonitis. A polynuclear leukocytosis is commonly present, but may be wanting in fulminating cases. The urine commonly shows an increase in indican, and may contain micro-organisms suggestive of the bacterial cause of the peritonitis. In local peritonitis in the lower abdomen retention of urine is common. If the patient survive long enough, fluid appears in the flanks. In perforation of the intestinal tract with escape of gas the changing areas of resonance and dulness upon changing the position of the patient may be demonstrated. The free gas may entirely obliterate the liver dulness anteriorly. In the perforative peritonitis of typhoid pain may be manifested in so slight

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a degree because of the stupor present as to fail to attract attention, but the physical examination is commonly decisive.

Palpation determines the rigidity of the abdominal wall in average cases, and extreme tenderness in certain areas, as over the appendix, in inflammation of that organ. The general distention is demonstrable by percussion, and the presence of fluid or gas in certain cases. The rectal examination or the vaginal examination in

FIG. 84.—POSTERO-ANTERIOR VIEW OF STOMACH AND JEJUNUM IN CASE OF TUBERCULOUS PERITONITIS. Röntgenographic diagnosis proved by operation. (Dr. G. H. Stover.)

women gives much evidence as to the local condition in the pelvis and lower abdomen, and should not be neglected.

Course.—The severer infections are often fatal within two days, while in milder ones the course may extend over a week or more. The perforative varieties in general are of great severity and short duration. Gonococcal peritonitis is generally of rather feeble virulence, although the onset may be sharp and sudden. Puerperal peritonitis is noted for its extreme gravity. Rheumatic peritonitis is stated to be somewhat amenable to the usual antirheumatic therapy, and is of fairly good prognosis.

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Diagnosis.—In typical cases this ordinarily offers no difficulties, the sudden onset, with pain, tenderness, distention, rigidity, rapid pulse, vomiting, constipation, fever, leukocytosis, and effusion in many cases, being characteristic. In many instances the presence of a well-recognized lesion, such as chronic appendicitis, gastric ulcer, pus-tube, etc., may suggest the diagnosis. The preponderance of cases due to appendicitis, inflammation of the pelvic organs, and peptic ulcer suggests careful inquiry as to symptoms pointing toward these affections. In many cases, however, the peritonitis is secondary to other trouble, as in cases of intestinal obstruction, liver abscess, etc. Peritoneal irritation or a mild peritonitis may supervene upon the twisting of the pedicle of an ovarian cyst, or a floating spleen, or upon thrombosis of the mesenteric vessels, or the portal vein, or rupture of a tubal pregnancy. I have twice known death to occur with many of the signs and symptoms of peritonitis as the result of bleeding from the free end of the tube at the menstrual period, in the absence of pregnancy. The severe abdominal symptoms of acute hemorrhagic pancreatitis are very suggestive of peritonitis. Localized areas of tenderness from fat necrosis may be found upon examination of the abdomen or the whitish patches upon the peritoneum may be discovered at operation.

The reflex pain and rigidity in the abdomen resulting from acute disease in the chest, most commonly acute pneumonia with diaphragmatic pleurisy, often suggest an acute peritonitis, and the abdomen has been repeatedly opened under these conditions. On the other hand, a perforative peritonitis of the upper abdominal region may extend to the lesser peritoneal cavity, set up an inflammation of the diaphragmatic pleura by extension through the diaphragm, and give rise to a pleural friction rub just above the splenic region. Such a finding is of much value in case of doubt as to the character of an acute abdominal disease.

Hysterical peritonitis is to be distinguished by the earmarks of the disease of which it is a manifestation, but it is often extremely difficult of recognition. The differential diagnosis from intestinal colic, renal colic, lead colic, and the attacks resembling peritonitis, noted occasionally in uremia, Addison's disease, and pernicious ane-

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mia, should take into account, first, the possibility of the existence of any of the conditions mentioned; and, secondly, their characteristic features.

Localized Peritonitis

This variety commonly occurs about some organ in the abdomen especially subject to acute inflammation. The female genitalia, the appendix, the stomach and duodenum, and the gall-bladder are the most frequently affected organs, though local peritonitis may be found in association with infarction, tuberculosis, or cancer of any of the abdominal organs, about acutely inflamed mesenteric glands, diverticulitis, or other localized abdominal disease.

The peritoneal inflammation may be non-suppurative, but the suppurative forms are much more frequently met with. A very common variety is that seen in association with gonorrhea in the female, the tubes becoming inflamed and frequently leaking their infectious contents through the fimbriated extremity and setting up an acute inflammation in that region. Tube, ovary, and adjacent parts become matted together and abscess may form. The extension of the process on the right may involve the appendix as well. The tube may become so distended with pus as to be scarcely recognizable. Other infections may produce similar results. A slowly developing type is due to the tubercle bacillus, and the tubal involvement may not be recognized until the presence of general tuberculous peritonitis leads to operation.

The most common of all forms of localized peritonitis is that seen about the appendix. It may be mild and chronic, in case of tuberculosis of this organ, but it is commonly the acute type due to suppuration and extension of the inflammation to the surrounding peritoneum. An abscess about the appendix results and may be in almost any location in the abdomen, since the appendix is so variable in position. The subject will be more fully considered under appendicitis. The especial tendency of the retrocecal abscess to give rise to subphrenic abscess should be noted. Localized abscesses are an especial feature of pneumococcic peritonitis.

Perigastric abscess, the result of perforation into the peritoneal

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cavity of ulcer or cancer of the stomach, and localized peritonitis about the gall-bladder, will be described elsewhere.

The most important and gravest variety of localized peritonitis is that of the subphrenic region, commonly leading to subphrenic abscess. The infection may occasionally come from above the diaphragm, commonly from empyema or abscess of the lung. The great majority, however, are of abdominal origin. In the order of frequency the appendix must be placed first as to causation, while liver abscess, peptic ulcer, pancreatic disease, and various other infectious processes connected with the colon, spleen, portal vein, etc., follow. The suspensory ligament of the liver separates the sub-diaphragmatic space into right and left divisions, and these are further subdivided by the arrangement of the ligaments into anterior and posterior divisions. In addition, Barnard described the right and left extraperitoneal locations, and the subphrenic abscess may affect any one of the regions described. Because of the predominance of the appendix and the right lobe of the liver in the causation of subphrenic abscesses, those upon the right are much more frequently met with than those upon the left. In general it may be stated that abscesses are not commonly sharply confined to the more or less arbitrary divisions mentioned. Many of the serious forms affect the lesser peritoneum, for with this cavity may communicate suppurative processes originating in the gall-bladder and pancreas, and ulcerative lesions of the stomach and duodenum. Inflammatory closure of the foramen of Winslow may confine the abscess to this cavity. Appendiceal suppuration may induce subphrenic abscess by creeping up behind the ascending colon, reaching the right pouch, whence originates a right posterior intraperitoneal subphrenic abscess. If the suppuration be retroperitoneal it may lead to a right-sided extrahepatic subphrenic abscess. If the infection spread upward from an appendiceal abscess in the pelvis along the paracolic grooves, the resulting subphrenic suppuration may be bilateral. If the portal vein become infected, embolism into the liver may result in abscess, which not infrequently ruptures into the subphrenic space over the dome of the liver. This type may rupture upward through the diaphragm, leading to empyema or to perforation of the lung, perhaps in certain cases without

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diffuse subphrenic suppuration. Suppurative processes in the liver tend to rupture into the subphrenic space more frequently upon the right because of the more frequent involvement of the right lobe. The abscess pushes up the diaphragm on the affected side, and in many cases cannot be distinguished, before aspiration, from an ordinary empyema. I have seen perforation of the diaphragm so that pus existed both above and below it in several instances.

FIG. 85.—POSTERO-ANTERIOR VIEW OF SUBDIAPHRAGMATIC ABSCESS COMMUNICATING WITH BRONCHUS. Arrow points to shadow of fluid at the angle. (Dr. G. H. Stover.)

Perforative gastric lesions, ulcer much more frequently than cancer, give rise to subphrenic abscess, commonly bounded below by the left lobe of the liver, the stomach, and spleen. Ulcer of the duodenum upon perforation commonly gives rise to infection of the general peritoneal cavity, but not infrequently subphrenic abscess of the right kidney pouch variety, or a right retroperitoneal subphrenic abscess results.

Suppuration about the kidney, pelvic abscess, abscess of the spleen, pericolic abscess, traumatic injury to the abdominal viscera, ulcera-

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tive processes in the esophagus and the mediastinum, and other conditions may be occasional causes of subphrenic abscesses.

Pyopneumothorax Subphrenicus

In this affection air or gas is present in the abscess cavity. It occurs in over half of the cases from perforation of gastric ulcer, according to Osler, from the appendix in 10 per cent., duodenal ulcer in 6 per cent., and from the various other causes of subphrenic abscess in the remainder. Perforation of a suppurative process from above the diaphragm is an occasional cause.

Bacteriology.—The colon bacillus is generally present in subphrenic abscess and the streptococcus, staphylococcus, pneumococcus, and B. pyocyaneus are frequently found. The ray-fungus has been reported.

Symptoms.—These are commonly superadded to those of the gastric ulcer, appendicitis, hepatic, or pancreatic disease, etc., to which the subphrenic abscess is secondary. In the case of a perforative lesion the onset is sudden, with violent pain, vomiting, and the usual symptoms of general peritonitis heretofore described. In the more common type in which the abscess develops as a result of an infection traveling slowly by vascular channels or by contiguity, no definite time of origin can be stated. Following an operation for suppurative appendicitis or cholecystitis, or during the course of one of the other types of abdominal disease mentioned, irregular fever is noted, perhaps a week or two after the operation or the onset of the primary disease. It is only too frequently the case that the patient is treated for typhoid or other continued fever, since localizing signs of the process are inconspicuous in many instances. The continued fever, broken by irregular chills in some cases, the sweats, dyspnea, leukocytosis, and generally unsatisfactory condition, lead to the examination of the abdomen, but little may be found here. Tenderness and deep soreness may be present in the lower chest, and I have seen several times, in neglected cases, bulging, redness, and edema of the chest wall over the abscess, as in empyema. The motion of the diaphragm is practically abolished upon the affected side. The liver

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is often pushed downward if the right side be affected. In the back the pushing upward of the diaphragm suggests a pleural effusion, or the subphrenic abscess may have perforated and caused empyema, or may have set up an effusion, either serous or purulent, without gross perforation. The possibility of pleural involvement demands the most careful consideration. I have seen left-sided empyema follow subphrenic abscess, due to suppurative cholecystitis, in the course of typhoid fever, the invasion being by way of the lesser peritoneal cavity.

Almost any combination of signs and symptoms may be present in obscure cases. The liver may be pushed downward, and tenderness and muscular rigidity are often present beneath the costal border. The X-ray demonstrates the shadow of the purulent effusion, the displacement of the liver and the arching upward of the diaphragm with marked immobility in respiration. An increased area of dulness is noted, either behind, as mentioned, often arched upward, or in front, due to the effusion above the liver, and the displacement of this organ downward. Upon auscultation the usual breath sounds are heard above, with suppressed respiration over the effusion and the region of the compressed lung. Pleural friction is not uncommon. Splashing in pyopneumothorax subphrenicus is much less frequent than in the usual supradiaphragmatic type.

In a considerable number of cases the abscess bursts through the diaphragm with resulting empyema, or breaks through the lung into a bronchus with coughing up of pus, giving generally the characteristic colon bacillus odor. The "anchovy sauce" pus of amebic abscess of the liver is easily recognized, and the amebæ may commonly be demonstrated. In spite of the infrequency of the recognition of perforation of subphrenic abscess through the lung from other cause than amebic liver abscess, I am satisfied that in temperate regions, where cases of amebic dysentery are infrequent, the appendiceal type is perhaps half as frequent as the hepatic variety. I once discovered two indisputable examples of the post-appendiceal form in a single day, both following suppurative appendicitis, operated upon after the abscess had been permitted to burrow upward for a week or two after intervention had been indicated.

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The subphrenic abscess may follow upward along the mediastinum, as in a recent fatal case, the tract being well demonstrated by the X-ray plate. An abscess on the right side of the neck finally resulted. The pericardium is occasionally perforated, and the abscess may perforate externally. In one of my cases it burst into the colon after being drained.

The left-sided subphrenic abscess, commonly arising from gastric, duodenal, or left renal lesions, gives an area of dulness on the left side, often displacing the left lobe of the liver, the stomach and the spleen downward, and causing the epigastrium to bulge. The upward pressure upon the diaphragm causes a displacement of the heart upward and to the left. Gas is frequently present, since a communication with the stomach and duodenum often exists. Movable dulness is difficult to detect if any fluid contents are present in the stomach, so that this organ should be evacuated with the stomach tube before examination. The bismuth plate may be of great assistance in demonstrating the relative positions of the stomach and colon. I have elsewhere pointed out the significance of dry pleuritic friction in the region above the spleen in suspected left-sided subphrenic abscess. It may precede an empyema on this side. Thrombosis of the veins of the region affected, with pulmonary embolism, is not infrequent in these desperate cases. If air or gas enter the cavity, as from perforation of one of the hollow viscera, or be generated by bacterial action, as may occur in appendiceal abscess, the signs commonly associated with pneumopyothorax are produced, but in part or wholly beneath the diaphragm, depending upon the presence of perforation of that organ by the suppurative process. Tympany in the hepatic region or movable dulness may be demonstrated.

Diagnosis.—This depends upon the recognition of the not infrequent association of the condition with the abdominal disorders mentioned. In the appendiceal variety cases are very commonly regarded as typhoid fever for a week or two, as in several cases under my observation. Following operation the diagnosis should be less difficult, since a continued febrile course with obscure signs in the upper abdominal region should suggest it. If the diagnosis be not established by the expectoration of pus, after bursting into a bronchus,

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or by the finding of movable dulness in pneumopyothorax, by the Röntgen ray investigation, or by edema and redness, which go before the attempted external perforation, the abdomen should be explored if the signs are chiefly in that region or the chest should be investigated laterally or posteriorly with the exploring needle. This should be of good size, so as to carry the thick pus commonly present, and should be introduced in several interspaces over the area of greatest dulness if the first punctures are not successful. Unfortunately the abscess may be so far from the surface under the dome of the diaphragm that it may not be accessible to the needle. In one case the patient had been twice operated for supposed empyema without finding pus, and indeed without a suspicion of the abdominal origin of the suppuration, although the history of the primary appendicitis was startlingly clear when sought for. Systematic aspiration by Dr. H. R. McGraw failed to show the location of the purulent focus, which we found by exploration to lie near the center of the right chest, anteroposteriorly, and adjacent to the mediastinum, a not very infrequent position. These cases present many difficulties.

Differential Diagnosis.—Abscess of the liver causes in most cases a sharp bulging upward of the diaphragm. The history of dysentery is very often present, and the aspiration of the characteristic pus is decisive. The liver is also enlarged or pushed downward in these cases. The character of the fluid aspirated may indicate the diagnosis as between empyema, simple pleural effusion and subphrenic abscess. The presence of gas, of food particles, of the colon bacillus, or its odor, suggest the latter condition, even though the aspiration may have been performed above the normal liver border. The not infrequent perforation of the diaphragm with consequent communication between the subphrenic abscess and the secondary empyema, a condition which I have seen several times, must not be overlooked. I have seen such a condition in which the subphrenic abscess was secondary to a left-sided empyema, as proved by post mortem examination. The study of the movements of the needle, pulled downward internally upon inspiration and hence raised externally if the diaphragm be pierced, and of the pressure within the abscess, as studied by a manometer connected with a needle, or by noting the increased

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flow from the needle upon raising of the intra-abdominal pressure in the act of inspiration, are interesting and of importance. If pus be found, however, surgical intervention is indicated, regardless of the relative position of the diaphragm and the focus of suppuration.

From pneumothorax the subphrenic pneumopyothorax may be generally distinguished by a consideration of the history of the abdominal rather than thoracic disease, by the relatively slight lateral displacement of the heart, and by the position of the diaphragm as shown by the X-ray. Cough is less prominent in the subphrenic affection. In a recent case of traumatic diaphragmatic hernia Dr. Stover was able to state the diagnosis positively through the finding of the diaphragmatic shadow by the X-ray and the demonstration of the bismuth shadow in the stomach *above the diaphragm.* The differentiation from subphrenic abscess in this case would have been difficult without the means of diagnosis mentioned.

Prognosis.—This is always grave, and especially so because of the frequent lack of such clear signs and symptoms as may lead to prompt recognition and treatment. The cases frequently linger for two or three months and die of sepsis or of perforation with prolonged suppuration. Nearly all die if not operated upon. Probably under the best conditions 80 per cent. of the cases may be saved by timely surgical intervention.

There is no argument of greater force as to the advisability of early operation in appendicitis than the tendency to the development of this grave complication in neglected cases. In a reported series of 500 cases of appendicitis I found subphrenic abscess nine times.* The gaseous abscess is of graver outlook than the simple form. It is certain that subphrenic abscess will become less common with earlier and more skillful intervention in appendicitis, peptic ulcer and gall-bladder disease. The possibility of septic arterial embolism, from infection of thrombi in pulmonary veins adjacent to the fistulous tract through the lung in cases of perforation upward of subphrenic abscess, should be considered. In one of my reported cases three such accidents occurred, one involving loss of the right thigh by

* *Surgery, Gynecology and Obstetrics*, October, 1911.

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amputation. I have mentioned elsewhere * the "bowing" of the patient with the concavity to the right from the cicatricial contraction about the subphrenic abscess and the fistula in the lung.

B. CHRONIC PERITONITIS

This occurs as a localized or as a diffuse process. The localized form originates from some inflammatory process not sufficiently virulent to give rise to the usual acute peritonitis. Chronic inflammation of the fallopian tubes resulting generally from gonorrheal infection or uterine sepsis, is most frequently the cause. Next to this probably comes the chronic form seen about the appendix. The long-continued irritation of this organ by mildly inflammatory contents or mechanical conditions gives rise to localized peritonitis with resulting adhesions. About the gall-bladder, at the hernial orifices and in the region of gastric and duodenal ulcers, ovarian cysts, diverticula from the large bowel, and in the chronic inflammations of the capsules of the liver and spleen, as in leukemia and cirrhosis, such inflammation is very common. Localized peritonitis is not uncommonly of tuberculous or malignant origin.

As a result of the inflammation, local adhesions between the neighboring peritoneal surfaces occur and interference with peristalsis frequently results if the bowel be involved. More serious is the obstruction of the intestine by the slipping of a loop through or behind a band or adhesion. It is extremely common to find local adhesions which have been of no clinical significance, so far as known. On the other hand, many of the symptoms following chronic appendicitis or other abdominal inflammations are the result of the damage to the peristaltic function. Attacks of biliary colic indistinguishable from those caused by gall-stones may be due to adhesions distorting the duct. Chronic pericolitis is frequently the cause of peculiarly obstinate constipation. The ureter may be blocked by the contraction of firm pelvic adhesions.

The diffuse form often affects the entire peritoneum and may completely obliterate the peritoneal cavity by adhesion of the layers.

** *Medical Record*, October 17, 1908.

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The type due to tuberculosis will be spoken of elsewhere. It may result from the unusual spread of a peritonitis, at first localized, there being less resistance to the extension of the process than usual. Alcoholism undoubtedly acts as a predisposing factor, both by lowering the resistance and by its tendency to set up cirrhotic changes in the liver, with secondary changes in the spleen and the portal territory in general. In connection with long-continued ascites chronic peritonitis is very common, perhaps at times as an effect rather than a cause. An extreme type is that described as chronic proliferative peritonitis. In this variety great thickening of the peritoneal layers occurs with such contraction that the surgeon may scarcely be able to unite the layers after an abdominal section, as in one of my cases. The sclerosed stomach in this case was of the "leathern bottle" type, and no relief could be afforded by the operation. Marked thickening of the capsules of the liver and spleen, and of the peritoneum covering all the abdominal organs is commonly present, with effusion, generally of small amount, in many instances. The ascites may be attributable to compression of the portal vein by the constricting effect of the dense adhesions. The shrinking of this dense tissue results in more or less complete matting together of the intestines, so that it would appear that any peristaltic function would be impossible. The general nutrition suffers severely through this condition.

In certain cases general arteriosclerosis and not infrequently chronic interstitial nephritis may be the cause of the chronic peritonitis. Marked examples are those seen in connection with chronic serositis, the pericardial and pleural cavities being involved as well. Chronic indurative mediastinitis with involvement of the peritoneum and such thickening of the capsule of the liver as to give rise to the name "iced liver" represents the extreme grade.

Symptoms.—These depend upon the interference with the digestive processes and consequently the general nutrition, and upon the local circulatory disturbances. Indigestion, failure of strength, emaciation, abdominal distress, ascites, often requiring repeated tapping, and, late in the course, edema of the lower extremities may be expected. In the chronic pericarditic type dyspnea and cardiac symptoms are superadded. Friction of the roughened peritoneal

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surfaces may be felt or heard. Owing to extensive adhesions the fluid may be encysted, and give rise to irregular contour of the abdomen.

Prognosis.—In the localized form serious effects are commonly due to accidental strangulation of the bowel as described. In the chronic diffuse variety the outlook is grave, but recovery occurs after many tappings in occasional instances.

Cancerous Peritonitis

This is common in connection with malignant growths, especially of the stomach, ovary, and liver, but primary endothelioma of the peritoneum is occasionally noted. Most important of the primary malignant growths is the retroperitoneal sarcoma (Lobstein's cancer), this being more frequently met with than the intraperitoneal growths. The lymph glands are probably first involved in a majority of cases. A tumor arises, often in the lumbar region, and more frequently upon the right, but somewhat variable in position. The examination in the early stages is extremely unsatisfactory, but after a few months the deep-seated tumor, evidently behind the intestines, becomes demonstrable. It is generally fixed and may be smooth or nodular. Indigestion, constipation, intestinal obstruction, cachexia, marked anemia, and rapid general failure are frequent symptoms. In one of my cases a discoloration like that of Addison's disease was present. In one case the right kidney was removed upon my advice by Dr. A. J. Campbell under the belief that it was the primary seat of the sarcoma. The subsequent course and the autopsy proved that the kidney condition was secondary to the sarcoma of the retroperitoneal glands. Steele states that if glandular masses in the abdomen soften under observation the diagnosis of retroperitoneal sarcoma may be made. Mullally concludes that "symptoms do not develop until near the fatal termination, and are due only to involvement of neighboring organs, and depend upon the position of the growth; that emaciation and loss of flesh are usually rapid, and the intestine is frequently involved, and may perforate; that there is no distinguishing diagnostic sign even when

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the growth is palpable; and that age and sex are not etiological factors."

Secondary cancer of the peritoneum is of very frequent occurrence. The membrane may be so covered with fine nodules as to be mistaken upon gross examination for tuberculosis, but the nodules are commonly larger. In connection with scirrhous cancer of the stomach the secondary enlargement of the lymphatic glands may be extensive, and a cancerous ascites is much more frequent than in other forms of gastric cancer.

The source of the cancerous invasion may lie outside the cavity, the testis and the breast being not infrequently the original sites of malignant disease. In general sarcomatosis the invasion is of vascular origin. In cancer of the stomach it is very common to have secondary growths in the pelvic region (rectal shelf) through detachment of cancer cells which settle into the pelvis and give rise to metastatic growths. The rectal examination is thus of great importance in the consideration of the advisability of operation upon gastric cancer. The symptoms are commonly those of gastric disturbance and ascites, superadded to those of the original malignant disease. Adenitis, secondary growths in the region of the navel, points of pain, and tenderness in the abdomen, partial or complete intestinal obstruction, steadily increasing ascites, edema of the lower limbs, obstruction of the inferior cava, pigmentation of the face, and a crop of angiomata over the skin of the abdomen are common features of secondary cancerous peritonitis. In colloid cancer the abdomen may be enlarged by the gelatinous mass without the presence of fluid.

Diagnosis.—This is easy if the diagnosis of the original lesion has been made, but correspondingly difficult under other circumstances. The presence of a bloody ascitic fluid is presumptive evidence of either cancer or tuberculosis. The latter affection, as a rule, occurs before middle life, and cancer during or after that period. After withdrawal of the ascitic effusion the malignant nodules or the thickened or rolled-up omentum may be palpated. The fluid may show cancerous fragments, or, if tuberculous, gives rise to tuberculosis in the guinea pig. Nodular tumors in the abdomen should suggest the possibility of cancer, tuberculosis, especially

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in children, fecal tumors, cystic growths, and echinococcic cysts in the omentum or mesentery.

Prognosis.—The course is commonly a short one and invariably fatal.

C. TUBERCULOSIS OF THE PERITONEUM

This occurs in a considerable number of cases of pulmonary tuberculosis (4 per cent. to 18 per cent. according to different statistics). The eruption of tubercles in miliary tuberculosis always involves this membrane. In women the common cause is tuberculosis of the fallopian tubes. In children, intestinal tuberculosis is the ordinary cause, and in adults the appendix and cecum are often the seat of the original invasion. In cirrhosis of the liver a terminal tuberculous peritonitis is a frequent event, and effusion in the peritoneal cavity is even thought by some to be very frequently of tuberculous rather than of circulatory origin, even though the tuberculous infection be not easily demonstrated. Negroes, Indians, and Mongolians are more frequently affected than Caucasians. Tuberculous peritonitis is much more frequent in females, chiefly because of the frequent involvement of the tubes.

Varieties.—Allchin's classification is into the miliary, ulcerous, and fibrous forms. The miliary form presents a myriad of tubercles, without adhesions, and the ascitic fluid is often serofibrinous, and frequently bloody in character. A shrinking process develops in the omentum and the mesentery, giving rise to the rolled-up omentum felt across the upper abdomen, frequently more to the right, and to the short mesentery which ties down the intestinal loops to the spinal column. Either of the conditions described may lead to the diagnosis of tumor of other than tuberculous origin. The mesenteric glands are commonly involved. In the ulcerous form degeneration of the tubercles occurs with formation of the characteristic cheesy masses, the glands being similarly affected. Shrinking fibrous bands unite different coils of intestine or other of the abdominal organs together, and ulcerations may occur, perforating through the loops of bowel so connected. In the pockets formed by the adhesions may be found serofibrinous or seropurulent fluid, definite abscesses, or

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even fecal abscesses. The caseous mesenteric or retroperitoneal glands may be felt through the abdominal wall. Suppuration about the navel is not uncommon, and the tuberculous abscesses may perforate through the vagina or elsewhere. The fibrinous form commonly represents the stage of healing of the acute miliary form, but may develop as a subacute process. The tubercles undergo a fibroid

FIG. 86.—POSTERO-ANTERIOR VIEW OF THE LARGE INTESTINES. Extensive adhesions of the cecum, ascending and transverse colon caused by tuberculous peritonitis. Conditions shown verified by operation. (Dr. S. B. Childs.)

transformation with pigmentation, and universal adhesions result. Effusion does not ordinarily occur in this form. The matting together of the omentum, bowel, and mesentery may lead to the diagnosis of a tumor of other origin.

Symptoms.—If the peritoneum in the region of the appendix and cecum be affected, the diagnosis of subacute appendicitis is not infre-

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quently made. Tubal disease of other nature is often suggested by the involvement in the pelvis. The acute forms may so embarrass the peristaltic function as to lead to a diagnosis of intestinal obstruction, which indeed is often present. In case the peritoneum at the hernial openings be involved, the diagnosis of strangulated hernia may be suggested. General abdominal tenderness with perhaps palpable tuberculous masses in the abdomen may be noted. Effusion, often bloody in character, is frequent. In certain cases the outbreak may be so sudden as to suggest an acutely infectious type of peritonitis, but more commonly it is subacute or chronic. As in the case of generalized miliary tuberculosis, the diagnosis of typhoid is often made.

Diarrhea, or constipation, pain, vomiting, fever, and rapid pulse are frequent symptoms. The respirations are often much increased in frequency and a dry pleurisy is not infrequent. Dyspnea may be marked, anemia and wasting are to be expected. Abdominal distension may be in part due to tympanites, and not infrequently the distended bowel floats upon the effusion. The failure in peristalsis causes an exaggeration of this feature of the disease. The condition may become chronic in course, with low fever, wasting, moderate distension of the abdomen, distended veins over the abdominal walls, a peculiarly doughy feel of the skin and subcutaneous tissues, and even slight edema of the surface in certain cases. Pigmentation of the Addisonian type is not very infrequent, perhaps confined to the abdomen, but occasionally diffuse. This may be due to the tuberculous involvement of the suprarenal glands. The blood picture is that of secondary anemia, commonly with leukopenia, but with polynuclear leukocytosis in case suppuration occurs. The diazo-reaction is often present in the urine. Upon opening the abdomen the surgeon often notes the peculiar slimy feeling of the peritoneum.

Diagnosis.—This is easily made in case the disease be secondary to well-marked tuberculosis elsewhere. In many cases, however, the onset is so insidious and the symptoms so lacking in distinctness that much difficulty is experienced. The presence of ascitic fluid raises a presumption of tuberculous peritonitis, and the same remark applies in case an abdominal effusion occurs in a young woman with

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supposed tubal disease. The presence of a tuberculous testicle suggests a similar origin of an accompanying abdominal effusion. In the typhoidal type the absence of the Widal reaction and the effect of the effusion upon injecting a guinea pig should be decisive. In case of the tumor-like masses mentioned, cancer and ovarian tumor are suggested. In case of doubt the former is probable if multiple tumors be present. The encysted exudate may be impossible to differentiate from ovarian cyst without exploration, although the presence of tuberculous lesions elsewhere in the body may be of much service in the diagnosis. Marked digestive symptoms of course point to tuberculosis and the discharge of pus from the navel is practically conclusive of its presence.

Cirrhosis of the liver with ordinary ascites may cause much confusion, since a secondary tuberculous peritonitis is so frequent in this disease. Alcoholism, of course, strongly suggests cirrhosis, yet it predisposes to peritoneal tuberculosis by lowering the general resistance. Chronic intussusception in children may be mistaken for peritoneal tuberculosis.

Prognosis.—The disease is often curable through the removal of the original tuberculous focus. In the affection of the fallopian tubes the prospect is particularly good if both be removed. Other cases recover as the result of the usual reparative changes noted in tuberculosis elsewhere. A supposed recovery, however, may be follower by relapse, with the development of a fatal miliary tuberculosis. Diarrhea, serious involvement of other organs, great digestive disturbances because of the intestinal involvement mentioned and the development of active tuberculous processes elsewhere are of grave significance. Fecal fistula is a very serious complication.

10. ASCITES

Etiology.—The symptom depends upon a disturbance as to the secretion or the absorption of fluid normally present in small amounts in the peritoneal cavity. More fluid may enter the sac than normal or less may be absorbed. The most frequent causes are those giving rise to general dropsy, particularly cardiac disease and nephritis,

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and those interfering directly with the flow in the portal vein, notably cirrhosis of the liver and obstructive diseases of the vein. Chronic peritonitis gives rise to inflammatory exudate, especially in case of cancer and tuberculosis. The tumors of the abdominal organs, notably of the ovaries and womb, kidneys and spleen, and severe anemias are also frequently noted in the etiology. A rare cause is obstruction of the inferior cava. In malarial countries, the splenic enlargement is often the cause of the effusion. The fluid may be a straw-colored serum, this being of higher specific gravity (1.015-1.018) in case it be of inflammatory origin, than when it is transudative in character (1.010-1.012). Bile is often present in case the cause is connected with the liver. In cardiac ascites and other mechanical forms the cells in the exudate are chiefly endothelial in character. In the infections the polymorphonuclear cells predominate, and in the tuberculous peritonitis the small lymphocytes. Cancer cells may be found in malignant disease. Bloody fluid is present in tuberculous and cancerous peritonitis. Its presence in hepatic cirrhosis suggests the possibility that the exudate is due to tuberculous invasion of the peritoneum.

True chylous ascites arises from the effusion of chyle into the sac, either because of obstruction of the duct or the lymphatics. Much fat is present, and a thick layer rises to the surface of the standing fluid. The fat globules are visible under the microscope, and leukocytes and other cells are absent. The obstruction may be due to pressure of malignant growth, tuberculous glands, dense adhesions, etc. In rare cases severe muscular strain has been thought to cause rupture of the thoracic duct or the receptaculum chyli (vomiting, whooping-cough). The second variety, chyliform ascites, is dependent upon the presence of fatty particles, cells which have undergone fatty degeneration being present in the fluid. The total solids and the total fat are much less in amount in the latter form. The fat globules are much larger and less uniform in size, and cellular elements much more abundant in the second variety. A lactescent ascites is described in which the opalescence is not due to fat, but to lecithin in combination with globulin, nucleo-albumin, or casein.

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Symptoms.—These relate to the gradual and uniform enlargement of the abdomen, the amount of fluid reaching five to six gallons or more. The mechanical inconvenience is notable. Dyspnea results from the interference with the action of the diaphragm and the heart.

Physical Signs.—The enlarged abdomen flattens at the "dome" in the recumbent position, the prominence of the flanks being noticeable. In the upright position the abdomen sags downward. The tense skin is marked by the white striæ common in conditions of great distention. Edema of the abdominal wall is frequently present. Enlarged veins course over the abdomen, perhaps most common in hepatic cirrhosis, and the well-known "caput medusæ" is frequently present in this condition—an enlargement of the veins centering at the navel. The umbilicus is often bulged outward and occasionally gives way, causing leakage of the ascitic fluid. In part because of the pressure of the effusion upon the iliac veins and the inferior cava, and probably more particularly because of the general causes lying back of the ascites, edema of the genitalia and lower extremities is common. Hemorrhoids are often present. In case the ascites depends upon obstruction of the portal vein, the collateral flow in the superficial abdominal veins may be noted to travel upward to a communication with the venous trunks above the obstruction. In encysted ascites the contour of the abdomen may be very irregular.

Palpation.—The fluid wave may commonly be demonstrated by tapping the relaxed abdomen with one hand, the wave traveling across the abdomen and striking the other hand upon the opposite side. In case of doubt pressure by the hand of an assistant in the median line obviates any deceptive movement of the abdominal parietes. By "dipping" with the fingers the enlarged liver or spleen, ovarian cyst, or other abdominal tumor may be detected.

Percussion.—The distinctive features are flatness in the sides, movable with the change in position, and the resonance at the highest point, due to the floating intestines. The liver, spleen, and heart may all be displaced upward. Absence of intestinal resonance suggests tuberculosis, the intestines being bound down to the spine by the shortened and thickened mesentery in this case. Fluid in less quan-

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tity than a litre cannot be demonstrated with certainty, since it sinks into the true pelvis and backward out of reach of percussion. With the assumption of the knee-chest position the fluid settles downward and comes in contact with the abdominal wall and may then give rise to flatness.

Differential Diagnosis.—The greatest difficulty arises in the diagnosis from large cysts, generally ovarian in nature. As a rule, the movable dulness and the resonant area at the "dome" of the abdomen are absent, and resonance is present in the flanks, due to the displaced intestine. The history of the growth of a tumor upward from the pelvis and the absence of recognizable cause of ascites should be considered. As a rule, the abdominal girth is larger below the navel in case of ovarian cyst, and above it in ascites. The specific gravity of the fluid is higher in case of cyst. In ascites the bulging into the pelvis may be much more notable, the tumor rising out of the small pelvis. The pregnant uterus in case of hydramnios may cause confusion, but the signs and symptoms of pregnancy are generally decisive. Even the fetal movements or the fetal heart may be detected. The distended bladder should never cause confusion, since it should be emptied, by catheter if necessary, before the investigation of any abdominal disease. The most deceptive cases are those in which chronic retention with overflow exists.

I have known an effusion of blood in ruptured ectopic pregnancy, probably with the addition of serous fluid from irritation of the peritoneum, to present the signs of an extensive ascites, but attention to the features of the case should prevent error. In similar manner, rupture of a hydrosalpinx may provoke a considerable peritoneal effusion. Lipoma, colloid cancer, dilated stomach, pancreatic cyst, and even great obesity are some of the conditions mistaken for ascites. Large quantities of fluid in the distended bowel, as in children with chronic enteritis may be very deceptive. Tympanitic distention should offer no difficulty unless the abdominal wall be of extreme thickness.

Prognosis.—This depends upon the character of the disease of which the ascites is a symptom. In malignant disease and in hepatic cirrhosis the outlook is bad and the end is commonly a speedy one.

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In tuberculous peritonitis recovery may follow the removal of the tuberculous focus. In certain forms of chronic peritonitis life may be prolonged over a number of years, many tappings being necessary.

11. DISEASES OF THE LIVER

A. CIRCULATORY DISTURBANCES OF THE LIVER

Anemia is not recognizable clinically. Congestion of the liver may well occur because of its great vascularity, and the variation in its circulation according to the condition of the portal vein and of the general circulatory systems. Increased inflow, or impeded outflow may cause it to swell, and it may decrease in size with the contrary combination.

Active Congestion.—The normal increase in vascularity of the liver associated with the digestive processes may be exaggerated by the use of irritants, condiments, etc., taken with the food, and by alcohol in large amounts. Chronic degenerative changes may eventually occur. I have felt the liver a hand's breadth below the rib margin after an alcoholic debauch, subsiding in a week or ten days, with complete recovery, but such cases are not common. Enlargement of the liver from exposure and chill and from alcoholic and dietetic errors are apparently much more frequently mentioned by practitioners in India and other tropical countries than in temperate climates. No especial symptoms, aside from feeling of fullness in the liver region and a complaint of feeling "bilious" are recognized. In more severe cases, as after a debauch, the distress in the liver, and traditionally in the right shoulder are more pronounced, and the furred tongue, headache, constipation, anorexia, and mental depression are marked. Fever is not a common feature. The liver is perceptibly enlarged and feels tender.

Passive Congestion.—This is extremely common, since it occurs with every condition of the heart leading to "backing up" into the systemic veins. The blood is held back in the veins leading from the liver, and swelling results. Mechanical causes interfering with

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the emptying of the hepatic veins into the vena cava inferior, or the latter into the heart, may bring about the same result. In tricuspid regurgitation, the systolic impulse is carried directly through the open tricuspid valve into the inferior cava, and to the liver through its veins, so that a systolic pulsation of the organ may be felt with the hand. The liver shows the well-known features of nutmeg liver. It is enlarged in the earlier stages, but later may be contracted through connective tissue growth.

Symptoms.—The liver often feels too large to the patient, giving a sense of fullness and distress. Slight icterus is common, this being the type mentioned under mitral disease. The stools are often light in color and the digestion of the flatulent type from the deficiency of normal bile in the bowel. Hematemesis and ascites may be noted. The urine is concentrated, contains bile coloring matter, and commonly albumin and hyaline and granular casts, chiefly from passive congestion of the kidneys, but accentuated by the irritation of the bile. The dyspnea and cough often noted are cardiac rather than hepatic in origin, although the enlargement of the liver and possibly the ascites may interfere with diaphragmatic action. The liver is found enlarged and moderately tender, and the expansile pulsation of tricuspid regurgitation may be felt. Ascites is not infrequent as a consequence of the venous engorgement.

Diagnosis.—This is commonly self-evident, since the primary cardiac disease or pulmonary disease and secondary cardiac failure, are easily recognized. The prognosis is that of the cardiac condition.

Diseases of the Portal Vein

Thrombosis may occur as a result of cirrhosis, cancer, etc., with the effect of blocking the portal circulation, and causing acute engorgement of the stomach, spleen, intestines, etc. Suddenly developing ascites might suggest it, or vomiting or passing of blood. A collateral circulation is occasionally found to have been established. Infarctions of the liver are occasionally met with, but are of little clinical interest.

(For septic pylephlebitis, *see* Liver, Abscess of.)

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B. ICTERUS

(*Jaundice*)

This is a staining of the skin and the tissues by bile pigments—biliverdin and bilirubin. It is a symptom of many different disorders in which the liver is by no means always primarily involved. It is common to describe jaundice as (a) obstructive, due to interference with the passage into the bowel of a properly secreted bile, (b) hemolytic, due to toxic destruction of red corpuscles in great numbers, furnishing to the liver a great amount of hemoglobin from which an excessive formation of bile pigments results, and this leads to jaundice because of the coincident angiocholitis, with so viscid a bile that it cannot flow readily. In the last analysis it is therefore obstructive. In proof of this hypothesis it may be stated that ligation of the afferent vessels of the liver in the toxic cases prevents the jaundice by preventing the formation of bile pigment. The so-called emotional jaundice, coming on in a moment under the influence of anger, etc., is supposed to be due to such lowering of the portal blood pressure that the bile flows into the capillaries instead of into the bile ducts.

Obstructive Jaundice.—The most common type is the ordinary catarrhal jaundice due to transient blocking of the duct by the extension into it of a gastroduodenitis (*see* Catarrhal Jaundice). Next to this comes the form due to blocking by gall-stones, which have reached the common duct or are at least in position to close it by pressure. Rarely a round worm or liver fluke has been the cause. Next to this type is that due to pressure on the duct from without, as from cancer of the head of the pancreas, cancer of the liver itself or the gall-bladder, or enlargement of the glands near the duct, as from cancer of the stomach, tuberculosis, or other cause. I have seen intense jaundice from the pressure of a hydatid cyst, and almost any tumor in the abdomen may be responsible for the condition. It is not infrequent for the duct to be blocked by kinking due to adhesions. I have mentioned a case in which it was due to kinking of the duct in a floating liver. Lastly, stricture of the duct,

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as from ulceration from a stone or a growth within the duct, may cause obstruction. As a result the bile enters the blood stream through the lymphatics, and the tissues become stained with it, while its absence from the bowel gives the characteristic clayey stools.

Symptoms.—The symptoms connected with the cause of the obstruction will be considered under diseases of the gall-passages, etc. The one indispensable feature of jaundice is of course the discoloration of the skin, the conjunctivæ, the tissues, urine, milk, sweat, etc. In the milder cases and in all beginning cases, it is a faint yellowish discoloration, becoming darker with long continuance. The duration of jaundice bears some relation to the degree of darkening in the discoloration. In the complete obstruction of cancer, occluding the duct, it becomes a greenish, dark bronze, or black color.

The conjunctivæ should be examined in good daylight in case of doubt. One should be alert in perceiving other evidence of obstruction of the flow of bile, since if the case be examined by artificial light and the patient neglects to speak of it, the color is overlooked.

Next in importance are the bowel symptoms, due to lack of bile in the digestive tract. The stools are of light yellowish color, contain more fat than normal, commonly float in water, and are more offensive than usual because of the more offensive type of intestinal fermentation. The stools are putty-like, and may cause so much fermentation as to provoke diarrhea. The fat is a still more prominent factor in increasing the bulk, the fattiness, the light color, and the tendency to float in water being yet more marked in case the cause of the obstruction also cuts off the pancreatic duct. The fat in the feces is said to be increased from 10 per cent. to 75 per cent. in severe jaundice. Owing to the absence of bile, anorexia, nausea, and flatulency are common. Pruritis is generally present, and is one symptom which calls attention to jaundice when the first examination is made by artificial light. The scratch marks may commonly be seen after the first few days. Sweating, furunculosis, urticaria, and telangiectasis are occasionally noted. In the very chronic cases the yellowish discoloration of the inner angles of the eyelids due to xanthelasma is not very uncommon. In a case due to neglected gall-

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bladder trouble which had existed with intermissions over several years, patches reaching the size of a silver dollar existed over the forearms, hands, regions of the knees and the legs. Osler states that they may occur in the bile ducts. The slow pulse of early jaundice and the slower respiratory activity are not of serious note. The irritation of the bile may give rise to albumin and tube casts in the urine, the latter bile-stained. The lengthening of the coagulation time from about four minutes to over ten is a very serious matter for consideration in advising operation in those long jaundiced. Cutaneous ecchymoses and hemorrhage from the mucous surfaces may occur in severe cases.

The most serious features of jaundice pertain to the nervous system. The ordinary irritability and mental depression are of little consequence, but after jaundice has existed for several weeks there is danger of cholemia, an intoxication with bile products, similar to the uremia of kidney disease. Delirium and coma may occur, with death in convulsions. It is much more common in hemolytic jaundice. It may perhaps be an acid intoxication.

Hemolytic Jaundice.—The most clear-cut form is that due to phosphorus poisoning, arsenic, various snake poisons, and to some destructive agent present in the system in septic disease. Yellow fever, malaria, and other infectious diseases may also be responsible. In the group of disorders which includes acute yellow atrophy, Weil's disease, and the epidemic or infectious jaundice, the icterus is of the hemolytic type. The jaundice may be so slight as to escape recognition, unless the physician be attentive and the light good. The appearance in any septic disease of a slight yellowish tinge in the conjunctivæ and of a shade of icterus over the abdomen, often so trivial that discussion occurs as to whether it really be jaundice or not, is of grave omen. The stools and urine may show no changes, but the nervous manifestations mentioned above are most marked. They are often mingled with those of the septic disease with which they are associated. The occurrence of petechiæ and hemorrhage from the mucous surfaces is ominous. The jaundice seen in mild or at least not very serious attacks of acute pneumonia is probably not hemorrhagic, but is possibly associated in some manner with

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the mechanics of respiration and their influence upon the hepatic circulation. It is rarely found unless the right lower lobe be involved, and is of no especial significance.

Icterus Neonatorum.—A considerable proportion of new-born babies present during the early days of life a mild type of so-called "physiological jaundice" with slight staining of the urine, producing no symptoms, and disappearing in the second week. Its cause is still under discussion. It is of little consequence.

A severe form is recognized depending upon congenital anomaly of the bile duct, inconsistent with life. Septic phlebitis of the umbilical vein and congenital syphilis of the liver are occasional causes.

Congenital Hemolytic Jaundice With Splenomegaly.—Minkowski described a hereditary and familial affection characterized by chronic acholuric jaundice, splenomegaly, and urobilinuria. The blood shows no especial anemia, nor is the general health seriously impaired. The absence of all the ordinary phenomena of biliary intoxication is most striking. A remarkable corpuscular fragility exists.

An acquired form of hemolytic jaundice exists, coming on in adult life, occasionally after accident, disease, or shock. There is present "chronic acholuric pleiochromic jaundice without the usual symptoms of biliary intoxication, associated with anemia, enlarged spleen, and siderosis of the viscera" (Thayer). The blood picture may approach that of pernicious anemia, excepting that the leucocytes are somewhat increased in numbers.

Certain of the cases, according to Thayer, simulate cholelithiasis, others pernicious anemia with jaundice, still others a chronic infectious cholangitis, while Banti's disease is closely approached by a fourth class.

Under the title Widal's Syndrome an acquired hemolytic icteroanemia is described, but it is not to be differentiated clinically from the last described affection.

C. ACUTE YELLOW ATROPHY OF THE LIVER

This is a rare disease, in which extensive destruction of the liver cells occurs, with shrinking in size of the liver, jaundice, and marked

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toxic phenomena. It is generally fatal. It is seen chiefly in young adults, more frequently in the female sex, evidently because many of the cases occur in connection with pregnancy. Next in frequency of incidence come the septic diseases, generally those of extreme severity. One instance coming under my notice was in connection with a virulent suppurative appendicitis. A few cases have been reported in the secondary stage of syphilis. A somewhat similar clinical syndrome is seen in certain cases of delayed chloroform poisoning. No definite causation has been established, although diligent search has been made for a specific organism.

Pathology.—The striking feature is the shrinking of the liver, often to less than half its normal weight. The organ is flaccid and wrinkled, dirty yellowish in color, and dotted with subserous hemorrhages. The mottled cut surface represents, in different areas, different degrees of the autolytic necrosis characteristic of the condition, being complete in certain portions. The spleen is commonly enlarged, the tissues are icteric, and show numerous hemorrhages.

Symptoms.—The early symptoms ordinarily suggest the usual catarrhal jaundice, with headache and general disturbance, nausea, anorexia, and perhaps vomiting. After the first two or three days, the jaundice appears and becomes more marked as the case progresses. Inside of a period varying from three or four days to a fortnight, the severe and characteristic symptoms appear,—persistent vomiting, hematemesis, severe headache, and delirium, trembling, coma, convulsions, and hemorrhages under the skin and mucous membranes and from various mucous surfaces. A typhoid state may develop. Fever is absent or inconspicuous in most cases. The pulse becomes rapid before the end comes. Dry tongue, sordes, dilated pupils, irregular and rapid respiration and fibrillary twitchings of the muscles may be present. On physical examination the most striking feature after the jaundice is the decrease or absence of liver dulness. It is due, first, to the absolute decrease in size and, secondly, to the flabbiness of the organ, so that it is crowded away by the distended bowel. In the earliest stages the liver has occasionally been found enlarged. A moderate enlargement of the spleen may be detected. The stools are often light in color from

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absence of bile, but may be darkened by blood. The scanty, high-colored urine shows bile pigment, a deficiency of urea, and commonly albumin and casts. Leucin or tyrosin or both of them are found in a majority of cases and, if abundant, add much to the probability of the diagnosis in a doubtful case, although not at all pathognomonic. A moderate leukocytosis has been reported. Ascites is a rare feature. The disease is generally fatal within two or three weeks, sometimes in the first half of the first week, yet a few cases go into the second month. A chronic course has been described in a few cases, with recovery.

Diagnosis.—The rapid decrease in the size of the liver occurs in no other disease, unless it be in acute phosphorus poisoning, and then the atrophy is commonly later in development. It is generally recognized by its history, the marked irritative digestive symptoms, and the rapid course; and not infrequently the enlarged liver of the early days of phosphorus poisoning persists long enough to arouse suspicion of its character.

Prognosis.—Only occasionally is recovery reported.

D. CATARRHAL JAUNDICE

This variety of jaundice is caused by the swelling of the mucosa of the common duct resulting from extension into it of a catarrhal inflammation of the duodenum. Temporary obstruction of the duct results in jaundice.

Etiology.—The disease is more common in the first half of adult life. An acute gastroduodenitis, commonly resulting from some dietetic error, is the usual cause, but exposure to cold, malaria, certain infectious diseases (typhoid fever, pneumonia) and even overwork and mental strain are alleged to be causative. In a great number of cases the eating of a meal of highly seasoned food with alcoholic drinks is probably responsible. The frequency of the affection with the advent of the bock beer season is to be noted in beer-drinking communities. Epidemics occurring especially in the spring, have frequently been reported. In patients with cardiac disease, passive congestion is a predisposing factor.

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Pathology.—Congestion, with marked swelling of the mucosa, and even edematous infiltration, is the essential feature. A plug of mucus has been found occluding the duct. The changes are most marked in the portion of the duct near the papilla.

Symptoms.—Not infrequently there are no symptoms sufficient to attract the patient's attention until the jaundice is apparent, but most patients complain of indigestion, anorexia, vomiting, diarrhea and malaise for a day or two before this. Constipation is much more frequently met with than diarrhea. The vomiting may be excessively severe. In one case we resorted to rectal feeding because of the exhaustion accompanying it, no cause for the vomiting being apparent until the jaundice appeared on the fourth day. A moderate increase in temperature is occasionally noted. In certain epidemics the onset has been more severe than above indicated, even a well-defined chill being recorded. The jaundice is of the obstructive type, with a light discoloration, as contrasted with the dark color of the jaundice due to impacted stone or malignant disease. The conjunctivæ, skin, and secretions become yellow, while clay-colored stools signify the complete absence of bile from the intestine. The pulse is slowed and occasionally becomes dichrotic. Itching due to the bile is commonly severe, and scratch marks may suggest the affection if the patient be seen in artificial light, when the yellow discoloration is imperceptible. Drowsiness and irritability are generally noted. The engorged liver may be palpable, and less commonly the spleen. The gall-bladder is rarely to be felt. A distaste for fats and meats is not infrequently mentioned by the patient.

Course.—Many cases show improvement in the third week, this being preceded by the appearance of bile in the stools, shown by the darker color. A course of over five to six weeks is unusual.

Diagnosis.—The affection is so much more common in young and otherwise healthy adults than other types of jaundice that, in the absence of pain, emaciation, marked changes in size and shape of the liver, evidence of malignant disease or precedent history of gall-stone colic, the diagnosis may be accepted with little doubt. A duration of five to six weeks suggests the possibility of other cause, and if the time be extended to seven or eight weeks malignant disease

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is very strongly suggested. I have twice known gall-stone obstruction to be absolutely devoid of pain so that the diagnosis of catarrhal jaundice was persisted in until the exploration seemed imperative at the seventh or eighth week, when the true cause was found. Cancer of the gall-bladder, of the ducts, or of the liver or pancreas is a much more common finding in such cases.

Acute infective jaundice is suggested in case the onset be severe, but the fever is more prominent, and enlargement of the liver and spleen and albuminuria are present.

Prognosis.—This is good, the only anxiety regarding it being based upon the fear of error in diagnosis. If improvement does not begin in six weeks it is probably safer to explore the abdomen with the probabilities in favor of finding gall-stones or malignant obstruction than to delay longer. Recurrence is rare, but the possibility should be borne in mind in view of the frequency of recurring jaundice in gall-stone disease.

E. CHRONIC ANGIOCHOLITIS

This may be (a) catarrhal and (b) suppurative.

(a) Catarrhal Angiocholitis.—This occurs in case of obstruction of the common duct from almost any cause, the hepatic secretions being held back, so that in extreme cases the ducts of the entire biliary system are dilated. The gall-bladder is enlarged and the common duct may appear nearly as large as the duodenum. Infiltration and new connective tissue formation supervene in the more chronic cases. In case of complete obstruction the ducts are filled with clear mucus, most frequently sterile, in marked contrast with the infected or turbid contents found in case of intermittent obstruction. The lining membrane of the ducts is smooth and devoid of evidence of severe destructive change in the former condition, while ulceration may be present in partial obstruction. The dilatation of the ducts is naturally much less marked in the latter condition. The complete obstruction is very often associated with malignant disease or stricture of the duct, the incomplete blocking suggesting rather the presence of gall-stones, with temporary cessation of the obstruction from the

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subsidence of the inflammatory process, or floating from its bed of the ball-valve stone so frequently found in these cases. Marked chills and sweats may be present, with recurring or varying jaundice, and do not necessarily indicate a suppurative process. In complete obstruction, infection, and consequently fever are commonly absent. The biliary passages in case of partial obstruction may develop so severe an infection that the cholangitis becomes a suppurative one.

(b) Suppurative Cholangitis.—This may originate independently or as a sequel of chronic catarrhal angiocholitis. In many cases it is the result of the spread of a suppurative pylephlebitis or cholecystitis to the ducts of the liver. The B. coli, the ordinary cocci of suppuration and the typhoid bacillus are the most frequent invaders. A general purulent angiocholitis exists, and may lead to diffuse abscess formation in the liver substance. Although gall-stone disease is the common cause of the cholecystitis from which the suppurative angiocholitis originates, obstruction of the common duct by a parasite (round worm, liver fluke) or by a foreign body (fish bone) or by malignant disease is not infrequently met with. A descending infection by way of the systemic circulation may occur, as in the infectious diseases, but perhaps never unless the gall-bladder or ducts be already diseased. The condition of the ducts suggests that noted under catarrhal cholangitis, with the addition of the changes due to the suppurative and ulcerative processes,—destruction of the wall of the duct, abscess formation, fistulous tracts communicating with the adjacent hollow viscera, and distension of the gall-bladder with purulent contents. The entire liver is enlarged and softened, and extensive abscess formation may be found, the result of the coalescence of the smaller foci. The pancreas and the adjacent lymphatic glands are often involved. Gangrene of the wall of the gall-bladder with perforation is not unusual.

Symptoms.—In the average case the symptoms supervene upon those of a neglected gall-stone affection,—chills, fever, sweats, emaciation, leukocytosis, enlargement of the liver and spleen, pain and tenderness over the liver, and jaundice, often variable in intensity. The condition will be more especially considered in the section upon gall-stone disease.

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F. ACUTE CHOLECYSTITIS

This condition has been mentioned in the preceding section, since it is a part of the picture of acute infection of the bile passages there described. As an independent affection it is due to an acute bacterial invasion. The typhoid bacillus is probably the most frequently demonstrated causative agent, but the B. coli, the cocci of suppuration and the pneumococcus are not unusual. Gall-stones are very often present, and, on the other hand, not infrequently result from the pathological processes left in the wake of the acute cholecystitis. Parasitic invasion through the duct from the intestine is an occasional method of infection, but in a majority of cases the active agent is carried by the portal stream or the systemic circulation. The frequent association of acute cholecystitis with appendicitis is recognized, the infection presumably travelling by way of the portal circulation.

Pathology.—The wall of the gall-bladder is found in a state of catarrhal inflammation in the milder cases, suppurative infiltration, and eventually gangrene with perforation being noted in severer ones. The gall-bladder is distended with bile-stained pus, commonly held securely by the inflammatory closure of the cystic duct. Churchman found the gall-bladder distended with calcium soap in one case. The viscus is commonly sufficiently enlarged to be palpable. Gall-stones are found in probably a majority of all cases. Lymphadenitis is demonstrable.

In the more acute cases perforation into the free peritoneal cavity may occur, while in cases of less rapid development local peritonitis or abscess formation or adhesion to nearby organs is found. If no destruction of the wall of the gall-bladder occurs, a chronic empyema of the organ results.

Symptoms.—The most striking feature of the symptomatology is its extreme variability. In typhoid fever many cases of acute cholecystitis doubtless escape observation even in the hands of men of experience, since the rather inconspicuous features add but little to the picture of typhoid, especially if there be no obstruction to the outflow of the contents. In most cases, however, the rigidity

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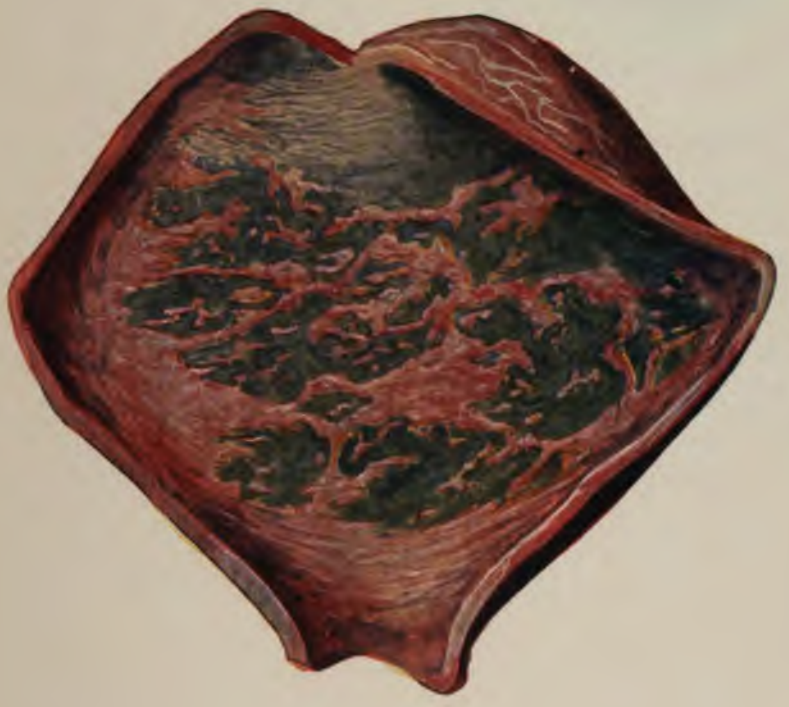

Acute Gangrenous Cholecystitis With Gall-stones.

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and tenderness of the region of the gall-bladder, the irregularity of the temperature curve, complaint upon the part of the patient of tenderness or pain, and the leukocytosis lead to its detection. The gall-bladder may be felt as an extremely tender, rounded swelling in certain cases, and rigidity of the overlying musculature is demonstrable. In the more acute cases, especially those not associated with typhoid, pain, nausea, vomiting, fever, often irregular in type, and marked tenderness and rigidity call attention sharply to the disease. The adhesions set up may partially obstruct the bowel, and gaseous abdominal distension results, increased by the spreading local peritonitis. The pain may have the characteristic radiation noted in gall-stone colic,—to the right dorsal region, especially to the right scapula; but more frequently the distribution suggests acute appendicitis, which is not infrequently suspected. It is not very unusual to find the two conditions associated. Jaundice may be present, but its absence is of no value as against the diagnosis, since it depends not upon the cholecystitis, but upon an associated involvement of the ducts.

Course.—In the milder cases, especially those associated with typhoid fever, the inflammation subsides without destructive processes involving the integrity of the gall-bladder, perhaps within one or two weeks. Such an affection is probably the most frequent source of later gall-stone formation. A chronic inflammation of the viscus persists in most cases, with a mild infection of the contents, thickening of the wall and adhesions to neighboring organs. An opaque whitish discoloration of the external surface of the gall-bladder develops, so that the condition becomes recognizable upon opening the abdomen. Exacerbations of the infection may recur over a period of many years. Inflammatory closure of the cystic duct may occur in mild cases, with distension of the gall-bladder with serous or mucous contents. Extensive matting together of adjacent loops of bowel may be found. In acute cases a pericholecystitis results from the gangrenous perforation, and either local or subphrenic abscess results. I have seen in a case of typhoid, extension to the lesser peritoneal cavity, thence through the diaphragm to the left pleura, with empyema as a final result. Liver abscess may

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occur from the extension of the process into that organ. In one case there was extensive gangrene of the liver with gall-stones free in the cavity as a result of such an extension of the acute cholecystitis.

Diagnosis.—The history is of prime importance. In many cases the erroneous diagnosis of acute appendicitis or intestinal obstruction is made. The fever, chills, pain, tenderness, rigidity, and leukocytosis suggest an acute abdominal infection. If attention be paid to the point of greatest tenderness and rigidity, and to the movements of the tumor, which can commonly be noted with respiration, it should be possible to make a correct diagnosis in a majority of cases. It is more important to make the diagnosis of acute abdominal infection upon the affected side, and to resort to early exploration, than to wait for sufficient evidence of the exact nature of the infection, since the more exact diagnosis may be purchased at the price of the patient's life. Milder cases do not call for surgical intervention, but marked pain, tenderness, and rigidity, chills, fever, and leukocytosis do not permit of delay. Gangrene may develop as insidiously as in acute appendicitis, and in case of doubt, safety lies upon the side of early exploration. The relationship between acute cholecystitis and gall-stones will be considered in the section treating of the latter condition.

Prognosis.—Most cases of acute cholecystitis subside within a week or two, tending to become mild chronic types of infection. The marked tendency to the formation of gall-stones should be recognized. The likelihood of extensive adhesions to other organs and even to consequent development of pyloric obstruction is to be considered. In the gangrenous form the outlook is extremely grave unless early diagnosis and surgical intervention be possible.

Stenosis of the Biliary Passages

The bile ducts may be obliterated through congenital malformation, or obstructed through cholangitis or hereditary syphilis. Jaundice appears early and hemorrhages, often from the navel, are a serious complication. Death commonly occurs within a few months. In the adult the cause of the occlusion may be a foreign body reach-

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ing the duct, either of the various parasites occasionally found in this region, or more commonly the extensive ulceration with cicatricial contraction, resulting from gall-stone disease. The common temporary obstruction from gall-stones is considered elsewhere. From without occlusion is of more frequent occurrence, generally from cancer of the duct, the head of the pancreas, the glands in the neighborhood, or the pylorus. The obstruction resulting in jaundice of many weeks' duration after removal of gall-stones from the common duct is often due to the pressure upon the duct of a chronic pancreatitis. In such cases the diagnosis should not be changed lightly to that of cancer, since even the most ominous ones may eventually clear up, as in a woman recently operated by Dr. W. B. Craig. I have seen a fatal result from the pressure of an echinococcic cyst. Aneurismal or other tumors may be the cause.

Symptoms.—These have been discussed under the heading Obstructive Jaundice. The primarily enlarged liver eventually shrinks and becomes darker in color, and cirrhotic changes appear.

Diagnosis.—This is based upon the finding of a chronic persistent jaundice with early enlargement of the liver, frequently pain, often of the type of biliary colic, and unless in cases of complete and permanent occlusion, fever with recurring chills. The cause of the obstruction may be inferred from the history and associated symptoms. If gall-stone colic has preceded the obstruction, it is presumably due to the lodgment of the stone in the common duct, to ulceration and cicatricial stenosis resulting from its presence, to chronic pancreatitis, resulting from the blocking, or to cancer of the bile passages or the head of the pancreas. In cases of known infection with the echinococcus the pressure of the cyst may be surmised. In malignant disease the diagnosis is commonly quite easy and certain, even though the original seat may be in the pelvis, breast or elsewhere, for secondary hepatic carcinoma is very frequently met with. The presence of a marked adenitis is often of value as signifying the malignant nature of the obstruction. Courvoisier showed that marked enlargement of the gall-bladder points rather to other sources of obstruction than to gall-stone disease, since in the latter the cystic wall is so damaged as to be unable to expand readily. In case of

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doubt the ducts should be explored, but unfortunately most of the cases offer little encouragement, since malignant disease is so commonly the cause of occlusion. The case of blocking through pressure of an echinococcus cyst might possibly have been saved by operation if seen early.

Cancer of the Gall-bladder and Bile Ducts

Cancer is present in 2 per cent. or 3 per cent. of the cases of gall-bladder disease coming to operation. In a very great majority of the cases the irritation of gall-stones is regarded as the cause of the malignancy. Women are more often affected with cancer, as with gall-stone disease, the proportion in each condition as compared with men being about three to one. The gall-bladder is much more frequently the seat of the disease than the ducts, and the base is oftener affected than the neck. In case of carcinoma of the ampulla of Vater gall-stones are but rarely found. Cancer of the biliary passages is occasionally secondary to malignant disease elsewhere.

Symptoms.—These are rarely distinguishable from those of gall-stone disease or the cholecystitis which so commonly precedes the malignant disease. Pain, tenderness, palpable tumor, jaundice, chills, fever, emaciation and associated digestive troubles are commonly present if the gall-bladder be involved. If the ducts alone be affected the tumor is due to distension of the gall-bladder. A nodular tumor signifies disease of the gall-bladder rather than of the ducts. Perforation into the peritoneal cavity may occur, or invasion of the liver, pancreas, colon, or neighboring organs.

Prognosis.—The affection is usually fatal within six months. Exploration should be made in all doubtful cases, since in no other way can the exact diagnosis be made, and because of the fact that a few cases are curable by operation.

G. CHOLELITHIASIS

Etiology.—The affection is about three times as frequent in the female sex as the male, and nearly all the women affected have borne

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children. Mayo states that in many cases the symptoms date from a certain pregnancy. Few cases are seen under 20 years of age and most occur after 35 or 40 years. It should be noted, however, that in many cases the history of attacks of biliary colic signifies that the disease began even several decades before the demonstration of the stones at operation or autopsy. Gall-stones are said to be more commonly found in certain European countries than in the United States. In great collections of statistics the figures as to the presence of gall-stones at autopsy vary between 3 per cent. and 8 per cent. Over 7 per cent. of the women operated at the Mayo clinic for uterine fibroid had gall-stones. Mayo believes that perhaps ½ of 1 per cent. of all the population are affected, but that 2 to 4 per cent. of men and 5 to 8 per cent. of women over 50 would perhaps be conservative figures. Miyake (*Archiv für Klin. Chirurgie*) believes that the infrequency of gall-stones in Japanese subjects, as studied post mortem, depends chiefly upon the fact that the women do not wear corsets, since the chief difference in statistics as to both sexes, taken from all countries, lies in the relative infrequency of gall-stones in the Japanese women.

Origin.—Gall-stones are formed under conditions in which stagnation of bile in the gall-bladder is associated with the presence of micro-organisms. The first condition is promoted by sedentary habits, certain occupations tending to prevent free exit of bile because of the constrained position assumed, pregnancy, wearing of tight corsets, enteroptosis, and, according to Kehr, obesity. The frequency of bacterial infection, especially by the typhoid and colon bacilli, is becoming more widely recognized though other suppurative organisms may be found. The infection is commonly an attenuated one, and is believed to reach the gall-bladder through the portal circulation. Infection through the ducts is probably unusual. In the severer infections of the gall-bladder the destruction of the mucous membrane prevents the formation of the cholesterin and lime salts essential to the origin of a concretion, so that gall-stones are commonly absent. The production of the substances mentioned is carried on under the influence of mild catarrhal inflammation of the mucosa of the gall-bladder and the ducts, this inflammation resulting

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from the bacterial infection mentioned (lithogenous catarrh). The typhoid bacillus has been found in pure culture in the gall-bladder 2 to 3 decades after typhoid fever, and clumps of bacilli have been demonstrated as the nuclei of gall-stones, commonly in association with epithelial debris. The great majority of gall-stones are formed

FIG. 87.—CASE OF GALL-STONES (MULTIPLE). Colon filled with bismuth from bismuth meal given one day before. Note the isolated boluses of bismuth, showing spasticity. Ileal stasis shown by bismuth still in ileum at 26th hour. Should have been empty at 10th hour. (Röntgenogram by Dr. James T. Case, of the Battle Creek Sanitarium.)

in the gall-bladder, but small, dark colored concretions devoid of cholesterin may be formed in the hepatic ducts. This fact is of much clinical interest because of the occasional blocking of these ducts by such stones after complete removal of the stones in the gall-bladder and cystic and common ducts.

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Pathology.—The gall-bladder is found in a state of chronic inflammation, generally with marked thickening, and not infrequently tightly contracted about its contents. The natural delicate blue color changes to an opaque, often whitish tint, and adhesions in some degree are commonly present. The gall-stones may be adherent or pocketed. The incrustation of the mucosa of the gall-bladder with a deposit of cholesterin is not unusual. The diagnosis of gall-stone disease should not be considered erroneous in such a case, in the absence of larger concretions. The cholecystitis may be catarrhal in character, generally chronic, but occasionally acute, and in certain cases purulent, or even gangrenous. Occasionally a cystic dilatation of the gall-bladder results from impaction of a stone in the cystic duct, or the valves in the neck of the gall-bladder, with accumulation of secretion. The walls are much attenuated and the mucosa may be destroyed. The enlarged viscus may be palpable. A chronic cholangitis of greater or lesser infectivity is a common accompaniment of the cholecystitis, and is a most important feature of gall-stone disease. The occurrence of malignant disease in over 2 per cent. of the cases should be noted.

In advanced cases the inflammation has commonly spread to surrounding tissues, and adhesions, fistulae, pylephlebitis, abscess of liver, subphrenic abscess, pancreatitis, and even general septic invasion may be present. The development of the so-called "Riedel's lobe," involving the projection of a portion of the liver in association with the enlargement of the gall-bladder, so that a tongue of liver tissue several inches in length is formed, is not infrequently met with.

The concretions vary in number from one to several thousand, a half dozen to a score being very commonly present. The single stone is commonly ovoid in shape and of a size too great to permit its passage through the cystic duct. Such a stone of 1 or 2 cm. in diameter is not infrequently found in the ampulla. If a moderate number of stones exists they commonly present facets which result from their mutual contact. Multiple stones are commonly of the same general color and appearance, excepting as they vary in size. If enormous numbers are present many of them are mere granules of

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sandy material. The color varies from a light "soapy" one to almost black, a grayish or brownish mottling being very common. Not infrequently the several layers, representing successive depositions of stone-forming material, may be distinguished. Occasionally black stones may consist almost wholly of bile pigment, showing beautiful reddish and greenish shades under the microscope. If the stone be

FIG. 88.—GALL-STONES IN GALL-BLADDER. (Röntgenogram by Dr. James T. Case, of the Battle Creek Sanitarium.)

dissolved in nitric acid a fine reticulum may be found as a base for the deposit of the cholesterin, lime salts and pigment. Cholesterin commonly forms 3-4 of the total structure of the average gall-stones.

Occasionally the stones conform to shape of the ducts in which they have long reposed, and branched stones are not unknown. In general, recently formed stones are softer, and perhaps lighter in color than older ones. Cholesterin tends to render the stone softer than the other constituents. Deaver reported that 55.5 per cent. of

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his series had stones in the gall-bladder alone; 12.5 per cent. in the gall-bladder and cystic duct; 10.5 per cent. in the gall-bladder and common duct; 6.6 per cent. in the common duct alone; 6 per cent. in the cystic duct alone; 2.8 per cent. in the gall-bladder, cystic, hepatic and common ducts, with the remaining cases scattered.

Symptoms.—Gall-stones are so much more frequently found at autopsy than recognized clinically that we must conclude that either they give rise to but trivial symptoms or that the symptoms are unrecognized. In many cases, symptoms, while certainly present, are of such a character as to fail to suggest gall-stone disease, if the clinician be on the watch for typical symptoms only. A foul breath, muddy complexion, presence of so-called "liver spots," severe constipation, more or less continuous indigestion and various indefinite complaints, are frequently present. An inability to fully depress the diaphragm because of pain is not infrequent. It is perhaps most satisfactory to place the symptoms under two headings: (a) those relating to the gall-passages directly; (b) those resulting from reflex irritation of other organs.

(a) Direct Symptoms of Gall-stone Disease.—(1) *Symptoms of Mechanical Origin.*—In this class we shall speak first of biliary colic. This is commonly described as being due to the mechanical blocking of the cystic duct, common duct, possibly occasionally the hepatic duct, by stone. In a typical case a stone sufficiently small to enter the cystic duct arrives at the entrance, perhaps through the influence of the attempted emptying of the contents of the gall-bladder, especially shortly after a full meal, but not infrequently while the patient is in a recumbent posture, as if it had fallen into the neck of the gall-bladder from the posture assumed. Spasm of the duct presumably results, so that the symptoms of colic appear almost instantly. That the pain is not due to the actual passage of the stone in all cases must be assumed from the study of the numerous cases in which a rounded stone is found alone in the gall-bladder, yet perhaps hundreds of attacks of biliary colic have occurred. In one case just operated upon, we found such a stone, yet the history of frequent attacks of biliary colic was very clear, and extended for a period of over 25 years. I believe all of the attacks

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came from the same stone, which presumably never fully entered the duct, but fell back as the spasm relaxed and awaited another opportunity. It seems scarcely possible that biliary colic can occur perhaps almost weekly, for a decade or a score of years without ever an attack of jaundice, unless it be that the stone, or stones, have never been able to reach the common duct, yet such histories are common. In case of a smaller stone its size permits it to fully enter the duct, when trauma and resulting inflammation are added, as causes of pain. Probably more important than anything else is the obstruction of the duct, with spasmodic attempts of the gall-bladder to empty itself, with still further stretching by retained secretions, yet jaundice does not result since the main track is still open from the liver to the bowel. In a few cases, however, inflammation about a large stone, which has entered the cystic duct, perhaps by a process of gradual stretching, may involve the hepatic or common duct and produce jaundice. As the stone descends it arrives in the common duct and, if of fair size, jaundice commonly develops. Yet in perhaps a fourth or a third of the cases it is wanting, as bile escapes around it in sufficient quantities to prevent the holding back of the flow from the liver. Here the stone is believed to take a rotary course because of the presence of the Heisterian valve and the sensitive mucous membrane of the duct is bruised and stretched, becomes swollen from the trauma, and not only the gall-bladder, but the liver itself is stretched and over-distended by the retained secretions.

The pain of gall-stone colic is commonly sudden in development, and in many cases ends abruptly after a period of a few minutes to several hours, even days. The abrupt ending is thought to signify the dropping back of the stone from the entrance of the cystic duct into the gall-bladder, or its escape from the common duct into the bowel. The pain is agonizing in character in the typical cases, said by many women who have experienced both kinds, to be worse than the pains of labor. It is first felt in the epigastrium or to the right of the center, and commonly radiates to the back, and more especially to the right scapula. It occurs in paroxysms, but without full relief in the intervals. In many cases the patient speaks of the pain as being of a "distention type" as if, as one patient described it, "a rub-

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ber bag in the gall-bladder region were being blown up with a tire pump." I have come to regard this particular type of pain as being as characteristic as the radiation of pain to the scapula. The patient bends forward, either holds the breath in agony, or groans with the pain, commonly vomits, not infrequently has a chill, and in most cases, sweats freely if the attack be prolonged. Rapid pulse, weakened in its volume in severe cases, and prostration, are noted, and even collapse and death, in very rare cases. Convulsions have been noted. The duct has been found ruptured in cases fatal from peritonitis.

In many cases the paroxysms are less severe but recur with frequency over a period of hours or days, giving rise to the inference that the stone is lodged in the duct. Jaundice may appear, giving rise to such a conclusion, and persist after the colic has practically disappeared. The distress and pain of a continued rather than of a paroxysmal character in such cases are probably due to the associated inflammatory changes and possibly infection, rather than the causes mentioned as being active in acute colic. In this type of the affection dilatation of the heart from exhaustion, and not rarely a mitral systolic murmur may appear, the latter being presumably due to a relative insufficiency at the mitral orifice.

The jaundice of biliary colic is often transient, lasting but a few days, but in case the stone become impacted, may last for weeks. It should be noted that deep jaundice may be present for months in case of stone in the common duct, without the slightest pain, but such cases are rare. Jaundice occurs in probably half of the cases. The chilly feeling or definite chill of the attack may be accompanied or followed by a sharp rise in temperature, perhaps to 103°.

Upon examination there are found tenderness and rigidity in the region of the gall-bladder, and not infrequently definite enlargement of the liver and occasionally of the spleen. If the gall-bladder has not been so compromised by previous cholecystitis or adhesions as to destroy the capacity for expansion, it is commonly palpable, and may become very large. If the pancreas be affected by the obstruction of its flow by a stone in the ampulla, or, as mentioned by Opie, by the entrance of bile into its ducts, pain may be felt to the left of

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the epigastrium, and deep tenderness may be detected. The urine is often albuminous, and red cells may be found in the sediment. If jaundice be present, hyaline and granular casts are often found, frequently stained with bile. Glucose is an occasional finding. In cases complicated with jaundice, and frequently in others, even of brief duration, the stone may occasionally be recovered from the feces by use of a sieve after stirring up the stool in water. The stone recovered may indicate by the presence or absence of facets the likelihood of the passage of other stones or of their presence in the gall-bladder. In the vast majority of cases no stone is to be found, for in but a relatively small number is the colic "successful," the stone dropping back into the gall-bladder in a greater number of cases. In others as we shall see, the colic is not due to the passage of a stone. Conversely the stone may pass with but little pain and that rather a distress than a colic.

In many cases of biliary colic the belching of gas from the stomach is a prominent feature, with some accompanying relief. Patients frequently remark that they "would feel better" if they "could only belch." Gall-stone colic cannot be differentiated from other varieties of biliary obstruction. Perfectly typical attacks occur in duodenal ulcer (*See* Duodenal Ulcer), and in case of blocking of the duct by a parasite. In one case the kinking of the duct by the descent of a movable liver was the obvious cause of repeated attacks of colic, which disappeared permanently after correction of the hepatoptosis by operation. A false biliary colic is occasionally seen in neurotic women, often in connection with an emotional cause. The true characteristics of biliary colic are wanting. Gall-stone fremitus may occasionally be detected by palpation or with the stethoscope or even felt by the patient.

With or without biliary colic there may be other results due to the mechanical effects of the stone. It may ulcerate through the gall-bladder, adhesions having previously taken place, and enter the small bowel, the colon, stomach, or other neighboring viscera. In rare cases the presence of a duodenal ulcer has been attributed to the influence of the disturbance in nutrition of the duodenal wall through the pressure of a large stone. The small bowel occasionally becomes

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obstructed by a stone, reaching it through ulceration, and perhaps as the result of passage through the common duct without ulceration.

As the result of impaction of a stone in the cystic duct there may be notable distention of the gall-bladder, at first with bile and mucus, but finally with a mucous fluid alone. The contents may of course become infected, but are commonly thin, albuminous, and alkaline or neutral in reaction. The distended viscus may even be mistaken for an ovarian cyst, though commonly its position in the upper right abdomen, its characteristic shape with the neck upwards, and the history of colic or jaundice, suffice for the diagnosis. Courvoisier's observation that dilatation of the gall-bladder is more common as the result of obstruction by cancer or other condition than from stone, should be borne in mind.

(2) *Symptoms of Infectious Origin.*—These may be of most varied character. Infection of the contents of the gall-bladder, or the ducts, notably the hepatic duct, occurs through the blood stream, or by extension upward through the common duct, and naturally more easily if the flow of bile be interfered with. Colic is one result of such infection, and in a considerable proportion of cases of biliary colic, supposed to be due to stone, no calculi are found, but products of infection are present. An acute cholecystitis may thus mimic true calculous colic, and the changes described under the appropriate section, may follow. Empyema of the gall-bladder or suppurative cholecystitis is an occasional complication of gall-stone disease. The gall-bladder becomes distended with pus, which may perforate the wall, and give rise to abscess or other complications. Subphrenic abscess is an occasional result.

Chronic cholecystitis is a more frequent complication of cholelithiasis. A low grade of infection remains for years in the gall-bladder and the typhoid and colon bacilli especially may be present. As a result of the long-continued inflammation the gall-bladder wall becomes thickened and often adherent to the pylorus, bowel or other nearby organs. In many cases the gall-bladder shrinks down over a single stone which it contains until it fits so tightly as to immobilize the calculus, and not infrequently several stones are held tightly in apposition by a similar process. If the stones have been passed be-

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fore the atrophic process has been completed the gall-bladder may shrink into a mere nodule of fibroid tissue. Not infrequently a diverticulum exists perhaps containing a stone which may easily be overlooked.

The chronic cholecystitis associated with gall-stones may be catarrhal in character, with erosions of the apices of the villi as described by McCarty (strawberry gall-bladder), and in other cases, a papillomatous or a malignant degeneration is noted. The mucosa may be infiltrated with salts of calcium or a virtual ossification of the whole wall may occur, especially as a sequel of suppurative cholecystitis. In the ducts the infectious process may be even more serious. In case of mechanical obstruction due to the lodgment of the stone in the cystic duct, the gall-bladder and the duct may be dilated and filled with mucus, clear or bile stained, with a mild type of infection. In the common duct a series of stones may be found, but more commonly a single rounded calculus with evidence of its having been imbedded or the more typical ball valve stone in the diverticulum of Vater. As a result of the partial obstruction and the infection cholangitis arises and extends upward into the hepatic ducts. The bile passages become much dilated, but the gall-bladder, as mentioned elsewhere, often escapes. In this type of mildly infective cholangitis, the mucosa of the ducts and gall-bladder is not seriously damaged.

A much more serious type of infection is the suppurative cholangitis with ulcerations of the mucosa, the presence of pus in the ducts and the gall-bladder, and not infrequently disseminated abscesses in the liver, originating from the suppuration in the ducts. These abscesses may coalesce, or may break into various viscera, as mentioned under pathology. The liver enlarges in these cases, in part from the distention of the ducts and in part from the associated congestion. It is tender upon sudden "bumping." As a result of the infection in the bile passages inflammation of the serous coat ensues with adhesions, which still further compromise the function of the parts affected, or of those which become adherent. More than half the cases of gall-stone disease coming to operation have such adhesions, and they constitute reliable evidence of pre-existing inflamma-

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tion. The frequency of partial obstruction of the pylorus and duodenum from such adhesions deserves mention.

As a result of the chronic infection and distention which often accompany it a tongue of liver enlarges with the gall-bladder, the so-called Riedel's lobe. It may be diagnosed during life in a considerable proportion of cases. The infection in the ducts causes fever, which is absent when only mechanical obstruction exists. It is therefore important to record the temperature at frequent intervals, in case of obstruction in order to note the advent of infection. This may be a mild, more or less continuous fever in cases of mild infection, and intermittent in case of partial obstruction, typically by a ball-valve stone (hepatic intermittent fever), or a type of remittent fever, in the cases of definite suppurative cholangitis. The first variety may continue for months without chill or other evidence of sudden increase in the virulence of the infection.

The hepatic intermittent fever is characterized by a group of symptoms so sharply defined that there is no longer an excuse for the administration of quinin, as has so often been carried out in the past under the erroneous diagnosis of ague. The recurrence of chill, fever and profuse sweats, strongly suggests malaria, but in addition there are definite signs of liver disease. Pain over the hepatic region is present and the liver becomes enlarged and tender, digestive disturbances are present, and, more significant than any other feature, jaundice of varying intensity. With the onset of the paroxysm this deepens, to become less marked in a few days as the infective type of obstruction lessens and bile escapes more freely into the bowel. The continuance of these paroxysms over months or years without actual suppuration within the duct, or the liver, is an extremely interesting phenomenon. In no other condition is definite suppuration so strongly suggested with so reasonable a preservation of the general health and strength. Even the attacks of severe pain, nausea, and vomiting which are commonly present do not seem to exhaust the patient, as one would expect. Osler believes that the paroxysms occur only when a certain degree of tension develops within the biliary passages. A remarkably good condition exists between the paroxysms, the temperature becoming normal, the appetite returning,

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and the patient frequently believing that at last he is on the road to recovery. The gall-bladder does not commonly enlarge, regardless of the degree of obstruction. In case suppurative cholangitis develops the fever is more persistent, remitting rather than intermitting and the periods of comparatively normal temperature and general improvement, noted in the last mentioned condition, are absent. The patient presents a muddy, jaundiced color, rather than the sharper and clearer jaundice of the paroxysms of the intermittent infection, and this is not so subject to variation as in the latter condition. The suppuration within the liver causes marked enlargement and tenderness, leukocytosis is commonly high, and the patient finally dies of a gradually deepening septicemia.

The diagnosis as to the location of the stone, and the degree of the infection in case this be present is of importance. In the cystic duct the stone frequently gives rise to repeated paroxysms of colic, but without jaundice or fever. These patients are eating and at work as usual the next day, in sharp contrast to those with serious infections. The passage of the stone into the common duct brings generally an attack of jaundice, with prolongation of the pain. The lodgment of the stone in the cystic duct gives rise to tenderness and moderate pain, rather than to jaundice and septic accidents, as in the case of lodgement in the common duct. Ulceration through the duct into neighboring viscera may occur, but is more common in case of involvement of the common duct. In the latter situation there is generally jaundice, permanent and gradually increasing in depth if the obstruction be complete, but in other cases intermitting as variations occur in the degree of infection, and of swelling of the mucosa. Yet in a considerable percentage of cases of common duct calculi jaundice is absent throughout.

Fever is much more frequently met with in common duct involvement, since infection is so much more constantly present. The general symptoms are more severe, interference with appetite and digestion are prominent, and pain, sour stomach, belching and constipation are often troublesome. If the stone be in the diverticulum of Vater the duct of Wirsung is often blocked, and in case of absence or noncommunication of the duct of Santorini, the symptoms of pan-

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creatic obstruction are added. Mayo found chronic pancreatitis in 18.6 per cent. of the cases of gall-stone disease in which the common and hepatic ducts were involved. The organ becomes hardened by the inflammatory process, and has often been mistakenly believed to be cancerous. The danger of acute hemorrhagic pancreatitis in case of flow of bile into the pancreatic duct should be considered. The stools become more fatty and more bulky than in case of simple obstruction of the bile ducts, and free fat floats upon the surface. In the absence of grave infection of the passages the liver is not notably enlarged and the spleen remains of normal size. Obstruction from other cause than stone is more complete and continuous as a rule, and the jaundice is thus permanent, tending to become gradually deeper. If obstruction of the common duct lasts for over a year the presumption is entirely in favor of stone as the cause. The further symptoms associated with permanent and with intermitting obstruction have been sufficiently detailed.

(b) Reflex Symptoms of Gall-stone Disease.—These are very commonly referred to the stomach. Many cases of persistent hyperchlorhydria are instantly cured by the removal of stone, even of the cystic variety. Not rarely we find a chronic gastritis, with presence of decreased acidity and marked increase of mucus in the stomach contents. Pyloric spasm with gastrectasis is a frequent result of the chronic irritation. Frequent dyspeptic attacks should always suggest examination for tenderness and rigidity in the region of the gall-bladder, and a searching inquiry for a history of jaundice, colic or chills. A feeling of distention, often gaseous in character, nausea, chilliness and "heaviness" in the epigastrium are often mentioned by the patient with gall-stone disease. In not a few cases obstinate attacks of palpitation, tachycardia or other functional cardiac disturbances are found to be due to cholelithiasis. No examination of the heart is complete under such conditions without an inquiry as to colic and jaundice, and a careful examination for rigidity, pain or tenderness in the region of the gall-bladder. A chronic myocarditis may eventually develop. Itching, urticaria, and the development of xanthomata should always lead to investigation as to this affection. The latter condition is occasionally found in the gall-passages.

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Complications and Sequelæ of Cholelithiasis.—The mechanical and infectious results of the affection so far as the biliary passages are concerned, need no further consideration at this time. The rupture of the distended gall-bladder or ducts into the peritoneal cavity is not uncommon, the process resulting from an acute, septic, gangrenous process, or less frequently, from a chronic ulcerative one, or rupture of an abscess not permanently walled off. Subphrenic abscess may occur. The rupture of the biliary passages or a secondary abscess may take place into the stomach, with vomiting of pus, bile, or gall-stones, although the latter may enter the stomach by way of the pylorus. Rupture into the duodenum is much more frequent than that into the jejunum or ileum. In certain cases the communication is into the colon. The discharge of a large number of gall-stones simultaneously is significant of rupture of the gall-bladder into the bowel. In one of my cases 175 stones were passed per anum in one day. The bowel may become obstructed at once by a large stone, or late secondary obstruction may develop as a result of cicatrization after healing of the ulcer. Permanent fistula may remain in connection with any of the varieties of perforation mentioned. More than half of all biliary fistulæ are cutaneous (184 out of 384, Naunyn). The falsiform ligament leads the abscess to the vicinity of the navel in most cases. The pus may burrow downward and suggest the type of suppuration occasionally seen in connection with appendicitis, or ruptured duodenal ulcer. Rupture communicating with the pleura or lung, and even giving rise to evacuation of gall-stones through the bronchi is rare, but most cases of bronchobiliary fistula are due to this cause. The communication probably takes place through the intermediation of a subphrenic abscess in many cases. Communication with other portions of the biliary tract, the portal vein, hepatic artery, pericardium, urinary passages, or retroperitoneal space is occasionally recorded. Intestinal obstruction by gall-stones has been mentioned in the appropriate section. The ileum is the favorite site of lodgement. Spontaneous recovery may occur after a stormy course. The stone has usually reached the bowel by ulceration into an adherent loop, but in certain cases enormous dilatation of the common duct has permitted the stone to enter the duodenum. The finding of

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a gall-stone in the appendix is a not very unusual event, as in a recent case operated by Dr. I. B. Perkins.

Most serious of all the complications and sequelae of gall-stone disease is the development of carcinoma of the gall-bladder or ducts, usually after years of chronic irritation. The fact that this occurs in between 2 to 3 per cent. of all operative cases suggests the desirability of earlier operation, since the operative death rate under good conditions is less than that from this complication alone.

Diagnosis.—The diagnosis of typical biliary colic is easy, if one recognize the usually sudden onset, frequent sudden termination, the "pressure-pain," chill, vomiting and radiation to the back and right shoulder. The advent of jaundice renders the diagnosis practically certain. Unfortunately the symptom-complex of acute cholecystitis closely resembles that described, so that great departure from the classical picture justifies doubt as to the cause of the attack. The paroxysmal pain of duodenal ulcer is sometimes indistinguishable in my experience, and perhaps because it may be commonly due, as it certainly is in some cases, to actual biliary obstruction. The finding of rigidity and tenderness over the gall-bladder is significant. The characteristic radiation of pain in urinary calculus, supported by the urinary findings, prevents error in this direction. Appendicitis may be the cause of confusion, especially in those cases, of which I have seen several at operation, in which the appendix is actually attached to the gall-bladder. The region of greatest pain, tenderness and rigidity is lower in the abdomen and not infrequently further to the right than in gall-stone colic. Lead colic, ordinary intestinal colic, and gastric crises of tabes are recognized by attention to the history and examination for their characteristic features. There is more danger of failure of recognition from forgetting to consider them than from any especial difficulties in differentiation. The X-ray is of some assistance in the recognition of gall-stone disease since the shadow may be sufficiently deep to be distinguishable through that of the liver. The distortion of the small bowel and the pyloric end of the stomach, as shown in the bismuth plate, may disclose adhesions due to peri-cholecystitis. Cancer is commonly accompanied by progressive failure in strength and

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weight, by more permanent jaundice, by tumor, often nodular, adenitis and cachexia. Metastasis to the liver, as shown by the development of tender nodules at a distance from the gall-bladder, is practically pathognomonic. The development of so-called "black jaundice" strongly suggests cancerous obstruction of the ducts. There is less likelihood of intermittency in the jaundice, and of hepatic intermittent fever, in cancer than in gall-stones.

In two cases the surgeon has had the utmost difficulty in finding the gall-bladder, because of its being hidden in the depths of the fissure by the liver tissue. In both cases, fortunately the history of gall-stone colic was so absolutely clear that persistent exploration revealed the gall-bladder, and in each case a single stone was removed successfully. In one secondary hemorrhage from the damage to the liver tissue was a feature, but without serious danger.

Indications for Surgical Intervention.—(a) The indication for exploration is absolute in acute suppurative cholecystitis with the characteristic fever, chills, leukocytosis, pain rigidity and tenderness; (b) perforation of gall-bladder or ducts; (c) chronic obstruction of the cystic duct; (d) chronic obstruction of the common duct; (e) in abscess about the gall-bladder and subphrenic abscess; (f) when the presence of tumor first suggests malignant disease; (g) when sepsis begins; (h) when the condition, whatever its character, renders the patient unfit to work or live in comfort; (i) when food stasis and gastrectasis indicate that either pyloric spasm or adhesions have compromised the ability of the stomach to discharge its contents; (j) when in case of doubt jaundice has persisted for a month; the danger of hemorrhage in operation if longer delay occurs should be considered; (k) when intestinal obstruction occurs. The prognosis is better in accordance with the promptness of action in such obstruction.

Operation is advisable but not imperative in the case of any patient in whom the attacks of colic, especially if any acute infection has been present, have occurred sufficiently often to suggest that a chronic infection, with periodic exacerbations, is present. If the attacks be of moderate severity, a year or two apart, unaccompanied by fever, tenderness, rigidity and jaundice, and if the digestion be not disturbed, delay is perhaps justifiable for a time, but such cases are

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unusual. If facilities for the attainment of the best operative results are available, even these cases are probably better operated early than late, for practically all of the dangers of the operation are associated with delay. Infection, descent of the stones into the common duct, formation of adhesions, ulceration, perforation, cancer, subphrenic abscess, dilatation of the stomach, and general nutritional failure, may all be avoided in most cases by early operation before the symptoms have become severe.

In case of doubt the decision should always be in favor of intervention. The tendency is more and more toward early operation and avoidance of the complications of advancing disease—a plan which has done so much to improve the results and decrease the mortality in the case of the appendix. The contrast between the light mortality at the Mayo clinic and the admittedly high mortality in Kehr's clinic is to be explained largely by the probably earlier and thus better diagnosis in the former, and by skillful operation at a time when serious complications, which are the cause of high mortality in gall-bladder surgery, are largely absent. Mayo's operative mortality was 2.75 per cent. in 4,000 cases, while Kehr's was 15.5 per cent. in 720 cases. The mortality is steadily decreasing with improvement in technique and especially with earlier operation. If the disease be confined to the gall-bladder, the mortality is practically nothing under the best operative conditions, while involvement of the common duct raises the mortality to 8 per cent. Cancer, cholangitis, long continued jaundice, and other complications render the operation very dangerous. The opportunity for avoiding the increased risk of cholecystectomy and saving this unfortunate organ by early operation is rigidly emphasized by Mayo.

The operation is more or less definitely contra-indicated by advanced age, nephritis, pulmonary or cardiac disease, marked arteriosclerosis, and by extensive cancer, or ascites, often dependant upon cancer or upon involvement of the portal vein.

Prognosis.—In biliary colic the outlook is good, but with the possibility of rupture of the duct, collapse or other accident. Rupture of the biliary passages is commonly fatal unless early operation be done. The outlook in case of intestinal obstruction is dependent

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upon the promptness of intervention. Phlegmonous cholecystitis is fatal without operation, and suppurative cholangitis in any event.

In case of hepatic intermittent fever the prognosis is good if operation be not too long delayed. In adhesions the completeness of recovery depends upon their extent and location. The possibility of reformation of stone exists, but it is very rare, only 3 cases in 4,000 at the Mayo clinic. It is much more common to have recurrence of symptoms from stones left in the common or hepatic ducts. Concretions occasionally occur around silk sutures left in the gall-bladder.

H. THE CIRRHOSES OF THE LIVER

(1) Hypertrophic Cirrhosis

(*Hanot's Disease, Biliary Cirrhosis.*)

This type was first clearly differentiated by Hanot.

Etiology.—Males are affected in the great majority of cases. The incidence is mainly in the third decade and it is very unusual after the fourth. A juvenile type is decribed in children and is said to be especially found in India. The most striking feature as to the etiology is the absence of any known cause. If the so-called hypertrophic types of cirrhosis noted in syphilis and in the early stages of alcoholic cirrhosis, the fatty cirrhotic liver and the large liver of hemochromatosis described elsewhere be excluded, a group of cases of unrecognized causation remains to which the term biliary cirrhosis is applied. A radicular cholangitis of infectious origin is thought to lie at the origin of the cirrhosis but the nature and origin of the infection have not been demonstrated. The fever, adenitis and leukocytosis seem to point toward its infectious nature.

Pathology.—The enlarged liver weighs from two to four kilograms. Its surface is smooth or finely granulated, and its consistency increased. The olive green or yellowish green color is especially notable upon section. The trabeculæ of connective tissue are wider than normal. The radicles of the bile ducts are involved in a cholangitis, with proliferation and desquamation of the epithelial cells. The larger biliary passages, the gall-bladder, and the blood vessels

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of the liver are little affected. The spleen is much enlarged and in children may even exceed the liver in weight. All the organs are stained with bile. Moderate enlargement of the lymphatic glands in and near the portal fissure is common, but no pressure is found upon the bile ducts as a rule.

Symptoms.—A slight and variable jaundice is perhaps the most striking and characteristic feature of the disease. The tendency is to become more marked as the disease progresses. Contrary to the rule in many varieties of jaundice, the bile enters the intestine freely enough to produce normally colored stools, or they may be even darker in appearance than usual. Yet the skin and urine are stained with bile. Itching is often present as in other varieties of jaundice; and eczema, xanthoma, telangiectasis and purpura may develop. A marked feature of the disease consists of recurring attacks of pain in the hepatic region, associated with increase of jaundice, with leukocytosis, and not rarely with nausea and vomiting. A temperature of 102° may be present even for several weeks. Occasionally delirium and high fever are associated with the attacks of pain, and the patient may die in coma. Diarrhea is occasionally noted.

FIG. 89.—HANOT'S CIRRHOSIS OF THE LIVER. Note bulging.

Physical Examination.—Physical examination reveals a very large liver, smooth and not especially sensitive to touch. The enlargement of the abdomen, the protrusion of the ribs upon the right side or, in case of notable enlargement of the spleen, upon both sides,

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presents a picture rather characteristic of the disease. The hard edge of the liver may be easily felt, and the spleen is commonly palpable and more firm in consistency than in other conditions. A moderate shrinking of the liver may be noted late in the course of the disease, due to contraction of the new-formed connective tissue. The absence of obstruction of the bile ducts accounts for the usual absence of distension of the gall-bladder. The usual absence of ascites is a notable feature of biliary cirrhosis. Sweating in the axillae and groins is occasionally noted. The caput medusae of alcoholic cirrhosis is absent. In certain of Osler's cases deformity with depression of the right shoulder occurred. Progressive weakness, moderate anemia, dyspnea, dilatation of the heart and death from exhaustion or some complication may be expected. The course may extend over five to ten years. Death from hemorrhage has been noted. The urine frequently presents albumin and bile-stained casts, and leucin and tyrosin have been reported.

Diagnosis.—The other types of hypertrophic cirrhosis may be excluded. In the presence of marked hepatic enlargement, especially in young males, with enlargement of the spleen, jaundice, "bilious" instead of acholic stools, fever, attacks of abdominal pain, and progressive weakness and a long chronic course, the diagnosis is usually easy and dependable.

Prognosis.—The outlook is hopeless as to cure, but remissions are not very infrequent, during which the patient is very comfortable. The advent of high fever and delirium with increase of jaundice and especially with hemorrhages is of grave omen.

(2) Alcoholic Cirrhosis

Etiology.—It is found chiefly in males of middle age who have been addicted to the use of strong liquors, especially taken upon an empty stomach. It is notorious that periodical drinkers are much less subject to the disease than steady topers. Beer is rarely the cause. In France the disease is frequently attributed to the dry wines. I have observed a case confirmed by abdominal exploration, in a baby of less than two years which had been fed upon whiskey from the day of its birth. The enlargement was so marked as to lead

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to a suspicion of sarcoma of the liver or right kidney. (Case of Dr. I. B. Perkins.)

The fatty atrophic form is said to occur rather from the use of malt liquors.

Pathology.—The liver in the typical form of alcoholic cirrhosis is found at post mortem examination to be decreased in size, its weight being less than half the normal; yet it is not infrequently markedly increased in size in the early stages, and in a large proportion, at the time of death, the organ is above normal weight. The surface is typically "hobnailed," islands of liver tissue projecting from the surface surrounded by wide bands of connective tissue. These protuberances may even attain one or two centimeters in diameter, and project so far as to be palpable through the emaciated belly wall. The yellowish color of the liver is very striking in many places. The process may be generally distributed or to some extent localized, as chiefly to a single lobe. A proliferating, adenomatous process may be present.

Ascites is usually present at post mortem examination, with opacity of the peritoneum. Notable enlargement of the spleen is the rule, chiefly congestive in origin. Terminal peritoneal tuberculosis is present in a considerable proportion of the cases. An interstitial pancreatitis is occasionally demonstrable, and interstitial nephritis is a frequent concomitant lesion. Microscopically many hepatic cells are found to be destroyed. Marked increase of connective tissue is seen, the finer branches of the hepatic artery are dilated, while many small hepatic veins may be obliterated. The portal venules, especially between the lobules, are frequently compressed and thrombosed, while the larger ones are often dilated. The normal anastomotic communications between the portal system and the systemic circulation are commonly dilated, giving opportunity for a part of the portal blood to reach the inferior and superior venae cavae without the necessity of passing through the portal capillaries. The communication is most easily demonstrable between the veins of the peritoneum and those of the wall of the abdomen; the superior hemorrhoidal veins and the middle and inferior hemorrhoidal veins, tributary respectively to the inferior mesenteric and the internal iliac

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veins, esophageal veins and veins of the stomach; and various veins more directly connected with the liver.

The caput medusae results from the dilatation of the veins about the navel, belonging to the mammary and epigastric distribution, through their communication with an umbilical or para-umbilical vein, or vessels coming forward from the liver in the round or suspensory ligaments. Many of the symptoms of hepatic cirrhosis are dependent upon the mechanical modification of the circulation and upon admission to the general circulation of the portal stream unmodified by the action of the liver.

Symptoms.—There are rarely any evidences of the disease until failure in the collateral circulation occurs. I found advanced cirrhosis at autopsy in case of death from acute infection in the case of a physician of bibulous habits, whom I saw daily, and who presented no symptoms suggestive of the disease. Moderate loss of weight and easily induced fatigue may be noted. The preliminary enlargement of the liver from congestion may be detected, and during a patient's stay in the hospital the size of the organ may be noted to decrease greatly until it is smaller than normal. The morning vomiting of the chronic mucous gastritis of alcoholism is so frequently a preliminary feature as to deserve attention, this symptom being in part dependent upon the portal obstruction characteristic of the affection.

The obstructive symptoms due to the holding back of the portal circulation give rise to practically all of the physical signs of cirrhosis of the liver. The whole portal system is engorged and hemorrhage is frequently a result. Sharp and sudden hematemesis is not infrequent, and blood-stained vomitus is very common. Some of the most severe attacks of hematemesis are found at autopsy to have originated from much dilated esophageal veins in association with hepatic cirrhosis.

The stools not infrequently show fresh blood or the black discoloration characterizing intestinal hemorrhage with retention of the blood in the bowel for a time. Hemorrhoids are very frequently present. The spleen may enlarge as a result of the passive congestion, although in certain cases a toxic origin is believed to exist.

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It may be found to be much decreased in size after free diarrhea, hemorrhage, or in connection with renewed ascitic effusion after tapping.

The superficial abdominal veins are often much enlarged and the caput medusæ mentioned is fairly characteristic of the disease.

As a result of the congestion and the chronic alcoholic gastritis, failure of digestion occurs; and coated tongue, bad breath, tympanites and constipation, perhaps alternating with diarrhea, are present. In the peritoneal cavity an accumulation of serum occurs, and not infrequently the development of ascites constitutes the first definite indication of the disease. It is apparently a transudate from the engorged vessels in certain cases, but may depend upon a chronic peritoneal inflammation of low grade. This may be tuberculous in nature, although the exudate is generally sterile. The fluid is commonly straw-colored, but may be chyliform or hemorrhagic. It varies in amount up to several gallons. After tapping, the abdomen commonly refills very quickly, and a rapid failure in general condition is not rare after the first removal of the fluid. The moderate edema of the feet often seen may disappear temporarily with the paracentesis, but commonly reappears in a few days. Repeated tappings are very unusual in cirrhosis without chronic peritoneal involvement. After the removal of the ascites by the tapping, the liver may commonly be felt and is generally decreased in size at this time, the left lobe being especially affected. An increase in size by no means negatives the diagnosis of cirrhosis, for in many cases enlargement persists through the course, especially in cases of fatty cirrhosis. In very thin subjects the hobnail surface may be palpable. The spleen is generally hard, moderately enlarged and easily palpable after the tapping. The face is usually sallow, and the so-called "facies hepatica" is frequently very suggestive. Actual jaundice occurs in a third or a fourth of the cases, depending upon the obstruction of the gall-passages. Angiomata and "mat" nævi have been especially mentioned by Osler. The urine is commonly decreased in amount, frequently albuminous, and the sediment frequently shows a number of bile-stained hyaline and granular casts, presumably due chiefly to the irritation of the ex-

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creted bile. The blood shows the usual changes of a secondary anemia. Dependent upon the anemia and the myocardial failure, there may be cardiac murmurs, but not infrequently the cardiac involvement is so marked a feature that the murmurs are to be regarded as those of relative leakage rather than as of hemic origin. The epigastric venous hum, occasionally with definite thrill, is believed to originate in the veins of the falciform ligament. A venous murmur may be present over the spleen. The pulse may be slowed in jaundice but commonly becomes weaker and more rapid as the disease advances. A slight elevation in temperature is not unusual. Rapid respiration is frequently due to the cardiac failure mentioned, but is often mechanical in origin and due to the extensive ascites. It may in other cases be toxic.

The toxic symptoms of cirrhosis are commonly later in appearance than those due to obstruction. Mental hebetude is in part toxic, but largely of exhaustive origin. Restlessness, headache, stupor, coma and even delirium and convulsions may be noted. The resemblance to uremia is often very great. Jaundice is not a necessary accompaniment, and the toxic symptoms are evidently dependent upon a simple cholemia.

Diagnosis.—The history of alcoholism is generally present, or evidences of the addiction are apparent. In the presence of the characteristic facies hepatica, with loss of flesh and strength, a notable change in the size of the liver, either an increase or decrease, a palpable spleen, the digestive symptoms mentioned, and hemorrhage of any of the varieties described, the diagnosis is reasonably established, and is rendered practically certain by the appearance of the ascites. The enlarged liver of chronic cardiac disease should be easily differentiated, and of the dropsy of this condition and of nephritis the same statement may be made. The occurrence of tuberculosis of any of the serous membranes is sufficiently frequent to add to the probability of the diagnosis in any given case. A sudden increase in the ascitic fluid suggests portal thrombosis, well recognized as a frequent complication. Syphilitic cirrhosis gives rise rather to a nodular than a hobnail liver, and the history and the possible presence of the Wassermann reaction are to be investigated. The

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therapeutic test is indicated in case of doubt. The hematemesis is frequently profuse, as in gastric ulcer, but rarely accompanied by the high acidity so frequently found in ulcer, but rather by the signs of a chronic gastritis.

In abdominal operations the value of the inspection or the mere palpation of the liver when accessible is not to be overlooked, as I have repeatedly seen the diagnosis made by these means before the advent of any definite symptoms when other conditions required exploration.

Prognosis.—The patients commonly die within a few months after the diagnosis is made, especially if ascites be present. A not inconsiderable number, however, through the establishment of a sufficient collateral circulation, may live in comfort even for several years. A few cases have practically recovered for the time from operative intervention, designed to bring about a better collateral circulation. Although the occasional cases do well with repeated tappings, the average hospital case rarely long survives the first or second. Alcoholics seen in the stage of congestion, with chronic gastritis, which so often precedes atrophic cirrhosis, may often be restored to health by the abandonment of the use of alcohol, and appropriate medication. There is no certainty in any given case, however, that cirrhosis would have ensued.

(3) Capsular Cirrhosis

(*Glissonian Cirrhosis*)

The process represents in the capsule the same connective tissue increase which in the substance of the liver gives rise to hepatic cirrhosis. In many instances the absence of any interstitial change in the liver itself is very striking. The capsule is thick, fibrous and contracted, destroying some of the liver cells, and decreasing the size of the organ. The capsule of the spleen and the peritoneum are in a state of chronic inflammation in the majority of cases, and chronic interstitial nephritis is commonly present. Indeed, capsular cirrhosis is regarded as dependent upon it by some authors. Syphilis is looked upon as causative in certain instances.

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Symptoms.—In the more typical cases they are those of ordinary alcoholic cirrhosis, from which there are no diagnostic criteria excepting that the course is more chronic in many cases, many tappings of the abdomen being requisite for relief of the ascites. Improvement under antisyphilitic treatment is suggestive of this variety of cirrhosis. The occurrence of ascites in chronic interstitial nephritis is thought by White, in the absence of jaundice, to point toward it.

The prognosis is practically that of alcoholic cirrhosis, though the course may be a slower one.

Syphilitic cirrhosis is discussed in the Section upon Syphilis, and the variety of capsular cirrhosis seen in connection with chronic mediastinopericarditis is considered in the appropriate section.

I. FATTY LIVER

Fatty infiltration of the liver is so closely associated with the more serious process described as fatty degeneration that it seems best to speak of the two conditions as constituting the fatty liver. To some extent fatty infiltration is normal, the liver cells being little affected. In other cases the liver cells are degenerated and fat replaces the destroyed tissues, in part arising from these tissues and in part being derived from other sources of fat in the body. These processes are characteristic rather of fatty degeneration. In a liver affected chiefly by infiltrative processes enlargement is the rule, while the contrary holds in fatty degeneration.

Etiology.—The infiltrative process may be merely a part of a general obesity, this being the most frequent cause. In conditions of decreased oxygenation, as in chronic pulmonary tuberculosis, and in alcoholism, the accumulation of fat in the liver is a mark of the interference with the proper metabolism. A marked increase in the size of the liver thus becomes a grave prognostic sign in phthisis. In severe anemic and cachectic diseases it is sometimes present. The more typically degenerative process is found in most marked degree after phosphorus poisoning, to lesser extent in poisoning by arsenic and by chloroform. In acute yellow atrophy the fatty degenerative

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process is so similar to that of phosphorus poisoning as to be distinguished with difficulty. The liver becomes yellow, soft and flabby, and the debris resulting from the destructive process may be indistinguishable microscopically.

Symptoms.—There are none characteristic of either fatty infiltration or fatty degeneration, the symptoms present in any given case being due rather to the condition upon which the hepatic changes depend. If no symptoms are present in a case presenting hepatic enlargement, fatty infiltration is to be assumed. The absence of jaundice is to be noted. Although the stools may be lighter in color than normal they do not approach in appearance the acholic stools of obstructive jaundice. Ascites, caput medusæ and other features of cirrhosis are absent.

Physical Examination.—The infiltrated liver is large, smooth, rounded and insensitive to pressure. It may reach below the navel and the right upper quadrant of the abdomen may bulge perceptibly. The left lobe may reach nearly to the splenic area. In cases with marked wasting the liver is easily palpable, but in the obese type of enlargement percussion may offer the only means of diagnosis.

Prognosis.—This is that of the disease with which the fatty liver is associated.

J. AMYLOID LIVER

Etiology.—The waxy liver is found under the conditions mentioned in other Sections as contributing to the development of amyloid disease of the intestines, spleen, kidneys, etc. The liver is less frequently affected than the last two named viscera. The most common causes are the chronic suppurative conditions associated with tuberculosis and syphilis. In many of the cases bony involvement is present. In chronic phthisis with extensive cavity formation and long continued expectoration of purulent sputum, it is to be feared, and also in empyema, especially when imperfect drainage has taken place through a fistulous opening. Suppurative processes in or about the rectum, and specific sacro-iliac disease seem especially prone to originate the lardaceous disease. In cancer, rachitis, and after ex-

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haustive disease the condition may develop even in the absence of suppuration.

Symptoms.—There are none directly attributable to the waxy disease of the liver, although those associated with the anemia and exhaustion of the primary affection are notable. Neither pain, jaundice, acholic stools nor ascites or other signs of portal obstruction are present. In case the colon be affected diarrhea occurs, but it is not attributable to hepatic involvement. Upon examination, the liver is found to be large, smooth, rounded at the edges, and painless upon palpation. The coincident involvement of the spleen adds much to the probability of the diagnosis in doubtful cases, and may be considered decisive in the differentiation as between fatty and lardaceous liver in pulmonary tuberculosis.

Diagnosis.—The fatty liver never reaches the enormous proportions of amyloid disease, a weight of five to ten pounds being not very unusual in the latter, while much greater weights are recorded. In general the diagnosis of amyloid disease depends upon the recognition of hepatic enlargement in connection with the condition of chronic suppuration mentioned above. The evidence derived from the condition of the spleen, the diarrhea associated with intestinal involvement, and the changes in the urine noted under amyloid disease may be necessary for the diagnosis.

Prognosis.—This is dependent upon the original disease to which the amyloid degeneration of the liver is secondary.

K. ACUTE HEPATITIS

In the tropics an acute inflammation of the liver not leading to suppuration is recognized, commonly dependent upon the malarial infection, but occasionally upon other forms. Immoderate eating and drinking are thought to be of importance in the etiology. The affection is occasionally seen in young unacclimated adults, and has been especially studied in India. It may be regarded as an advanced stage of the condition described under acute congestion. Moderate fever, mental depression and a slight jaundice indicate that the stage of active hyperemia has been over-stepped. The marked enlargement

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of the liver occasionally seen after an alcoholic debauch, with anorexia and a febrile course of a week or two, suggests that a real inflammation of the organ is present.

L. ABSCESS OF THE LIVER

(*Suppurative Hepatitis*)

Etiology.—An acute inflammation of the liver tissue ending in suppuration is most frequently dependent upon infection from amebic dysentery, 85 per cent. according to Kelsch being of this origin. The suppurative cocci are not essential in the formation of an amebic liver abscess, but are practically always present in other forms. In regions where amebic dysentery is found, hepatic abscess is to be assumed to be due to this disease until proved otherwise. In other regions the abscess originates from ascending suppuration from appendiceal infection in most of the instances observed, and more especially in cases of retrocecal appendicitis. In other suppurative processes in the portal territory infection of the liver by septic emboli in the portal distribution with the development of abscesses is not infrequent, and especially in colonic ulceration, pelvic abscess, suppuration about the rectum and anus, and at times after typhoid fever. I have seen an acute septic involvement follow the injection cure of hemorrhoids by a charlatan, with cirrhosis of the liver as a later development, and in the absence of any other recognizable cause of cirrhosis. A common cause of abscess is the infection of the bile passages, especially in connection with cholelithiasis. The liver may be so filled with abscesses as to be spotted over with them upon cross section. In pyemia the hepatic suppuration is a frequent complication, and often from other source than the portal territory. The hepatic artery and vein and the inferior cava may be the paths of the transmission, and in certain cases the lymph vessels. The occurrence of hepatic abscess in suppurating scalp wounds has long been recognized. Parasites, notably echinococci, liver flukes and round worms, may be the source of suppuration. The suppuration of a large echinococcic cyst in the substance of the liver in not very un-

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usual. Traumatism by crushing force, or by entrance of a knife, splinter, etc., from without, or of a needle, fish bone, etc., from within, may originate a liver abscess.

Pathology.—The abscess may be found between the layers of the broad ligament, especially in case the source of origin has been in the lymphatics of the upper surface of the liver, or beneath the organ if the lymphatics of this region be involved. The majority of abscesses, however, occur in the substance of the liver. If due to external trauma a single large abscess may exist, and in case of infection from within, as by fish bone, parasites, etc., the suppuration may be sharply localized. In case of infection coming by way of the hepatic artery, the portal vein or through a suppurative cholangitis, multiple foci of suppuration are found in the respective vascular distributions. The pus is often fetid in character, and frequently stained with bile. If the course of the disease be prolonged fusion or partial fusion of the separate abscesses may be noted. The tropical or so-called solitary abscess depends upon the presence of the Entameba histolytica, while the other types are associated with the presence of the usual streptococci and staphylococci, typhoid bacilli, B. pyogenes fetidus, B. coli, etc.

(For amebic abscess *see* section upon Amebic Dysentery.)

Symptoms.—In deep-seated suppuration due to a mild infection, the abscess may not be suspected during life. As a rule pain is present, especially if the superficies of the organ be involved. It is acute, aching or dragging in character, and often radiates to the right shoulder. Acute stabbing pain is due to peritoneal involvement, and may be accompanied by audible and palpable friction. An extremely severe diaphragmatic pleurisy may result from the extension of the inflammation upward through the diaphragm. The liver is commonly perceptibly enlarged and is decidedly tender upon pressure. Owing to its increased weight and the tenderness, the patient is unable in many instances to lie upon the left side because of the dragging pain produced. In case the abscess be solitary it affects predominantly the right lobe, and is especially frequent in the dome of the liver. Here a uniform bulging may give rise to a half-moon-shaped area of dulness above the normal hepatic border. Fever,

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generally associated with the occurrence of chills, often quite regular in appearance, is a notable feature of hepatic abscess, but may be absent for days together or inconspicuous throughout. Its irregularity is notorious. Because of the associated chills and sweats it is too often treated for malaria, even when the history of gall-stone disease or other possible cause is recognized. Marked leukocytosis, weakness, emaciation, and all the phenomena of general sepsis may be present. Jaundice may result from pressure upon the main ducts, or in lesser degree from the cholangitis from which the suppuration arises. A sallow dirty color is more frequently present, and may be extremely suggestive of hepatic suppuration. Vomiting, flatulence and diarrhea are not uncommon. In the multiple pyemic abscesses the characteristic features are rather those of pyemia than of the special hepatic involvement. The enlargement and tenderness of the liver with the icteroid skin suggest the hepatic origin or complication of the septic process.

Marked nervous symptoms may be present in suppurative hepatitis, notably headache, muttering delirium, tremor and coma. Melancholia may develop. A toxic arthritis has been reported. Upon palpation the more or less uniform enlargement mentioned may be detected, and tenderness dependent in degree upon the superficiality of location of the suppuration. If the peritoneum be not involved the tenderness may be trivial. Fluctuation is occasionally demonstrable in large abscesses. Rigidity of the rectus is an important and valuable sign of the hepatic involvement, and may interfere with successful palpation of the liver. The limitation of respiratory movement may be very marked, owing to the inability to depress the diaphragm. Cough is not infrequent, being especially common when the abscess tends to invade the subphrenic space. The decreased respiratory murmur over the region of the right base is suggestive of the underlying inflammation. In certain cases the suppuration approaches so near the surface that edematous infiltration of the overlying skin may be present, as in the case of subphrenic abscess. Notable enlargement of the spleen, and ascites are lacking in liver abscess.

The use of the Röntgen ray is to be recommended in diagnosis,

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the irregularity in shape and size of the liver and the crowding up and immobility of the diaphragm being well shown. The laboratory examination shows the presence of a decided polynuclear leukocytosis, and a secondary anemia may develop. The urine shows commonly a trace of albumin, a few hyaline and granular casts and a few leukocytes. Bile may be present and the casts may be strongly stained. In case the abscess ruptures the pus evacuated shows a reddish color and under the microscope the pus cells and necrotic liver tissue are distinguishable. Amebæ are to be found in amebic abscesses. Rupture occurs in over one-fourth of the cases of amebic abscess and in a lesser proportion in other varieties. The lung is most frequently perforated, but the pleura, pericardium, stomach and bowel are often involved. Perforation through the lung is a not infrequent event in liver abscess following appendicitis, with expectoration of foul smelling pus. Death may occur virtually from drowning in case a large abscess opens freely into the bronchi. After evacuation of an abscess through the bowel or stomach prompt recovery may occur.

Diagnosis.—Inasmuch as hepatic abscess is practically always secondary to trouble elsewhere the history is of especial importance, that of dysentery being most suggestive. Next to this in importance should be placed appendicitis, while gastric ulcer, rectal disease, cholelithiasis, injuries to the head and trauma are to be considered. The irregular fever, chills and sweats suggest malaria, but the enlargement and tenderness of the liver and leukocytosis should prevent error even in absence of the examination for plasmodia. In amebic abscess there may be no increase in the white cells. The large liver of lymphatic leukemia, with the fever and the increase in the white elements of the blood, may strongly suggest hepatic abscess. In one of my cases the liver has been unsuccessfully aspirated by two different surgeons. The differentiation was easily made by study of the blood slide. I have seen death from internal hemorrhage from the unjustifiable aspiration of the large liver in splenic leukemia under the suspicion that abscess was present.

Suppurating echinococcic cyst of the liver is virtually hepatic abscess. The diagnosis may be made if daughter cysts or hooklets are found. Empyema upon the right side just above the liver may

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be easily mistaken for abscess of that organ, and I have seen both the abscess and the empyema present, with communication through the diaphragm, on the one hand, from an ascending infection in appendicitis, and on the other hand from an empyema perforating downward. Even after a rib was resected in one case it was difficult to determine the exact character of the abscess until the diaphragm was located.

Basic pneumonia may be present just above an abscess of the liver. The recurring chills of gall-stone disease are most deceptive. In case of a ball-valve stone or severe cholangitis, the fever, chills and sweats are accompanied by jaundice of variable intensity in most cases, and colic or a history of the attacks may be present. Yet no suppuration occurs even after months or years, while liver abscess runs a more rapid and decisive course. The more steadily downward progress of abscess and the remissions of the gall-duct infection are to be considered. Cancer of the liver may give rise to so much fever and enlargement as to require care in the differentiation. In one doubtful case, aspiration yielded pus, yet it proved to be a mere localized abscess with colon bacillus infection in the region of a breaking-down cancerous nodule.

In the diagnosis the aspirating needle must be freely used, and in case of large solitary abscess, the localization of the cavity is often easy. In certain cases the aspiration is best made after a preliminary laparotomy, since the best operative results are obtained by the open drainage which then becomes possible. Preparation for operation should be made before aspiration in any case. Rupture of the abscess into the peritoneal cavity calls for immediate exploration, the sudden pain, rigidity, collapse and alteration in the shape of the liver sufficing for the diagnosis.

In general the needle should be of sufficient caliber to carry thick pus, and should be introduced in the region where the increased hepatic dulness gives reason for expecting suppuration. In case of a bulging upward of the upper border of the liver in front or behind, the needle should be inserted well inside the border of the dull area. The use of a general anesthetic is advisable, since many punctures may be necessary, and life may depend upon the finding of

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the abscess. The multiple small abscesses are rarely found by aspiration, and are rarely successfully operable. The X-ray is of great use in determining the shape of the liver and the probable location of the abscess if this be single and of considerable size. In case of doubt the absence of a discoverable source from which hepatic suppuration might arise casts great doubt upon the diagnosis. Tenderness is very suggestive of the location of the abscess beneath the point of greatest intensity. Free mobility of the liver with change of position suggests the absence of adhesions. The occurrence of local inflammatory edema is practically pathognomonic of abscess beneath.

Prognosis.—The small multiple abscesses of the liver generally cause death within a few weeks, the condition being inoperable. In the large solitary abscess recovery is probable, if it can be located and evacuated, the mortality being perhaps 25 per cent. The outlook after rupture of the amebic abscess through the lung is fairly favorable, while the septic abscess rarely permits recovery under these conditions. Rupture into the bowel with evacuation may result in complete cure.

M. CARCINOMA OF THE LIVER

Primary cancer of the liver is rare and in general the diagnosis of cancer practically presupposes a lesion elsewhere as the original focus. Secondary cancer is relatively common, more frequently in middle age, and more often found in the female sex because of their greater liability to malignant disease, and the frequency of hepatic involvement in both uterine and mammary cancer. The liver is commonly involved in cancer of the gall-bladder, and this occurs in 2 per cent. or 3 per cent. of the operative cases of gall-stones. The origin of primary cancer of the liver is unknown. The secondary type originates by direct extension, as from the gall-bladder, or by transference through the blood or lymph vessels.

Pathology.—Primary cancer may be nodular, massive, or diffuse, the latter at times associated with a cirrhotic process. The secondary form is commonly seen as multiple nodular growths, diffused through

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the liver, generally grayish or yellowish white in color, projecting above the surface and covered with an inflammatory exudate in many cases. The nodules may soften, and become umbilicated, and localized abscesses may result. The histology resembles that of the primary growth. The liver flatness is not infrequently eight or ten inches in perpendicular extent, and the weight of the liver may exceed 30 pounds.

Symptoms.—These are practically the same, whether the growth be primary or secondary. In many cases the growth from which the secondary involvement arises may be unsuspected during life. Thus a small scirrhous cancer of the stomach may give no very definite symptoms, while the involvement of the liver attracts the physician's attention. Pain is commonly present, and is often of a dull and constant type, little relieved by any but strong anodynes. If the surface of the liver be involved by a nodule a localized peritonitis over the growth gives rise to sharp pain and exquisite tenderness. Radiation of the pain in the classical manner to the right scapula is not unusual. The absence of pain does not militate against the diagnosis of hepatic cancer. Emaciation and failure in strength are notable features and may first attract attention to the disease. Anorexia, nausea and vomiting are often troublesome. Fever is more commonly present than in cancer elsewhere, and I have known two cases to be treated for a month as typhoid fever. The temperature may reach 103-4° but is generally late in appearance, and decidedly irregular. Chills may be noted. Jaundice occurs in over half the cases, and generally tends to become more marked as the disease progresses. A bronzed, almost blackish color may be present, if the common duct be blocked by the growth, or by pressure of glands or of associated cancer of the head of the pancreas. Ascites may develop because of similar pressure upon the portal vein, but may be due to a cancerous peritonitis. The effusion may be hemorrhagic, chyliform, or stained yellow in case jaundice be present. Obstinate hiccough is an occasional late symptom, and may exhaust the patient rapidly.

Upon physical examination the increase in the size of the liver is the most striking feature, and because of the nodular development

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of the growth and the great emaciation of the subject, the diagnosis may practically be made at a glance in a considerable number of cases, since the projection of the nodules and the evident increase in the size of the organ are easily observed. The right lobe is more commonly enlarged in greater degree than the left, but the whole liver area is greater than normal. The nodules are palpable in many cases, may be insensitive, or tender because of associated peritoneal involvement, or may be felt to be umbilicated, and even fluctuation may be detected. Deep inspiration may bring down a palpable nodule otherwise concealed beneath the ribs. Peritoneal friction may rarely be heard over an inflamed area. The superficial veins may be enlarged. Secondary metastases may be found. Because of the increase of the size of the liver, the diaphragm may be pushed up, the base of the right lung compressed, and the heart displaced. Metastasis to the lung is not very unusual. Edema of the feet and legs may be due to mechanical compression of the inferior cava, but in most cases is cachectic in origin and slight in degree. Marked enlargement of the spleen may occur, especially if the portal vein be badly compromised by the malignant process. A marked secondary anemia develops, and hemic heart murmurs may be present. Leukocytosis may be found because of involvement of the peritoneum, or from other complications. Albuminuria and bile-stained casts are often demonstrable. Hydronephrosis may originate from mechanical compression of the ureters.

Diagnosis.—With a history of cancer elsewhere the diagnosis is generally easy. In fact no operation for extensive cancer should be undertaken without examination of the liver for secondary nodules, deep inspiration being essential to the examination. Great loss of weight (even 40 per cent.) with enlargement of the liver, nodular in character, and jaundice, practically always indicates cancer. No doubtful diagnosis of cancer of the liver should stand unless the Wassermann reaction be negative or until the therapeutic test be applied. In case of amyloid disease with gummata, the diagnosis may be thus established. I have seen a physician without known specific history recover from such a condition under iodid of potash. The withdrawal of pus from the liver may signify merely that a

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cancerous nodule has broken down and become infected, as from the adherent colon. A primary cancer upon the edge of the liver may be mistaken for a gall-stone, as in a case seen with Dr. Leonard Freeman and reported by him to the American Surgical Association. The patient is still living six years after the removal of the growth, a point to be remembered in the question of prognosis.

The echinococcic liver may be large and nodular, but jaundice is infrequent and the patient may protest that he is not ill, but merely inconvenienced by the size of his abdomen, as in one of my cases. The aspiration of clear watery fluid is decisive. In babies the great enlargement of the right kidney in sarcoma may suggest hepatic cancer, but the diagnosis is easily possible upon careful physical examination. Cancer of the colon with fecal impaction may be confused with cancer of the liver, but definite bowel symptoms are present. The Röntgen ray may be of much assistance. Hypertrophic cirrhosis with the great enlargement of the organ and jaundice bears a superficial resemblance, but the absence of nodules, of adenitis, and of wasting and cachexia are decisive. Cancer with cirrhosis presents the picture of hepatic cirrhosis. The well-recognized features of hepatic abscess, already considered, suffice to prevent confusion in most cases. The differentiation between cancer of the gall-bladder or the ducts and that of the liver proper is often extremely difficult. In early cases it is not infrequently made in the operating room. In certain cases the increase of size of a portion of the liver, as the so-called Riedel's lobe, occasionally found in connection with disease of the gall-bladder, or the enlargement of the left lobe in syphilis, or in cirrhosis, may suggest malignant disease.

Prognosis.—The patient commonly succumbs within three to six months after the discovery of the disease. The possibility of recovery after operation, as in the instance of primary cancer quoted, must be borne in mind, but is scarcely great enough to lighten perceptibly the prognosis in any given case.

Other Growths of the Liver.—The most important is melanosarcoma, which is rarely primary in the organ, but not excessively rare after the occurrence of melanosarcoma of the iris, or a pigmented nevus, etc. Multiple metastases in the skin are frequently

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associated. Sarcoma, angiomata, myxosarcoma, gliosarcoma, and other growths are rare. Two instances of congenital cystic degeneration of the liver have been discovered at operation recently in St. Joseph's hospital, in one known to be associated with the same condition in the kidneys.

Anomalies of Form and Position.—The entire organ may be symmetrically transposed in situs viscerum inversus. The liver may be so mobile as to produce symptoms of biliary obstruction by distortion of the duct, so that the diagnosis of obstruction by stone is confidently made, as in one of my cases. The organ may tilt upon its transverse axis so that more of its surface than usual is in contact with the anterior abdominal wall, which gives rise to the belief that it is enlarged. The virtual "cutting in two" of the liver by tight lacing is occasionally detected. The gall-bladder may be concealed in the depth of the fissure, so as to escape recognition unless most carefully sought for. In two of my cases the stone which had been diagnosed would have entirely escaped us but for a confidence in its existence sufficient to lead to a prolonged search for the gall-bladder. One of the patients had serious secondary hemorrhage as a result of the necessary laceration of the liver tissue. The ducts may vary greatly from the normal in size, shape, position, and even in number, duplication having been observed. Congenital obliteration of the ducts is occasionally reported.

12. DISEASES OF THE PANCREAS

For the detection of disease of the pancreas a study of the stools should be made. Because of the inability to digest fats in the absence of the pancreatic juice, steatorrhea results. The normal stool may contain 20 to 30 per cent. of fat in the dried state, but in cancer of the pancreas, for example, this figure may be greatly increased. The diminution in the amount of fatty acids and soaps in proportion to the neutral fat is very striking. The fresh stools show liquid yellow fat floating upon the surface of the fluid in the jar, this fat hardening upon cooling. The entire stool is often grayish in color with a greasy appearance, differing from that of the acholic stool. The

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fat may be demonstrated by staining with Sudan III or osmic acid. The meat fibers are undigested, and are to be found with the microscope (creatorrhea). In certain cases the undigested masses of meat are visible to the naked eye. The proteid waste in the stools, in the absence of pancreatic secretion, is 5 to 8 times the normal. Schmidt's nucleus test may be applied, being based upon the fact that the nuclei of the muscle fibers are not digested in the absence of pancreatic secretion. Cammidge's test seems to have failed of recognition as of value in the detection of pancreatic disease. In case the internal secretion is suppressed because of damage to the islands of Langerhan's, the carbohydrate metabolism is interfered with, the tolerance for sugar being lowered. (*See* Diabetes). Oser lays especial stress upon the bulkiness of the stools in pancreatitis, and the dried residue is heavier than normal. The great increase in the fat content is the most important factor in bringing about this condition.

FAT NECROSIS

The pancreatic secretion contains a fat-splitting ferment which produces the lesion mentioned whenever the secretion is thrown back upon the gland by obstruction of the duct, or finds its way through lymph spaces to other tissues. The entrance of bile into the pancreatic ducts may greatly favor the process. It is more common in hemorrhagic and gangrenous pancreatitis than in other conditions. The omental and other fatty tissues are studded with rounded whitish patches several mm. in diameter, with frequently narrow hemorrhagic zones surrounding them. The fatty acids combine with calcium salts and lime may be deposited in the softened tissue, sometimes showing brilliantly as in a recent case seen with Dr. Craig.

In certain cases the entire pancreas is involved in the necrotic process. The areas of fat necrosis are of extreme importance to the surgeon, since they may indicate the seat of the trouble to him upon opening the abdomen. In suspicious cases the abdominal surface should be critically examined before operation, since localized areas of tenderness may indicate the existence of necrotic spots and thus throw light upon the diagnosis.

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PANCREATIC HEMORRHAGE

(*Pancreatic Apoplexy*)

Apart from the hemorrhagic type of acute pancreatitis there is an affection characterized by sudden and severe hemorrhage into the pancreas and the surrounding tissues, without evidence of especial disease of that organ. In probably a majority of cases reported, the hemorrhage has been but a part of an acute or chronic pancreatitis, but in a few of Draper's cases no disease was found unless in the vascular walls, so that the designation "pancreatic apoplexy" is applied with some reason. The affection occurs most often in males of middle age, frequently alcoholics. Trauma may be noted in the history, but the attack is as unexpected as cerebral apoplexy in many instances. Sudden pain of extreme severity appears in the upper abdomen, and is frequently colicky and paroxysmal. Nausea, vomiting, cold sweat, pinched face, collapse and death in from one hour to twelve or twenty-four hours characterize the attack. Abdominal tenderness appears early, and tympanites, if the lethal issue is delayed. Fever is absent. The diagnosis is rarely if ever made during life, cases having commonly been reported from the office of the coroner or medical examiner. The affection should be recognized as an occasional cause of sudden death.

ACUTE PANCREATITIS

Three subdivisions are made: (a) hemorrhagic pancreatitis; (b) suppurative pancreatitis; (c) gangrenous pancreatitis. The borders are not sharply defined, and one type may be the sequel of another.

(a) Hemorrhagic Pancreatitis

Etiology.—No definite bacterial causation has been established. The affection is most frequently found in males, especially of stout habit, and in the middle decades of life. Alcoholism is frequently noted in the anamnesis. Gastritis and gastroduodenitis are often

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precedent conditions. Gall-stone disease is associated in so many cases that the theory of Opie seems well established. He found that a small calculus impacted in the diverticulum of Vater, so as to block the exit, converted the common bile duct and the pancreatic duct into a continuous channel. The injection of the bile into the pancreas through this mechanism is believed to be the cause of the acute inflammation of that organ. The lesion has been produced experimentally.

Pathology.—The pancreas is swollen and mottled by areas of hemorrhage. Bleeding occurs into the neighboring areolar tissue, and at times into the lesser peritoneal cavity. Extensive disseminated necrosis is present in the gland. Most characteristic is the wide spread fat necrosis, seen as areas of opaque whitish appearance, beneath the peritoneum, and especially in the mesentery and mesocolon.

Symptoms.—In many cases a history compatible with the existence of gall-stone disease may be obtained. Traumatism of the abdomen is occasionally noted. Sudden deep-seated epigastric pain, perhaps radiating to the left, appears with nausea, belching, vomiting, collapse, subnormal temperature, delirium and death in 48 hours, in the severer cases. Cyanosis is prominent in certain instances. In milder types, fever appears after the shock passes away, with a tense tympanitic distention of the abdomen. Actual biliary colic, due to passage of gall-stones has been reported in the midst of the attack. Constipation is the rule. Chill may occur. The epigastrium is rigid and exquisitely sensitive to pressure. Atrocious pain in the back may be present. Jaundice is an occasional feature (10 per cent.). There are no especial characteristic findings in the vomitus, the stools or the urine. A sharp leukocytosis may be present. The attempt to feel the tumor mass is nearly always unsuccessful because of its small size, deep situation, and the rigidity and tenderness present. Death results in many cases from a definite acute trypsin poisoning.

Diagnosis.—This has been occasionally made during life, based upon the suddenness and severity of the pain and collapse, the nausea and vomiting, and the frequently fatal issue. In most cases the

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diagnosis has been made by the surgeon, the abdomen having been opened under the diagnosis of rupture of the gall-bladder or of gastric or duodenal ulcer, intestinal obstruction, etc. In one of my cases the circumscribed tenderness associated with the disseminated lesions of fat necrosis was easily made out. Fecal vomiting and abdominal distention characterize intestinal obstruction, and the pain is less paroxysmal and severe in most cases. The distended stomach and colon are found to lie in front of the tumor, so that affections of the liver, spleen and gall-bladder may be excluded by this means. Because of the fear of overlooking perforative peritonitis or intestinal obstruction the diagnosis must be made by exploration in doubtful cases. It is extremely important to look for hemorrhage, fat necrosis or tumor in the pancreatic region immediately upon opening the abdomen, since operative intervention is badly borne by these patients. The obvious presence of gall-stone disease upon exploration would favor the diagnosis of pancreatitis in a doubtful case. The knowledge of glycosuria should prepare one to suspect the pancreas in case of a high acute abdominal affection.

(b) Acute Suppurative Pancreatitis

This may supervene in case of the hemorrhagic type if the fatal issue be postponed long enough for its development. The presence of gall-stones is frequently noted, and is of great importance in the etiology in at least a considerable proportion of cases. The suppurative process may result from the direct invasion of the organ by a nearby inflammation of a similar character. Trauma has been present in the history in certain instances. No definite bacterial origin is recognized. Pus may be present in a definite cavity or in multiple cavities, or a diffuse purulent infiltration may be found. The entire gland may be practically destroyed. The parapancreatic abscess may rupture into the stomach, intestine or peritoneal cavity. The portal vein may become thrombosed. Fat necrosis is less frequently present than in the acute hemorrhagic variety.

Symptoms.—A fever of considerable degree but of great irregularity is commonly noted. Pain, nausea, vomiting and prostration

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are commonly present. Hiccough, diarrhea or hemorrhage from the bowel may occur. Jaundice may result from compression of the duct by the abscess. The course is a much slower one than that of the acute hemorrhagic form. Irregular chills are not infrequent, and sharp leukocytosis is present. Tenderness, rigidity, and frequently tumor are found in the epigastric region, the latter to the left. The spleen may be palpable, and the splenic artery is occasionally found thrombosed. If the course be prolonged the characteristic changes in the stools may develop, and glycosuria is occasionally detected. Emaciation and weakness are marked in these cases. Perforation into the general peritoneal cavity may occur. In the latter case, the friction sound due to pleurisy originating by extension from the sub-diaphragmatic inflammation, may occasionally be detected in the region above the spleen, as in one of my cases, and effusion may occur. Subphrenic abscess is not an uncommon complication. Multiple liver abscesses have been reported. The detection of a deep-seated suppurative process with the symptoms mentioned and with a subacute or chronic course calls for exploration, which is not infrequently successful.

(c) Gangrenous Pancreatitis

This is commonly a late stage of the hemorrhagic, occasionally of the suppurative variety. The tissue of the gland becomes necrotic, and bacterial invasion takes place after a week or two of illness. Septic fever is finally followed by collapse and death, usually within 15 or 20 days. Recovery has followed the evacuation of the necrotic gland through the bowel and occasionally after surgical drainage, but the outlook is always desperate. Gangrenous pancreatitis cannot be distinguished clinically from the precedent conditions. The abscess about the necrotic gland may be palpable deep in the epigastrium, and the indication for exploration is urgent if the general condition justifies it.

CHRONIC PANCREATITIS

Etiology.—The disease is intimately associated with those conditions producing blocking of the pancreatic duct, so that gall-stones

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and cancer, so commonly found as causes of obstruction, are prominent in the causation. Alcoholism produces changes analogous to those of hepatic cirrhosis. All of these causes are especially operative during the 5th and 6th decades, and two-thirds of all cases occur at this time.

Experimental ligation of the duct produces the lesions of chronic pancreatitis. The retained secretion is of itself very irritating, and secondary bacterial invasion may be added, with resulting sclerosis. Pancreatic calculi are probably dependent upon the infective process rather than causative of it, although some authors believe that the obstruction caused by the calculus is a common cause of the condition. Certainly little proof of it is forthcoming.

Opie distinguishes two varieties of chronic interstitial pancreatitis. The interlobular type follows obstruction of the duct by any of the causes named, with an ascending infection similar to that seen in the bile ducts. The colon bacillus is often found, and occasionally the typhoid bacillus or other organisms. The most typical cases are in connection with pancreatic calculi. The cells making up the islands of Langerhans have no communication with the ducts, and are commonly spared. The contractile process eventually compromises the function of the islands, presumably by cutting off their blood supply. The interacinar type is characterized by "a diffuse new growth of interstitial tissue, penetrating between the acini. The organ is tough rather than hard, and does not exhibit the nodular surface seen with the interlobular type of inflammation." It is more commonly associated with arteriosclerosis and hepatic cirrhosis than with obstruction of the hepatic duct. Arnsperger believes that a pancreatic lymphangitis is responsible for the swelling of the head of the organ, as is so commonly seen in gall-stone disease. As Deaver states, this may explain why the affection is so much benefited by drainage of the gall-bladder.

Symptoms.—These were almost unrecognized before the surgical treatment of gall-bladder diseases made the study of the pancreas possible during life, and are still very indefinite. They are likely to be associated with the group of symptoms dependent upon gall-stones and cholecystitis, and the entire symptomatology of these con-

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ditions may be imitated by chronic pancreatitis. In general, the symptoms of some type of chronic indigestion are noted. Chronic jaundice results in two-thirds of the cases from mechanical occlusion of the common duct. Steatorrhea may be present from the lack of the pancreatic secretion, often associated with diarrhea. Deep-seated paroxysmal epigastric pain is noted at times, but may be attributable to the involvement of the common duct. Attacks of faintness and general weakness and emaciation are further features. Glycosuria develops if the islands of Langerhans are compromised, but is therefore uncommon in cholelithiasis in which disease the interlobular type of pancreatitis is present.

Upon examination the hardened head of the pancreas may occasionally be felt, although the rarity of the discovery of a tumor in cancer of the pancreas suggests that deception may easily occur. Upon opening the abdomen, as in gall-stone disease, the induration is palpable, and has very frequently been mistaken for carcinoma. Such a chronic inflammation constitutes a serious complication of gall-stone disease as stated above. Definite pancreatic lymphangitis may be present. The feces show the usual fatty excess and the nucleus test may be positive. The urine may contain sugar. Bile is often present. The Cammidge reaction is often positive, but little dependence is placed upon it by others than its author. The most important point in connection with the diagnosis is the need of emphasis upon the brilliant results obtained by drainage of the bile passages, and the consequent indication to explore early in case of doubt. The frequency with which unsuspected gall-stones are found, if they are only sought, in abdominal operations for other conditions, lends force to the suggestion.

Prognosis.—The outlook is grave under any but surgical treatment, but is reasonably favorable under these conditions.

PANCREATIC LITHIASIS

This is a rather rare condition. The stones are light in color, composed of phosphate and carbonate of lime, and are commonly multiple. They are probably formed, as are gall-stones, under the

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influence of bacterial infection of the ducts. Biliary lithiasis may be present at the same time.

Symptoms.—These are so indefinite that the diagnosis is rarely possible. In general they resemble those of cholelithiasis sufficiently to render the diagnosis of the latter condition, which is so vastly more frequent, more reasonable. Epigastric pain of the general type of biliary colic is described, often radiating to the left and to the left shoulder. The fatty stools, containing undigested meat fibers, signify absence of pancreatic secretion from the intestine, and therefore suggest the possibility of calculous obstruction. The Röntgen ray may possibly show the stone, whereas gall-stones are commonly invisible. A calculus may be identified by chemical analysis if found in the stools. Jaundice may occur from blocking of the papilla by the stone, but the probability in any given case would point to blocking by chronic pancreatitis associated with biliary lithiasis.

With the chronic inflammation is frequently associated a marked dilatation of the ducts. Extensive cicatricial contraction, acute abscess formation, glycosuria, and carcinoma may be mentioned among the complications of pancreatic lithiasis. The indications for surgical intervention are rather those of chronic pancreatitis, which is capable of diagnosis, than of the lithiasis, which is rarely so.

PANCREATIC CYSTS

Cystic disease of the pancreas is not a very unusual condition. It occurs chiefly in middle life, and about equally in the two sexes. Lazarus classifies pancreatic cysts as follows: (a) retention cysts of the secretory ducts; (b) cystadenomata, the most frequent variety; (c) retention cysts of the smaller ducts of the acini, resulting from chronic pancreatitis; (d) cysts resulting from softening of carcinoma, autodigestion of a hematoma, or degeneration of the lobules of the gland, as the result of acute pancreatitis; (e) pseudo-cysts. These are really situated in the lesser peritoneal cavity. The contents are hemorrhagic or inflammatory, and may or may not contain pancreatic ferments. The irritation by the digestive action of the fluid drained from the cysts when it comes in contact with the skin, may be ac-

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cepted as proof of the pancreatic nature of the fluid. The cysts may be traumatic, but are probably more frequently of inflammatory origin. Other cysts arise without known cause and may exist for many years before coming to operation, on account of their size and inconvenience. The cyst may develop in the lesser peritoneal cavity, grow forward, crowding the stomach upward, and reach the anterior abdominal wall between the stomach and the colon. In a second group the cyst grows forward between the lesser curvature of the stomach and the liver, pressing the stomach downward. If near the

FIG. 90.—CYST OF PANCREAS. (Entirely above navel.)

tail of the pancreas, the cyst may penetrate between the layers of the mesocolon, and the tumor may be palpable near the spleen.

Symptoms.—There may be none. In other cases, pain may be present, even colicky in nature, and at times radiating to the left shoulder. Jaundice, ascites, steatorrhea, azotorrhea, glycosuria, and pancreatic salivation may be noted. Upon examination the contour of the abdomen may suggest the diagnosis. In typical cases a rounded and comparatively insensitive tumor projects under the left ribs, between the splenic region and the central line, or in the epigastrium, sometimes fluctuating, and slightly movable with respiration.

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The cysts may be movable by bimanual palpation, one hand being placed in the lumbar region, and the pressure may be felt to be transmitted in immovable cysts. In general, the stomach after dilatation with air is found above the tumor and the transverse colon below, but the exceptions as indicated in the preceding paragraph are numerous. The cyst may empty itself and disappear, usually with diarrhea, as in a case seen with Dr. Tennant. Periodical emptying has been recorded, and rupture into the peritoneal cavity has been noted.

Diagnosis.—This depends chiefly upon the physical examination, since the symptoms are indefinite. The diagnosis from hydatid cyst and cyst of the mesentery may be difficult, but is easily made after opening the abdomen.

Prognosis.—The cyst tends to grow and therefore eventually demands operation. The outlook under surgical intervention is excellent. The aspirating needle should not be used, since exploration is safer and much more certain from the diagnostic standpoint.

TUMORS OF THE PANCREAS

Carcinoma is by far the most frequent and most important. Sarcoma, adenoma, and lymphoma are occasionally found, and syphilis is the cause of tumor growth in rare instances. In many cases chronic interstitial pancreatitis has been wrongly diagnosed as carcinoma, especially at operation for gall-stones. The complete recovery of the patient indicates the error. Secondary cancer is occasionally found. The head of the pancreas is most frequently involved in carcinoma (82 times in 113 cases, Marallie).

Symptoms.—These are so undependable that the disease is rarely correctly diagnosed during life. Chronic indigestion is a frequent symptom, doubtless generally due to the conditions which have finally resulted in cancer. Pain is the most frequent symptom, often dull and boring, but not infrequently paroxysmal. It is probable that in many cases it may be due to the associated biliary obstruction. Jaundice is generally present, since the head of the pancreas is commonly affected, and thus the common duct is compressed. It is deep,

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permanent, and of gradually increasing intensity in typical cases, and may result in a deep bronze discoloration. The gall-bladder is commonly distended in accordance with Courvoisier's observations, and may be of great size. The tumor is rarely palpable, since it is situated so deeply under the epigastrium, and examination is so commonly hindered by the muscular rigidity and the tenderness. The use of an anesthetic may render detection easier. The aortic pulsation may be transmitted through the tumor. Pressure of the tumor upon the portal vein may cause ascites, which may be of chylous nature, if the chyle duct be involved. If the inferior cava be pressed upon, edema of the parts below may occur. Intestinal obstruction may result from the increasing pressure of the growth. Nausea and vomiting, at times accompanied by collapse, are occasionally prominent symptoms. The growth may cause such loss of function in the pancreas that the usual symptoms arising therefrom may be present. Wasting and cachexia become notable features as the case progresses.

Diagnosis.—This depends upon the recognition of permanent jaundice, with dilatation of the gall-bladder, the characteristic pain, the wasting and cachexia, and possibly the fatty stools with diarrhea. In rare cases recovery has followed removal of the growth when this could be accomplished completely without destruction of the gland. Exploration is to be advised in case of doubt, for the diagnosis is never certain enough to preclude the possibility of recovery from some operable condition.

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SECTION V

DISEASES OF THE KIDNEYS

1. MALPOSITIONS AND DISPLACEMENTS

Congenital absence of the kidneys is incompatible with life, and hence of no clinical importance. A supernumerary kidney may be found, and one or both normal kidneys may be displaced congenitally or by trauma. Absence of any functionating kidney tissue upon one side occurs approximately once in 4,000 individuals, rendering it imperative to be assured of the presence of a second kidney before nephrectomy. The most frequent anomaly in shape is the persistent fetal lobulation, but this and most other deformities are of no significance as to function. The fusion of the inferior poles of the two kidneys constitutes a horseshoe kidney and this may be displaced, and even found in the pelvis. Anomalies of the arteries and ureters, the normal number being increased in most instances, are not rare. Multiple cysts of the kidney are not infrequent as the result of obstruction of tubules in chronic nephritis. Single large cysts are occasionally reported. Echinococcus cyst may occur.

The most important condition is the congenital cystic kidney, or the cystic condition which develops in later life, presumably upon a congenital basis (polycystic kidney). The enlarged kidneys are made up of islands of kidney tissue situated in a mass of cysts, with thin walls and varying from a millimeter to several centimeters in diameter. The contents may be clear, blood-stained or dark. The condition may be present in the fetus and interfere with birth. The kidney tissue commonly presents the changes of chronic interstitial nephritis. Several members of the same family may be affected. I have seen associated congenital cystic liver in one case at operation, and the same association was noted in another case at St. Joseph's Hospital by a colleague.

Symptoms.—The kidneys are enlarged and nodular, though one

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may greatly exceed the other in size. In the three cases which I have seen two were proved by operation, and one by X-ray examination. The nodular condition of the kidneys had suggested the diagnosis in all. In two of the cases the tumors were gradually increasing in size. The fibroid changes are responsible for the excretion of urine which presents the characteristic features of chronic interstitial

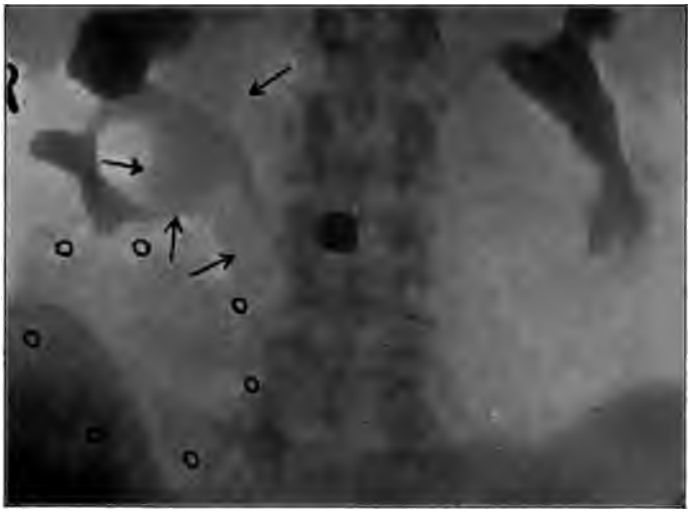

FIG. 91.—POLYCYSTIC RIGHT KIDNEY. The arrows point to the shadows cast by several cysts in the kidney. The small circles circumscribe the shadow of the largest cyst at lower pole of kidney. Pelvis and calices of kidneys injected with collargol. The shape of the pelvis of the right kidney and the dilatation of the upper calyx are due to pressure from cysts on the ureter and pelvis. The shadow between the ureteropelvic junction and the lowest calyx on the right side is demonstrated by the stereoscope to be on a plane anterior to the pelvis of the kidney. Diagnosis of polycystic kidney made from the X-ray examination. Conditions shown verified at operation. (Dr. S. B. Childs.)

nephritis. Arterial changes, hypertrophy of the heart and increased blood pressure, and death eventually from uremia or vascular disease, are to be expected. Bronzing of the skin is occasionally noted. Hematuria is a fairly common symptom, often occuring only at intervals. Rupture of a cyst with abscess formation has been recorded. Aching or dull dragging pain in the side may be present, and ureteral colic from the passage of blood clots.

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Diagnosis.—This depends upon the demonstration of bilateral enlargement of the kidneys, nodular in character, oftentimes with pain, hematuria and the features of chronic interstitial nephritis. The röntgenograph would ordinarily relieve any doubt. Uremia is a common feature.

Prognosis.—This is practically that of chronic interstitial nephritis, with the chances of infection of the kidney and rupture of

FIG. 92.—CONGENITAL CYSTIC KIDNEY. Visible through the abdominal wall at (x). Cysts punctured. Recovery. (Case of Dr. Oliver Lyons.)

the cysts added. In one of my cases Dr. Freeman removed the infected cystic right kidney, and the less involved organ on the left has carried on the urinary function perfectly for six years.

2. TUMORS OF THE KIDNEY

Benign growths are occasionally found. Lipoma, fibroma, adenoma, and angioma are commonly proved only at post-mortem examination, no symptoms existing.

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Of malignant growths the Grawitz tumor, or hypernephroma, is the most important, numerically and clinically. Many of the cases heretofore reported as carcinoma and sarcoma belong to this class.

Etiology.—The hypernephroma grows from an adrenal "rest" in connection with the kidney, and more commonly in the male. Heredity apparently plays no part in its origin.

Symptoms.—In many cases the tumor is small and shows no tendency to increase rapidly in size, and no symptoms are present. If the growth is more actively malignant, pain and hematuria are commonly present, and a tumor is detected. Pain of a dull dragging character may be present in the region of the tumor, and may extend down the thigh. If clots of blood pass down the ureter, the characteristic ureteral pain results. In many cases there is no pain, and even an absence of discomfort. Hematuria appears as the first symptom in perhaps half the cases, and is present eventually in the majority. It may cause a staining of the urine more or less constantly or occur in sudden attacks, perhaps a month apart. The sudden clearing of the urine with pain in the side suggests blocking of the ureter by a clot. Long ureteral blood casts may pass. The tumor may be seen to increase in size in the course of weeks or months, and this is the more apparent because of the increasing emaciation. A small growth in the upper pole of the kidney may escape detection. The whole kidney may be enlarged or unduly movable. It is as a rule not especially sensitive, may be of smooth or undulating surface, or decidedly irregular in shape. Fluctuation may be noted. The enlarged kidney may fill up the entire flank without resonance posteriorly, but covered by the colon in front. If the growth be large the movements of the diaphragm may not affect it. Dilatation of the veins over the tumor may be present. Varicocele as the result of venous obstruction is common, especially on the right side. Dyspnea, ascites, edema of the legs, and jaundice may be present. Metastasis to bone and to the lungs is common. The urine commonly shows little beyond the hematuria, but albumin, sugar, and even fragments of the tumor growth have been reported. The "three glass" test of the urine shows all equally bloody.

Diagnosis.—When the tumor is of considerable size and movable

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it is readily made out to be renal in character, the shape and position, with the colon in front and flatness behind, being decisive. The continuous flatness of the liver tumor and the notches on the edge of the spleen, with its respiratory mobility, serve to differentiate these organs. Retroperitoneal sarcoma is less movable, lies more centrally and deeper in the abdomen. Tumors of the female genitalia need consideration, but may generally be excluded by pelvic examination. The knowledge that metastasis is frequent is of value in difficult cases. For the details of the cystoscopic and radiographic examination the reader is referred to the special works. Braasch states that "the cystoscopic examination of the bladder may reveal (1) dilatation of the veins of the bladder; (2) tumor tissue loose in the bladder or protruding from the ureter; (3) blood clot in the ureteral meatus; (4) atrophy of the affected meatus; (5) marked comparative decrease in volume and force of secretion; (6) unilateral dark-colored secretions; (7) unilateral hematuria." By means of pyelography he finds that the changes in the pelvic outline as seen in the radiograph will be found to be as follows:

"1. Retraction of one or more calices well into the cortex giving a bizarre, 'spider-leg-like' appearance;

"2. Partial obliteration of the pelvic lumen by invading renal tissue with remaining thin streaks;

"3. Irregular pelvic dilatation following tumor necrosis or secondary infection;

"4. Retraction and dilatation of the upper ureter by surrounding tumor.

"5. Abnormal position of the renal pelvis so that its outline is found lying either extremely median or lateral."

Cancer of the kidney is rare, does not increase in size to the extent seen in hypernephroma, and yet is more rapidly fatal. Sarcoma more commonly occurs in children. The rapid development of an abdominal tumor in the first few years of life, with emaciation and development of large veins over the abdomen, is extremely suggestive of renal sarcoma. The abdomen may be so filled by the mass that differentiation is practically impossible. In one of my cases, a baby of 18 months, a tumor filling the entire right abdomen and

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reaching to the pubes was supposed to be sarcoma of the kidney. It was proved upon exploration to be an alcoholic cirrhosis of the liver, the infant having been fed whiskey from the day of its birth.

Prognosis.—The outlook in cancer and sarcoma is hopeless, excepting the occasional cases curable by operation. Hypernephroma may occasionally develop so slowly that the patient may live for several years, and recovery may follow surgical intervention.

MOVABLE KIDNEY

(*Floating Kidney*)

Normally the kidneys are fixed in their position, but in enteroptosis, after trauma, as the result of tight lacing, etc., they frequently become displaced downward. The right kidney is abnormally movable at least five or six times as frequently as the left, and in the female sex approximately the same proportions hold, as compared with the frequency of floating kidney in the male. The relaxation of the walls of the abdomen in pregnancy contributes to this preponderance in the female sex. Congenital relaxation of its supports, increased weight because of tumor growth, dragging by extraneous tumors, and possession of the characteristic enteroptotic conformation of body all contribute to its occurrence. The congenitally misplaced kidney differs from the floating kidney in that it is firmly fixed in its abnormal position. The kidney may be merely palpable, the lower pole coming within reach of the fingers of one hand when the patient lies relaxed with the examiner's hand pressed well into the lumbar region. Not infrequently the movable kidney may be felt over half or more of its extent by the same procedure, and frequently when the patient stands erect, resting the hands upon the table to assist in relaxing the abdomen. In the third degree we have the floating kidney, entirely palpable and movable freely in the lower abdomen. In the thin subject, this type may occasionally be located by the eye, as the patient lies on the back. A lack of normal fullness may be detected in the corresponding lumbar region.

Symptoms.—In most cases there are none, and the subject should

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not ordinarily be told of the presence of the abnormality under these conditions, since most neurasthenic individuals are given to the finding of symptoms if there is a possible basis. Neurasthenia, especially in women, is very commonly associated with floating kidney, and hysterical phenomena are frequently added. Since movable kidney is so common a feature in enteroptosis, and so many such subjects are prone to neurasthenia and hysteria, regardless of the degree of renal prolapse, it is hardly just to attribute all the symptoms to the kidney. Because of the disturbed relations of the duodenum, gastric disturbances, and especially dilatation and prolapse, are often present. The frequent association of floating kidney and chronic appendicitis is recognized, and is so important that neither condition should be operated upon without careful consideration as to the possibility of the other's existence. Pain, especially of a dull dragging nature, is not infrequent, but a more common complaint is of discomfort and of alarm at feeling something move in the side of the abdomen. Severe pain is found in the so-called Dietl's crisis, in which the renal vessels and ureter become blocked to some extent from torsion or kinking. It is much more frequent upon the right side. The pain is of the usual renal type and distribution, of great violence and accompanied by nausea, vomiting and collapse. A chill may occur, followed by fever. Blood may appear in the urine, which is generally scanty and concentrated. The kidney may be palpably enlarged and tender, and rigidity of the overlying muscles is present. After hours or even days the kidney resumes its normal position and the symptoms abate. With relief of the obstruction a large amount of urine may be passed, a definite acute hydronephrosis having been present. (*See* Hydronephrosis.) Jaundice, constipation, menstrual disturbances and even intestinal obstruction have been attributed to floating kidney. If the renal circulation be embarrassed, definite albuminuria with hyaline and granular casts may be present.

Diagnosis.—This is rarely in doubt, since the movable tumor in the kidney region, of approximately the size and shape of the kidney, slipping from the hand up to its fossa, and reappearing upon bearing down or assuming the upright posture, is easily recognized. The

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possibility of a distended gall-bladder or an ovarian cyst must be considered.

Prognosis.—There is no danger excepting in the very exceptional instances in which a movable kidney becomes strangulated. The symptoms may usually be relieved by fixation of the kidney or by measures to prevent its downward dislocation. The albumin and casts may disappear after operation.

3. TESTS FOR ESTIMATING RENAL FUNCTION

Geraghty and Rowntree have developed the phenolsulphonephthalein test. For the method of its application the reader is referred to the special works. Their conclusions are given below:

1. The absorption of phenolsulphonephthalein following injection into the lumbar muscles is better than the absorption from the gluteal injection, while the latter is superior to subcutaneous injection.
2. Administration into the lumbar muscles is the method of choice.
3. Experimentally those diuretics that stimulate the renal cells to increased activity cause some increased secretion of phenolsulphonephthalein, while those that act mechanically produce no increased secretion. Clinically diuretics do not influence the phthalein output.
4. Experimental evidence seems to indicate that phenolsulphonephthalein is excreted mostly by the tubules but probably also to a slight extent by the glomeruli.
5. The renal cells display a striking specificity in the excretion of phenolsulphonephthalein.
6. The phenolsulphonephthalein as used by us has many advantages over all other functional tests so far proposed.
7. It is better adapted for use as a functional test than any other drug previously employed for the same purpose, on account of its early appearance in the urine and the rapidity and completeness of its elimination by the kidney and the reliance to be placed on its findings.
8. The method of quantitative estimation of the amount of drug excreted is simple and exceedingly accurate.
9. It is of immense value from a diagnostic and prognostic standpoint in nephritis inasmuch as it reveals the degree of functional derangement in nephritis whether of the acute or chronic variety.
10. In the cardiorenal cases so far studied the test has proved of value in determining to what degree renal insufficiency was responsible for the clinical picture presented.
11. The test has proved of value not only in diagnosing uremia from

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conditions simulating it, but has also successfully indicated that uremia was impending when no clinical evidence of its existence at the time was present.

12. The test has proved of great value in revealing the true renal condition in cases of urinary obstruction. It is here of more value than the urinary output, total solids, urea or total nitrogen, and enables the surgeon to select a time for operation when the kidneys are in their most favorable functional condition. The improvement in the renal condition in cases of urinary obstruction following the institution of preliminary treatment is strikingly indicated by this test.

13. In unilateral and bilateral kidney diseases the absolute amount of work done by each kidney as well as the relative proportion can be determined when the urines are obtained separately.

4. CIRCULATORY DISTURBANCES OF THE KIDNEY

ANEMIA

Anemia of the kidney is commonly an accompaniment of some general anemic condition, and results in imperfect nutrition, and consequently imperfect function of the tissues involved. Marked fatty degeneration may take place. Lessening of the amount of urine may be noted. The partial or even complete anuria of hysteria may be caused by vascular spasm, and the suppression of function of the sound kidney, following the blocking of the ureter of the other, as by stone (calculous anuria) is almost certainly of this origin. Contrary to our belief heretofore, Mendelsohn has shown that the scanty albuminous urine early in acute febrile disorders is due to an acute anemia.

ACTIVE HYPEREMIA

This occurs when the function of the kidney is stimulated by exposure to cold, or when the organ is irritated by turpentine and other irritants. An active hyperemia accompanied by the passage of albuminous urine, often with blood cells and a few tube casts is preliminary to acute nephritis. The latter condition is frequently wrongly diagnosed when the acute congestion really does not go on to the stage of actual nephritis.

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PASSIVE HYPEREMIA

In case of chronic circulatory disturbances in the kidney, whether produced by heart disease, fibroid lung, direct pressure upon the renal vein or otherwise, a venous congestion results, showing most distinctly in the medullary portion. The cortex is especially affected if the arterial inflow is weak, as in dilatation of the heart. The organ is enlarged and firmer than usual (cyanotic induration). The integrity of the epithelial cells lining the tubules is compromised, and albumin, hyaline and granular casts and blood cells appear in the scanty urine. A secondary fibrosis may eventually develop, and in these cases only need we fear the development of symptoms indicating grave renal insufficiency.

THROMBOSIS OF RENAL VESSELS

The blocking of the artery may be by thrombosis following embolism, that of the vein more commonly by a marantic type of thrombosis. In the latter case the symptoms are those of a passively congested kidney. In case of embolism, an infarction with bloody urine and renal pain may be recognized, or the entire kidney may become gangrenous if the obstruction become complete. A septic infarction may result in abscess formation.

ANOMALIES OF URINARY SECRETION

Ischuria and Polyuria

The diagnosis of the conditions mentioned must be based upon a measurement of the urine for twenty-four hours. In general the scanty urine will be of abnormally high specific gravity and a polyuric secretion of contrary character, but exceptions may be noted. A scanty urine of high specific gravity may still suffice for the excretion of the body waste, while if it contain but little solid matter, uremia may be imminent. An abundant urine of low specific gravity signifies but little in many cases, while if heavy, such a

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urine practically means that sugar must be present to account for the great increase in urinary solids. A marked ischuria in acute nephritis is of grave omen, as it is also in renal calculus, often signifying that both kidneys are affected, either organically or functionally. In intermittent hydronephrosis, the passage of much clear urine may be coincident with the disappearance of an abdominal tumor, the distended kidney having emptied itself. The marked polyuria after exposure to cold with suppression of the skin function, and after hysterical attacks may be mentioned. Extirpation of the posterior lobe of the hypophysis may produce prolonged polyuria. (Cushing.)

Hyposthenuria

The term hyposthenuria is applied to that condition in which the kidney is no longer able to secrete a normally concentrated urine, so that the specific gravity of the twenty-four-hour sample is too low.

Anuria

The most common cause is the blocking of one ureter by stone when the other kidney is absent, functionally incompetent, or is blocked by reflex action. A condition known as latent uremia develops and the patient may live for five to ten or twelve days without the usual signs of intoxication, but nevertheless in utmost danger. Thrombosis or mechanical obstruction, as by tumor, of the vessels of both kidneys, may bring about the same result. These cases are fatal unless operable. In the very intense inflammation of acute nephritis there may be total suppression of urine, and in yellow fever and in cholera after severe purging and collapse, the same condition develops. In poisoning, as by turpentine and corrosive sublimate, in the conditions of very low blood pressure after injury or operation, and in hysteria, anuria may be present. Many fatal cases have occurred through neglect of the rule to make sure of the presence of two kidneys before removing the diseased one.

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Pneumaturia

Gas may be passed with the urine, or bubble out of the catheter after being introduced in instrumental examination of the bladder, without clinical significance. After the rupture of an appendiceal abscess or in other type of communication between the intestine and the bladder, intestinal gas may be passed. The most interesting cases are those in which decomposition of sugar by the yeast fungus or the colon bacillus occurs, carbon dioxid being generated. The B. aërogenes capsulatus may bring about decomposition of protein compounds, with liberation of gas. In one of my cases with general sepsis due to the colon bacillus, with abscess formation in various regions, and with mild glycosuria, the infection of the urine with production of pneumaturia was apparently of systemic origin.

Hematuria

Blood may appear in the urine as the result of trauma of some portion of the urinary tract without especial significance medically. In any diseases of a general nature in which hemorrhage of a purpuric type occurs, blood may appear in the urine, and also in hemophilia and leukemia. The irritation of the urinary passages by stone, by crystals of calcic oxalate, or of uric acid, especially in babies, may produce well-marked hematuria. The congestion associated with acute nephritis, strangulation of a floating kidney, or resulting from the taking of various medicinal agents—cantharides, turpentin, phenol, etc., may cause it, and I have seen it from the use of quinin in non-malarial conditions. In tuberculosis and syphilis of the kidney, in hypernephroma, fibroma in rare instances, and other growths, and, what is not so well recognized, in certain cases of chronic interstitial nephritis, the bleeding may be so abundant as to produce severe secondary anemia. The bleeding caused by the filaria and the Bilharzia, and in malaria, is mentioned elsewhere. We have spoken of the hematuria caused by renal thrombosis and infarction. Prostatic disease and gonorrhea are occasional, and tumors within the bladder, especially of papillary nature, are frequent causes of bleeding. A few blood cells may be found in the

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urine of many cases of acute appendicitis. In the so-called essential hematuria, none of these causes mentioned can be demonstrated, and the terms renal epistaxis and renal hemophilia have been applied. Dilatation of the vessels of a single papilla has been found by Fenwick, but in other cases no lesion could be found, even after the kidney had been removed because of the severity of the hemorrhage, although recovery was complete. The disease occurs in young men and fortunately rarely requires such extreme measures. A family type of hematuria of unexplained origin has been described.

Diagnosis.—The cystoscope readily determines the question of vesical or supravesical origin, and the catheterization of the ureters affords further assistance in the latter cases. If the urine be red or smoky, we must assume the blood to have a renal origin, while if it pass after the bladder has been nearly emptied of a normal urine, it presumably comes from bladder, prostate or urethra. Clots from the ureter or pelvis are distinctive. The presence of blood, epithelial or granular casts with the blood cells in a smoky urine are decisive in favor of renal origin. The sudden cessation of hematuria may mean that the ureter has been blocked by a clot from the diseased kidney. The blood cells are easily recognized under the microscope, even though the coloring matter be "washed out" to a considerable extent. The guaiac test is decisive in case of doubt. In alkaline urines a portion of the dissolved hemoglobin may be reduced.

Hemoglobinuria

This differs from hematuria in the fact that the coloring matter of the red cells only is present, having been liberated by some hemolytic process. The color varies from pink in the lighter forms, as in fevers, to the dark color caused by the methemoglobin liberated by potassium chlorate. In the paroxysmal form the color is deep red or brown, and a sediment of hemoglobin may be found. Under the microscope a few disorganized red cells may appear, and the brownish blood pigment and urates and albumin may be convincing in case of doubt.

Hemolysis may have resulted from poisoning by potassium chlor-

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ate, carbon monoxid, or some other chemical agent, by transfusion of blood, or from the action of the malarial plasmodium or other organism, as in typhoid, scarlet fever, etc. Hemoglobinuria from exposure to cold and the type described by Winckel in the new-born are rare. All of these come under the head of toxic hemoglobinuria.

Paroxysmal hemoglobinuria is a rare type occurring in certain susceptible, sometimes syphilitic, individuals, after exposure to cold, and occasionally after muscular or even mental exertion, and commonly associated with symptoms of Raynaud's disease. Yet most cases of this latter trouble are free from hemoglobinuria. The attack develops suddenly, occasionally with chilly and febrile manifestations, but often without them. Pain in the back and vomiting may be present. The local asphyxial signs develop and the attack passes away, often after but a few hours. Renewed exposure brings on another attack. Garrod's explanation is as follows: "In the organism of a patient who suffers from paroxysmal hemoglobinuria there is present a potential hemolytic toxin which only becomes active under certain favoring conditions, the chief of which is exposure of the blood to a lowered temperature. The toxin is of dual nature, one part acting as amboceptor and the other as complement. It would seem then that the amboceptor which is the specific poison is constantly present in the blood of the patient and is not merely produced at the time of exposure, but that only when the temperature of the blood is lowered is it able to become attached to the red corpuscles of the cooled peripheral blood. When the blood regains the normal body temperature hemolysis results under the influence of the complement, which is present only in normal serum and is not peculiar to the disease under consideration. Only those corpuscles will be destroyed which, during the period of exposure to cold, have become linked with the amboceptor."

Albuminuria

Under certain conditions the kidneys allow the albumin of the blood to escape with the urine. A generation ago this condition was recognized as practically always indicating structural disease of the

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kidney, and at this time the persistent passage of albumin is sufficient to bar an applicant for life insurance in most cases, yet no nephritis may be demonstrable. It is recognized that normal urine may contain albumin in an amount not capable of demonstration by the ordinary clinical tests.

Albumin may pass the kidneys: (a) when the secreting structure has been damaged by active congestion, as in acute fevers, after inhalation of anesthetics, etc.; a slight and temporary swelling is present, and a few tube casts may be found; or by passive congestion, as in cases of dilated heart, in pregnancy, in the slightly strangulated kidney, etc.; (b) when acute or chronic nephritis exists; (c) when fatty, lardaceous or other degenerative processes have occurred, or the secreting structure is compromised by tumor growth, etc.; (d) in suppurative conditions of the kidney or its pelvis, the albumin appearing with the pus; (e) albumin may appear in the urine in case too much is ingested, especially in the shape of raw eggs, there being presumably no perceptible kidney lesion; after severe trauma; in epilepsy, meningeal hemorrhage or other nervous disorders, in any severe anemia, primary or secondary, presumably due to malnutrition of the renal cells; in the group of cases spoken of as orthostatic, cyclic and intermittent albuminuria, and the albuminuria of adolescence and irritation of the kidney by the products of increased metabolism, as after severe exercise; (f) as the result of various inflammatory processes affecting the ureter, bladder, prostate, etc., in many cases being due to the pus or blood which enters the passages; (g) as the result of the infection of the urinary passages by various parasites-Tenia echinococcus, Eustrongylus gigas, Schistosomum hematobium, etc. Blood may be present as well as albumin.

In general the amount of albumin may be much greater in acute and chronic parenchymatous nephritis than in any of the extrarenal conditions, reaching even 2 per cent. by weight of dried albumin, and causing the urine to solidify on boiling.

Albumosuria

The most important condition under this heading is the so-called myelopathic albumosuria, in which the Bence-Jones albumose is

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found in conjunction with multiple myelomata. The body is recently classified as a true protein. There may be a history of bone trauma, and more or less constant pain in certain bony parts is nearly always present. It is notable that the flat bones, often of the skull, are involved. They are tender upon pressure. Hideous deformities of the face may develop with bony changes elsewhere. Facial neuralgia is frequently noted. Emaciation, glandular enlargement, jaundice, retinal hemorrhage and paralysis of various nerves may be noted. The persistent presence of the Bence-Jones bodies may justify a provisional diagnosis of multiple myelomata before any bony changes can be detected. The quantity of urine often exceeds the normal, and the specific gravity may be very low, or on the other hand, the urine may be of syrupy consistence. It is sometimes of a chocolate color, or milky in appearance. The albumose is precipitated by nitric acid, but disappears upon boiling, to reappear upon cooling. A paradoxical behavior of urine in applying the ordinary tests for albumin should lead to a definite search for albumose.

Albumose, globulin and peptone may be found in the urine during the resolving period of acute pneumonia, in chronic suppuration, etc., but are of little interest clinically.

The methods of detection of albumin have been sufficiently discussed elsewhere.

Prognosis.—The discovery of the Bence-Jones albumose persistently in the urine gives reason for the gravest alarm, since the development of myelomata may be looked for. Albuminuria, which is inconstant and which is not accompanied by tube casts, arterial changes, increased vascular tension or other symptoms, especially in the young, is to be watched with some anxiety, and yet is generally of little significance from the standpoints of health, endurance or longevity. The transient albuminuria of fever and of acute diseases in general commonly disappears without leaving any damage in its wake. The albuminuria which appears in men of middle age, accompanied by some increase of tension and a few hyaline casts, is to be regarded rather as a warning to live more correctly than as indicative of the immediate approach of danger. The character and

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abundance of the urinary sediment and the state of the circulatory organs is of more importance as a guide than the trace of albumin.

Chyluria

The parasitic form due to the Filaria bancrofti is considered in the section upon parasites. In the event that communication is established between the lymph vessels and the urinary tract, milky urine may be passed. It is not a very infrequent occurrence after surgical operation. The milky urine is often blood tinged (hematochyluria), and under a microscope not only fat droplets but red blood cells may be found. A soft clot may be formed upon standing. The milkiness is often increased after taking food and after lying down, the chyle being increased after the former act, and the facilities for its egress into the urinary tract by the latter. In a case of Van Zant's the obstruction of the chyle duct was produced by tuberculous glands, and the overfilled vessels emptied into the urinary tract as a result. Only the most careful exclusion of the filariæ justifies the diagnosis of non-parasitic chyluria. The embryos may be found in the urine, but may demand careful search.

Pyuria

Pus may appear in the urine from many causes. A few leukocytes in the sediment are normal, but if a considerable number appear in every field, pyuria is present. In doubtful cases in the female sex it is necessary to have the urethral orifice cleansed and the urine withdrawn by catheter, since contamination with perhaps unrecognized vaginal discharge may exist. Many flat epithelial vaginal cells will be found. In the male, some inflammatory process in the urethra, seminal vesicles, prostate or adjacent structure may cause a pyuria. The more typical cases result from contamination in the bladder or above it. Cystitis is a common cause, the urine being generally alkaline or feebly acid, and many flat epithelial cells being present in the sediment. Blood cells may also appear. The colon bacillus and the tubercle bacillus are the common causes

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if the urine be acid, and proteus or a mixed infection if it be alkaline. The sediment is more ropy in the alkaline specimen, in part because of the increased quantity of mucus.

In infection of the pelvis of the kidney and in renal calculus the pus is constantly found, and well mixed with the urine, and the reaction is generally acid. Round, renal epithelial cells may be present. The discharge of a large amount of pus, with much less contamination of the urine afterward for an interval suggests the rupture of an abscess communicating with the urinary tract. Subsidence of the inflammatory focus in the kidney or appendix regions may coincide with the appearance of the pus. The colon bacillus is often present. The urine in pyuria is cloudy, and thick whitish sediment is often found at the bottom of the vessel. This is likely to be ropy and of ammoniacal odor in the cases of proteus or mixed infection with alkaline urine, while in the acid tuberculous urine it often settles into a sharply defined even white layer at the bottom, with less than the usual turbidity above.

Diagnosis.—This may generally be made at a glance, but light colored urates or especially phosphates may cause an error. If the urine be acidified and heated it will clear before any albumin present is precipitated. The microscope makes the diagnosis certain, and by showing the character of the epithelial cells and the microorganisms gives some help in locating the source of the pus. If all the pus appears in the first glass, when the three-glass method is used, it is presumably urethral in origin. If the urine be clear at times, the presumption is established that the pus enters the urinary tract intermittently from an adjoining focus or that a single diseased kidney becomes intermittently blocked. The frequency with which the tuberculous kidney is overlooked because of the supposed cystitis should be mentioned. The use of the cystoscope and ureteral catheter have simplified matters greatly.

Bacteriuria

The frequent presence of the typhoid bacillus in the urine is now well recognized. The colon bacillus is the one most frequently

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found, and the streptococcus, gonococcus, etc., are not unusual. The most typical of these is the infection with the bacillus coli. The urine is acid, but the offensive odor leads one at first to believe it to be alkaline. It has a peculiar cloudy shimmer from the presence of the bacilli and is alive with them when viewed under the microscope. The frequency of this infection in surgical cases, even though the catheter has not been used, is better recognized than formerly. Unless promptly detected and treated, cystitis and pyelitis are to be feared. In case of unexplained irregular fever after operation the urine should be examined carefully for this possibility and it will frequently be found present.

Phosphaturia

Normally, approximately one to two grams of earthy phosphates and two to four grams of alkaline phosphates are excreted daily. The urine becomes cloudy from the precipitation of the earthy phosphates because of its alkalinity, after eating a meal of vegetable matter, or because of the withdrawal of the normal acidity at the time of the secretion of the gastric juice. This type of alkaline and cloudy urine is normal. It is frequently seen also after the free use of alkalies, as in gastric and urinary diseases. The settling of the earthy phosphates in the urine while still in the bladder and the passage of this portion at the end of micturition is common in neurasthenic men, and many such are treated by quacks for alleged spermatorrhea on this account.

The phosphatic elimination through the urine is markedly increased after acute disease, in leukemia, diabetes, dyspepsia and in the so-called phosphatic diabetes. In this form of phosphaturia the total phosphates increase to double or treble the normal, and thirst, dry skin, and neurasthenic symptoms are common. In children an excess of calcium has been found by Sootbeer, with diminution of the amount normally excreted by the bowel. The phosphoric acid combines with the calcium salts, and the acid phosphates upon which the normal acidity of the urine depends are thus lessened in amount. The phosphates are decreased in anemia, hepatic cirrhosis and other

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wasting chronic diseases. A deposit of phosphates in the urine is not to be taken as indicative of excessive excretion. The total for the 24 hours should be estimated. Unfortunately no very valuable clinical deductions have been drawn thus far from the study of phosphates in the urine.

Oxaluria

Under certain conditions oxalic acid, present only in traces in the normal system, is formed, unites with calcium and is excreted in the urine as calcium oxalate. This generally appears as the well-known envelope-crystals, but occasionally in the dumb-bell form, fortunately easy of recognition because of the accompanying octahedral crystals. Calcium oxalate appears in the urine more or less normally after the ingestion of rhubarb, fresh cider, etc., but its habitual appearance is commonly due to lowered gastric acidity and intestinal indigestion. The carbohydrates are imperfectly digested in these cases, oxalates accumulate in the tissues and shortly appear in the urine, often as an "oxalate of lime shower." Irritability, depression, itching of the skin and erythematous eruptions are common, and neuralgic pains may be present. The frequent presence of oxaluria in gouty individuals should be mentioned. The local symptoms from the passage of the crystals through the delicate structures of the urinary tract are frequently overlooked. The urine examined instantly after passage may contain enormous numbers of the crystals and blood cells are not infrequently present, notwithstanding statements to the contrary. Many supposed attacks of renal colic are due to the irritation of the crystals of calcium oxalate. One physician who had been examined by many eminent men for stone in the kidney, and in whose case the X-ray repeatedly gave negative evidence, continued to suffer attacks of renal pain, with the usual radiation. The first specimen passed in such an attack showed a hundred crystals of calcium oxalate in the first field, under a medium power, with red blood cells in fair numbers. His attacks occur rarely except when his urine is permitted to become concentrated. This aspect of oxaluria demands more attention than is commonly accorded it.

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Lithuria

Uric acid is excreted in normal urine to the amount of ¼ to ½ gram per day, chiefly as urate of soda and ammonia. If the urine be concentrated and of high acidity, the uric acid crystalizes out and the grains become adherent to the sides of the glass, or collect upon the surface of the urine in the test tube. They may be seen to settle down through the urine after breaking up the surface "scum" by shaking the tube. The presence of one-half to one dozen ordinary crystals in the usual test tube does not signify an excess of uric acid. The addition of a few drops of a mineral acid hastens the deposition. The urates, chiefly as acid sodium urate, are deposited as a pinkish or brick dust sediment if the urine be acid and concentrated, and especially if it be allowed to cool. The alarm felt by the laity upon the discovery of such a sediment is generally groundless, since it offers no evidence of excessive excretion. The uric acid in health bears a fairly constant relation to the urea (1 to 50 or so) but increases markedly during the intervals between the arthritic attacks in the gouty, to return to normal with the advent of gouty manifestations. (Futcher.)

Uric acid is increased by a heavy meat diet, by violent exertion, in fever, leukemia and acute rheumatism. In anemia and certain wasting diseases and under a vegetable diet the amount is decreased. The danger of uric acid calculi in those with habitually over-acid and concentrated urine should be borne in mind. No very striking benefits have resulted to the clinician from the study of the uric acid excretion, excepting in the case of gout, and much less credence is now given than formerly to the claims of its preponderating influence in many nervous conditions.

Cystinuria

Cystin is excreted in the urine through some vice in protein metabolism, often hereditary, and this excretion may persist for life without serious damage to health, unless from its sparing solubility cystin calculi form. This has happened in the cases of two

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patients of mine, on one or two separate occasions. The latter patient could not carry silver nor wear silver jewelry without the well-known tarnishing because of the sulphur content of the cystin, which is known to be excreted in the sweat. Unless calculi attract the attention of the physician, the discovery of cystinuria is commonly the result of finding the colorless hexagonal crystals in the course of the urinary examination. Cystin should always be sought in the urine of patients who complain of the tarnishing of jewelry, for even in the case of gold ornaments, silver may be present as an alloy, and produce the effect.

Indicanuria

The colorless indoxyl potassium sulphate is excreted in the urine to the extent of a few milligrams per day. The proportion is larger upon a meat diet, since it is derived from indol, which comes from the decomposition of albumin in the intestine, under bacterial influence. Indigo, set free by the strong hydrochloric acid used, gives rise to the color seen in the ordinary test. Indican is increased in those conditions in which unusual decomposition of albuminous food occurs in the intestines. Retention beyond the usual time, as in peritonitis, appendicitis or even constipation; lack of proper proportion of hydrochloric acid with impaired digestion as a result; excessive hydrochloric acidity, as in gastric ulcer, and various other conditions in which the complete digestion and proper elimination of the residue of the food taken is interfered with, may cause an increase. In gangrene of the lung or of the extremities, in putrid empyema, and other conditions in which putrefactive processes are at work, the indican may be increased. Indican may be freed within the body, so that the urine is blue when passed, and even calculi may form in very rare instances.

Alkaptonuria

This rare urinary anomaly is of interest chiefly because of its association with ochronosis (*see* Ochronosis). Because of its reduc-

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ing action upon Fehling's solution, further tests must be tried for glucose, if suspected. Diabetes is wrongly diagnosed occasionally. The soiled clothing of an infant may be darkened by the urine, since this may be of dark color when passed. As the condition does not interfere with health, it is of slight general interest. It occurs in certain families, especially Germans, is generally congenital and lasts through life. Consanguinity in the parents has been frequently noted.

Hematoporphyrinuria

This is of interest chiefly because of its occurrence as a result of the long-continued use of sulphonal and trional. It occurs rarely in tuberculosis and certain other diseases. The urine is of deep red, port-wine color, and may even be nearly black. The spectroscopic examination is decisive.

Melanuria

This term is properly applied to the urine passed by patients suffering with melanotic sarcoma. The normal color, when passed, gives way rapidly to a dark and finally black discoloration, proceeding downward from the surface. The darkening from blood pigment, indican, hematoporphyrin, alkapton and phenol has been spoken of elsewhere. In long-continued jaundice the urine may become dark from excess of biliverdin.

Lipuria

The presence of fat in the urine in chyluria has been mentioned. In chronic parenchymatous nephritis, with extensive fatty degeneration of renal cells, microscopic fat is a common finding, globules, fatty casts and crystals being common. Even calculi composed of fat are occasionally passed. Aside from the conditions mentioned, fat may be passed in the urine when overabundant in the blood. In diabetes, acute yellow atrophy of the liver, phosphorus poisoning, in pregnancy, after excessive feeding of fat, as in the olive-oil treat-

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ment of gall-stones, after fractures and operations upon bones (fat embolism), lipuria may be noted. The volatile fatty acids (acetic, butyric, etc.) may be passed (lipaciduria). It is important to exclude fat accidentally introduced, as in the use of the catheter.

Choluria, acetonuria, glycosuria, leucinuria and tyrosinuria have been considered elsewhere.

5. UREMIA

This is a toxemia occurring in cases in which insufficient urinary excretion exists, the exact nature of the toxin being undetermined. Since it was shown long ago that urea had no serious deleterious effect upon the organism, many theories have been put forward, but none has been generally accepted.

Symptoms.—These may be acute, chronic, or latent, the latter being the type mentioned as occurring in the anuria of renal calculus. The acute and chronic forms are seen in different varieties of nephritis, the latter especially in chronic parenchymatous nephritis. The symptoms may be described as they pertain to the nervous, the alimentary and the respiratory systems.

(a) Nervous System.—The most commonly noted symptom referring to the nervous system is headache, of almost any variety, and frequently accompanied by dizziness. Since arteriosclerosis and high arterial tension may give both symptoms apart from any uremic condition, judgment is essential in properly estimating the imminence of danger. Persistent contraction of the pupils is to be regarded as ominous. Curshmann states that the Babinski sign is always present in impending uremia.

Convulsions.—These are amongst the most frequent and striking manifestations of uremia. Most commonly the convulsion is preceded by twitching of various muscles, but sooner or later tonic and clonic convulsions appear, resembling closely those of epilepsy. Although the convulsions may apparently come out of a clear sky, one may practically always find that headache, nausea, vomiting, edema, dizziness, debility, polyuria, ischuria, or retinal difficulties have been present even though unnoticed. Unconsciousness usually

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follows the fit, and other convulsions follow in many cases before consciousness is regained. Amaurosis, deafness, and hemiplegia or other paralyses are of toxic origin but may be due to hemorrhage, in which case they persist. The convulsions may be incomplete and of the most varied character, the convulsive tendency being of more import than the exact manifestation.

Coma.—This has been mentioned as a sequence of the convulsions, but it not infrequently appears as the earliest serious manifestation of the toxemia and remains till the fatal ending, even for some weeks. Convulsions are always to be feared, and the twitching of various muscles is often noted. The uremic odor of the breath may first attract the attention of the physician to the probable cause. Cheyne-Stokes respiration is often present.

Mental Abberation.—This may consist of delirium, muttering, and incoherent, or violent and even maniacal, and may occur in one not known to have had kidney disease. Melancholia, delusions of persecution, and actual acute mania may develop. The patients are not infrequently sent to institutions as insane.

(b) Alimentary Tract.—Loss of appetite, furred tongue, nausea and vomiting are frequent manifestations of uremia. The vomiting may be severe and persistent, and in one not known to have nephritis is too often for a time attributed to other causes. Severe diarrhea may accompany it. The vomiting is often of central origin. Hiccough may be present, and is of evil significance. Stomatitis, hemorrhage, erosion of the stomach and ulceration of the colon may appear.

(c) Respiratory Tract.—Dyspnea in some form is a very frequent symptom of uremia. The purely uremic form must be differentiated from the difficulty in breathing due to extensive anasarca, dilatation of the heart, emphysema, edema of the larynx, etc. The uremic form may be continuous or paroxysmal, the latter type being prone to occur in the night. No physical signs are to be found in the chest to account for it, since it is a toxemic manifestation. It may last for many weeks.

The pulse tension is commonly very high. Cheyne-Stokes respiration has been mentioned with the nervous manifestations of uremia.

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The temperature may be normal, or in chronic cases, subnormal for long periods. Pyrexia should lead to a suspicion of some inflammatory complication, but it may be of purely uremic origin. If the temperature becomes very high the outlook is grave. Itching, erythematous eruptions, muscular cramps and the accumulation of urea upon the skin, and especially on the hair about the temples, may be noted. Osler has called attention to the frequency of death from a terminal infection of one of the serous membranes.

Diagnosis.—This depends upon a recognition and acceptance as a basis for action, of the truth of the statement than either headache, dizziness and delirium, coma, mania, convulsions, amaurosis, deafness, monoplegia or hemiplegia, dyspnea, Cheyne-Stokes respiration, nausea, vomiting, diarrhea, hiccough or other of the symptoms mentioned may be of uremic origin, regardless of any known previous signs of kidney disease. As in the case of syphilis and tuberculosis, the manifestations may be so protean that the possibility of the condition must be always in mind. Fortunately some distinctly urinary signs or symptoms commonly appear, such as suppression of urine, bloody urine, as in acute nephritis, or uremic odor of the breath. Further, in the event of inexplicable symptoms the physician always examines the urine. Evidence of disease in the urinary tract is always forthcoming if carefully sought. The phenolsulphonephthalein test promises to be of assistance. In many cases of chronic interstitial nephritis, the oculist points out the approaching danger from the retinal appearance, the headache and dim vision having caused the patient to seek his first advice from that source.

Differential Diagnosis.—The most dangerous error is probably the mistaking of uremic coma for alcoholism, the occasional alcoholic odor of the breath leading the superficial observer into error. Narcotic poisoning, especially by opiates, is to be considered. The contracted pupils of the latter condition are sometimes imitated in uremia. The mere finding of a trace of albumin and a few hyaline and granular casts does not suffice for the differentiation, since they are commonly present in any comatose condition. The finding of a fair amount of albumin and of granular and especially of fatty and epithelial casts, renders the diagnosis of uremia fairly safe, as does

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the demonstration of a retinitis. Arterial degeneration and high arterial tension are, if present, extremely valuable aids in the diagnosis.

Chronic uremia is occasionally mistaken for typhoid fever or other infectious disease. The differentiation from organic disease of the brain cannot be made at once, positively, in many cases, since the coma, stertorous respiration, and paralysis may be equally attributable to either condition. The safe rule is to act as if the patient had uremia in these cases until the diagnosis becomes clear.

Prognosis.—This depends entirely upon the condition giving rise to the uremia.

6. SUPPURATIVE CONDITIONS OF THE KIDNEY AND ITS PELVIS

We shall consider under this head pyelitis, pyelonephritis, pyelonephrosis, the various types of suppurative nephritis, and perinephric abscess.

A. PYELITIS

This is an inflammation of the renal pelvis and the calices, unilateral or bilateral.

Etiology.—Although due to bacterial infection in most cases, some predisposing condition is to be found in a majority. The pelvis may have been irritated by the elimination through the urine of some poison, a catarrhal process resulting, and infection following; a calculus may have produced the primary irritation; the trouble may have been caused by an ascending infection from an overdistended and infected bladder; a hydronephrosis may have been induced in a movable kidney, or pregnancy, one of the infectious fevers, tuberculosis, traumatism, parasitic invasion, malignant growth, etc., may have been operative.

Bacteriology.—The colon bacillus is the most frequent organism, the tubercle bacillus next in order, while the streptococcus, proteus, typhoid bacillus, staphylococcus, pneumococcus, gonococcus, and influenza bacillus account for most of the remaining cases. The

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infection is hematogenous in those diseases (typhoid, sepsis, etc.) in which the organisms are present in the blood stream. An ascending infection from the bladder is extremely common, notwithstanding the evidence that overflow into the kidney cannot be readily induced in healthy animals. Infection by contiguity, as from the colon, is not infrequent.

Symptoms.—It is notorious that a majority of cases of pyelitis are overlooked in hospitals as well as in private practice, evidently because the symptoms are so inconspicuous. For example, few cases will be recognized in typhoid fever without careful urinary examination, since a mild complicating pyelitis adds practically no symptoms to the disease. The patient may complain of pain and tenderness in the loin upon the affected side, and a definite chill may introduce the disease. A moderate fever with occasional chilliness is common and sweating may be a troublesome feature. Malaria is sometimes suspected. The general health suffers and attention is drawn to the urine because of its appearance, or the irritation of the bladder produced by the infection. The latter feature is commonly the first symptom to attract attention in tuberculous pyelitis. In other cases the finding of the greatly distended kidney by the patient is the reason for consulting a physician. Various nervous symptoms, even coma, may attract attention.

The Urine.—Attention is drawn to the urinary tract and examination of the urine commonly renders the diagnosis easy. It is cloudy, more often acid, but possibly alkaline, and contains albumin, pus and blood cells, pelvic epithelia and bacteria. Shreds of mucus, with pus and epithelial cells and bacteria entangled, are found. The colon bacillus is almost always present as a secondary invader, if not as an original infection. The bladder is irritated by the purulent urine and the epithelial cells from this source mingle with those from the pelvic wall. In general the large placques of flat cells are of bladder origin, and numerous tailed cells and round granular cells suggest a desquamation of the pelvic epithelium. The urine may vary much in its content of pus, since a temporary blocking of the ureter upon the diseased side may take place. In case of doubt, the urinary sediment should be stained for tuberculosis, and

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a blood culture made. Animal injection may be necessary for the decision. In infancy pyelitis is common, and unfortunately generally overlooked, chiefly because of the difficulty in securing the urine for examination. Unexplained febrile movement should always suggest the possibility. The frequency in girl babies is about seven times that in boys, the explanation being that the urethral contamination from colon-bacillus-infected diapers is so much more readily brought about.

Diagnosis.—Pain in the loin should suggest an examination of the urine, as should bladder irritation or unusual cloudiness in the urine. In many cases tenderness may be elicited more readily by "bumping" the region of the kidney with the fist than by palpation. This is important in view of the frequency with which bladder symptoms predominate and lead to erroneous diagnosis, and even to operation. The use of the cystoscope and segregation of the urine, with study of the condition of the pelvis by the X-ray after the injection of collargol, should prevent error. The existence of pregnancy should raise a presumption in favor of pyelitis or pyelonephritis in case of doubt, from the known but too often forgotten frequency of this complication. The right kidney is commonly involved, but both are affected in 15 per cent. of the cases (O'Connor).

The diagnosis from other conditions considered in this section will be considered as they are taken up.

Prognosis.—This is excellent in the milder bacillary types, these often recovering in a few weeks with the administration of the urinary antiseptics. The tuberculous form may recover by inspissation and calcification of the contents; but if unilateral, the results of surgical intervention are much more satisfactory. Calculous and ascending types depend upon the ability of the surgeon to meet the indications.

B. PYELONEPHRITIS

Pyelonephritis is a sequel of pyelitis ordinarily, the inflammation having extended from the pelvis to the substance of the kidney. The symptoms are those of a gradually developing severe type of pyelitis, and no sharp demarkation is clinically possible.

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C. PYELONEPHROSIS

Pyelonephrosis commonly results from infection of the pelvis of the kidney in connection with retention of infected urine in the diseased bladder (surgical kidney). In this case there are added multiple abscesses in the substance of the kidney. Portions of sloughing tissue may be seen in the pelvis, or may pass in the urine. Pyonephrosis is a term used to signify suppuration within the pelvis with great distension from retention of the contents.

D. SUPPURATIVE NEPHRITIS

Suppurative nephritis signifies an inflammation of the kidney proceeding to suppuration, and may be due to trauma, to infection by contiguity or through the blood stream. Several small abscesses may coalesce and produce a large abscess of the kidney.

E. PERINEPHRIC ABSCESS

Perinephric abscess signifies suppuration in the connective tissues around the kidney. It may be primary, originating from trauma, and especially penetrating wounds of the kidney region. Most cases are secondary and arise from the extension of a suppurative process within the kidney or its ureter, from extension of an ascending infection coming from the appendix, the infected female pelvis, cancer of the colon, caries of the spine, etc. A blood-clot from bleeding consecutive to injury may become infected, or the infection may be carried by the lymphatics or blood vessels.

A more or less extensive abscess exists around the kidney, particularly posteriorly. If long neglected it is likely to have burrowed upward through the diaphragm, causing empyema, emptying through the lung, or passing downward and showing near the groin or at Poupart's ligament. Perforation of the bowel, bladder, or vagina may occur. The pus is generally foul and is especially likely to show the colon bacillus infection, though the streptococcus, staphylococcus, tubercle bacillus, etc., are often present in a mixed infection.

Symptoms.—The first complaint is of dull aching or throbbing in

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the back, with tenderness, much exaggerated by pressure or movement, and particularly by sudden shock, as by the fist. The pain is often reflected downward, even to the thigh. Irregular fever, chills, or chilly sensations and sweating may be present. The patient cannot straighten up, and commonly lies in bed with the thigh of the affected side drawn up. Adduction is painful. The testes may be retracted. In the loin one may note the increased fullness of the affected side, and in extreme cases, redness, edema, and the evidences of impending rupture. Fluctuation may be felt, and the respiratory movements produce no effect. The abdominal muscles are rigid upon the affected side. Sudden flattening out of the full area suggests perforation into the kidney, ureter, bladder, bowel, pleura, lung, etc.; and following the escape of the pus, marked amelioration of the symptoms may be noted. The urine may show a moderate quantity of pus, followed by a lesser amount continuously. This, of course, suggests rupture of the abscess into the urinary tract. Blood cells, renal epithelial cells, tube casts, albumin and bacterial infection may be present under the varying conditions.

Diagnosis.—This depends upon the local pain, tenderness, and rigidity, fever, swelling, and perhaps redness, edema of the affected side and the presence of the urinary findings mentioned in many cases. A marked leukocytosis may exist. Fluctuation suggests the use of the aspirating needle. Coincident disease of the hip or spine may often be excluded by noting the effect of shock transmitted to the suspected bony part.

The tumor, fever, leukocytosis, and urinary findings suffice for the exclusion of lumbago. Hydronephrosis has none of the evidences of infection, and of tumors in this region we may make the same statement.

Prognosis.—This depends upon the timeliness and efficiency of drainage.

F. HYDRONEPHROSIS

This term is applied to dilatation of the pelvis of the kidney by retained contests, without suppuration, and with secondary distension and partial destruction of the organ.

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Etiology.—The condition arises from some obstruction of the ureter, which may be even of fetal origin, so that birth is interfered with by the dilated kidneys. Any condition interfering with the patency of the ureter may cause retention of the flow and dilatation of the pelvis, such as stricture, impacted stone, twisting, as in floating kidney, aberrent vessels near the pelvis of the kidney causing a kinking of the ureter, pressure from without, as by cancerous or other tumors, pressure of the fetal head, extrauterine pregnancy, adhesions, and finally retention of the urine in the bladder, of whatever origin, with overflow to the pelvis of the kidney. Hugh Cabot states that mobility of the kidney without corresponding mobility of the upper portion of the ureter and abdominal renal vessels is the most frequent cause of hydronephrosis.

FIG. 93.—HYDRONEPHROTIC KIDNEY. From pressure on the ureter by Lobstein's cancer.

The retained secretion gradually dilates the pelvis of the kidney, until in extreme cases only a shell of kidney tissue remains, with ribbed projections indicating the subdivisions of the pelvis. The fluid in general resembles dilute urine, the pus cells and epithelial elements being found with the microscope. The dilated kidney may contain from a few ounces to several gallons of fluid. The opposite kidney is often hypertrophied to make up for the insufficiency in urinary secretion.

Symptoms.—The patient may be unaware of the condition or merely recognize the presence of a tumor in the abdomen. Pain may be present, perhaps more often in the intermittent type, and discomfort from the presence of the swelling. If the trouble be

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bilateral, uremia with signs of hypertrophy of the heart may develop. In intermittent hydronephrosis the obstruction is temporary and intermittent in its action, and the largest kidneys appear in cases of this type as a rule. Indeed, complete and permanent obstruction of the ureter may be followed by atrophy of the kidney

FIG. 94.—COLLARGOL INJECTION OF ENORMOUS HYDRONEPHROSIS. Kidney ptosed. (Dr. G. H. Stover.)

without at any time any recognizable dilatation. An aberrant vessel near the origin of the ureter is a very common cause of the intermitting obstruction, and the kidney empties itself after becoming filled to such a point that the kink is straightened out. The kidney is generally movable. Most of the instances in which a kidney tumor disappears between the time of examination by the surgeon and the time set for operation are of this type. Attacks

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of acute pain of the usual renal type, with fever, chills, and sweating, may occur, most often in the intermittent form. Headache, debility, neurasthenia, attacks of nausea and vomiting, and constipation are frequent sources of complaint. Examination of the abdomen shows one side distended by the tumor, or both sides in case the disease be bilateral. The tumor is movable, unless so large as to fill the abdomen too completely, and it is notable that it reaches well back into the kidney fossa. In this it differs from the most common condition with which hydronephrosis is confused, namely, ovarian cyst. The smooth feel of the surface, comparative painlessness upon handling, fluctuation, presence of the colon in front of the tumor, and absence of the evidence of ovarian tumor upon vaginal examination are of value. The kidney need not necessarily be found upon its own proper side of the abdomen, or it may be unduly immobile because of adhesions. Aspiration gives a fluid with some of the characteristics of the urinary secretion. If pus be present in any quantity, the case is to be re-

FIG. 95.—EARLY HYDRONEPHROSIS DUE TO OBSTRUCTIVE KINK IN URETER. Kink caused by looping of ureter over abberant artery to lower pole of ptosed kidney. (Dr. G. H. Stover.)

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garded rather as one of pyonephrosis. Catheterization of the ureters may be practicable.

Diagnosis.—This is based upon the presence of tumor in the abdomen, occasionally bilateral tumors, in babies especially, without the evidence of suppuration or malignancy, with or without attacks of pain, frequently variable in size, fluctuating, comparatively insensitive, filling the abdomen more toward the loin than in the case of ovarian cyst, and frequently without material interference with health. Sudden disappearance of such a tumor with coincident free passage of urine establishes a diagnosis of intermittent hydronephrosis.

Prognosis.—If bilateral, the outlook is bad, uremia being a frequent termination. Blocking of the ureter of the good kidney may precipitate the same difficulty. The sac may rupture even through the lung. Suppuration may take place within the sac. Cure may result by relieving the cause of the obstruction of the ureter, particularly by doing away with the aberrant vessels sometimes found, or by anchoring a floating kidney.

7. NEPHROLITHIASIS

(*Renal Stone*)

The formation within the kidney of concretions derived from the urine is termed nephrolithiasis.

Etiology.—The calculus may be deposited in an otherwise healthy kidney, or as a result of disease, the latter or secondary type being capable of formation anywhere in the urinary tract. The stony formation may be within the pyramids, as the uric acid infarcts in children, the calcium deposit in the aged, and the uratic deposit in the gouty; or in the substance of the kidney, or more commonly in the pelvis. Small stones are found in the ureter, and the large elephant calculi may fill the distended pelvis.

In size the concretions range from that of fine sand upward. I have seen sharp renal colic from the passage of a uric acid stone 2 m.m. in diameter, but most attacks are caused by stones larger

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than this, yet small enough to enter the ureter. Chemically the stones may be:

(a) Uratic, consisting of uric acid and urates, often with some calcic oxalate; they are generally smooth, hard, and reddish brown in color;

(b) Calcic oxalate.—These are far more frequently met with; the stones are dark in color, oftentimes from the associated uric acid, and are likely to be rough, the "mulberry stone";

(c) Phosphatic deposit, in an alkaline urine, and often with one of the preceding varieties as a nucleus. The phosphate of lime, ammoniomagnesium phosphate, and calcic carbonate are present in varying proportions. It should be made clear that the change in the reaction of the urine and of its constituents at different times governs the formation of stones, and that fibrin, necrotic cells or tissue, blood clot, masses of bacteria, etc., may determine the calculous deposit. There is little doubt that change in the reaction and concentration of the urine may cause partial solution of already formed calculi. In addition to the varieties mentioned, there are certain decidedly unusual stones, of which we may mention calcic carbonate, indigo, xanthin, cystin, urostealith, and even fat.

In etiology, heredity plays some small part. The presence of relatively insoluble substances like cystin, uric acid, calcic oxalate, etc., in a urine favorable to their insolubility, is of importance. Anything which may act as a nidus for the formation of a deposit, as a minute blood clot, collection of bacteria, or shred of necrotic tissue, may induce the precipitation of salts from the urine. High living and a gouty tendency are distinctly favorable to the formation of stone. Males are relatively more often affected. In some countries the drinking water of different sections is thought to be influential. Infancy, with its uric acid infarcts, is a predisposing factor. Sedentary occupations are thought to favor lithiasis. In countries in which the bilharzial infection is found (Africa), the eggs in the pelvis of the kidney serve as a predisposing cause of stone.

Symptoms.—There may be none. If the stone be too large to enter the ureter, or the sand be so small as to pass readily, colic will probably not occur. The pain may be constant and aching in

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character, and felt in the region of the kidney. The more typical pain is that coming in paroxysms, and radiating down the course of the ureter to the genitalia and down the inner side of the thigh. "Flushes of hot pain" are described by Osler. The pain in rare instances is attributed by the patient to the sound kidney, as afterward proved by operation. Pain is often absent in case the stone

FIG. 96.—RENAL CALCULUS SHAPED LIKE CLUSTER OF GRAPES WITH STEM. (Dr. G. H. Stover.)

is imbedded in the pelvis more or less immovably and may be when a smooth calculus is already in the ureter. The most severe colic probably occurs in the case of a very rough (calcic oxalate!) stone, large enough to fairly distend the ureter, yet this is disputed by Bevan, who believes that the increased intrarenal tension from obstruction of the ureter is the sole cause of the pain.

So-called renal colic must not be interpreted as certain evidence of the presence of stone, since pyelitis, contracted kidney,

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and possibly a pure nephralgia, may account for the pain. The attack lasts for minutes, hours, or even days. Chill, fever, nausea, vomiting, fainting, collapse, and frequent micturition may occur. The temperature may reach 102° or 104° and an intermittent type of fever may be present.

FIG. 97.—THREE CALCULI IN THE LOWER END OF THE RIGHT URETER. Calculi indicated by arrows. Cystoscope and ureteral catheters in situ. Right catheter in contact with one of the calculi. The calculi were subsequently removed through the bladder. (Dr. S. B. Childs.)

Changes in the Urine.—Hematuria commonly occurs, though perhaps so slight as to be evident only on microscopic examination. The urine is often definitely bloody or smoky. Pus cells and renal epithelial cells are probably always present sooner or later, excepting in those cases where the affected ureter is entirely blocked. In

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this case the urine may remain normal. The pyuria may occur constantly for years. The danger of calculous anuria has been mentioned elsewhere. The bleeding is likely to occur during the attack of colic, but microscopic blood is one of the most constant

FIG. 98.—URETERAL CALCULUS; LOCALIZATION BY MEANS OF STEREO-RÖNTGENOGRAPHY WITH CATHETER IN URETER. The tip of the catheter has gone past the calculus. (Dr. G. H. Stover.)

signs of stone in the pelvis. Exercise or rough riding commonly causes increase of blood, as it does of pain.

Physical Examination.—Aside from tenderness over the kidney region, especially brought out by a sharp tap, and rigidity of the abdominal muscles, little is commonly found. Occasionally a stone is palpable, or grating may be felt, and a stone in the lower end of the ureter has been felt upon pelvic examination—and even through

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the abdominal wall. The cystoscope and ureteral catheter give valuable evidence in many cases. Renal stones, contrary to the rule which applies to those of the gall-bladder, practically always give a shadow in the skillfully taken X-ray plate. In one of my cases Stover obtained an excellent shadow of a cystin stone. Since the introduction of the X-ray we have learned that ureteral stone is more commonly found accompanying colic than that in the renal location.

FIG. 99.—VERY LARGE RENAL CALCULUS. In upper left-hand corner. (Dr. G. H. Stover.)

Diagnosis.—Renal colic should always lead to searching investigation of the urine for blood, pus, etc., to examination of the bladder and ureters, and the taking of a Röntgen picture. The latter is commonly the decisive element in the diagnosis. If the urine has been known to contain blood and pus, indicating a pyelitis, and the patient has had the symptoms rendered worse by exercise or riding in a rough vehicle, an attack of colic would ordinarily suffice to make the diagnosis certain. Yet a calcic oxalate "shower" will give every symptom of the passage of a stone, and only in emergency is operation upon the kidney justifiable without the resort to the X-ray. The lower end of each ureter must be

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included, and even the bladder, in case of doubt, since the stone may have passed into it. An unexplained fever, with repeated chills, should always lead to a careful search for renal stone.

Prognosis.—This is good if the stone be removed, unless some serious suppurative or other complication arise.

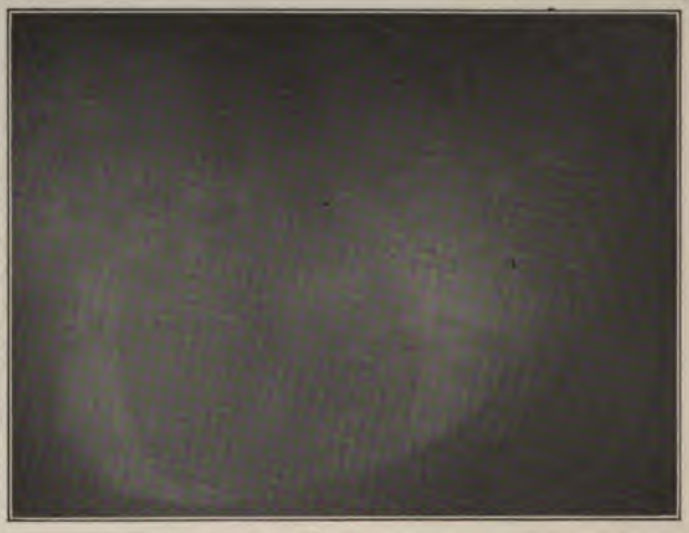

FIG. 100.—BLADDER COMPLETELY LINED BY DENSE INCRUSTATION. (Dr. G. H. Stover.)

8. ACUTE NEPHRITIS

An acute parenchymatous inflammation of the kidney, generally caused by exposure to cold, the toxins of acute infectious disease, or intoxication from other agents, is termed acute nephritis.

Etiology.—The disease is more common in youth, because of the increased exposure to the toxins of acute disease, and in the male sex later in life, because of greater exposure. In children it so commonly follows scarlet fever, that in case of doubt the occurrence of acute nephritis is commonly regarded as raising a presumption that a preceding infectious disease must have been of this nature. It occurs occasionally after any of the acute infectious diseases, and in malaria, typhoid fever, and in syphilis (in the secondary

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stage) it is not very uncommon. Chemical irritants probably come next in frequency in the production of the disease. Turpentine, phenol, potassium chlorate, ether used in anesthesia, and bichlorid of mercury are perhaps the most common chemical causes. I have seen acute nephritis develop as the result of the overuse of salol in a mild attack of typhoid fever, and have taken care of two physicians who suffered after the accidental swallowing of a 7½-grain bichlorid tablet. Exposure to cold while intoxicated is a common cause. Several cases from lying on the stone pavement in winter under such conditions have come under my observation. Acute nephritis from the toxemia of pregnancy is not uncommon. Trauma and extensive burns are occasional causes. It is likely that many cases in adults regarded as acute Bright's disease have as a basis a chronic or subacute nephritis, which has produced no symptoms, and therefore been unrecognized.

Pathology.—The kidneys in the height of the disease are swollen, mottled, and reddish or bluish in color. The capsule strips easily. The cortex is dark red to grayish red, according to the amount of fatty degeneration which has occurred, while the pyramids are deep red in color. Degenerative and inflammatory changes are found in the secreting structure, and affect the different elements of the kidney differently in the various types of acute nephritis. Some interstitial change may be demonstrated in severe cases.

Symptoms.—These may be anything from headache alone to convulsions and coma. A convulsion in children, and a chill, or chilly feeling in adults may initiate the attack. There is generally pain in the back, with nausea, and dropsy appears in the first day or two. In other cases the child becomes pale, loses the appetite, looks flabby and puffy, and after several days definite edema is found, and the urine upon examination shows albumin, blood, and casts. A moderate fever occurs in typical cases, but is often absent. I have known the patient to be found comatose and to die before consciousness was regained without the occurrence of convulsions. Upon physical examination little beyond the edema may be noted, generally first in the face and ankles. In severe cases anasarca develops. Even in a fortnight perceptible thickening of the wall of the left

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ventricle may be found post mortem, but several weeks generally elapse before increase in the cardiac area and heightened blood tension are demonstrable. The aortic second sound is commonly accentuated under these conditions. Anemia of the usual secondary type is present. Petechiæ may be found, but retinitis is rather uncommon.

Examination of the urine shows the characteristic smoky color, although it may be red with blood. The amount may fall to even 5 drachms in 48 hours, as in a case of septic origin in a physician, but commonly a few ounces are passed. There may even be anuria. Albumin is abundant and the urine may solidify on boiling. Blood, blood casts, epithelial cells, epithelial, granular, and hyaline casts are generally present. The specific gravity is high, but owing to the small quantity of urine the excretion of solids is very small. Typhoid bacilli and other organisms have been occasionally reported.

Diagnosis.—In mild cases the diagnosis cannot be made, and may not be even suspected, without the examination of the urine. Headache, nausea, vomiting, coma, convulsions, pallor, and especially edema should lead to the examination of the urine if it can be obtained. If anuria be present under such conditions, a diagnosis may be assumed to be correct so far as the institution of active treatment requires. In scarlet fever and other acute infectious diseases, it is common to find a trace of albumin with a few hyaline and granular casts and a few red cells. Although these may preface the development of acute Bright's disease, they do not suffice for the diagnosis, without much more positive evidence that the process has passed beyond the stage of acute congestion. During pregnancy the appearances mentioned justify the assumption that danger may be imminent, and the proper measures should be taken without delay.

Prognosis.—This is serious, since a mortality of 30 per cent. may occur in the scarlatinal form. It is less serious in adults. There is danger that the disease may run into a subacute and then a chronic form, and eventually prove fatal from uremia. Favorable cases may recover in six or eight weeks.

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9. CHRONIC PARENCHYMATOUS NEPHRITIS

This is a chronic form of diffuse nephritis similar to the acute form described, often following it and distinguished anatomically in most cases by the presence of the large white kidney.

Etiology.—In childhood it not infrequently follows the acute form of Bright's disease. In adults it may develop insidiously without recognizable cause, but it not infrequently occurs in those exposed to cold and damp. Thus it occurred in one of my patients, a fat butcher, who habitually cooled off by sitting in the refrigerating room of his shop. It is more common in cold, rough climates than elsewhere. Those most exposed to such influences are most often affected, hence young males predominate over those of advanced years and over females. Alcohol is thought to have a definite influence in its causation and it is not improbable that the taking of certain drugs, or of food preserved or adulterated with chemicals over a long period, may be the cause of the disease. In the 19 cases spoken of in the last paragraph of this section, syphilis was admitted in 3, and chronic alcoholism in 12. Chronic suppuration, malaria, syphilis, and tuberculosis are mentioned by most authors as operative in its production.

Pathology.—The typical finding is the large white kidney without amyloid change, but with marked hyaline, granular, and fatty degeneration. Tube casts, generally epithelial and fatty, are present in the tubules. A moderate increase in the interstitial tissue is found.

The so-called secondary stage of this process is illustrated by the small white kidney, in which the increase of connective tissue and the degeneration and destruction of the secreting elements have gone on hand in hand, until a much smaller and firmer organ with thinner cortex is developed, cutting with resistance and showing spots of marked fatty degeneration. From the shrinking process the surface becomes granular and the capsule adherent. As in the chronic interstitial kidney, marked arterial changes are often found. This form probably at times develops without passing through the changes mentioned in the first type. In such a case the name, secondary con-

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tracted kidney, would obviously be inappropriate. The large red kidney found in the so-called chronic hemorrhagic nephritis represents much the same changes as described under white kidney, excepting for the presence of reddish areas due to the staining from bleeding into the cortical tissues. The organ often presents irregularities of surface, owing to patches of greater shrinkage amongst the degenerated areas. The capsule is often adherent as these points. The mottling due to the red hemorrhagic areas distributed amongst the gray fatty ones may be very pronounced—the variegated kidney.

Symptoms.—They often represent merely the ones we have studied under acute nephritis, metamorphosed into a chronic form. No line can be drawn between acute and chronic parenchymatous nephritis, for if the former fails to recover, it is common to have the disease gradually lose its acute features, when, without the acquirement of new ones, we have the form we are considering. It is probably more common to find the disease developing so insidiusly that the patient cannot tell within several months the date upon which he considers that health gave way to illness. In some instances digestive difficulties, headache, anemia, and puffiness of the face are noted, but only after a visit to the oculist does the patient consider himself ill enough to consult his physician, though this is a much less frequent history than in interstitial nephritis, since retinitis is much less common. Progressive weakness, increased dropsy, dull, aching pains, nausea, and vertigo may be noted. Vomiting and diarrhea are not rare.

The Urine.—When attention is attracted to the urine it is found to be lessened in amount, often but one-third of the normal. It is generally dark and turbid, with a heavy sediment. The specific gravity is often abnormally high, yet the total excretion of solids is markedly lessened, since the quantity is reduced. The albumin is abundant, but rarely sufficient to cause solidification in the tube upon boiling, as mentioned in acute nephritis. The sediment shows typically, hyalin, granular and fatty casts, leukocytic casts, fatty cells, free fat globules, and not infrequently red blood cells. Increase in the quantity of urine is not infrequent as the disease advances toward the secondary form, the specific gravity and amount of albumin

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falling. The total solids, however, remain below normal, and may show an increasing deficiency. The increase in the albumin during the day as compared with the night, should be mentioned. As the disease advances, dropsy becomes more notable, and ascites, hydrothorax, hydropericardium, and all of the features of the most advanced type of anasarca may be noted. More than in any other type of dropsy there is a tendency for the swollen tissues to be influenced by gravity. The roll of edematous tissue at the point where the trunk and hips touch the bed as the patient lies upon his back is often very striking, and speaks strongly for the diagnosis. The pale, pasty face is characteristic. The patient presents a white edema rather than a cyanotic one, as in heart disease, or a tawny one, as in hepatic cirrhosis.

The arteries become thickened and the blood tension increases in most cases. Continuous headache, nausea, vomiting, retinitis, dyspnea, rupture of the edematous skin, or even of the navel, with weeping of serum, and eventual dilatation of the hypertrophied heart, with uremia, convulsions, and death too often make up the closing history of the disease. The blood shows the signs of a marked secondary anemia.

In the earlier months one may be reasonably assured that the large white kidney is present. If the disease lasts for a year or two, with gradual increase in the blood pressure, advancing arterial changes, development of retinitis, lessening of the dropsy, and increase of the total quantity of urine, with lessening of the albumin and the sediment, the interstitial change which characterizes the small white kidney may be anticipated. The term which best characterizes the process is, probably, chronic diffuse nephritis without attempt to define too closely the changes most pronounced in the kidney.

Diagnosis.—The determination that some form of chronic kidney disease with dropsy exists, may be easily made, but the difficulty mentioned in deciding between the large and the small white kidney may extend still further, and we may even have difficulty in excluding the chronic interstitial type. In general, however, the predominance of dropsy over the cardiovascular manifestations of chronic

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nephritis points to a disease chiefly involving the parenchyma, while the opposite condition of affairs points toward interstitial involvement. When we consider the abundant albumin and sediment of the former and the scanty or even temporarily absent albuminuria with scanty sediment of the latter, we should expect to differentiate most cases easily unless the two types be too closely associated in a given case. The existence of syphilis or of suppuration with the frequent polyuria leads one to suspect amyloid disease of the kidney, but the diagnosis cannot be certainly made by the examination of the urine.

Prognosis.—Recovery is possible in the cases which follow acute Bright's disease in children even after extensive dropsy lasting a year or two, but is not to be expected in any case in the adult. Uremia or intercurrent disease is likely to carry the patient off if he escapes death from the dropsical or cardiac dangers. Of 19 cases of chronic parenchymatous nephritis under my care in the Denver City Hospital during the winter of 1901-2, fourteen were fatal during the term of service, and four were in desperate condition at the end of the time. This, perhaps, represents what one may expect under public hospital conditions, but the outlook as to length of life is decidedly better in private practice. The advent of retinal changes makes a fatal result exceedingly probable within a year or two.

10. CHRONIC INTERSTITIAL NEPHRITIS

This is a type of chronic disease of the kidney, in which extensive fibroid development predominates over the inflammatory changes.

Etiology.—The name secondary contracted kidney signifies its relationship to the kidney of chronic parenchymatous nephritis. A greater number of cases probably originate as independent and primary nephritis, while a very large number are intimately associated with advancing arteriosclerosis. Some authors distinguish a senile form as well.

Heredity, gout, lead poisoning, alcoholism, syphilis, overeating and overworking probably cover most of the causes of the disease, so far as we now know. Middle-aged males are chiefly affected. A

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fibroid change in the kidney tissue is not infrequent as the result of irritation of stone, pyelitis, or retention of urine. Pathologists speak of the secondary contracted kidney as the small white kidney; of the primary type as the red granular kidney. In all forms the organ is firm, generally reduced in size, the capsule is generally adherent, and the surface granular or coarsely uneven. Associated with the renal lesions are very striking cardiac and vascular changes. The hypertrophy of the heart, especially of the left ventricle, is very pronounced in many cases, especially of the primary type, and arteriosclerosis may be found in its most marked form. The high blood pressure which goes with these conditions may produce symptoms which completely overshadow the renal trouble, and so many of these cases have heretofore passed unrecognized that the insurance companies in recent years seem rightly to depend more upon the evidence of the sphygmomanometer than that furnished by the test-tube and the microscope. The exact relationship between the renal lesions, the albuminuria and the arterial and cardiac conditions has not been satisfactorily established.

Symptoms.—In perhaps no other common disease is the patient so entirely unaware of the gravity of his condition, when his attention is first called to the fact that something is wrong. An increasing number are sent to the clinician by the ophthalmologist, the retinitis having already advanced so far as to lead the subject to seek the aid of stronger glasses. Many cases are also discovered in the course of the ordinary examination for life insurance, the albuminuria and the high blood pressure being perhaps about equally likely to attract attention. Many men of powerful constitution and bearing heavy responsibility are wholly unaware of any material reduction of their powers. Symptoms suggesting an examination of the vascular system and the urine for evidence of this disease are headache, dizziness, failure of vision, general failure of strength, digestive difficulties, increased frequency of micturition, especially at night, and sleeplessness of the type that goes with increased vascular pressure. The failure of vision may be noted or complaint be made of "specks before the eyes," before any marked retinal changes appear. In other cases attacks of dyspnea or other evidence of uremia, even convulsions or

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coma, may be among the first symptoms noted. Many patients dying of cerebral hemorrhage are found post mortem to have suffered from interstitial nephritis without any knowledge of the trouble on their part or that of the physician.

Heart and Vessels.—Because of the sclerosis of the arteries and the increased blood pressure, the patient presents the signs of hypertrophy of the heart, especially of the left side, namely, increase in the area, displacement outward and downward of the apex-beat, accentuation of the aortic second sound, and a powerful heart beat. The metallic tone of the first sound may be sufficient to suggest the diagnosis. As the disease progresses the heart area may increase still further because of dilatation, the heart beat becomes more rapid and often irregular, and a relative systolic murmur develops at the mitral orifice. Rarely does the circulatory failure lead to edema unless near the end of the disease. The sclerosis of the vessels is commonly well marked and the temporal and brachial arteries especially, may be seen to pulsate forcibly. Perhaps the highest blood tension encountered by the clinician is found in this disease. I have seen the systolic pressure in a negro of about 50 years, above the 325 mm. mark of the Riva-Rocci instrument, with the old 5 cm. arm band. Death from cerebral hemorrhage occurred in a few days. The thickening of the arterial wall is evident upon careful investigation in practically all cases.

The Urine.—It is practically always increased in amount; perhaps rather more than double in typical cases. The specific gravity is correspondingly reduced, 1.005 to 1.010 being common figures. A trace of albumin may generally be found but its absence in occasional specimens, especially on arising, is of no especial import excepting as it enforces the necessity of examining more than one specimen in cases of importance. As a rule, the proportion of albumin lessens with increase in the quantity of urine. A light sediment only is present, and upon centrifuging, a moderate number of hyaline and granular casts may be expected. A few red cells are occasionally found. In a rare form persistent hemorrhage may occur. I have seen the hemoglobin fall to 40 per cent., to regain its normal percentage after stripping of the kidney. After several years the hem-

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orrhage recurred, and the kidney was removed. It presented the typical characteristics of the red granular kidney and no local source of hemorrhage could be found.

The solids are commonly moderately decreased. In the arteriosclerotic type of interstitial nephritis, the increase in urine may not be noted, and the albumin is likely to be more abundant. The blood shows the changes of a secondary anemia. The hemoglobin is often reduced to 75 per cent. or less. Anders mentions the increase in the number of red cells above the normal after cardiac failure occurs, and disturbs the distribution of the blood.

Digestive System.—Coated tongue, loss of appetite, indigestion and diarrhea are the most common features. They may be present for a year or more before attention is attracted to the kidneys. Uremic vomiting of great severity may appear. Epigastric pain and hiccough are occasionally seen.

Respiratory System.—The most striking feature consists in the attacks of dyspnea coming on at night, perhaps of great severity, and commonly attributed to the heart, as similar attacks occur in pure arteriosclerosis. Many of the attacks are uremic beyond doubt. Sudden edema of the lungs or larynx may occur. If the patient lives in the Northern States during the winter, the tendency to bronchitis may be of sufficient moment to justify careful consideration of the advisability of a change to a warmer or more equable climate. Cheyne-Stokes respiration is very frequently present toward the end.

Nervous System.—The tendency to uremia is obvious, and many of the nervous manifestations spoken of under that heading may be present. Headache is much the most common symptom. The danger of cerebral hemorrhage is to be borne in mind. Various neuralgic pains occur, and muscle cramps are complained of. Temporary paralysis of the eye muscles or even a hemiplegia may be regarded as uremic unless definite evidence of hemorrhage be forthcoming. The dry skin is subject to pruritus and eczema. Edema may occur after the heart dilates. Nose-bleed and other types of hemorrhage are occasionally noted. The ringing in the ears is either uremic or associated with high vascular pressure. The albuminuric retinitis which so often leads to the diagnosis of interstitial nephritis

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by the ophthalmologist is more common in this variety of kidney disease than any other. The liability to inflammation of the serous membranes has been mentioned. Because of the lowered resistance, pneumonia and other acute diseases are not infrequent.

Diagnosis.—The occurrence of persistent headache, coated tongue, indigestion, eye trouble, palpitation, loss of weight, night micturition, general debility, dyspnea at night, or other of the symptoms mentioned should call for careful examination of the urine for albumin and for casts. This examination should be repeated with a specimen passed late in the day if any doubt exists. The palpation of the arteries and taking of the blood pressure must not be neglected. The diagnosis is not likely to be overlooked after the disease is well developed if one only bear in mind its frequency in middle-aged men and the relationship which it bears to arteriosclerosis. Yet, perhaps half the cases escape diagnosis in our best hospitals because of insufficient development to attract attention or because the vascular symptoms or cerebral hemorrhage cover up the original disease.

Examination of a single specimen of urine which happens to have no albumin and therefore is not examined microscopically is another frequent source of error. On the other hand, the finding of a bare trace of albumin and one or two hyaline casts in a man of middle age, is by no means sufficient in the absence of increased pressure, arteriosclerosis, retinitis, etc., for the diagnosis. In unconscious patients the uremic odor of the breath, and the "frost" of urea upon the hair of the temples and face may practically suffice for the diagnosis in many instances.

Prognosis.—The patients do not recover, but may live for years if the diagnosis be made early and the pressure be not excessive, provided they are willing to follow a proper course. A life of ten years or more after the diagnosis is made is not uncommon under these circumstances. Too many of the cases are seen by the physician only after dilatation of the heart, uremic manifestations, retinitis, or other signs of imminent trouble have appeared. Even private patients rarely live longer than two years after hemorrhage appears in the retina, and the usual albuminuric retinitis is even more sinister in its meaning.

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11. AMYLOID DISEASE OF THE KIDNEY

(*Waxy Kidney*)

Amyloid degeneration of the kidneys is but a part of the general lardaceous degeneration of organs seen in many chronic diseases accompanied by serious cachexia. Prolonged suppuration and syphilis are the most frequent causes, but bony disease and chronic pulmonary tuberculosis in which suppuration plays a part are often noted. It has occurred in leukemia. It is not uncommon in patients sent to Colorado with old neglected empyema or chronic fibroid phthisis, with extensive cavity formation. The disease is distinctly less frequent since improved surgical measures have been adopted in some of the cases known to give rise to it.

Pathology.—The amyloid kidney is generally large, pale, firm, and smooth, with a thickened waxy cortex, at times mottled, the pyramids contrasting sharply because of their red color. If amyloid degeneration supervenes in the kidney of the small white type, or the interstitial type, the size of the organ is not above normal. The distinctive feature is the proof of the presence of amyloid deposit, by its turning to a mahogany brown under the application of Lugol's solution of iodin. The glomeruli and the walls of the blood vessels are especially involved. The liver and spleen are generally affected, and the walls of the intestine and even the heart may be involved.

Symptoms.—These are dependent upon the associated conditions which have given rise to the waxy degeneration and the anemia, rather than upon the renal changes. The patient complains of being easily exhausted and breathless, and has headache, dyspepsia, palpitation and ringing in the ears. The abdomen protrudes from the enlargement of the liver and spleen, and some puffiness of the ankles is often present. A troublesome diarrhea and even chronic dysentery may be noted. Nothing in the symptoms aside from those attributed to the causative disease attracts attention to the kidneys, other than is the case in ordinary chronic nephritis. The urine is generally moderately increased and resembles that of chronic interstitial nephritis excepting that the albumin is often greater in amount

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and the casts are less strictly hyaline and granular in type. Fatty and epithelial casts may appear and the amyloid reaction may be present in the broad, plump, waxy-appearing casts often seen. The solids of the urine are generally decreased. Cardiac, vascular and retinal changes if present are to be attributed rather to a definite nephritis which has perhaps preceded the amyloid change, and extensive dropsy may be accounted for in the same way. Uremia may develop.

Diagnosis.—This depends upon the demonstration of enlargement of the liver and spleen, with the history of exhausting disease in connection with the urinary evidence of kidney disease, rather than upon the deductions drawn from the urine, for the diagnosis cannot be based upon these alone. Practically there is no especial difficulty in the diagnosis if the case be carefully examined, for the chronic bony disease, tuberculosis, syphilis, or other wasting affections, with large spleen and liver, and the diarrhea in many instances, suffice for a definite conclusion.

Prognosis.—This is decidedly grave, but often on account of the contributory disease rather than the renal trouble. In a boy of 7 years with a neglected empyema of two years' standing, operation was refused, in part because the large liver and spleen with the urinary signs made me believe that the outlook was serious in any event, because of amyloid disease. He was operated some months later with complete recovery. The occasional report of similar cases should encourage us to urge operation even in the face of probable amyloid disease, for it seems likely that the deposit may be absorbed in certain cases.

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SECTION VI

DISEASES OF THE RESPIRATORY TRACT

Hay fever and diseases of the nose and larynx will be omitted, since they are better considered from the standpoint of the rhinolaryngologist than that of the internist.

1. DISEASES OF THE BRONCHI

A. ACUTE BRONCHITIS

Definition.—An acute inflammation of the bronchial mucous membrane.

Etiology.—Acute bronchitis is perhaps the commonest of diseases, and few individuals have escaped its visitations. As an independent affection we may have it after exposure to cold, especially after previous overheating. It more commonly follows an acute coryza. It constitutes a part of the disease in measles, influenza and typhoid fever. Changeable climates and changeable seasons predispose to its development. It is a disease of the dwellers in well-built and well-warmed houses rather than of those who live in tents and camps. I practically never saw the affection in cattlemen, sheepmen, hunters and other frontiersmen, with whom I formerly came much in contact, during that portion of the year when they lived out of doors or in tents. Exposure to irritating dusts may cause it, and those who accidently inhale chlorin, sulphurous acid gas, formaldehyd and other irritating gases, as employees of health departments engaged in fumigation, are especially subject to it. The young, the debilitated and the aged are most affected.

Pathology.—The mucous membrane of the trachea and the larger bronchi is found reddened and swollen, with a mucous or purulent secretion on the surface, or entirely blocking the smaller tubules

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The latter feature is rather more characteristic of bronchopneumonia, under which heading it will be further discussed. The ciliated epithelial cells degenerate and the mucous glands become swollen and distended with secretion. Abundant leukocytic infiltration is present in the severe cases, and the elastic fibers and muscle layers may be involved.

Bacteriology.—The ordinary attack of acute bronchitis is caused by no especial organism a mixed infection being commonly present, in which are found the pneumococcus, streptococcus, micrococcus catarrhalis, influenza bacillus, Friedländer's diplobacillus and possibly other organisms. Probably the pneumococcus and the influenza bacillus are most often found as the predominant infection. In the specific bronchitis of influenza the latter is of course the main agent, while in diphtheria, tuberculosis and other specific diseases, the specific organism is responsible.

Symptoms.—These may be stated as cough, expectoration, slight fever, frequently dyspnea, and pain in the substernal region. Some malaise often precedes the attack, in part attributable, perhaps, to the coryza which has gone before. Sneezing and hoarseness are common accompaniments. With the early cough, a feeling of tightness in the chest is found, which often disappears as soon as the expectoration "loosens up." Soon pain under the sternum is complained of, and the violent movements of the diaphragm and abdominal muscles may cause distress. In those with weak abdominal walls, as recently confined women and in patients recently operated upon, the abdominal distress upon coughing is great. Absence of cough, as in the aged or in feeble children, is of serious omen owing to the retention of the expectoration. The secretion expectorated is at first scanty and viscid, becoming mucopurulent after a few days, and much more easy of expectoration. A tinge of blood from ruptured capillaries is not uncommon. Pus cells and epithelial cells are abundant under the microscope.

Physical Signs.—A slight increase in the frequency of respiration often occurs, but a marked acceleration warns the physician of the danger of bronchopneumonia. Material dyspnea is rare in the absence of this complication. Sibilant rales in the early stages and

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coarse mucous rales after the expectoration has become more abundant are found in the more severe cases. In the milder ones, no departure from normal may be present, as is indicated by a consideration of the subjoined data taken from a study of 100 cases, reported to the Colorado State Medical Society in June, 1897. In 53 cases no abnormal signs were noted. In 35 cases sibilant and sonorous rales occurred, and in 4 of these coarse moist rales were present later. In 9 cases the respiratory murmur was stated to be rough and puerile. Sternal pain was complained of in 58 cases. These statistics probably represent the average severity of the disease.

In feeble individuals it is necessary to be on the watch for an extension to the finer tubules and the development of bronchopneumonia. Fine moist rales in the bases of the lungs in such patients give reason for some anxiety. The presence of very loud wheezing rales, often palpable over the chest, should always suggest an inquiry as to an asthmatic family history, and this will be obtained in the majority of such patients.

Course.—In the great majority of cases complete recovery occurs in less than two weeks. In those suffering from mitral disease, gout or nephritis, or debilitated from any cause, convalescence is delayed. The chief danger lies in the extension to the finer tubes and the alveoli in the young, old and feeble. In the asthmatic and emphysematous patients the danger of an all-winter cough must be considered.

Diagnosis.—If the onset be the usual one, and the physical signs are equally distributed upon the two sides there can be little question of the diagnosis. The practical absence of fever in many cases of senile pneumonia makes it necessary to examine the chest carefully to exclude this possibility. Localized signs, especially in one apex, are extremely suggestive of pulmonary tuberculosis, and if they persist the sputum should be examined. Sharp increase of the respiratory rate, cyanosis and dilating alæ nasi suggest an extension to the alveoli.

Prognosis.—This is excellent in all but the cases with the serious complications mentioned, and, in these, depends upon the course of the complications.

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B. CHRONIC BRONCHITIS

Definition.—A chronic inflammation of the bronchial mucous membrane, often associated, after a time, with emphysema and asthma.

Etiology.—It is common in the latter half of life, and especially in the regions having a cold winter climate. It practically always accompanies asthma and emphysema, and is very common in chronic nephritis, valvular disease of the heart and gout. Repeated attacks of acute bronchitis predispose to it, and it not infrequently follows a single attack of influenzal bronchitis. These are the cases most likely to present bronchiectasis. Exposure to dust and irritants is a common cause.

Pathology.—Naturally only well-advanced cases are commonly seen in the post-mortem room, and in these the emphysematous and bronchiectatic changes of the late stages of the disease often overshadow the bronchial features. The mucous membrane of the larger tubes is a slatey gray, and it is often thickened from the chronic inflammation and distorted by the development of fibrous tissue. The mucous glands are often dilated. In some cases the mucosa is much thinned, and the epithelial layers depleted.

Varieties.—In addition to the ordinary type, we may have a dry form, with very scanty expectoration, though the paroxysms of cough are severe—the so-called "dry catarrh." In bronchorrhea, the expectoration is very abundant and either thin and watery or thin and purulent in some cases. There is always danger that these cases will eventually merge into those of the next class—fetid bronchitis. We find here a foul sputum, which suggests gangrene of lung, abscess of lung or marked bronchiectasis, yet in the type of bronchitis we study none of these conditions exists. The sputum separates, like that of bronchiectasis, into a frothy, a fluid and a sedimentary layer, the latter containing the so-called Dittrich's plugs—foul masses of pus cells, bacteria and epithelial cells. The more serious conditions mentioned in this paragraph not infrequently develop later. In the earlier half of life, chronic bronchitis is occasionally seen in children without serious results even for years, and in young women

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after influenza. The danger that any type will eventually present dilatation of the bronchial tubes and thus become serious must be noted.

Symptoms.—These resemble those of acute bronchitis, excepting that pain and fever are commonly absent, and the cough is chronic in character. The distress from the abuse to which the respiratory muscles are subjected is frequently severe. Those who expectorate easily suffer much less than others. Dyspnea sooner or later de-

FIG. 101.—VERTICAL HEART. C, calcified bronchial gland. D, cross-sectional view of small bronchus with peribronchial thickening. (Dr. G. H. Stover.)

velops, but is generally cardiac or emphysemic in origin. There are patients who are in fair condition until the first cold weather arrives, when the cough becomes severe, and lasts until the weather is well settled the next summer. Perhaps a majority of all the valetudinarians who visit Florida and Southern California in winter belong to this class.

Physical Examination.—The chest shows the conformation, good resonance, and wheezy bronchial rales of the emphysematous patient in most instances. The heart is often more or less covered by the

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distended lung, though the frequent slight dilatation may be apparent. Some evidence of arteriosclerosis is a very frequent accompaniment. Cyanosis is present only in extreme cases. The pulmonary second sound is commonly accentuated.

Prognosis.—This depends very largely upon the care that the patient is able to exercise, and this is frequently a financial problem. If compelled to remain in a rough cold climate, every winter makes the condition more serious. If on the other hand the patient can, by going south, escape the cold, or still better in serious cases, remain in a warm climate permanently, he may live his years out in reasonable comfort.

C. FIBRINOUS BRONCHITIS

This unusual affection is found in association with such diverse conditions as pneumonia, chronic pneumonia, tuberculosis, diphtheria, chronic pleurisy, and heart disease, the connection being apparently only accidental. More important is the chronic idiopathic type, in which attacks affecting the same area in the lung recur at intervals even for several years. Chronic skin disease may be associated with it. The acute cases are more commonly associated with the acute infectious diseases. Osler reports a case due to the Aspergillus fumigatus. The disease is characterized by the formation of fibrinous casts of the bronchial tubes. The acute cases are desperate, the chronic ones not especially serious. Cough may dislodge one of the casts, cause a partial obstruction of a bronchus, interfering with both entrance and exit of air, and causing sharp dyspnea and loud sonorous rales. The chronic form is occasionally seen as a complication of the usual type of chronic bronchitis, and may recur. The diagnosis is dependent upon the demonstration of the fibrinous cast, having the shape of a portion of the bronchial tree. The blood from the bronchial tubes after hemoptysis may somewhat resemble such a cast.

D. BRONCHOPNEUMONIA

This is a form of pulmonary inflammation resulting typically from the extension of a bronchitic process into the capillary tubes

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and the alveoli. It was formerly known as capillary bronchitis, and this term well expresses the character and to some extent the pathology of the affection. The terms catarrhal pneumonia and lobular pneumonia are also used.

Etiology.—The pneumococcus is the organism commonly present, but the disease is by no means a manifestation of the activity of any single bacterial cause.

Staphylococci, streptococci, Friedländer's bacilli, influenza bacilli, and the diphtheria bacilli are all frequently found either separately or oftentimes variously associated. The every-day type of catarrhal pneumonia, due to the tubercle bacillus, is better classified for our purposes under pulmonary tuberculosis.

The primary form, common in previously healthy children, and, more frequently than other forms caused by the pneumococcus, is found in about one-third of the cases.

The secondary form is that seen so commonly after the infectious diseases of childhood—notably measles, whooping-cough and diphtheria, and it is naturally found at the age during which these diseases prevail, namely, in the first five or six years of life. In scarlet fever in children, and in typhus, typhoid, plague, small-pox and other severe infectious diseases of adult life it is a common cause of the fatal result. In the epidemics of measles occasionally seen in young soldiers a heavy mortality may result from this complication, the unusual exposure of camp life being a factor. The western Indians have suffered severely under the same conditions.

After anesthesia, from the inhalation of the secretions of the respiratory tract, of vomitus, and probably at times because of the irritating and chilling effect of the vapor (ether), bronchopneumonia is frequently noted, and the so-called "ether-pneumonia" is ordinarily of this type. In the insane, in comatose patients or others failing in perfect control of deglutition, food particles enter the trachea, and set up the so-called "deglutition pneumonia," this being of the bronchopneumonic type. Although commonly looked upon as a disease of childhood it is a very frequent affection in the debility of old age, and the high death rate from influenza and other epidemic diseases in the institutions for the aged is chargeable to broncho-

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pneumonia. The disease is not very infrequent in obese women in the third and fourth decades.

Pathology.—There are present, inflammation of the finer bronchi, and patches of consolidation where the alveoli are involved. The name "lobular pneumonia" refers to the involvement of lobules, in contradistinction to the lobar involvement of the other form. The scattered dark patches are sunken below the surface of the lung, typically over the posterior aspects of the lower lobes, the atelectasis and the surrounding compensatory emphysema both contributing to render the depression of the affected area more noticeable. One lobe may be predominantly involved, so that a pseudolobar form of bronchopneumonia is recognized by certain authors. The bronchi and the alveoli are filled with the inflammatory products. The enlargement of the tracheobronchial lymph glands is very marked in certain cases.

Symptoms.—Typically, bronchopneumonia develops as a secondary result of an acute bronchitis, by extension into the finer bronchioles. The child with such a bronchitis, either existing as an independent affection or more commonly as a feature of one of the infectious diseases mentioned, becomes more seriously ill at the very time when we should look for improvement. The rise in the respiratory rate, pulse rate and temperature curve signifies the invasion of the smaller tubes by the inflammatory process. The fever reaches to 104° or 105° in severe cases, but is much less regular and typical than that of lobar pneumonia. Its duration may be from two or three days to even several weeks, although in protracted cases the rise is commonly less than the figures given would indicate. The fall is commonly by lysis rather than by crisis, as in the lobar form.

The pulse rate rises sharply, and in babies may reach 150 or 180 per minute. In the severer cases the pulse may be uncountable, and the evidence of cardiac dilatation and exhaustion soon appear.

It is the sharp rise in the respiratory rate that ordinarily first attracts the physician's attention. The child with bronchitis is playing almost as usual one day, but with the advent of the bronchopneumonic process, is found with anxious face, dilating alæ nasi and a respiratory rate of 50 or 70 per minute at the next visit. The

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increase in the frequency of breathing is relatively greater than that of the pulse in typical cases.

The cough is frequent and distressing. In small children no expectoration occurs, since the loosened secretions are commonly swallowed. In older patients a light yellow or grayish sputum is noted. The typical red color of the sputa of lobar pneumonia is conspicuously absent, though a light staining by blood is occasionally seen.

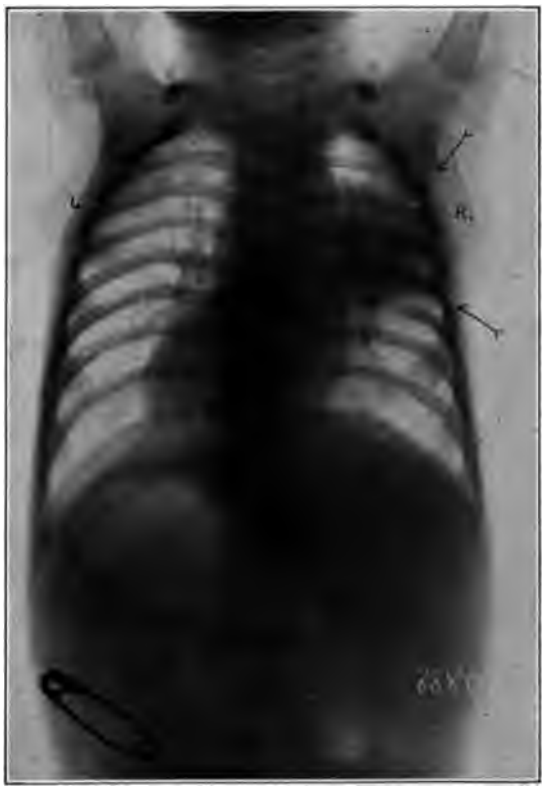

FIG. 102.—BRONCHOPNEUMONIA IN CHILD. (Dr. G. H. Stover.)

The interference with the respiratory function and the enfeeblement of the heart lead to the cyanosis which is so conspicuous a feature of the severer forms. The cold extremities which are often present in the cases with marked cyanosis indicate extreme danger. The urine is commonly scanty and often albuminous. The eruption of the infective disease, of which the bronchopneumonia is a complication, is often present.

In the aged the temperature follows a lower curve, but the frequent respiration, the prostration and the obvious gravity of the condition are unmistakable. It is impossible in certain of these cases to make a sharp demarkation between hypostatic pneumonia and the form we describe.

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Physical Signs.—Upon inspection one may note the distressing dyspnea, the cyanotic lips and nails, and the movements of the nostrils. Percussion demonstrates, in marked contrast to the large areas of flatness of typical lobar pneumonia, only isolated patches of moderately decreased resonance, and even these may escape detection unless the percussion be done with care and skill. In the type in which a single lobe bears the brunt of the invasion the dulness is more notable, but still less marked than in the lobar form of pneumonia. One may often distinguish the hyperresonance of the compensatory emphysema commonly present.

With the stethoscope one hears in early stages the signs of an acute bronchitis, but these give way to the fine moist and subcrepitant rales typical of the invasion of the capillary tubes. The vesicular murmur is impaired, and becomes rather bronchovesicular in character. Typical bronchial respiration is practically never noted. A moderate leucocytosis is often found.

Course.—This is utterly irregular as compared with the course of many of the infectious diseases. Death may occur in the first two or three days. A fairly common form shows sharp fever for a few days or one or two weeks, and then a gradually decreasing temperature with convalescence. A continuance of the disease with improvement and relapse over a course of several weeks is not unusual.

Complications.—These are practically those of the lobar form of pneumonia. Among the more unusual ones, I have seen pneumothorax, apparently due to rupture of a lung abscess into the pleural cavity, and suppuration of the tracheobronchial glands with rupture into the air passages, and recovery. Pleural effusion is generally purulent. The heart is not often affected excepting as it gives way to the strain of the disease. The most serious complication is the later development of pulmonary tuberculosis, and the advent of this affection after measles, whooping-cough and typhoid presupposes a bronchopneumonic complication of the disease in question.

Prognosis.—In young children a mortality of 25 to 50 per cent. is common. It should be noted that the fatalities in the infectious diseases of childhood are commonly chargeable to this complication. The gravity of the outlook lightens as the child advances in years.

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In the old and feeble the death rate is high. The best prognosis is found in the primary form in children beyond the third or fourth year. The possibility of a recrudescence or even a recurrence of the disease must be considered.

E. BRONCHIECTASIS

In this disease marked dilatations, cylindrical and sacculated, are found in the bronchial tubes, with atrophy of the tissues of the wall.

Etiology.—It may be congenital and affect practically all the tubes. Since the healthy wall of the bronchus does not give way readily, the acquired form is found in those diseases in which its structure is weakened. The damaged tissues cannot stand the strain induced by coughing, or other causes raising the air pressure within the tubes, and even the mere weight of the retained secretion is detrimental to them. In chronic fibroid phthisis the pull of pleural adhesions is regarded as an important etiological factor. The weakening of the wall generally results from some type of chronic bronchitis, especially that associated with influenza, from tuberculosis of the lung, bronchopneumonia, pleurisy of the fibroid type, foreign body within the bronchus, or the pressure from tumor or aneurism from without, with retained secretions. Syphilis affecting the wall is said to be an occasional cause of local bronchiectasis. The disease is said by Osler to be much more frequently met with since the last wave of influenza, and the influenza bacillus is very commonly present.

Pathology.—In the cylindrical form, the tubes are fairly uniformly dilated, but there are generally saccular dilatations as well, scattered through the lung. A local compensatory emphysematous distension of the lung is common. Upon opening the bronchi, the dilatations appear, with the shrunken lung tissue between. Pleuritic adhesions and tuberculous cavities are frequently obvious. The sacculi may be as large as a small orange, although cylindrical and fusiform dilatations of moderate size and affecting many separate bronchi are more common. The mucous membrane may be smooth and intact, but in large cavities with long-retained secretion ulcera-

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tions have often penetrated to the muscular or elastic coats. The character of the contents of the larger cavities is such as the appearance of the sputum would lead one to suppose. The finding of the bronchial cartilages in the wall of the dilatation, even though advanced ulceration be present, is proof of the bronchiectatic and not purely ulcerative character of the lesion. The tracheobronchial glands are enlarged. Secondary abscess may be found, especially in the brain.

Symptoms.—The striking features are cough, generally paroxysmal, and at considerable intervals expectoration of an unusual quantity of generally very offensive sputum. The cough is especially likely to occur with change of position on rising or retiring. The large accumulation of the night, overflowing into some part of the bronchi susceptible to irritation is most likely to start a severe paroxysm, bringing up the greatest quantity of the twenty-four hours. The total may amount to over one quart for the time. It separates into three classical layers, froth, fluid, and sediment, the latter containing pus cells, fatty acid crystals, and elastic tissue if the cavities have ulcerated. Fresh blood is occasionally present. The odor is fetid in most cases of long standing, but may be merely sour and slightly offensive in more recent ones.

Pain and fever are not a part of the usual picture of bronchiectasis aside from its complications. Hemorrhage is not infrequent. Dyspnea may be present, late in the course, and chronic pulmonary osteoarthopathy is not infrequent. Amyloid disease of the liver and spleen, pneumothorax, diarrhea, albuminuria, pyemia, empyema, and abscess of the brain may be late developments.

Physical Examination.—The chest may be of emphysematous type, but is often the contracted chest of chronic fibroid pleurisy or tuberculosis. Percussion may yield abnormal resonance, dulness, cracked-pot resonance, or various combinations of these signs. The note over a superficial sacculation may change from dull to cavernous or tympanitic after a paroxysm of cough and free expectoration. Rales of the usual bronchitic type, or gurgling in character may be found, and abnormal sounds may even be due to the pounding action of the heart upon adjacent collections of fluid in the cavities.

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Diagnosis.—This generally lies between abscess of the lung, empyema breaking into the lung, chronic phthisis with cavity formation, and bronchiectasis. The first is excluded by the lack of history of sudden bursting of an abscess with profuse expectoration of pus, lessening rapidly afterward, and by the absence of localized signs, signifying suppuration, in the chest. The same reasoning serves to exclude empyema breaking through the lung. Tuberculosis has a characteristic history in most cases, and patient search in such a case will prove the existence of the tubercle bacillus in the sputum. The Röntgen ray examination is of most assistance. In one instance, following an acute influenzal attack, the signs were those of a single cavity in the base of the right lung behind. Aspiration produced pus, but no elastic fibers could be found in the sputum. The boy's condition was so pitiable that drainage was done under the belief that an abscess cavity existed, but it proved to be a bronchiectatic cavity which at times held a large quantity of pus. Smaller dilatations existed around it, not demonstrable by physical examination. The case went on to a fatal termination.

Prognosis.—The more chronic cases go on for years without extreme disability, and may live in fair comfort, especially if they are able to empty out the cavities freely in two or three coughing spells daily. It is said that complete recovery may take place in very mild acute cases, but these can scarcely be diagnosed with any certainty. Many cases go on to a fatal ending within a few years, and a few, as after influenza, in still less time. Unfortunately but few cases present sufficiently localized lesions to justify attempt at drainage, which is at best a dangerous measure. I have seen death from virulent pneumonia in a case in which a general anesthetic was probably unjustifiably given.

F. BRONCHIAL ASTHMA

This is an affection characterized by spasmodic attacks of dyspnea, with marked vasomotor and other disturbances of the respiratory tract. The use of the term in connection with other types of dyspnea should be abandoned.

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Etiology.—Heredity, and perhaps especially an hereditary neurotic taint, play a most important part. In a fairly extensive experience with this disease, in a region to which asthmatics are sent from all over America and Europe, I have been much impressed with the certainty with which a fairly direct hereditary taint may be traced. As mentioned under acute bronchitis, the patients much given to wheezing in an attack of that disease almost invariably state that asthma is present in the immediate family. Gout, neuralgia, and migraine are frequently mentioned in the history. Men are affected nearly twice as often as women. The very close relationship existing between hay fever, nasal polypi, and other affections of the nose, and asthma have attracted much attention. Many cases originate at the same time of the year that certain types of hay fever appear. Many attacks start with a severe acute bronchitis, others may originate with whooping-cough, in both cases the enlarged bronchial glands being possibly under suspicion. The exact explanation of the attack is still in dispute, there being reasons in favor of spasm, of vasomotor swelling of the mucous membrane, and of the exudative bronchiolitis described by Curschmann.

Exciting Causes.—No disease offers a stranger conglomeration of exciting causes. Though most attacks occur in spring and fall, certain patients have the paroxysms only in winter or summer. The inhalation of certain odors or dusts induces the attack, or the smell of certain flowers or new hay, or the dust of curried horses, or the sweat of horses, the odor of feathers, the inhalation of pulverized ipecac, the dust from flour mills and threshing machines, etc. It is said that the stream of patients entering London from the country to obtain relief from the disease passes a similar number of asthmatics going countryward for help. One man works at the gas works to relieve his asthma, and another dares not pass them for fear of an attack. One patient of mine moved from eastern Kansas to Goodland at the western border, and obtained relief. Within a few years he sought successively higher elevations at Denver, Colorado Springs, Cripple Creek, and Corona, the latter with an elevation of over 11,600 feet, as his attacks returned at each successive place. Holmes speaks of the attacks he suffered in the cabin of a steamship, and so many

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asthmatics have similar experiences in stuffy rooms that it seems that the mental influence must be a contributory factor at least. The influence of a too-hearty diet, of gout, emotion, fear, menstruation, pregnancy, renal disease, travel and even lack of accustomed exercise should be mentioned. One patient who had asthma when she smelled horses had a violent attack upon the administration of diphtheria antitoxin and death may occur under such conditions. The resemblance between the action of guinea pigs, in which anaphylaxis has been induced by the injection of egg albumin, and the attacks of asthma in man is very close; and there is reason for the belief that further study will show that anaphylaxis is of great importance in the production of the affection.

Symptoms.—A great variety of prodromal symptoms are mentioned—headache, depression, exaltation, dyspeptic attacks, vertigo, irritability, and frequent urination. A bronchitis often precedes the paroxysms. The chronic asthmatic may be trusted to foretell with fair accuracy the coming of the paroxysm. Most attacks aside from those directly induced by the inhalation of such substances as we have mentioned begin in the night. The resemblance in this regard to the attacks of spasmodic croup is interesting. The dyspnea increases rapidly until it is extreme, and a troublesome paroxysmal cough is experienced. The patient generally seeks the open window and supports the elbows to have the benefit of the use of the accessory muscles of respiration. The difficulty in expiration is extreme, and the period in the respiratory cycle devoted to expiration is much increased. Pallor and great anxiety are expressed in the face, but cyanosis of the ears, lips, and face develops in the severe attacks. The respirations are slowed rather than hastened. The pulse is rapid, frequently a profuse sweat occurs, and the extremities become cold. Connected speech is impossible. On examination of the chest it is seen to be in the extreme inspiratory position, and it has a temporary appearance of acute emphysema, even though the disease has not lasted long enough to make such a condition permanent. The respiratory expansion is much limited. The abdomen protrudes because of the constant low position of the diaphragm. The distension and throbbing of the vessels of the neck, cyanosis, sweating, weak pulse,

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cold extremities, and acute respiratory embarrassment make up a very distressing picture. Percussion shows hyperresonance over the chest. The wheezing rales, most prominent in expiration, require no stethoscope for their perception, since they may even be audible in adjoining apartments.

After the interval of perhaps two hours on the average, but with many variations from this, the patient, apparently upon the verge of suffocation, finds his cough slightly more productive, a mucous sputum appears, and the dyspnea becomes less. He may drop to sleep and awake in almost his accustomed health in the morning. Examination at the time of the freer expectoration mentioned demonstrates many moist rales throughout the chest. The eosinophiles in the blood are tremendously increased, and because of the cyanosis the number of red cells is above normal. The sputum shows chiefly the "perles" described by Laennec, floating in clear mucus. These perles may be easily unfolded, and are the Curschmann's spirals. They represent the mucous casts of the bronchioles, and under the microscope show degenerated epithelial cells, leukocytes, chiefly eosinophiles, and the Charcot-Leyden crystals. Traces of blood are not unusual.

Course.—There is every variation from the occurrence of one or two paroxysms a year to several on successive days, and even complete invalidism because of their frequency. The forenoons may be free from distress. Emphysema and chronic bronchitis eventually develop and add about as much to the cough, dyspnea, and general distress as is subtracted by the lessening of the severity and frequency of the asthmatic paroxysms. A physician, whose case I have reported, had asthma following severe whooping-cough, was compelled to stop practice for six years, lost nearly half his weight, took during that time 200 ounces of the 1/1000 solution of adrenalin hypodermatically, and eventually recovered and is practicing in fair comfort at this time.

Prognosis.—Patients practically never die in a paroxysm. So many patients finally obtain complete relief by climatic therapy that there is some justification for the belief that every patient may find some place in the world where he can breathe normally. One of

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Williams' patients traveled for ten years, and finally at an elevation of some 11,000 or 12,000 feet in the Andes obtained absolute and permanent relief.

2. DISEASES OF THE PLEURA

A. HYDROTHORAX

Definition.—A transudation of the serum into the pleural cavities, generally bilateral, without inflammatory changes in the pleura. The transudation is secondary to some other process, being merely a symptom of that trouble. The fluid is generally clear serum, and the pleural surfaces are entirely normal.

Hydrothorax is commonly a part of a general anasarca, due to one of the two most frequent causes of this condition—renal disease and heart disease. That of nephritis is commonly bilateral, but in heart disease the right pleura is often filled earlier and to a higher level than the left, owing to interference with the return circulation through the azygos veins. The influence of the lateral decubitus in causing one cavity to be more full than the other is also of importance, and the left side frequently presents the greater effusion. In grave anemias the condition may be present, and in leukemia, pernicious anemia, and other cachectic diseases, it may be slightly bloody in character. Hydrothorax may result from local conditions within the chest, especially those involving pressure on the vena cava or its branches, or the thoracic duct. The bloody exudate of cancer of the lung or pleura is inflammatory rather than edematous in nature. Since it is entirely possible for double hydrothorax to be present in the absence of general dropsy, the possibility of its occurrence should not be overlooked in any case involving dyspnea. Percusion of the lower dorsal regions is decisive.

Diagnosis.—This is that of pleurisy with effusion (*see* Pleurisy with Effusion) less the inflammatory symptoms. The latter disease is rarely bilateral, while hydrothorax is generally so.

Prognosis.—This is dependent entirely upon that of the disease of which it is a symptom.

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B. PLEURISY

Inflammation of the pleural membrane occurs frequently and under many different conditions. We shall consider it under the arbitrary classification of:

Acute pleurisy
- (a) dry fibrinous form
- (b) serofibrinous effusion
- (c) purulent effusion.

Chronic pleurisy
- (a) dry fibrinous form
- (b) serofibrinous effusion
- (c) purulent effusion.

(a) Acute Pleurisy: Dry Fibrinous Form

The dry fibrinous pleurisy may be an acute primary infection. After exposure to cold a previously healthy individual complains of pain in the side, aggravated upon deep breath or cough, and a friction sound may be heard over the affected region. The pleura loses its normal gloss and a scanty fibrinous exudate appears. This may entirely disappear, but in many cases goes on to the formation of adhesions. The number of cases diagnosed clinically is so trivial as compared with the number in which adhesions are found in the post mortem room as the result of an acute pleurisy, that we must conclude that most of these cases do not come under the observation of a physician. The adhesions are generally very limited in extent and of little clinical importance. Dry fibrinous pleurisy is very frequently a secondary process, the most typical form being that connected with practically every case of acute pneumonia. In almost all inflammatory diseases of the lung, abscess, gangrene, bronchopneumonia, etc., a limited fibrinous pleurisy plays a part, and is of especial importance clinically because of its influence in producing the chief pain of the disease with which it is associated. The process may be part of the general infection in many diseases of septic type, endocarditis, septic arthritis, etc. The pain and friction sounds

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are most often found over the side of the chest anteriorly, but may occur elsewhere. The diaphragmatic type is probably the most painful. The tubercle bacillus, pneumococcus, and other organisms may be responsible for the inflammation. In many cases the specific germ may be suspected from a knowledge of that general infection of which the pleurisy is a part.

Symptoms.—The patient complains of sharp pain low in the side and reflected into the abdomen if the diaphragmatic pleura be affected. The most common site of the pain is the region of the nipple. Cough, malaise, and slight fever are present. The respiratory rate is increased in part because of the fever, but more especially because of the pain caused by attempted full respiration. In the diaphragmatic type pressure upward under the edge of the ribs causes exquisite pain. Unless previous attacks have caused thickening of the pleura the physical signs are limited to the friction sounds, grazing or rubbing in character, heard over the affected region. A slight leukocytosis may be present.

Diagnosis.—The occurrence of sharp pain in the chest with the slight fever and other signs noted, without the evidence of involvement of the lung, and without the presence of other disease involving the chest wall, justifies a diagnosis of dry pleurisy of the primary type. The secondary form may present the same symptoms, oftentimes with more severity, but dependent upon the original disease for their character. In rare cases all of the symptoms may point to the abdomen rather than the thorax as the seat of the disease. Appendicitis is not rarely suggested.

Prognosis.—That in the primary form is good, excepting that a considerable number die eventually of tuberculosis, of which it is to be assumed the supposed primary pleurisy was a symptom. The outlook in the secondary type depends entirely upon that of the disease of which it is a minor part.

(b) Acute Pleurisy with Serofibrinous Effusion

Etiology.—It may follow any of the dry fibrinous forms described, and, in fact, dry pleurisy always precedes the serofibrinous form,

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though not always recognized. It is probable that a fair number, such as those that follow exposure to cold, and in which the effusion is sterile, even as judged by animal injection, are primary. Most of them are admittedly secondary, and the majority from the single cause—tuberculosis. Probably seventy-five per cent. is not an overestimate in this matter, since many of the cases not proved to be tuberculous at the time of the exudate yet die in after years of that disease. The pneumococcus is next in order of frequency, sometimes primary, more often secondary to a pneumococcic process in the lung or possibly elsewhere. The streptococcus produces an extremely grave form, generally in connection with some septic process. Other organisms may be present, and especially so because a serofibrinous pleurisy is often secondary to disease processes even in distant parts of the body. Trauma is of some influence in certain cases.

Pathology.—A serofibrinous fluid is present in any amount up to that necessary to fill the pleura upon one side. The fluid is generally straw-colored with flocculi of fibrin floating in it, but otherwise fairly clear. It has a specific gravity of 1.018 or upward, and contains much albumin. If blood cells be present in any considerable number, the fluid may be reddish, or brownish if it be of long standing. The presence of many polynuclear cells suggests a transformation toward a purulent effusion. If the small lymphocytes predominate the effusion may be regarded as probably tuberculous. Mitotic division in many cells is often noted in the pleural effusion of malignant disease. There is a tendency in or out of the body for the polynuclear cells to settle so that the upper parts of the fluid suggest pus less strongly than the lower. A fibrinous layer covers the pleural surfaces, the fluid being generally in the lower spaces. The exudate may rarely be encapsulated.

The lung is shrunken in correspondence with the size of the effusion and the duration of the illness. The left side is more often affected. In considerable effusions the normal negative intrathoracic pressure is replaced by a positive one, even of 10 to 48 mm. of mercury. In effusion upon the right side, the diaphragm and the liver are depressed and the heart pushed to the left, left-sided effusion having a contrary effect upon the heart, but a similar result

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upon the diaphragm. The displacement of the heart is chiefly a pushing over of the organ with the mediastinum to the right or left without a special rotation or twisting effect.

Symptoms.—The onset is the same as that described under dry pleurisy. Chill and the violent onset so often seen in acute pneumonia are uncommon, and in many cases even the pain is trivial. It is not infrequent for the patient to apply for relief from dyspnea without a suspicion of his effusion, there having been no symptoms to suggest his ceasing work. In general, the pain when present becomes less after the first few days, the layers of inflamed pleura having been separated by the effusion. A temperature of 100° to 102° is common. Cough is infrequent and less painful than in the dry form, and expectoration is trivial. The pain in cases in which the chief involvement is diaphragmatic is very deceptive, owing to the frequent reflection into the abdomen, such cases having been operated upon wrongly for appendicitis, gall-stone disease or other abdominal affection. It may be referred to the lower back. The dyspnea of the early stages is due to the pain of movement of the pleura and in part to the fever. Later it is due to the embarrassment of the large effusion, and is more severe in the more rapidly developed cases. Since the patient must use his good lung to the best advantage, he generally lies upon the side of the effusion. Orthopnea exists in extreme cases. Dysphagia is a very uncommon symptom, due to pressure upon the esophagus. The urine is commonly decreased in amount and deficient in chlorids.

Physical Examination.—Inspection shows an abnormally full and immobile chest upon the affected side, making due allowance for the normally large right side. The respiratory movements may be practically nil, and the intercostal spaces are obliterated. The heart is often seen to be displaced, generally upward one or two interspaces and to the left as far as the anterior axillary line, or to the nipple line on the right, in very large effusion, upon the right and left sides respectively. Cyanosis may exist in extreme cases, and is said to be more common in left-sided effusions, perhaps from interference with the great vessels at the base. The diaphragm-shadow is absent upon the affected side. Pulsation has been seen in cases of serous

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exudate though most reported cases have been in purulent ones and practically always upon the left side.

PALPATION.—The lack of movement of the affected side may be more readily apparent to palpation than inspection. The location of the apex-beat is to be sought, but may not be found if the heart is displaced under the sternum. The affected side is sometimes warmer to the touch. Friction is rarely present at the time of the effusion. One of the most important signs in the diagnosis is the absence of tactile fremitus over the area of the effusion if this be a large one, although it may be only diminished in case of small effusion. In women and children the voice may not set up sufficiently vigorous vibrations of the chest wall to enable us to determine the absence of fremitus. Furthermore, fremitus may be present over a considerable effusion in children.

PERCUSSION.—Flatness is to be found over any considerable exudate if the layer of fluid at the point percussed be of fair thickness and the percussion not too forcible. The flatness is at the base first, in all but sacculated effusions, and rises as the effusion increases. The heart should be accurately located by percussion and palpation of the apex-beat at the first examination in order that the displacement may be recognized later. The presence of pleural adhesions may cause a resonant area to persist as an island in the area of flatness. The resistance of the fluid may be appreciated by the sense of feeling in the act of percussion. As the effusion rises, the relaxed or possibly compressed lung in the upper third of the chest gives rise, upon percussion, to the peculiar skodiac tympany. This is not pathognomonic of effusion, as it may be found in the location mentioned, when the lower and back part of the lung is consolidated in acute pneumonia. With the patient in the upright posture, and with a moderate effusion, the curve of the upper line of flatness as marked out by percussion (Ellis-Garland S-curve) rises from the spine toward the axilla in a prolonged S-curve and then passes forward to the sternum. With large effusion it becomes more nearly horizontal. The elasticity of the lung is sufficient to cause that organ thus to modify the line of the upper level of the fluid. At the region of the root of the lung in the back a triangle of dulness, rather than

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flatness may be detected in large effusions, representing the compressed lung. With firm percussion and the mouth of the patient open, cracked-pot resonance is occasionally obtained in large effusion over the upper anterior portion of the chest on the affected side. The crowding over of the movable mediastinal tissues toward the free side gives the wedge-shaped area of dulness with its base at the base of the free lung posteriorly, and running upward along the spine on that side, as described by Grocco. The breadth at the base may be two to six or seven centimeters. The line between the effusion on the right and the liver is best judged by the degree of depression of the lower border of the liver, since the upper border is continuous in its flatness with that of the effusion. Traube's semilunar space is obliterated by the crowding downward of the diaphragm upon the left in large effusions. In those of moderate size, the lines of flatness may be noted to shift with changes in the position of the body, provided pleural adhesions do not interfere. In case the chest be full upon one side, no shifting can be made out. The entire side may be flat in these cases, and the anterior mediastinal dulness is pushed to the opposite side.

Auscultation.—Friction, present at the beginning in many cases, disappears as the effusion increases, in part because of the separation of the layers of pleura mechanically, and in part because of the inability of the lung to move freely and thus permit motion between the two layers of pleura. The reappearance of the rub, generally in the upper portion of the chest, signifies a subsidence of the effusion. Pain is commonly absent at this time, although severe in the pleural rub at the beginning of the disease. The fine pleural crepitation heard at the beginning may also reappear with the subsidence of the fluid. The respiratory sounds are weakened and seem far away, conditions readily explicable when we consider that the lung is compressed so that little interchange of air takes place in respiration, and the feeble sounds thus produced are "deadened" by the liquid. The bronchial element in the breath sounds is often heard, but distantly. In children, however, tubular respiration is often so marked as to suggest consolidation of lung, a point which should not be overlooked. The compressed lung above the line

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of effusion gives a harsh vesicular or bronchovesicular sound, and loud rales may suggest primary lung condition rather than effusion, especially in children. A cavity is even suggested by the character of the rales and the bronchial type of respiration, but the possibility is easily dismissed upon a consideration of the evidence of effusion.

The absence of vocal resonance accords with the lack of fremitus mentioned. Bronchophony may be found, especially in children, and egophony (bleating) is often noted at the level of the effusion in the scapular region. The transmission of the whisper through an effusion raises a presumption that the liquid is serous (Bacelli), but I have seen exceptions to it and their occurrence is generally admitted. The Röntgen ray examination may demonstrate an effusion with lowered diaphragm on that side when it is doubtful upon physical examination. For atypical and encapsulated effusions it is indispensable.

One of the most reliable signs of pleural effusion is the displacement of the heart mentioned. As soon as the pleura is filled up to the line of the seventh or eighth rib this displacement may become apparent, and is later very marked. Mobility may be prevented by previous adhesions. If under the sternum the position of the heart's apex may have to be determined by auscultation rather than otherwise. A left-sided effusion produces relatively more displacement of the heart than one of the same size upon the right owing to the normal position of the organ upon the left. After the subsidence of the effusion the side upon which it has occurred must not be judged by the position of the heart to the right or the left of its normal place, since it may become attached and remain upon the side to which it has been pushed, or be drawn back to the side of the effusion by the shrinking process often occurring after absorption. The blood shows no especial changes except frequently a moderate leukocytosis. An increase in the white count suggests a possible purulent tendency in the effusion.

Mediastinal Pleurisy.—The effusion may be upon either side. Frick states that cyanosis is a marked feature in right anterior mediastinal pleurisy, the regions drained by the superior cava being especially affected. Effusion upon the left anteriorly can scarcely

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be distinguished from pericarditis with effusion. Posterior exudates may cause respiratory stridor, deviation of the trachea from pressure, dysphagia and paroxysmal cough, the pneumogastric nerve being compromised through pressure.

(c) Acute Pleurisy with Purulent Effusion

(*Empyema*)

Etiology.—Purulent pleuritis may arise as the result of infection from without, as in case of fractured rib, wounds of the chest or perforation of the pleura, as by a subphrenic abscess, abscess about a foreign body impacted in the esophagus, or malignant growth. The great majority of cases arise from some process in the lung—pneumonic, bronchopneumonic, tuberculous, or in association with abscess or gangrene. The cases claimed to be of primary origin are largely in children, but it is especially difficult to exclude some obscure lung condition to which the effusion of pus is secondary.

The great frequency of purulent effusion in children as compared with serofibrinous exudate should be mentioned. Empyema not infrequently follows scarlet fever in children, and sepsis, typhoid fever, etc., in adults. The change from a serous effusion to a purulent one is not very uncommon, and raises no presumption of origin from lack of care in aspiration.

Most serofibrinous exudates are of tuberculous origin as heretofore mentioned, and in empyema the proportion due to the pneumococcus, either alone or in mixed infection, is almost as large. The streptococcus comes next in frequency, and almost any of the common organisms and even the ray-fungus may also be found as the cause. Mixed infection is not infrequent. Sterile effusions are usually of tuberculous origin.

Pathology.—The pleura is covered by a thick fibrous layer, and sacculation is much more frequently met with than in serous effusions. Ulceration and even perforation is not uncommon in neglected cases. A fistulous tract into the lung is not rare. The fluid is of a specific gravity of 1.030 or more, and is a yellowish, greenish or

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creamy pus, the latter more frequent in pneumococcic infection. It may be reddish or brown from presence of blood. Frequently the upper layers are merely turbid serum, the pus cells having settled below. The odor may be sweetish, but is that of gangrene in case ulceration of the pleura is present, and that of colon bacillus pus in the cases dependent upon rupture upward through the diaphragm of subphrenic abscess. Pus cells and detritus are found under the

FIG. 103.—ENORMOUS EMPYEMA OF THE LEFT THORAX; INTERLOBAR EMPYEMA IN THE RIGHT THORAX. (Dr. G. H. Stover.)

microscope, and various micro-organisms. The lung is compressed against the spinal column unless held away by adhesions. In the chest or abdomen may be found caries, malignant growth, subphrenic abscess, etc., to which condition the empyema has been secondary.

Symptoms.—There is generally a history of pain in the side, which may have been due to a fibrinous pleurisy or connected with an underlying pneumonic process. There are generally cough, dyspnea, irregular fever, with sweats, the history of chills or chilly

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sensations, loss of appetite and of weight, and bad color. In the more serious types with streptococcic or colon bacillus infections the septic phenomena may be extremely pronounced. I have seen the course of empyema practically afebrile after typhoid fever.

Physical Examination.—The signs given by empyema are those of pleurisy with effusion, but generally exaggerated. The bulging of the intercostal spaces and displacement of the heart, mediastinum

FIG. 104.—PLEURAL ABSCESS FILLED WITH BISMUTH-OIL SUSPENSION. Arrows point to bismuth in bronchi, through which pus was discharging. (Dr. G. H. Stover.)

and liver are much more marked. The disparity between the two sides may be very noticeable in children. The sallow, clayey complexion is a prominent feature. In children, in neglected cases, the growth of long, downy hair over the chest is at times suggestive of the disease. Large veins may be prominent, and I have seen them extend up over the shoulder of the affected side.

Diagnosis.—The tubular respiration may in children suggest an acute lobar pneumonia, as has been mentioned under serofibrinous effusion. Bacelli's sign is commonly absent. (*See* Serofibrinous

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Effusion.) A sharp polynuclear leukocytosis is usually present. "The shadow of an empyema is as dense as that of a simple thickening of the pleura, but the outlines are different" (Stover).

PULSATING EMPYEMA.—In a few cases the effusion may be felt to pulsate, synchronously with the heart, in nearly all instances in left-sided effusion. In my own case* the pulsation was not present when lying down, though visible and palpable when sitting upright,

FIG. 105.—CIRCULAR SINUS IN PLEURA. One arm of it has been draining through a tube. At "B" is shown clump of bismuth from a former injection, encapsulated during healing. (Dr. G. H. Stover.)

and extremely well marked. In certain cases the pus attempts to break through the chest wall, and, with edema, redness and swelling, presents between the ribs, commonly in the region about the nipple, and especially of the left side. The pulsation is limited in some cases to the region described.

The pus may escape through the wall of the chest, through the

* *Medical News*, July 31, 1897.

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lung, with or without the production of pneumothorax, through the esophagus into the pericardium, or as in one of my cases, by perforation of the diaphragm into the abdomen. Extensive gangrene of the pleura occurred in one case, requiring a most extensive resection of ribs and the right scapula. In 30 private cases reported by me pneumothorax occurred twice as a complication, the pus was coughed up four times, and broke through the fifth interspace once.*

(a) Chronic Pleurisy: Dry Fibrinous Form

(1) Primary dry pleurisy is said to occur without any definite acute symptoms. It is not infrequently tuberculous in origin. Adhesion of the pleural layers takes place, but with no especial manifestations clinically excepting in the abolition of the Litten phenomenon. It may be purely an accidental post-mortem finding. Osler speaks of the vasomotor phenomena associated with chronic pleurisy, from involvement of the first thoracic ganglia. Flushing or sweating of one cheek, and dilatation of the pupil may be present.

(2) Chronic dry fibrinous pleurisy is not infrequent as a secondary process after the subsidence of a pleurisy with effusion, either serofibrinous or purulent. The pleural layers are much thickened, and occasionally dry friction, generally without pain, is heard, and not infrequently felt, subjectively and objectively. In the thick fibrinous layer may be found, in the more serious cases, small pockets of effusion, of either type mentioned. The thickening may go on for several years and eventually calcification of the thickened layers may be found. Shrinking of the side is the rule. The resonance and respiratory sounds are naturally impaired, but the general health may nevertheless be fairly good. In many cases fibroid changes extend into the lung from the pleura. Displacement of the heart is a frequent accompaniment. Cavities in the lung are not uncommon, usually being of a tuberculous nature. Bronchiectasis occurs as in chronic interstitial pneumonia, which has so many points of similarity.

* *International Clinics*, Vol. IV., 15th Series.

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(b) Chronic Pleurisy with Serofibrinous Effusion

This is sufficiently described under the section dealing with the acute form, excepting to add that the acute variety finally becomes subacute and then chronic, in a few instances even after many aspirations. It is probably more common in cases not tapped early and with deficient expansion of lung, but these are not necessary conditions. There seems to be no especial tendency to become purulent.

(c) Chronic Pleurisy with Purulent Effusion

This may follow in neglected cases through the formation of such thick layers of pleura and such firm adhesions about the lung that reexpansion cannot occur after the pus is removed, and nature cannot obliterate the cavity within the chest. The diaphragm is drawn up on the affected side, the heart and the opposite lung are drawn over, the intercostal spaces sink in, the shoulder is drawn downward, and the spine becomes curved, without entirely overcoming the difficulty. The prognosis is good with efficient operation in many cases.

Other Varieties of Pleurisy

(a) **Tuberculous Pleurisy.**—This has been mentioned in the section upon tuberculosis, and sufficiently described in the foregoing sections.

(b) **Hemorrhagic Pleurisy.**—The signs and symptoms are practically those of the other types. Bloody effusion suggests, first, tuberculosis, and secondly, malignant disease of the lung or pleura. Less frequently it may be associated with cachectic states, as in chronic nephritis and cirrhosis of the liver, or with malignant types of infectious diseases. The cachectic type of effusion is very commonly due to a terminal tuberculous infection. Alcoholism and arteriosclerosis are given amongst the occasional causes. It has been reported without any explanation in otherwise healthy individuals. Traumatic perforation of lung or chest wall, with blood in the pleura, should not be included here, but is to be classed as hemothorax.

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This is common after gunshot wounds and stab wounds of the chest. I have known death from a hemorrhage into the pleura from cutting of an intercostal artery with an aspirating needle in the hands of an irregular practitioner.

(c) **Encysted Pleurisy.**—This has been spoken of as being not infrequent in empyema, as a result of limiting adhesions. One reason for aspirating in the center of the largest area of flatness is because this procedure makes error, because of the results of encysting of the exudate, less probable. The rare cases in which a patient has recurring illnesses over a period of years with sudden coughing up of a pint or two of pus, with temporary recovery, but with relapse in subsequent years, and always without physical signs, as in a case* reported by me may be explained upon the hypothesis that pus is encapsulated over the dome of the diaphragm, or in some fissure, not reaching to the surface, but in no other way so far as I know.

(d) **Interlobar Pleurisy.**—It is not uncommon for serofibrinous effusion to be walled off in the space between adjacent lobes. It may be spoken of as encysted effusion, but between the lobes of the lung, and not lung and chest wall or lung and diaphragm, as the term is usually applied. Empyema of the same regions may develop, either as a part of a general empyema or as a separate localization. The X-ray and the free use of the aspirating needle are imperative, excepting in the cases in which the pus is evacuated through a bronchus with recovery. The space between the upper and lower lobes of the right lung is most frequently involved.

(e) **Diaphragmatic Pleurisy.**—The severe pain, exaggerated by pressing upward with the fingertips under the margin of the ribs, has been mentioned. Abdominal rigidity is frequent, and hiccough may occur. In my experience many cases result in ordinary empyema, probably because this variety of pleurisy is common as an extension of subphrenic abscess. The extension to the parietal pleura occurs generally before the purulent pleural effusion develops. The dry pleurisy just above the spleen seen in patients with subphrenic abscess which has originated in or extended to the left side is, I believe, merely the outward extension of a pleurisy first starting in the

* *International Clinics*, Vol. IV., Series 15.

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on the same side together, the diagnosis can be settled only by the needle. Hydrothorax is generally double, and associated with some cause of general anasarca. The absence of fever should be noted. Pyopneumothorax should be considered, if great dyspnea, unusual displacement of the heart, tympany, resonance over the upper portion of the chest, with flatness below, and great mobility of this flatness are present. A very thick pleura might cause confusion, but the chronic course and the absence of fluid on aspiration would be decisive.

Large pericardial effusions sometimes give difficulty, and I have seen aspirated from the pericardium a purulent effusion after bronchopneumonia, as was proved at operation, when all the evidence, so far as we could judge, pointed to the pleura as the source.

The dyspnea and general conditions are much more serious in pericardial involvement. The skodaic resonance appears in the axilla, whence the lung is pushed, rather than above the fourth rib, as in pleural effusion. The heart is not dislocated in the manner characteristic of the latter trouble, the heart sounds and the apex-beat being both suppressed to some extent. When a subphrenic abscess, abscess of the liver, or other process originating beneath the diaphragm crowds that organ upward, the signs of effusion in the lower right back may be present. The diagnosis is not generally settled until the aspiration withdraws a fluid recognized as of subphrenic origin, or the needle, or more often later, the surgeon's hand settles the position of the diaphragm. So long as prompt action is taken, there is little regret over such an error.

C. PNEUMOTHORAX

Upon rupture of the pleura, air escapes into the pleural cavity and immediately sets up an irritation or an infection, so that serum or pus soon appears. Most cases diagnosed at first as pneumothorax are or soon become hydropneumothorax or pyopneumothorax.

Etiology.—It is said that pneumothorax may occur from infection of a pleural exudate by a gas producing organism, but the cases are unusual. The common causes are perforation of the visceral

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layer of pleura with escape of air from the lung, perforation of the wall of the chest and lung, as by a broken rib, or especially by external violence, generally an aspirating needle, perforation of the diaphragm, as in subphrenic abscess, or of the esophagus, as in ulceration from cancer, etc. The perforation of the lung is due to pulmonary tuberculosis in the vast majority of cases, probably 90 per cent. of the cases of lung origin. The remainder are made up of cases of perforation from empyema, infarction, abscess, gangrene, bronchopneumonia, emphysema and bronchiectasis, with occasional cases which are believed to occur in perfectly healthy lungs. The latter hypothesis is supported by the fact that these cases may recover without any effusion, and may even recur on the opposite side. (Goodhart.)

Closed Pneumothorax.—In this type the valvular opening has become closed. There is danger in draining away too much of the accumulated fluid with the aspirator, since the changes in the pressure may open the valve again, as I have several times noted. In the cases of open pneumothorax, a solid-walled fistula and an adherent lung exist together. Double pneumothorax has been reported. In examining tuberculous cases one should bear in mind the possibility of finding the artificially induced pneumothorax, as by Murphy's method. In the cases arising by perforation of the diaphragm in subphrenic abscess there may be gas in the subphrenic space as well, as is not uncommon in the cases of ascending infection in appendicitis. To this condition the name subphrenic pyopneumothorax is given, for pus is always present. Males are affected in the ratio of 4.5 to one female.

The left side is somewhat more frequently the seat of the pneumothorax. Few cases are reported in children, but of 12 private cases in the four years from 1902 to 1906 (*Medical Record*, August 25, 1906), two were children, one from bronchopneumonia in a boy of ten, and one from pulmonary tuberculosis in a girl of thirteen.

Pathology.—The chest is found, post mortem, to be much distended, and air or gas escapes upon puncture. The marked displacement of the heart and mediastinum is characteristic, and the diaphragm on the affected side is depressed. The further changes

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characteristic of a serous pleurisy or of an empyema, according to the nature of the exudate generally present, are found, and correspond with those described in the section upon pleural effusion. If an external or diaphragmatic perforation be not present, the site of the perforation in the lung can usually be found, since it is always situated in an area seriously diseased. The infection is most com-

FIG. 106.—PYOPNEUMOTHORAX. Exposure made with patient lying on left side. Arrow indicates level of fluid. (Dr. G. H. Stover.)

monly that characteristic of the mixed infection of pulmonary tuberculosis, but is occasionally sterile in these cases, unless as proved to contain tubercle bacilli by animal inoculation. In the subphrenic cases the colon bacillus and septic organisms predominate.

Symptoms.—Inquiry generally reveals a sudden painful onset

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with marked dyspnea and shock, but in tuberculosis it is not uncommon to find no such history, even upon careful cross-examination. In many cases of pyopneumothorax in pulmonary tuberculosis the diagnosis of the pneumothorax is missed, the attendant assuming that he is dealing with an ordinary empyema. This point will bear emphasis, because of the unfortunate result of opening the chest for drainage when no mixed infection has yet taken place. The dyspnea

FIG. 107.—PYOPNEUMOTHORAX. Exposure made with patient sitting up. Arrow indicates level of fluid. (Dr. G. H. Stover.)

is extreme in many cases, and cyanosis and cold sweat may be present. In case of a valvular opening the action of the valve causes the lung to "pump up" the pleura with marked increase of intrathoracic pressure, much displacement of organs, and corresponding distress. The pressure has been found to exceed 10 mm. of mercury in some cases. These valvular cases are serious and may be quickly fatal.

Physical Examination.—On inspection the chest is found to be unilaterally enlarged, and immobile upon the affected side. The

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heart's impulse is commonly displaced markedly and rapid action is often noticeable. The cyanosis, orthopnea, difficulty in speaking, and obvious distress make a very striking picture. By palpation one may confirm the lack of movement of the affected side, and verify the position of the heart beat. The displacement downward of the liver or spleen is often obvious to the finger. An increase in the

FIG. 108.—PNEUMOTHORAX AND COMPENSATORY EMPHYSEMA. Right: pneumothorax above. Diffuse thickening of pleura. Collapse of lung and chest wall. Heart pulled to left. Left: compensatory emphysema. Note intercostal spaces and scattered calcified tubercles. (Dr. G. H. Stover.)

size of the affected side of even an inch or two may be present. In a few cases emphysematous crackling is found under the skin of the chest, the air in the pleura having communicated with the subcutaneous tissues. Vocal fremitus is decreased or absent. The percussion note is generally a hyperresonant or tympanitic one over the region of the contained air, but flat over fluid exudate which is commonly present. This flatness over fluid is constant, but the varying

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degrees of tension of the confined air and perhaps other conditions lead to a variation from tympanitic to amphoric or skodaic resonance over the contained air, or even to a considerable degree of flatness in rare cases.

The lung is generally so much collapsed that it cannot be located by physical examination, though it may be adherent to the chest wall and show an island of resonance after the lower chest has filled above its level with fluid. The mobility of the dulness from fluid in pneumothorax far surpasses that in other conditions in which effusion into the chest occurs. The opposite lung may be hyperresonant because of the compensatory emphysema, but it is difficult of demonstration. The cardiac dulness may commonly be outlined without serious difficulty.

Upon auscultation there are two especially striking features,—the absence of breath sounds, due to the absence of normal respiration, and the splashing of the fluid upon change of position. This may be heard, by application of the ear to the chest, upon sudden movement of the body, and the patient may notice it upon change of position. Many patients with pneumohydrothorax become expert in producing the sound, so that it may be heard several feet away, by a lateral movement of the chest suddenly arrested, as in two cases to be quoted later. With the stethoscope, in addition to the diminished breath sounds, one may note a distant bronchial respiration, but an amphoric tone is more common. Any rales present, and the voice sounds, have their quality so modified by the "sounding board" qualities of the chest and the great cavity within it, as to present a peculiar metallic, amphoric, tinkling quality. The metallic tinkling heard after the splashing is probably produced, not by the falling of the drop into the pool, but by the bursting of a bubble of air from a communicating bronchus, as it comes to the surface. The coin sound, heard with the ear applied to the chest while a coin placed upon the anterior chest wall is tapped by another coin, is very characteristic of pneumothorax. The pulmonary second sound is accentuated.

Diagnosis.—This is certain if the splashing sound be heard originating in the chest, and not connected with the heart beat as in

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pneumopericardium. The dyspnea, often of sudden onset, pain, immobility of one side of the chest, decreased respiratory murmur, coin sound, displacement of the heart, and frequently the knowledge of previous pulmonary tuberculosis suffice in the absence of the splash. The diagnosis is not difficult in most cases, provided the physical examination be carefully made, and the possibility of pneumothorax

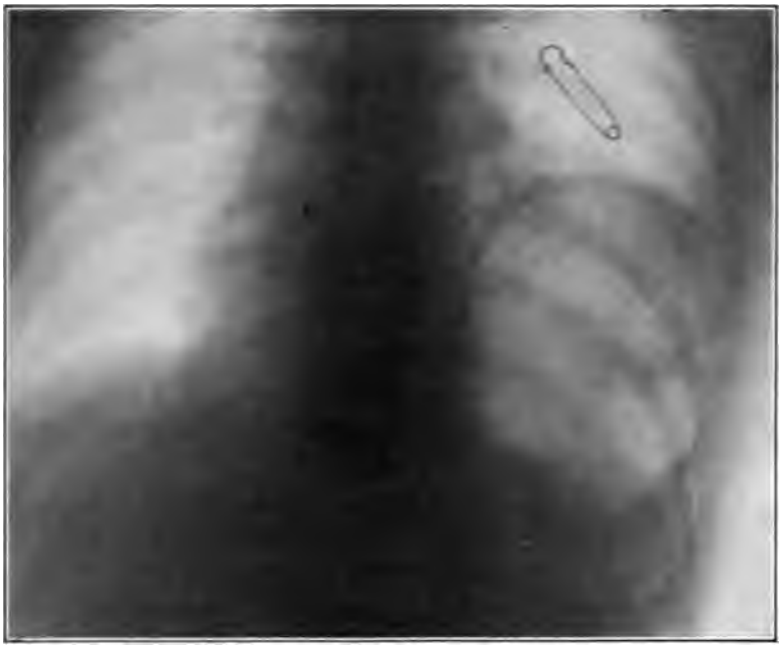

FIG. 109.—TRAUMATIC RUPTURE OF DIAPHRAGM. Stomach has passed into thorax through the opening. (Dr. G. H. Stover.)

be considered. Yet errors are frequent enough so that the disease, as we have mentioned under emphysema, might well be called "the unilateral emphysema of students," for such a diagnosis is not infrequent.

Differential Diagnosis.—Diaphragmatic hernia with displacement into the chest of the stomach, as in a recent case, suggests pneumothorax, but the resemblance is superficial only. Immense distention of the stomach and colon occasionally attracts sharp attention in percussing the left side, but is easily excluded. The cases of limited

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pneumothorax with but little air in a cavity circumscribed by adhesions are exceedingly difficult of diagnosis. Such cases are often overlooked. Many cases in tuberculous subjects may be examined after effusion has taken place, and be looked upon as ordinary empyema. Dr. Henry Sewall showed, at the Clinical and Pathological Society, a tuberculous lung excavated so that a mere shell of tissue remained around an enormous cavity. Such a case may with skill be distinguished from a limited pneumothorax, as this one was, for the dislocation of organs and splashing are absent. Osler mentions the presence of the coin sound over one such cavity, but this must be most exceptional. The overdistention of one lung by reason of an aneurism pressing upon its bronchus has been described, and may closely simulate pneumothorax. In one case in St. Joseph's Hospital a solid tumor produced a similar effect, but without serious confusion.

The Röntgen ray examination is practically certain in its showings. In the diaphragmatic hernia mentioned, the air bubble in the stomach and later the presence of the bismuth shadow, as shown by Dr. Stover, rendered its differentiation easy. "The pneumothorax shadow shows an area of less intensity than that of a space filled by lung, but without the superimposed shadow due to surrounding lung, as is seen when an abnormally clear area is due to cavity." (Stover.)

Prognosis.—Most of the tuberculous cases die within a few weeks. I have under observation two cases in tuberculous patients, one of them in a prominent physician, in which the effusion never became infected, as judged by the absence of temperature, and the general good condition, and in both of whom splashing was exceedingly pronounced. They have lived several years, both doing their ordinary work meanwhile, and with a practical arrest of the active tuberculous process. Both have held their weight and look well. In a similar case we refused to drain the cavity after the patient had been told that draining was imperative. He found a surgeon willing to operate, and died shortly, as all such cases do, as far as I know, of secondary mixed infection. In the accidental type of pneumothorax in healthy individuals recovery is the rule.

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3. DISEASES OF THE LUNGS

A. CIRCULATORY DISORDERS

Congestion of the Lungs

This may be either active or passive.

Active Congestion (Hyperemia).—This occurs as a forerunner or a part of the disease in such affections as pneumonia, bronchitis, bronchopneumonia and tuberculosis, and in these conditions may be general or local. Violent exercise, the chill of ague, the inhalation of irritants, or other causes determining a large amount of blood to the lung, result in the distention of its capillaries and may produce serious results. I have reported a case of a young man who was exposed a few hours to a temperature of 20° below zero 23 days after recovery from lobar pneumonia. He died in a few hours with evidence of acute pulmonary congestion. The intense congestion of which the French speak as "Woillez's disease" is regarded by most authorities as an abortive type of acute pneumonia. This affection begins with all the signs and symptoms of pneumonia; but drop of temperature and failure of actual fibrinous consolidation are noted after the first 24 or 48 hours. Up to this time the chill, fever, cough, pain, with defective resonance and fine rales in one lung have given every evidence of the onset of an ordinary attack of acute pneumonia, and it is classed in this country as an abortive or larval form.

Passive Congestion.—This may be best considered under two heads. There is, first, the mechanical congestion of the lungs corresponding to the pathological condition known as brown induration, and found in mitral and other diseases of the heart or in cases of pressure upon the vessels by which the return of the blood to the heart is interfered with. The vessels of the heart are engorged, the fibrous tissue of the lung is increased, and pigment from disintegrated red cells is found deposited in the connective tissue and in the alveolar cells. The pigment-containing cells which appear in the sputum are designated as "heart disease cells." A

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chronic bronchitis ensues eventually in these cases, with cough and expectoration. The dyspnea is due to the slowed circulation, the lessened capacity of the alveoli, on account of the space occupied by the engorged capillaries, and the obstruction of the finer bronchioles and alveoli by accumulated secretion, and perhaps edematous transudate.

Secondly, there is the type known as hypostatic congestion. This develops as the result of the action of gravity upon the body fluids, when the circulatory conditions are such that it has an opportunity to become actively operative. Acute exhausting diseases, notably typhoid fever, and chronic diseases in the aged which compel the recumbent position for considerable periods, are common causes. Comatose patients, most frequently after cerebral hemorrhage or organic brain disease, are especially exposed. It has been seen in the coma of morphine poisoning. The lung which according to the posture of the patient lies lower, and especially if this be on the side of a hemiplegia, is most involved. The lung tissue is found engorged, drips blood upon section and is often so devoid of air as to sink in water (splenization).

Symptoms.—These are cough, expectoration of mucus in the more favorable cases, increased frequency of respiration, with moderate dulness, decreased respiratory murmur, and moist rales over the affected part. Bronchial respiration is absent. The signs may be somewhat modified by change in the position of the patient. A consideration of the predisposing conditions renders the diagnosis of the trouble comparatively easy, and the outlook depends upon these conditions.

Pulmonary Edema

An exudation of serum into the interstitial tissue of the lung and the alveoli is a part of the acute inflammatory process which is found in localized affections, such as abscess, infarction, tubercle and tumor growth. More important is the general edema which forms a part of the symptomatology of cardiac disease, nephritis, serious anemias, chronic infections, and all conditions of general anasarca. The type of greatest interest is the acute pulmonary edema

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in which the lungs fill up with fluid rapidly, and in which life is threatened even in a few minutes. It is found in heart disease, especially mitral stenosis and angina pectoris; in severe lobar pneumonia, affecting the portions of the lung not involved by that process; in arteriosclerosis with increased vascular tension; in nephritis and in acute infectious diseases. I have reported, with Cooper, several cases of inhalation of nitric peroxid in which fairly acute edema of the lungs was a feature. The occurrence after ether anesthesia, in epileptic paroxysms, in angioneurotic edema, in hysteria and in pregnancy must be very unusual. Increased fluidity of the blood and impairment of the nutrition of the vascular walls are mentioned as contributory to its production, but nearly all authorities accept Welch's explanation: namely, that it is due to an increased tension in the capillaries of the lung due to the fact that the right heart, often hypertrophied in valvular disease of the left side, is more powerful than the crippled left ventricle. The blood accumulates in the pulmonary capillaries and transudation of serum occurs.

Pathology.—The lung may be affected only at its base, but in acute cases is universally involved. It is heavy and boggy, pits upon pressure, and gives vent to much clear or bloody serum, generally frothy in character, upon section. If the edematous fluid has coagulated, the affected areas may be gelatinous in appearance.

Symptoms.—Acute edema of the lung is preceded by a feeling of oppression within the chest, succeeded by cough, dyspnea and expectoration. Clear, or frequently blood-stained, pinkish serum is raised, often freely and sometimes in sudden gushes. One patient, whose case I have reported, spat out one drachm of pink serum about every 15 seconds by the watch, during the attack. This followed sharp exertion, was fatal in two hours, and the post mortem showed extreme mitral stenosis. The case in my experience which nearest approaches this in severity had also mitral stenosis but recovered with free bleeding. Dr. Whitney with whom I saw her, reported another attack later. Pallor, cyanosis and sweating are notable, and the chest bubbles with abundant fine rales. The heart action is rapid and weak. The dyspnea is intense. In the most acute cases, death may occur in a few minutes, but milder attacks sub-

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side after several hours. They may recur if some chronic circulatory condition underlies them, even scores of times, in rare instances.

Diagnosis.—This is rarely in doubt in the cases accompanied by expectoration, since the character of the fluid and the abundance of fine rales in the lung are decisive. The hyperacute cases, fatal before much expectoration can take place, could scarcely be diagnosed during life.

Prognosis.—This must depend upon the underlying condition. The amazing results of free bleeding should not be overlooked in considering the outlook.

B. HEMOPTYSIS

Spitting of blood from the respiratory tract in probably a majority of all cases is due to pulmonary tuberculosis. Next to this in frequency we may place mitral disease, and especially mitral stenosis. Many such cases are sent to health resorts with supposed tuberculosis. A considerable number of cases occur without known cause in persons who are apparently healthy at the time and remain so afterwards. Sixty-two of the 386 cases noted by Ware fall under this category. Rupture of aneurism into a bronchus is a not infrequent cause. I have observed at least three cases in which ordinary hemoptysis appeared with the onset of acute lobar pneumonia in patients entirely sound before and afterwards. In cancer of the lung it is a frequent symptom, and in connection with abscess, gangrene and bronchiectasis. Infarction of the lung, if extensive, is generally accompanied with expectoration of blood. In infection of the lung with the fluke, Paragonimus westermanii, hemoptysis is very common in Japan and China, and one or two such cases have been reported in the United States. Trauma, as by broken ribs, gunshot wounds, strain from heavy lifting, or in vomiting of migraine, as in a physician under my care, hysteria, pregnancy, arrested menstruation, bronchiectasis, leprosy and actinomycosis are occasional causes of blood spitting. In the subjects of chronic arthritis it may recur with great severity. Pernicious anemia or the purpuric type of diseases may cause bleeding from the lungs, and any ulcerative processes

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in the air passages may be responsible. A policeman under my care, in whom Dr. Levy demonstrated a syphilitic ulceration in the left bronchus, just at the point of bifurcation, has had severe attacks of hemoptysis extending over a period of a dozen years or more.

Symptoms.—The bleeding may be trivial and gradual in onset or so sudden as to cause death practically instantly, as in the frequent cases of rupture of aneurism of the aorta into the left bronchus. The patient notes a warm salty taste in the mouth and this is followed by the expectoration of blood. This may be anything from streaks in the saliva expectorated to a mouthful, or a few drachms or ounces at once, or repeated many times over a considerable period, to the deadly hemoptysis of aneurism or of chronic tuberculosis with cavity formation and the rupture of a large artery. In the great majority of cases the bleeding is relatively light in severity, yet occasionally a fatal result occurs in one not known to have had tuberculosis, but who shows a small lesion post mortem. As in case of typhoidal hemorrhage, it is not necessary that the blood appear externally, since the ruptured vessel may empty into the pleural cavity or flood the lung. In case of extensive fibroid disease with cavity formation it is not uncommon to have the hemorrhage recur at more or less definite intervals of a few hours as if the bleeding refilled the cavity soon after each attack. The pulse rises with the hemoptysis, but in milder cases more from anxiety than as a result of loss of blood, since no occurrence is more startling to the average patient. The blood in the early tuberculous cases appears pink and frothy, while if it comes from an extensive cavity it may be dark and clotted. All intermediate conditions are found.

The blood is alkaline in reaction and contains air bubbles and is mixed with saliva. The attacks in many of the conditions mentioned tend to recur. The patient coughs up for some days blood which has remained in the bronchi or in the cavities, and casts from the tubes may be demonstrated. Vomiting of blood is occasionally noted, it having been swallowed during the attack, and black stools are frequently passed after its subsidence.

Diagnosis.—Great skepticism is justified if there be hysteria. The diagnosis is rarely in doubt if the patient is seen during the at-

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tack. The cough, pink, frothy blood, alkaline reaction and symptoms pertaining to the respiratory system contrast sharply with the dark, clotted or fresh blood of acid reaction, with definite vomiting and history of digestive trouble, when gastric ulcer or cancer, cirrhosis of the liver, etc., is responsible.

Prognosis.—This is very grave in severe cases, but generally not of immediately serious import in milder ones. Patients with mitral disease may feel better after the attack, and may be assured of comparatively slight danger as contrasted with the cases in which an ulcerative lesion of the lung is present.

C. PULMONARY INFARCTION

This results from embolism, even fat embolism, less frequently from thrombosis of a branch or branches of the pulmonary arteries. Infarction occurs most frequently in chronic mitral disease. The embolus may come from the right auricular appendix. If varicose veins of the leg exist, and have been recently inflamed, or confinement, operation for uterine fibroids or other ground for suspecting the dislodgement of a clot from the veins of the pelvis be found, the explanation of the attack is at hand; but no source may be found, even post mortem, in some cases. A primary thrombosis of the artery sometimes exists. The right lung, from the favoring circulatory conditions, is most frequently affected, and the infarction is more likely to be in the periphery of the lung. Multiple infarction may be present. Blocking of the artery is not necessarily followed by infarction, the circulation not being completely cut off in such cases.

Pathology.—The infarction appears as a dark blood-colored area, roughly wedge-shaped and pointing into the lung, the pleura being commonly unbroken, but often inflamed. The embolus may be found in a vessel near the apex of the wedge. Lightening in color with shrinking and fibrous tissue formation take place if recovery ensue. A septic infarction may give rise to abscess, gangrene, pneumothorax, etc., while an embolus composed of tumor cells may start a new growth in the lung. Payr believes that all post-operative lung complications are due to minute emboli.

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Symptoms.—If a large vessel be blocked, death may result before an infarction has time to form. Ordinary infarctions of moderate size give rise to some discomfort, even sharp pain, dyspnea, and hemoptysis. If of considerable size, an area suggesting pneumonic infiltration may be demonstrated. In these cases very severe dyspnea and even an appearance of impending death may be noted. Thus I have known two men of middle age with inflamed varicose veins to have three infarctions in rapid succession, with intense dyspnea and bloody expectoration. One of them recovered and a month afterwards an area could be found in the right lung near the nipple, and another in the left base, in which dullness and bronchial respiration and moist rales were still present. The frequent hemoptysis of mitral stenosis may be due to embolism, though commonly supposed to be of congestive type.

Prognosis.—This depends upon the size of the embolism, the completeness of the infarction and the virulence of any existing infection.

D. GANGRENE OF LUNG

This occurs as a result of lessened resistance or death of a portion of the lung, with a virulent mixed infection supervening. In comparison with the number of cases in which portions of lung are cut off from their circulation the disease is rare. The process may be circumscribed, multiple in rare cases, or diffuse, even involving an entire lobe, as after acute pneumonia. Hare states the causes substantially as follows: (1) Acute pneumonia, possibly preceded by abscess; (2) aspiration pneumonia which I believe to be the most common cause; (3) pulmonary embolism, the embolus coming from an infected focus; (4) foreign bodies in the bronchi or in bronchiectatic cavities or tuberculous cavities; (5) trauma; (6) infectious debilitating diseases, as typhoid, diabetes mellitus, and long-continued bronchopneumonia; (7) suppuration in the lung; (8) pressure upon the pulmonary vessels, as by aneurism, or new growth, especially cancer, rupturing into the lung.

Pathology.—A sloughing, offensive, blackish-green mass is found in the lung, often circumscribed by a zone of congestion with edema

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beyond. The preference is for the periphery of the lung and the lower lobes. More than one area may be found, especially in cases following aspiration pneumonia. In the worst cases no line of demarkation is established, and a ragged sloughing mass or cavity is found, with dirty semi-fluid contents in the latter case. The more resistant vessels crossing the cavity may have finally given way with resulting hemorrhage. Perforation of the pleura and offensive pneumothorax may be present.

Symptoms.—Since the disease commonly appears as a complication of a preceding lung infection, it is not usually abruptly announced, the chief exception to this statement referring to the type which comes on with chill, fever, and malaise during the convalescence from acute lobar pneumonia. In general, there is absence of pain. The fever of the previous lung affection becomes exaggerated, with rapid pulse, increased cough, and the generally horribly offensive sputum and fetor of the breath. In case the necrotic area does not communicate with a bronchus, these features are in abeyance, and their sudden appearance is to be taken as indicative of establishment of such a communication. Rapid exhaustion, feeble pulse, higher temperature range, sweats, dry tongue, complete anorexia, diarrhea, and death generally follow. Hemorrhage may occur. The sputum is dirty, grayish or brownish, and separable into three layers, dirty froth, a brownish or greenish serum, and a heavy sediment of much the same color. The latter contains blood, fatty acid crystals, leukocytes, bacteria, epithelial cells, elastic tissue, and tissue fragments. The latter may even be of considerable size.

Upon physical examination the usual signs of a most exhausting disease are noted. In one lung we may find dulness, rales, bronchial respiration, and possibly the signs of cavity, but these are wholly uncertain, and are likely to be wanting in case the focus be central. The Röntgen ray is of great value in locating the area of gangrene. Evidence of embolism in the brain or elsewhere may be present. "Gangrene leads to a dense shadow without signs of anatomical structure differentiation, such as would be seen in bronchopneumonia, or in resolving croupous pneumonia." (Stover.)

Diagnosis.—This depends upon the history, the obvious gravity

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of the affection and the characteristic breath and sputum rather than upon the physical signs in the chest.

Prognosis.—This is in general desperate, but an occasional recovery may take place in a robust individual with a sharply circumscribed process. The diagnosis of such a favorable condition could scarcely be made during life.

E. ABSCESS OF LUNG

This may occur (a) as a result of septic embolism, (b) after penetrating wounds of lung with infection, (c) after lobar pneumonia, and (d) after aspiration pneumonia, (e) as the result of perforation of cancer, or from below the diaphragm, by liver abscess or subphrenic abscess, (f) as the result of the mixed infection of tuberculosis.

Abscess is generally single, but may be multiple, especially in case of septic embolus, in aspiration pneumonia, and in tuberculosis.

(a) Abscesses of this class occur frequently in pyemia, are multiple, cone-shaped, and often break into the pleura, causing empyema, or pneumothorax.

(b) These result from infection carried in by an aspirating needle or rarely from wounds from without.

(c) Abscess in lobar pneumonia is not very common, if the purulent infiltration which is found occasionally in resolution from accumulation of a liquified exudate be excluded.

(d) This type follows aspiration of septic material from the throat, nose, ear, pharynx, and larynx rather than from food particles.

(e) In this class the abscess may be large and may perforate a bronchus and empty itself. If the expectoration has the colon bacillus odor, the presumption is that of trouble originating below the diaphragm.

(f) This type is associated with the mixed infection always found in tuberculous cavities.

Symptoms.—Pain, fever, cough, and expectoration of pus, oftentimes in large quantity, suddenly attract attention to the lung, and

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a history of trauma, of source for embolic or aspiration infection, appendicitis or abscess of the liver, etc., adds probability in case of doubt. Chills, sweating, and the usual septic phenomena are present.

Physical Examination.—Signs of localized trouble may be detected if the abscess be large and near the surface, but in multiple

FIG. 110.—POSTERO-ANTERIOR VIEW OF THE CHEST OF A BOY 10 YEARS OLD. The arrows point to the median edge of a circumscribed abscess of the right lung. Abscess was opened and the patient made a complete recovery. (Dr. S. B. Childs.)

abscess the general condition is so bad that little is added to the picture by the added infection. The Röntgen ray may be very helpful.

Sputum.—This is generally the key to the diagnosis. It is purulent, offensive, contains pus, débris, elastic tissue, and possibly lung fragments.

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Prognosis.—This is very grave if the process be part of a septic condition. In acute lobar pneumonia it may empty through a bronchus and recovery takes place. Perhaps the more common sequel is the development of empyema which is drained with recovery. Dr. Freeman and Dr. Tennant of Denver have each operated a post-pneumonic lung abscess with complete recovery after I had been able to make a diagnosis by the finding of dulness, decreased and roughened respiratory murmur, and rales in the surrounding lung. In

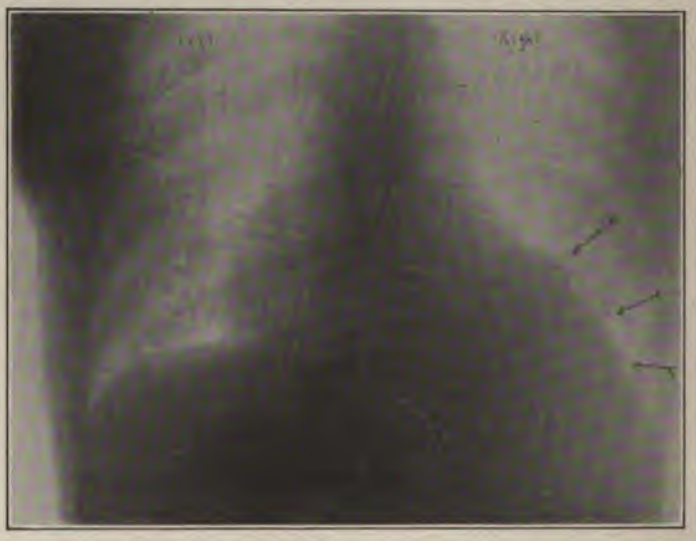

FIG. 111.—ABSCESS AT BASE OF RIGHT LUNG BEHIND. Postero-anterior view. (Dr. G. H. Stover.)

one of the cases the X-ray was of some help in localization. The outlook after operation is good if there has been no serious delay.

F. NEW GROWTHS IN THE LUNG

Cancer is more common than sarcoma, and males are more often affected than females. Aufrecht believes that trauma is a common cause. The frequency of primary lung cancer in the cobalt miners of Schneeberg has long been recognized. Most malignant growths are secondary. Cancer of the esophagus, breast, stomach, or liver may be the original focus in case the extension be a direct one, but

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metastasis often takes place through the lymphatics or blood vessels. The latter type is more likely to be bilateral.

Symptoms.—The two conditions will be considered together, since the symptoms are practically the same. Pain is generally present in the cases with pleural involvement, but not necessarily so. Cough and expectoration, frequently bloody, are present. Not infrequently the chief complaint is of dyspnea. This may be due to several factors,—the pleuritic pain, the pleuritic effusion, the growth in the

FIG. 112.—BEGINNING OF FORMATION OF ABSCESS OF LUNG, FOLLOWING CHRONIC FOCAL PNEUMONIA. (Dr. G. H. Stover.)

lung tissue, or the compression of bronchi or trachea by the growth, or more commonly, by mediastinal glands. Dysphagia, recurrent paralysis, pressure upon veins, intercostal pain from pressure neuritis, and moderate fever may be present. In a recent case obstinate sciatica in the left leg resulted from pressure of large cancerous glands upon the roots of the plexus, as proved post mortem. Cachexia may be almost wanting until the late stages.

Physical Examination.—The chest frequently bulges on the affected side, either because of the growth itself or of the effusion. The heart is frequently displaced. The signs of solidified lung, or

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more frequently of an effusion covering up the diseased lung, are present. Enlarged veins are frequently noted over the chest, and edema of the parts supplied by the superior vena cava may be present. Enlarged axillary and supraclavicular glands are generally found, and metastatic nodules occasionally. Aspiration shows bloody fluid in most instances, and this alone is extremely suggestive. I have seen secondary growths at the site of needle puncture in sarcoma of the lung, the pleura having become involved. Gangrene of lung, metastasis to other organs, and perforation of the chest wall are possibilities. The sputum shows little of interest in most cases, excepting the absence of tuberculosis, although cancer cells have been found. A secondary anemia develops.

Prognosis.—The cases commonly die within a few months, occasionally within one or two months. The possibility of successful operation is to be considered, but few cases would be amenable to this treatment.

Dermoid Cyst

A few cases of intrathoracic dermoid cyst have been reported. The diagnosis is occasionally made through the coughing up of hair escaped from the cyst, as in a recent case at St. Joseph's Hospital.

G. CHRONIC INTERSTITIAL PNEUMONIA

(Cirrhosis of Lung)

Any inflammatory lesion in the lung may determine the overproduction of fibrous tissue, and cirrhosis or, better, sclerosis of lung may therefore occur in most diverse conditions. It may be local or diffuse. The former is found around any inflammatory focus in the lung, be it tuberculous, suppurative, parasitic, syphilitic or traumatic. The fibroid patch in the apex from healed tuberculosis is a daily discovery in the autopsy room.

Diffuse fibrosis is a vastly more important matter. The common type resulting from inhalation of mineral dust and other foreign matter will be considered under the title "pneumonokoniosis."

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Certain of the cases result from imperfect recovery after acute pneumonia, a fibrous change taking the place of the absorption of exudate, which should occur. The condition is also spoken of as chronic fibroid pneumonia, and gray induration. In bronchopneumonia and in bronchiectasis a similar process may originate, and after influenza, even in the absence of definite pneumonia. More common is the pleurogenous type in which a primary pleurisy originates an interstitial process which extends into the lung, and may involve the entire organ in the fibroid change. The fibrosis of the lung long compressed by pleural exudate follows the collapse. In certain of these processes tuberculosis is found to have been the active agent, even though not recognized as such during life. A variety of fibrosis of lung closely simulating the ordinary fibroid lung of tuberculosis is due to syphilis.

Pathology.—The lung is firm and tough, cuts with increased resistance, and may be firmly bound to the chest wall, in case the pleura be especially involved. The shrinking may be so great that at first but a single lung may be apparent. Bronchiectasis is a prominent feature in certain cases. The less affected lung shows a marked compensatory emphysema. In the pleurogenous form, the thickening of the pleura may be enormous. Tuberculous cavities at the apex are not infrequent findings, even where the process has not been thought to be of tuberculous origin. Advanced amyloid degeneration of the liver and spleen is often present. Much displacement of the heart results if the process be predominantly unilateral, and dilatation and hypertrophy of that organ are common, especially upon the right side.

Symptoms.—There may be few symptoms of the trouble for many years if we except a chronic cough similar to that of chronic bronchitis, generally worse in winter, and accompanied by slight expectoration. With the advance of the fibrosis the shrinking of the lung offers more resistance to the passage of the pulmonary blood stream and less surface for its aeration. Dyspnea results. After some years it may become extreme. Meanwhile the expectoration has increased and commonly become more purulent. In certain cases tubercle bacilli are found in it. Fever is commonly absent,

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and many of the patients go about the ordinary affairs of life for many years. They are unable, however, to do work requiring much exertion. Hemoptysis is frequent and may be very severe, since the ulcerated artery surrounded by fibrous tissue cannot contract and check the bleeding.

Physical Examination.—The cases generally present marked deformity of the chest, one side commonly being shrunken, especially if there be extensive pleural involvement. It pulls the shoulder downward, and the liver or spleen upward, as may best be seen upon the X-ray plate. It displaces the heart, uncovers the base of the organ if the left apex be affected, and causes distortion of the spine. Respiratory movements upon the affected side are practically absent. Marked dulness or flatness is found over the affected area, hyperresonance over the emphysematous lung. Bronchial respiration, various rales, and the signs of bronchiectasis or cavity formation may be present. The pulmonary second sound is sharply accentuated. This is often more apparent because of the uncovering of the heart by the retraction of the left apex. As the heart fails, a systolic murmur at the apex is common. These are the cases in which with marked fibrosis the pulmonic accentuation gives way after sudden exertion to a soft diastolic murmur transmitted downward from the area of the valve. Examination after a few days' rest in bed shows an absence of the murmur, and the accentuation has been restored. There can be no doubt that a relative leakage at the pulmonary orifice occurs, as in the occasional cases of mitral stenosis, from enormous pulmonic resistance. The displacement of the heart may be extreme. I have seen the apex-beat at the right anterior axillary line.

Diagnosis.—The condition may be readily recognized, although the decision as to whether it has originated from the usual fibrosis from tuberculosis or from syphilis may be difficult. The presence of hemoptysis speaks against the pleurogenous form, and the finding of a positive Wassermann reaction might be much in favor of a specific origin.

Prognosis.—The disease is incurable, but may last half a lifetime in the most favorable cases, especially those associated with pleurisy.

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Death may occur from hemorrhage, exhaustion, cardiac dilatation, or the development of amyloid disease.

H. PNEUMONOKONIOSIS

This variety of fibrosis of the lung depends upon the inhalation over long periods of particles of dust, generally of mineral nature, and commonly associated with some occupation in which dust is directly produced. The term anthracosis is applied to the relatively mild type caused by the inhalation of coal dust in coal mining; siderosis to that induced by the inhalation of metallic particles, chiefly iron or steel, as in knife grinders (grinder's rot) and nail workers; chalicosis, to that associated with the inhalation of stone dust, as by stone cutters and miners (stone cutter's or miner's phthisis). Those working in grain elevators, in cotton mills, flax mills, and clay works, and even in street sweeping, are subject to similar trouble, the organic dust in certain of these occupations producing symptoms practically identical with those of the inorganic type.

Etiology.—Much of the inhaled dust is stopped by the hairs within the nares, and that passing further is largely cared for by the ciliated epithelial cells, the mucous and alveolar cells, and the secretions. Beyond a certain degree of exposure, however, the protective powers fail, and the dust particles penetrate the mucosa and reach the connective tissue beneath. Much of the pigmentation, however, comes from another channel, the absorption of pigment swallowed with the saliva, this being thought to go especially to the parenchyma of the lung. Phagocytes carry the pigment from the connective tissue to the lymph stream, and it is finally deposited in the interlobular septa and the peribronchial and tracheal glands. From the bronchial glands the pigment may be carried directly through their walls into the pulmonary veins and thence into the general circulation. Thus even the spleen and liver may eventually show pigmentation in extreme cases.

In the mines and mills of the Rocky Mountain region miner's phthisis is extremely common. The stone dust, steel dust from the drills, and the powder smoke all contribute. Wet mines are much

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less prone to the development of the trouble than dry ones where dust is abundant, hence the disease develops in certain districts predominantly. It is especially seen in those who have worked 10 or 20 years, but not infrequently symptoms develop in ranchmen beyond 50 who worked at mining for perhaps 5 or 10 years when young. The process of fibrosis has been started and continued after the exposure to dust ceased. In the most extensive marble mills of

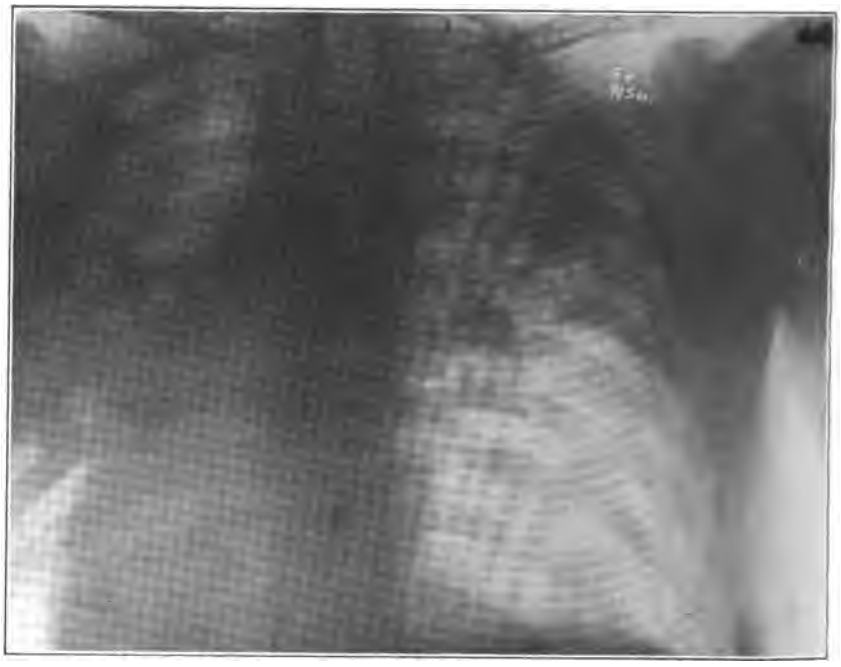

FIG. 113.—MINER'S PHTHISIS. Postero-anterior view. (Dr. G. H. Stover.)

the world at Marble, Colo., the trouble develops only in one or two departments, where the work has to be done dry. A considerable number of cases develop in the milling and elevator industries in the Northwest.

Pathology.—In those long exposed to the above agencies proliferation of interstitial tissue takes place, perhaps local in milder cases, but general in the more severe ones. In general the posterior and middle regions of the lung are more affected. The sclerosis may produce bands running into the lung from the pleura, or the root

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of the lung may be especially affected. In coal miners the tracheo-bronchial glands may be of the deepest black, while in other miners the color is grayish, and in those affected by organic dust it may be still lighter. A black lung may still crepitate freely, no especial interstitial change having developed. The lungs of those dwelling in smoky cities may be much discolored and yet apparently not damaged. The inhalation of iron oxid may give a distinct reddish color to the lung, while the silica of some of the mills where gold ore is crushed produces a peculiar grayish, glistening hue. Associated with the deposit of pigment and the fibrosis is a catarrhal inflammation of the bronchial mucous membrane, and the symptoms are especially due to the chronic bronchitis, bronchiectasis, and emphysema produced. The fibroid areas may break down, and may make cavities if they are able to empty through a bronchus, as frequently happens.

Symptoms.—After a variable period of exposure, perhaps five to fifteen years on an average, the workman becomes conscious of increasing cough and expectoration, and finds that his "wind" is impaired. The latter symptom is the first one to bring the patient to the physician's office in many elevated regions, where dyspnea is easily produced and where so many of the miners of precious metals are employed. The patient cannot stand exposure to dust as formerly, because of cough and dyspnea. The expectoration becomes more abundant. It is black in coal miners, but much less deeply colored in other occupations. Loss of weight and strength and increased dyspnea finally compel the abandonment of the occupation. In the workers in mills crushing silicious ores, the progress is much more rapid than in miners and other workmen. In one such coming to my knowledge, an electric lamp could not be distinguished because of dust at a distance of 3 to 6 feet. Of the first gang that worked here, all but one or two had been invalided at the end of three years, and many of these had already died of the disease. The bronchial glands were gritty when cut across, and incineration left a large portion of the weight of the gland as a silicious ash. In coal miners the progress is slower and there is a definite protective influence against pulmonary tuberculosis. In the miners of the

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Rocky Mountain region, a secondary tuberculous infection is very common, and it is said to be found in many other types.

Physical Examination.—Physical examination shows generally the signs of a chronic bronchitis and emphysema. In many instances I have found a shrunken fibroid lung upon one side, but these are the exceptions. Dilatation of the heart and accentuation of the pulmonic second sound are commonly present. Edema of the lungs may be a late phenomenon.

The sputum shows the grains of pigment of the particular dust responsible for the trouble. Leukocytes and epithelial cells may show granules of pigment within. Pus cells, bacteria, and frequently tubercle bacilli are present. In a coal miner, in whom softening of a fibroid area had occurred, on several occasions an ounce or two at a time of sputum resembling very heavy, sticky, black paint was raised, being evidently the product of liquefaction of fibroid lung areas or glands.

Diagnosis.—This is to be made by a knowledge of the occupational history, the chronic bronchitis and emphysema, or possibly of a definitely fibroid lung upon one side, the cough and expectoration, and the examination of the sputum.

Prognosis.—This generally depends so much upon the character of the inhaled dust that only general statements are possible. The patients may live from a year or two to several years after pronounced symptoms compel retirement from the occupation. In the more deleterious occupations, few workmen are found who pass the age of 40 or 50 years. Coal miners have a better prospect than any others.

I. EMPHYSEMA

Definition.—A chronic disease of the lungs, characterized by dilatation of the air cells with thinning of the walls, and generally accompanied by chronic bronchitis.

Varieties.—The varieties of the disease are generally described under the following classification:

(a) Interstitial or Interlobular Emphysema.—This is really a "surgical emphysema" affecting the lung, the alveoli having

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ruptured and permitted the escape of air into the connective tissue of the lung, whence it may reach even the neck. In a recent case rupture took place during a paroxysm of whooping-cough, and the crepitating emphysema reached to the fingers. The rare cases of spontaneous pneumothorax in healthy individuals are thought to be explained by this process.

(b) Acute Vesicular Emphysema.—This is an acute and transient overdistension of the air cells found occasionally in attacks of asphyxia, angina pectoris, bronchitis, or other conditions involving violent respiratory efforts. The lung is temporarily overdistended and hyperresonant, and rales may be present. Neither of the types just described is really properly classed with the chronic lung condition which we are to consider.

(c) Compensatory Emphysema.—This is an overdistension of air cells in certain portions of the lungs brought about to fill the chest space when other portions have collapsed. As a fairly acute process we have seen it typically around the collapsed portion of lung in bronchopneumonia. It is capable of complete restitution in such cases. More commonly we see it as a permanent dilatation of air cells with eventual atrophy of the alveolar walls, in chronic disease of the lungs in which marked decrease in volume has occurred elsewhere. Most typically it is found in chronic fibroid phthisis. The shrinking lung may here decrease in size until it is even found at autopsy only with difficulty, while by enlargement of its cells the better lung fills the space. In case of pleural adhesions and pneumothorax compensatory emphysema is often noted.

(d) Hypertrophic Emphysema.—This is the typical process, known also as large-lunged emphysema, or substantive emphysema.

Etiology.—There is a congenital deficiency in the ability of the lung to empty itself of air, due doubtless to some weakness in structure. If we add to this some cause of increased air pressure within the alveoli, the distension of the air cells, which constitutes the first stage of emphysema, is produced. The atrophy of the wall will be spoken of later. That the deficiency of the resisting power of the alveolar walls is hereditary is pretty well proved by the marked family history often noted in this disease. (*See also* Asthma.) The

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common causes of the increased air tension are chronic bronchitis, asthma, and, especially in the young, whooping-cough. In a much smaller number of instances in which the disease occurs in glass blowers and players of wind instruments, the same cause is operative, and those doing heavy lifting or similar work, in whom the chest is "set" in full inspiration during the effort, are also subject to the disease. Males are more frequently affected, since the accessory causes discussed above are oftener operative in this sex. The time of development of the disease is generally after middle life, when the elasticity of the lung tissue is impaired. A few cases are thought to be due to hyperplasia with premature ossification of the costal cartilages, as described by Freud, the emphysema being secondary to the condition of rigid dilatation produced. The frequency of emphysema in fibroid phthisis and pneumonokoniosis may be explained as being in part due to the violent cough with increased alveolar pressure.

Pathology.—The striking pathological feature in emphysema is the lack of the usual collapse upon opening the chest. The lungs push forward and fill the space usually occupied by the heart superficially beneath the sternum, this organ being crowded downward. The dry, pale, pleura, with soft feel, and pitting upon pressure, occurs in no other condition. Because of the destruction of the walls between the alveoli, the weight of the entire lung is lessened. Through the pleura one may see the bullæ caused by the coalescence of alveoli the septa of which have been destroyed. It is because of destruction of aerating surface and the contained pulmonary capillaries that dyspnea and increased pulmonary arterial tension are such characteristic features of the disease. The elastic tissue is deficient or has even disappeared in places. The lesions of a chronic bronchitis are found in the bronchi, with bronchiectasis in most of the cases. The right side of the heart especially is dilated and hypertrophied, and marked atheroma of the pulmonary arterial system is frequently met with. The changes which go with chronic passive congestion are noted in other organs.

Symptoms.—No complaint is made by the patient until the interference with aeration, due to the destruction of septa and their pul-

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monary capillaries, has advanced to the point that the increased demands for oxygen cannot be met under conditions of exertion. Dyspnea is thus the earliest feature. Any condition causing inability of the heart to keep up the proper pressure may precipitate shortness of breath, for the compensatory action of this organ is nature's chief defense. In the cases with chronic bronchitis and asthma, the addition of symptoms from the emphysema is so gradual as to be scarcely perceived until well marked. Most of the complaint up to this point is of the associated cough, expectoration, and wheezing. The usual winter exaggeration of symptoms of chronic bronchitis bears especially hard upon those patients with well-marked emphysema, and many of them become extremely cyanotic at this season, although in fair condition during warm weather. Owing to the loss of elasticity of the lung, expiration is much prolonged, as in asthma, the inspiration being much shorter and quicker.

Physical Examination.—The changes in the shape of the chest are extremely characteristic. The antero-posterior diameter increases greatly, the shoulders becoming rounded, the head shoved forward, the sternum bulges, and the clavicular regions become prominent. The accessory respiratory muscles stand out prominently, and the ribs are more nearly horizontal than normal. Dilated veins along the line of attachment of the diaphragm to the ribs are often present, but are of no especial significance. The movements of the chest are much decreased, for it remains in a more or less complete inspiratory position, because of the inefficiency of expiration. The chest rises, but does not properly expand with inspiration. The voluminous lungs displace the heart downward so that the apex-beat is absent from its accustomed place, while the right ventricle causes a distinct pulsation in the epigastrium. Because of the dilatation of the right heart, the venous return is interfered with so that the cervical or other veins may be prominent. In a considerable number of cases tricuspid insufficiency causes systolic venous pulsation in the neck. Percussion shows hyperresonance, and the lungs extend deeper in the chest than normal, the twelfth rib often marking the lower border of their percussion resonance. The superficial cardiac dulness is often wholly obliterated. The liver and spleen are found to be

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depressed. Upon auscultation the signs of the associated chronic bronchitis usually cover up the feeble respiratory murmur, with very marked prolongation of expiration, characteristic of emphysema proper. I have often told students that when they hear so little that they suspect an obstruction in the stethoscope, the condition is probably one of emphysema without marked asthmatic or bronchitic signs.

The heart sounds are often feeble because of being deadened by the overlying lung. Pulmonic accentuation generally exists, but may not be heard on this account. The frequent tricuspid insufficiency has been mentioned. Marked passive congestion of the liver may be demonstrable. Hemorrhoids due to the venous obstruction, and slight edema of the feet may be present. The sputum is that of the associated chronic bronchitis. The urine may show albumin and casts, as would be anticipated from the chronic venous congestion. The decided thinning of the lung tissue may be shown with the Röntgen ray. The nails may be markedly clubbed.

Diagnosis.—The barrel-shaped chest, cyanosis, cough, expectoration, dyspnea, and the evident chronicity of the condition suffice. Pneumothorax upon one side may well be spoken of as the "unilateral emphysema of students." It offers no difficulties if only considered.

Prognosis.—The disease is chronic and incurable, except in rare cases of the acute type in the young. The patients often live to a good age and more might do so if they could escape the cold winters. Hemoptysis and pneumothorax are rare complications. Death occurs from cardiac complication with dropsy, from intercurrent disease, or from gradual failure.

4. DISEASES OF THE MEDIASTINUM

A. TUMORS

These are not very common and are generally cancerous or sarcomatous in nature, but fibromata, lipomata, gummata, dermoid cysts, lymphomata, and other varieties are occasionally found. The malignant disease is more frequently primary if sarcoma, secondary if

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cancerous. Hare found that males were more frequently affected than females, and most often in the fourth decade.

Symptoms.—These arise in part from the cachectic manifestations of the malignant growth, but more especially from the pressure upon the important and delicate organs within the chest. Pain is common, but often a late symptom and is on the whole less severe than might be anticipated. Dyspnea, oftentimes orthopnea, is likely to be

FIG. 114.—CANCER OF MEDIASTINUM. Blocking of superior vena cava. Note large veins in axilla.

the most prominent symptom, and is due to pressure upon the trachea or bronchi, upon the heart, or to the general encroachment upon the air space. If the recurrent laryngeal nerves be compressed, the laryngeal difficulties add to the dyspnea, and a brazen cough, so common in aneurism, is heard. Aphonia is frequently present under these conditions. Pupillary changes, as in aneurism, occur from sympathetic involvement. From compression of the gullet, dysphagia is often present. The symptoms vary somewhat in accord-

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ance with the origin of the tumor from the structures of the anterior mediastinum, chiefly the thymus, or from the glands more deeply situated. The latter produce, in general, more serious symptoms, especially in the way of localized pressure.

Physical Examination.—The superior vena cava is more often compromised by pressure so that the face, neck, and arms are congested and dilated veins are present in the upper chest. Exophthal-

FIG. 115.—ANTERO-POSTERIOR VIEW OF ENORMOUS MEDIASTINAL TUMOR. Trachea crowded far to the right. (Dr. G. H. Stover.)

mos may be noted. Pressure upon the inferior vena cava may produce stasis in its region of distribution. Glandular involvement not infrequently obliterates the axillary vein upon one side with resulting edema and cyanosis of the arm. Pressure neuritis may be associated. The fingers may be clubbed. The tumor not infrequently erodes through the breast bone or the adjoining portion of the ribs. The tumor may pulsate and yet may not be aneurism, as in a gumma which I examined. The heart is often displaced by the growth. Dulness or flatness and entire absence of respiration and

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heart sounds are to be expected over the tumor. Because of pressure upon the azygos and other veins, pleural effusion is not uncommon.

Diagnosis.—The symptoms mentioned, with the finding of dulness over the mediastinal region, suggest the presence of some growth in that location. The knowledge of a malignant condition to which mediastinal tumor could be secondary would be of importance. The

FIG. 116.—OLD HEALED TUBERCULOSIS OF MEDIASTINAL LYMPHATIC GLANDS. Arrows point to calcified glands. (Dr. G. H. Stover.)

coughing up of pus and hair establishes the diagnosis of dermoid cyst. The presence of glandular enlargement speaks in favor of cancer or sarcoma. A history of syphilis or a positive Wassermann reaction speaks for a gumma or aneurism. In most cases the differentiation narrows down to a solid tumor or aneurism, but in a few instances the doubt long exists. Specific history, pulsation, diastolic shock, tracheal tugging, and a through-and-through heaving of the chest are decisive in favor of aneurism. The transmission of the diastolic shock to the trachea is sometimes found when it is not per-

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ceptible over the tumor, and I have never found it in cases other than aneurism. It is felt as a distinct shock immediately after the tug in the examination for the latter. (*See Amer. Jour. Med. Sc.*, Jan., 1900.) Long continuance of the symptoms is in favor of aneurism, but a patient with a spindle-celled sarcoma of this region lived over four years in the Denver City Hospital. In one case I

FIG. 117.—SARCOMA OF MEDIASTINUM WHICH HAS COMPLETELY ERODED A RIB. (Dr. G. H. Stover.)

saw a cancerous growth, with enlarged glands palpable externally, while the fluoroscope showed distinctly a pulsating aneurism beneath, and both conditions were proved post mortem. The aneurism was entirely silent, so far as I could judge. The X-ray is of much assistance in diagnosis.

Prognosis.—This is bad, excepting for the fact that a few cases are capable of operation.

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B. LYMPHADENITIS

This is common in Hodgkin's disease, and in certain types of sarcoma, and almost universal to some degree in pulmonary tuber-

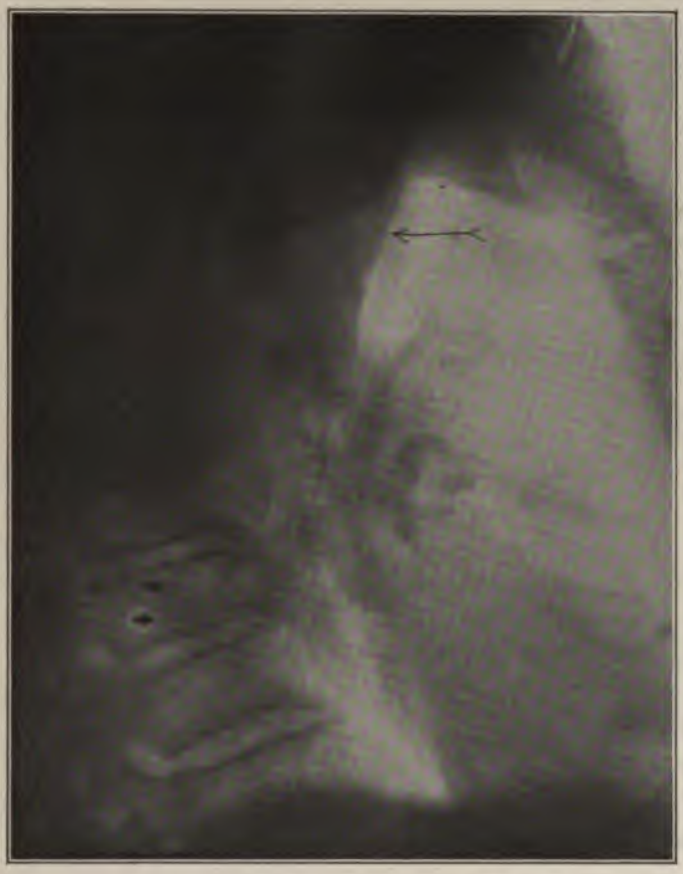

FIG. 118.—LATERAL VIEW OF THORAX SHOWING ARREST OF BISMUTH IN THE ESOPHAGUS. Mediastinal tumor; arrow indicating arrested bismuth. The tumor occupies the central region of the picture. (Dr. G. H. Stover.)

culosis. In whooping-cough the enlargement of the tracheobronchial glands may give definite dulness under the sternum. The persistent paroxysmal cough in children for months after the subsidence of whooping-cough is probably due to the irritation of these

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glands. In the acute infectious diseases of children they are commonly enlarged. In chronic tuberculosis the glands may cut off the entrance of air into the right bronchus, in the region of which the glands are largest and most numerous. I have found, post mortem, a caseous gland of three or four centimeters in diameter which had caused such pressure during life as to suppress the respiratory murmur almost completely on that side. The upper lobe is said to be more frequently involved by such pressure. Suppuration of the glands frequently occurs.

C. ABSCESS OF THE MEDIASTIUM

Nearly a fourth of Hare's collected cases came under the head of abscess. The acute suppuration commonly follows trauma, or some infectious disease, and the chronic type, tuberculosis. I have reported a case which discharged through the esophagus.

In addition to the signs and symptoms noted under tumor there are the inflammatory signs of the suppurative condition. Pain, throbbing, fever, chills, sweats, and leukocytosis should serve to decide the question. The abscess may rupture into the trachea, esophagus, pleura, pericardium, or abdomen. In one case seen with Dr. Tennant an abscess originated from the trauma of a fish-bone in the esophagus, set up a left pleurisy, involved the diaphragmatic pleura and gave the usual reflected abdominal symptoms in the left abdomen.

Emphysema of the mediastinum is occasionally seen after tracheotomy in diphtheria, and especially in whooping-cough and in pneumothorax. Indurative mediastino-pericarditis will be discussed in the section upon diseases of the pericardium.

Diagnosis.—The X-ray examination is essential to a proper investigation of the mediastinal affections and is commonly of sufficient assistance to enable a correct diagnosis to be made if the other features in the diagnosis already considered be given due weight.

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SECTION VII

DISEASES OF THE NERVOUS SYSTEM

1. DISEASES OF THE BRAIN

A. MENINGITIS

Definition.—An inflammation of the membrane covering the brain and cord. By pachymeningitis we mean an inflammation of the outer coat; leptomeningitis signifies an inflammation of the pia and arachnoid. These two membranes are commonly involved together, and except in local disease, the meninges of the brain and cord are simultaneously involved.

Cerebral Pachymeningitis.—This may involve the outer portion of the dura (external pachymeningitis), or the inner (internal pachymeningitis). The former commonly results from injury to the bone or from sepsis, syphilis, tuberculosis, necrosis, sarcoma, etc., involving it. Disease of the middle ear, and infection through the cribriform plate of the ethmoid are common sources of origin. Internal cerebral pachymeningitis is less common. It may accompany the external form. Pachymeningitis interna hemorrhagica may be found in the insane, in alcoholics, and in arteriosclerotic patients, effusion of blood occurring between the dura and the pia. Cysts may be present.

Symptoms.—The symptoms of cerebral pachymeningitis may be so obscured by those of the disease with which it is associated, as arteriosclerosis, alcoholism, or insanity, that no diagnosis is possible. In other cases, the symptoms dependent on the localized pressure exerted by the thickened membrane or the effusion present suffice for an accurate diagnosis. Headache is common, and localized tenderness over the skull may be present. Localizing symptoms, dependent upon the portion of the brain affected, are occasionally well defined. Loss of consciousness, coma, or delirium may be present.

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Leptomeningitis.—An isolated inflammation of the pia and arachnoid is not to be distinguished clinically. In cerebrospinal meningitis, tuberculous meningitis, in syphilis, and in general paralysis, the pia is involved. A serous meningitis especially affecting the pia arachnoid is recognized. In most cases the spinal and cerebral meninges are involved together, as in tuberculous meningitis and the cerebrospinal form, and the condition will be so described in this connection.

Septic and Purulent Meningitis.—This may arise from extension from an otitis media, an infected wound of the scalp, septic endocarditis, or other infective process. The membranes of the cord are usually equally involved. The streptococcus, staphylococcus, and pneumococcus are the organisms most frequently responsible. Cerebral pachymeningitis, encephalitis, and brain abscess are often associated.

Symptoms.—These are much like those of other varieties of meningitis described heretofore. High fever, perhaps chill, vomiting, violent headache, rigidity of the cervical muscles, optic neuritis, delirium, and coma, various paralyses, with frequently rapid pulse and a fatal ending, characterize the disease. The pulse may be slow from increasing cerebral pressure. Opisthotonus may occur. The paralysis may be more extensive, hemiplegia being not uncommon. Kernig's sign is generally present and the patient lies with flexed legs in many instances. Convulsions, ptosis, diplopia, irregular pupils, increased or later diminished reflexes, tache cerebrale, and late in the disease, serious respiratory and cardiac difficulties should be mentioned. The pneumoccic variety is especially violent, rapid, and fatal in course.

Diagnosis.—Lumbar puncture commonly demonstrates cloudy or purulent fluid containing pus cells and the streptococci, staphylococci, pneumococci, etc., upon which the infection depends. The special features of the epidemic form have been sufficiently studied, and the diplococcus of Weichselbaum may commonly be demonstrated in the spinal fluid. The tuberculous form has also been described. The tubercle bacilli may not be found in the fluid, but its nonpurulent characteristics are suggestive. The occurrence of

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a cerebrospinal form of leptomeningitis in connection with other acute infectious diseases must not be overlooked as in influenza, gonorrhea, scarlet fever, septicemia, erysipelas, mumps, measles, small-pox and rheumatism. Osler has mentioned the frequency of terminal meningitis in many chronic diseases. The organism found in the spinal fluid is not necessarily that of the disease under consideration, as a mixed infection may occur.

Spinal Pachymeningitis.—This may occur apart from its association with cerebral meningitis. The spinal dura is probably never involved alone, the pia always participating. The involvement of the dura is generally secondary to spinal disease, tuberculous, syphilitic, or malignant. The membrane may be involved in syphilis, aside from involvement of the bone, though generally the pia and the cord are affected also. A special form is that known as hypertrophic cervical pachymeningitis, characterized anatomically by thickening of the dura of the cervical cord, with pressure upon the nerve roots, and even upon the cord, a myelitis resulting from the pressure in extreme cases. It might better be termed a meningomyelitis. The bone is not affected. The process may extend to the pons and medulla. Syphilis is the cause in a certain proportion of these cases and trauma in another, the forms being said to be sometimes indistinguishable pathologically.

Symptoms.—The onset is gradual. The course is determined by the greater or less involvement of the membranes of the cord, being generally a progressive one. The gradually increasing pressure upon the anterior roots gives rise to fibrillary tremors, with paralysis and wasting. Contractures involving the hands supervene and as the cord is further involved spastic paraplegia develops, with increase in the knee-jerks and the Babinski phenomenon, and rectal and bladder trouble. The X-ray should be employed for the detection of any actual bony involvement.

B. MENINGISM: SEROUS MENINGITIS

Quincke has applied these names to that type of inflammation of the meninges, in which, commonly in association with an acute

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infectious disease, a congestion and probably later an edema of the membrane occurs, but without the development of the organic changes characterizing a definite purulent meningitis. A serous fluid only is poured out and this is found to be generally bacteriologically negative, as withdrawn by spinal puncture. The lymphocytes only are increased in this fluid, an increase in the polynuclear cells being conspicuously absent.

Symptoms of Meningism.—The typical symptoms are seen in typhoid fever, (the so-called meningeal form) and many cases of typhoid presenting this symptom-complex are treated throughout as cases of meningitis. The patient complains of headache and of pain in the neck and back. Photophobia may be present. Marked rigidity of the neck may be noted, with muscular twitching and increased reflexes. Cutaneous hyperesthesia may be present. The general symptoms of the fever are not materially altered, but it runs its course about as it would if the meningeal congestion were not present. If effusion occur, the case becomes one of so-called serous meningitis. In pneumonia, influenza, rheumatism, and the eruptive diseases, a similar irritation of the membranes may occur, but is generally of shorter duration.

Symptoms of Serous Meningitis.—This is a further development of meningismus, characterized by the effusion of serous fluid, not containing micro-organisms, and producing its effects by pressure. The symptoms vary as the effusion is confined chiefly to the spinal or the cerebral meninges, or distributed in both locations. The pressure upon the anterior and posterior roots gives rise to girdle pains, hyperesthesia, or other disturbances of sensation, increase, or later decrease of the reflexes, disturbances of bladder and rectum, and if the cerebral meninges be involved, marked cervical rigidity, possibly temporary optic neuritis, and disturbances of the ocular muscles. The fluid escapes under pressure upon tapping the spinal canal. The original disease runs its customary course, perhaps disturbed to some extent by the complication, but recovery ensues in the majority of cases in about the usual time. Hydrocephalus interna or externa or both combined may occur in these cases, the effusion being purely serous.

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C. ABSCESS OF BRAIN

This is generally the result of a purulent meningo-encephalitis, and the exact border between the two processes cannot be established clearly.

Etiology.—Most cases result from extension of a suppurative process from the middle ear and accessory sinuses of the nose, traumatic injury of the skull, or else arise as metastases from septic endocarditis, abscess of the liver, etc. The location of the abscess is intimately dependent upon its point and manner of origin. The pus may be well circumscribed, or diffused about a main central location. In the metastatic form multiple abscesses may be present. Sinus thrombosis and other secondary processes may complicate the picture. Any of the organisms mentioned under meningitis may be present.

Symptoms.—These are those of the disease which has given rise to the abscess, with the addition of any localizing phenomena due to the abscess. In metastatic abscesses the patient is commonly so gravely ill with the original septic process that the development of brain abscess is often unrecognized. The symptoms indicative of a meningitis—headache, vomiting, convulsions, fever, optic neuritis, disturbances of consciousness, local paralysis, etc., may not be notably changed by the advent of a definite abscess. Pain, convulsive phenomena and localizing paralyses give the main clues to the localization of the abscess. If the pain be sharply localized and associated with tenderness over a given area, corresponding to the location in which, from the mode of origin and the general features of the case, abscess may be suspected, it may be assumed to be a fairly reliable localizing indication. If the abscess is near enough to the motor areas of the brain, definite localization may be possible through the consequent paralysis or the convulsive phenomena.

The usual rules as to cerebral localization apply here. Sinus thrombosis may develop and be of some localizing value.

In general, unless the abscess develop slowly, apart from a general purulent meningo-encephalitis, its location and even its diagnosis remain in doubt. A slowly forming abscess well walled off

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may remain almost latent, even with a subnormal temperature. It produces symptoms similar to those of a tumor of the same region, including pressure phenomena, and its diagnosis depends rather upon the inferences to be drawn from the history of the case than from the signs elicited by physical examination. Lumbar puncture may be of value in the differential diagnosis from tumor of the brain.

D. SINUS THROMBOSIS

Primary thrombosis occurs as a terminal event in many exhausting diseases, whether degenerative or infectious in type, and occasionally in severe forms of anemia. The same causes operative in bringing about the thrombosis of the other cerebral vessels may induce thrombosis of the sinuses.

The secondary thrombosis in which we are especially interested is a septic process originating commonly in disease affecting the bone adjacent, as in case of middle ear disease, nasal disease, fracture, etc., but it may occur in erysipelas and septic diseases without primary involvement of bone. Septic sinus thrombosis is often but a part of a general septic trouble involving the meninges, brain, neighboring vessels, etc., and the thrombus may be chiefly infected blood-clot, chiefly pus, or any intermediate condition may be found.

Symptoms.—As in the case of abscess of the brain, the localizing symptoms may be so masked by those of general sepsis as to be indistinguishable. The onset in a case of middle ear disease, or other predisposing conditions, of sudden and severe headache, chills, high fever, with vomiting, and with the later condition of stupor, deepening into coma, with possibly convulsions, and even hemiplegia, leads to a strong probability of thrombosis of one of the sinuses. Local symptoms may aid in deciding as to which sinus is involved, either through the development of localizing paralysis or through enlargement of external veins communicating with the obstructed sinuses. The sinuses most frequently involved are the lateral and transverse ones, so commonly affected in otitis media and mastoid disease. The thrombosis may extend to the internal and external jugular veins. The cavernous and superior longitudinal sinuses are

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less exposed to the danger of thrombosis. Thrombosis of the cavernous sinus, because of the communication with the veins of the orbit, gives rise to swelling and discoloration about the eye, with protrusion, occasionally choked disk, and even thrombosis of the central retinal vein. The third, fourth, and sixth nerves may be involved. If the superior longitudinal sinus be blocked by thrombosis, as in case of disease of the nasal bones, swelling of the forehead through obstruction of communicating veins, and nose bleed may occur.

Diagnosis.—In general the diagnosis of sinus thrombosis is possible only through the consideration of the precedent disease. The addition of violent symptoms such as we have mentioned leads to a suspicion of extension of the septic process to the sinuses, and in certain cases a definite localization may be made. The fact that the general process may involve the meninges and the brain as well as the sinuses, gives reason for the difficulty of diagnosis in many instances.

E. HEMIPLEGIA

Definition.—A paralysis of one lateral half of the body, the leg, arm, and lower portion of the face being commonly involved, while a temporary paralysis or paresis exists at the beginning, of the muscles of respiration, which are bilaterally represented in the brain. Since rupture of a cerebral vessel is the most common cause of hemiplegia we shall consider first the variety arising from this accident, and later speak of the other forms.

Cerebral Hemorrhage.—Aside from the traumatic cases, hemorrhage from a cerebral artery commonly results from a combination of two factors,—gradual weakening of the wall, from atheromatous and other degenerative processes, and in many cases gradual increase of the arterial tension, which so commonly goes hand in hand with the arterial degeneration. We shall describe this general type of cerebral hemorrhage first, since it is vastly the most common one seen, the common apoplexy. A lighter attack is sometimes spoken of as a "stroke." As the vessel weakens from the degenerative atheromatous process which affects to some extent all vessels soon after middle age, a minute aneurismal bulging often appears. If increased

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arterial tension be present in connection with arteriosclerosis, nephritis, etc., the long-continued high pressure damages the vessels still farther, and a sudden increase in tension, as under the influence of physical or mental exertion, anger, sexual excitement, etc., leads to a giving way of the weakest spot. Yet many cases of rupture of cerebral vessels occur during sleep, the patient being found hemiplegic in the morning. Effusion of blood under tension follows, and consequent tearing and compression of the soft and delicate brain tissue. Although the rupture may be in any portion of the brain, the vessel which commonly gives way is the lenticulostriate artery, "the artery of cerebral hemorrhage" of Charcot. The posterior limb of the internal capsule is commonly damaged, causing hemiplegia of the opposite side of the body. The sensory fibers are not infrequently involved by the extension of the hemorrhage posteriorly, so that hemianesthesia of greater or less degree, but often of temporary duration results, and hemianopsia is noted if the visual fibers be destroyed. Premonitory symptoms are less common in cerebral hemorrhage than in other types of hemiplegia. They may be due to weakening and gradual giving way of the walls of the vessels or to the intense congestion which may precede the rupture. Pain and dizziness are occasionally mentioned, or indicated by the actions of the patient before the occurrence of the stroke, but vastly less frequently than in thrombosis.

Symptoms.—The patient commonly falls unconscious from the shock to the brain. Muscular tone is so completely abolished that one may be scarcely able to tell for the time which side is paralyzed. As the tonicity of the muscles returns one notes the drooping of the corner of the mouth, dribbling of saliva, flapping of the paralyzed cheek in the air current, and reflex movement upon irritation of the sound limbs. The pulse remains full and bounding. The light reflex is usually abolished in the severe cases. The pupils may be unequal, of normal size, dilated, in some instances, or contracted in case the hemorrhage involve the pons. The knee-jerk upon the affected side is commonly abolished in the severe cases, to become exaggerated in case of recovery, with contractures, ankle clonus, and the Babinski phenomenon. Consciousness may quickly return, but if coma become profound, and no return to consciousness be noted

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in twelve to fifteen hours a fatal result is to be expected. The pulse weakens, the temperature rises, the pupils fail to react, and death occurs, with Cheyne-Stokes respiration, and often with edema of the lungs. If hemorrhage be upon the left side of the brain, involving the speech center in right-handed persons, motor aphasia occurs. Various types of aphasia may be present according to the damage done to the cortical centers or the subcortical connecting structures. Some recovery generally occurs as to the power of speech. The temporary aphasia in case of hemorrhage into the side of the brain opposite the speech center is chiefly due to shock, and passes away shortly if the patient recovers.

In the milder cases consciousness returns even within a half hour, and the earlier it returns the better the outlook. If there be no return of function in the paralyzed parts within two or three days, the outlook is bad for recovery of function, though death may not occur. The leg recovers in greater degree than the arm, so that many hemiplegics walk fairly, yet have little use of the damaged hand. Contractures occur because of the greater power of the flexors of the arm and the extensors of the leg. The characteristic positions of the arm and leg result. The extent and permanence of the paralysis of course depend upon the destructiveness of the lesion as regards the motor fibers, no recovery being possible if they are destroyed by laceration or compression. Slight atrophy of the muscles occurs from disuse. The hemorrhage may occur in the medulla, when death commonly ensues from the damage to the respiratory center. If a small hemorrhage occur in the pons, alternate hemiplegia results, the motor fibers to the arm and leg of the opposite side and the fifth, sixth, seventh, and eighth nerves of the same side being involved. In the cerebellum a lesion may cause vertigo, vomiting and loss of power of equilibration. Hemorrhage into the corpora quadrigemina and the cerebral peduncles may involve the oculomotor and the fourth nerves of the same side, with the usual hemiplegia upon the other. Further reference to the exact localization of cerebral hemorrhage may be found in the special works. Hemiplegia may occur from trauma, brain tumor, abscess, uremia or other toxic process, but these types demand no further consideration at this time.

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Diagnosis.—When a subject, especially a male, in middle or advanced age, particularly if known to possess degenerated vessels and to have high vascular tension, becomes suddenly comatose, especially if this occur during exertion, anger, etc., the diagnosis is plain, since other forms of coma are rare under such conditions. In case of doubt we consider cerebral thrombosis and embolism, treated of elsewhere, and also uremic coma, diabetic coma, the coma following an epileptic fit, alcoholism, opium and chloral poisoning, and trauma. Uremia may generally be detected by the absence of hemiplegia and the presence of albumin and casts in the urine, albuminuric retinitis, vascular and cardiac signs of nephritis, subnormal temperature, and convulsions. Yet convulsions may occur in cerebral hemorrhage, rupture of a cerebral vessel may occur owing to the high blood tension of chronic nephritis, and temporary hemiplegia or monoplegia may be uremic in origin. Most comatose patients have albumin and casts in the urine regardless of the cause. A careful study of the whole problem is necessary in case of doubt.

Diabetic coma may generally be recognized by the presence of sugar, diacetic acid and acetone in the urine, the smell of acetone in the breath, and absence of hemiplegia. The presence of eczema, from irritation of the sugar, about the genital organs suggests diabetic coma. Post epileptic coma clears up in a few hours, and hemiplegia is absent. The presence of scars upon the tongue or bleeding from the tongue, and of course the history, if known, are of value. Intoxication by alcohol, opium, chloral, etc., has been spoken of elsewhere. A careful physical examination may be necessary to exclude trauma, and the blow from a sand bag, leaving no scar nor palpable fracture, may even then be overlooked.

Hysterical coma is not so deep as that of the conditions we are studying, and the whole clinical aspect is different. As between hemiplegia from hemorrhage or embolism, the diagnosis must be made through a consideration of a possible source of embolism, notably vegetative endocarditis. It often occurs in the young, and the condition of the arteries could only by coincidence correspond to that generally present in hemorrhage. The shock of hemorrhage is greater and consciousness is more likely to be abolished.

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Cerebral thrombosis is likely to give the same hemiplegia, but in many instances it is incomplete, consciousness is not greatly disturbed, syphilis or arteriosclerosis may be determined, and some cause (exhaustion, illness, severe anemia, low blood pressure, cardiac failure) for the occurrence of thrombosis may be found. Prodromata (mental failure, headache, dizziness, numbness and tingling, etc.) suggest the possibility of thrombosis rather than other causes of hemiplegia.

Hemiplegia from Embolism.—In case of hemiplegia from embolism, the first effect of the lodgement of the foreign body is the cutting off of the blood supply to the affected parts, with results grossly similar to those studied in cerebral hemorrage. If a sufficiently large vessel be blocked and the possibility of establishment of a sufficient collateral circulation be cut off, as by advanced atheroma, for example, the anemic portion of the brain loses its function rapidly, and the case may progress like one of severe hemorrhage. On the other hand, if the artery blocked be a minute one, in a young individual, the collateral circulation may become so completely established as to bring about practically a full restoration to health, for there are not necessarily, as in cerebral hemorrhage, organic degenerative lesions to contend with. Although hemiplegia is the typical result of cerebral embolism, other forms of paralysis often occur, according to the particular branch which is occluded. Thus a monoplegia, a hemianopsia, or hemianesthesia may occur. Aphasia is present if the vessel occluded prevents a proper blood supply to the centers of speech or their connections. Progressive thrombosis may follow embolism and cause extension of the areas affected, and hence increase in symptoms.

The hemiplegia from thrombosis is found in the blood states and under the conditions mentioned above. Prodromata are frequent, the onset is slow, unconsciousness is unusual, unless late in the disease, and gradual increase in the affected area is probable from extension of the thrombosis. Softening occurs in time, if the patient survive. Since most patients with cerebral thrombosis suffer from syphilitic arteriosclerosis, sepsis, or grave disease of some type, complete recovery is not to be expected. Nevertheless, a slight transient

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hemiplegia may completely disappear as if the obstruction had been completely overcome. Spasm of the arterioles has been advanced as a possible explanation of some of these cases.

F. CEREBRAL PARALYSES OF CHILDREN

These affections vary in many respects from those of adults. Hemiplegia, diplegia, and paraplegia are the common types.

Cerebral hemorrhage, excepting from trauma during birth or from without after birth, is practically unknown, excepting as the result of the enormous strain during the paroxysms of whooping-cough. The hemorrhages at birth are nearly always meningeal in location and are associated with the asphyxia so often seen, but occasionally result from the use of forceps or other artificial means of delivery.

In the course of infectious diseases thrombosis may occur, and syphilitic arteritis may also cause lesions which bring about paralysis. Cerebral sclerosis and porencephalus may be found as the result of infantile lesions.

Symptoms.—The onset of the paralysis may not be noted, although convulsions and coma may introduce it. Vertigo, vomiting, and fever may be noted. Hemiplegia is most common and generally due to meningeal hemorrhage. The child remains completely paralyzed upon one side in the well-marked cases, and the limbs do not develop normally. Athetoid movements are commonly present, and contractures and exaggeration of the deep reflexes develop. If the speech center be involved the child remains undeveloped as to speech. The face escapes entirely in many instances. These are the cases in which early diagnosis of meningeal hemorrhage with prompt operation possibly may restore the patient completely.

Diplegia results if hemorrhage occurs upon both sides, as is not uncommon at birth. Premature children may suffer from diplegia, not from injury, but simply from lack of development. They are undeveloped mentally as well. Convulsions, athetoid movements and spastic paralysis with contractures are features of this type. Internal hydrocephalus is also a possible cause of these lesions.

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During the first few years of life encephalitis may occur in connection with some acute infectious disease, with a similar diplegia as a final result.

Paraplegia of the type called cerebral spastic paraplegia may be present in case the upper portions of both hemispheres are involved. Monoplegia may occur. Every gradation and combination of motor and mental impairment may be found.

Diagnosis.—Infantile spastic diplegia, or Little's disease, is recognized by its occurrence in infancy, the bilateral spastic paralysis, exaggerated reflexes, Babinski phenomenon, mental defects, epilepsy, and athetosis, with absence of muscular atrophy and electrical changes. The paraplegic type is distinguished from spinal paralysis by the absence of the usual features of spinal paralysis, of bladder and bowel disturbances, and the presence of mental symptoms mentioned. The monoplegic types of paralysis due to poliomyelitis and obstetrical paralysis are readily distinguished if only they be considered.

G. HYDROCEPHALUS

Definition.—An abnormal collection of cerebrospinal fluid within the skull. It may be *internal*, the fluid being in the ventricles of the brain, or *external*, in the cortical meninges.

Etiology.—The foramen of Magendie or the aqueduct of Sylvius may be closed, congenitally, or as the result of disease. An overaction of the ependymal cells lining the choroid plexus is a feature in many cases at least.

The external form is the result usually of a chronic meningitis. The internal form may result from meningitis, from the attenuated infection by the Weichselbaum bacillus, often called posterior basic meningitis, from Quincke's serous meningitis, or from the congenital causes mentioned.

The skull is enormously increased in size, and appears larger by contrast with the baby face. The bones are thinned and the fontanelles often enlarged. Wormian bones are often present. Two or three liters of serous fluid may be found post mortem. The distention of the ventricles within is accompanied by the flattening and

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nondevelopment or atrophy from pressure of the entire brain, and consequent loss of function. Spina bifida may be associated with congenital cases.

Symptoms.—Because of the intracephalic pressure, the eyes may bulge, are often deflected downward, and vision may be impaired because of the pressure (optic atrophy). Intelligence is practically always impaired, but in every degree up to idiocy. The limbs fail to develop properly, and weakness, rigidity, contractures, exaggerated reflexes, and Babinski phenomenon are commonly noted. Any form of paralysis may be found in accordance with the intensity and distribution of the pressure upon the brain. In the milder cases the child may support the head naturally, while in the severer forms he may become bedridden. Incontinence and convulsions may be noted.

Diagnosis.—This may be made at sight in the well-developed cases. In milder ones, the failure of proper development, both mental and physical, the gradually increasing size of the head, the cracked-pot resonance upon percussion over the parietal bone, and bulging of the eyes, ordinarily suffice for the diagnosis. The possibility of rachitis must be recognized. The withdrawal, by spinal puncture, of much clear serous fluid under considerable pressure, in case the foramen remain open, with subsidence of the bulging of the anterior fontanelle, is very striking evidence. The danger of fatal compression of the pons and medulla because of the sudden withdrawal of too much spinal fluid should be mentioned.

H. BRAIN TUMOR

We shall arbitrarily include under this heading all the growths within the cranium, since the main symptoms upon which the diagnosis must rest are referable chiefly to the pressure effects rather than to the origin or the histological nature of the growth. The order of frequency of the different types of growth in the brain is said to be: (1) glioma; (2) sarcoma; (3) endothelioma; (4) fibroma; (5) fibrosarcoma; (6) carcinoma; (7) tuberculoma; (8) adenoma, with a considerable number, including gummata, psammomata, and various cysts which we must classify as "scattering."

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Bony tumors within the skull and aneurisms are comparatively rare, and parasitic cysts even more so, in America at least.

Etiology.—Brain tumors occur approximately twice as often in the male sex as in the female, and are most common between 20 and 40 years of age. Trauma of the head is not infrequently noted, though it may merely serve to bring an incipient disease into prominence. The frequency of syphilitic tumors of the brain, clinically, as compared with their relative infrequency in the post mortem room, deserves mention. The development of metastatic growths in the brain, in connection with cancer and sarcoma elsewhere, is not infrequent. Tuberculomata are generally secondary to a tuberculous process elsewhere, and are commonly multiple, while most of the tumors considered are solitary.

Symptoms.—These are commonly due to direct destruction of the parts involved, or more commonly to pressure, either direct or transmitted, upon certain parts of the brain. The symptoms of pressure may be exaggerated by a secondary increase in the cerebrospinal fluid, usually the result of mechanical pressure upon the veins of Galen, or the foramina affected in hydrocephalus. The first symptom is commonly headache, occurring in 95 per cent. of the cases, due to the pressure exerted upon the sensory fibers in the dura rather than to the disturbance of the brain tissues or the arachnoid. It may be absent, as in the small endotheliomata which are occasionally found below the tentorium, there being here no appreciable increase in tension. In many cases it is general and varies between a feeling of uncomfortable fullness and an agonizing torture. It may be localized at the site of the tumor, especially when the latter underlies the skull at the given point, and local tenderness may be noted. In these cases variation in percussion note over the tumor may be apparent, when the region is compared with other portions of the cranium. Vomiting occurs in only about one-third of the cases, notably in those of large size, and causing great pressure, and commonly associated with headache. It is often seen upon awakening in the morning, and may not be accompanied by nausea. Lesions producing pressure upon the medulla are prone to produce vomiting. Choked disk is a most important finding. It is present in at least

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90 per cent. of the cases which run their course, although it does not develop until after the diagnosis is possible without its consideration in many cases. Being due to a mechanical stasis it is often a late sign. It is often greater on the side of the tumor, and shows more distinctly in cerebellar lesions than in those of the cerebrum, though oftentimes later in the development.

Vertigo is a frequent symptom of tumor, and is especially characteristic of cerebellar growths Convulsions, drowsiness, loss of weight, and mental dulness may be present. Cushing regards dyschromatopsia, "interlacing and inversion of the color fields," as one of the most constant signs of brain tumor, although it has been regarded as of hysterical origin. (Charcot.) Hysterical symptoms frequently accompany those of tumor of the brain.

Focal Manifestations.—Because of the existence of large so-called "silent" areas in the brain, and because of the further fact that a tumor may, by causing pressure or thrombosis, or by stretching or compressing a nerve, cause symptoms at a distance from the true site of the lesion, many tumors of the brain are incapable of exact localization. Yet in general we may say that a tumor of the motor cortex will give rise to irritative phenomena (Jacksonian epilepsy) upon the opposite side of the body, with later paralysis. If the sensory cortical areas be involved, numbness, tingling, pain, etc., will be noted, contralaterally, with anesthesia, as the lesion progresses. Lesions in the occipital lobe give irritative and later destructive visual manifestations. Lesions lying beneath the cortex and destroying the conducting fibers, are likely to damage several paths of conduction, so that several functions may be damaged without irritative phenomena.

Frontal Lobe.—The distinctive feature of the tumors of the frontal lobe, and especially of the left lobe in the right-handed, is the mental disturbance, much like that of paresis, so often noted. The typical general symptoms of tumor, mentioned above, are not very common.

If the motor area or the motor path be involved, a more or less complete contralateral hemiplegia may be present, with aphasia, if the left lobe be the seat of the growth. By pressure of the tumor

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upon adjoining parts of the brain, additional symptoms may be brought out.

Temporal Lobe.—There may be only the general symptoms of tumor, headache, vomiting, choked disk, etc. If on the left side, sensory aphasia may be present.

Occipital Lobe.—Irritative visual phenomena constitute the first manifestations, as a rule, followed by various disturbances of vision, and eventually by crossed homonymous hemianopsia. All the typical general signs of tumor are likely to be present and cerebellar ataxia is often noted.

Cerebral Peduncles.—The distinctive feature of a tumor in this region, provided it be limited to one side, lies in the association of crossed hemiplegia, with oculomotor paralysis of the same side.

Pons.—In addition to the general symptoms of tumor there are likely to be nuclear paralyses of the fifth, sixth, and seventh nerves on the side of the lesion, with crossed hemiplegia.

Medulla.—The ninth, tenth, and eleventh cranial nerves are involved, with death from an encroachment upon the cardiac and respiratory centers.

Cerebellum.—To the typical symptoms of brain tumor is added the characteristic feature of cerebellar involvement, inco-ordination, especially notable if the vermis be involved. The nuclei of the cranial nerves adjacent may be compromised by pressure.

Because of the frequency of origin of tumors in the sheath of the eighth nerve, and consequent damage by pressure to the adjacent cerebellum, or damage to the nerve by a tumor growing from the cerebellum, deafness is often added to the cerebellar syndrome. Less of muscular tone is common, and the knee-jerks may be abolished, or differ upon the two sides. Nystagmus and loss of co-ordination of the muscles concerned in swallowing, speech, etc., are occasionally present. The staggering gait, with tendency to fall, generally to the side of the lesion, is the most characteristic feature.

For a more extended consideration of the subject the reader is referred to the special works.

Diagnosis.—We must consider not only the possible presence of a growth, but its nature and its location. The gradual onset of cere-

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bral symptoms, with the presence of headache, vomiting, optic neuritis, and vertigo, with generally some of the special localizing symptoms mentioned, and the absence of those causes predisposing to abscess or other focal diseases of the brain, commonly suffice for the diagnosis. Because of the slow growth of many tumors, the diagnosis is often necessarily long delayed. As to the nature of the tumor, we are guided by the probabilities of the case. If malignant growth, tuberculosis, or syphilis be recognized elsewhere, the probable nature of the tumor may be apparent. The predominence of gliomata and sarcomata in the cortex should be mentioned. The probable location is to be arrived at by a study of cerebral localization. Although often impossible of accomplishment, the possibility of operative relief in tumor should lead to the most careful consideration of all the localizing symptoms.

Differential Diagnosis.—Many cases are thought to be hysterical. In case of doubt the most persistent search should be maintained for dyschromatopsia, choked disk, change in knee-jerks, Jacksonian phenomena, pupillary changes, cerebral and nerve paralyses, etc. Cerebral hemorrhage with its sudden onset can scarcely be confused with tumor, but in young individuals the bleeding may take place in the substance of an unrecognized growth, and thus cause deception, or a blow on the head may cause a latent tumor to suddenly give symptoms simulating hemorrhage. Hemorrhage alone never causes optic neuritis. (Starr.) A slow cerebral thrombosis has been mistaken for tumor, but localizing signs are not commonly marked enough to cause confusion. Abscess may be indistinguishable if there be no known focus of origin. It may be of long continuance, afebrile, and without leukocytosis. The advance is likely to be a more steadily progressive one in tumor than in abscess. Associated hydrocephalus may obscure the diagnosis of the underlying tumor. The possibility of multiple sclerosis, general paralysis, nephritis with cerebral edema, traumatic cysts, and aneurism must be considered, for all have been looked upon as brain tumor in certain cases. Aneurism may give a cranial bruit, but it is perhaps equally common in vascular tumors. The diagnosis cannot generally be made. Death usually results from rupture of the aneurism.

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In many cases diagnosed as tumor of the brain, none has been found post mortem, or all the symptoms have subsided under treatment. They are to be accounted for by edema, serous meningitis, healed abscess, or tubercle, or other condition not leading to the formation of a definite and permanent tumor, yet giving rise to the pressure symptoms of a tumor for a time.

Prognosis.—Death generally ensues within a year after the diagnosis is made, but there are so many exceptions that the rule is of little value. Many cases live for years after localizing symptoms have developed. The possibility of relief from the symptoms by a decompressive operation or of complete surgical cure are to be considered, as well as the possibility of the presence of the so-called "false tumor," as described above. The chance of healing of tuberculomata or gummata under medical treatment is also to be taken into consideration.

Parasites in the Brain

Because of the rarity of the pork tapeworm in America, and of infection with the echinococcus, the occurrence of cysts in the brain from these sources is decidedly rare. Although often multiple, and prone to invade the fourth ventricle and the lateral ventricles, there are no distinctive signs which enable us to make the diagnosis from the true tumor, unless the history, or the possible finding of the cysticercus in the eye, or cysts under the skin, be of service.

2. DISEASES OF THE CRANIAL NERVES

The twelve pairs of cerebral nerves are numbered in the order in which they appear from before backward, but several of them are commonly named from their obvious functions (optic, olfactory, etc.).

First Nerve.—The sense of smell may be compromised by damage to the olfactory tract, olfactory bulb, or the nerves themselves. Meningitis is the most frequent cause of such injury, though tumors of the brain, trauma, etc., may also affect them. Anosmia may result in any of these cases, or parosmia (subjective sensation of smell) from

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of the face is the result of serious damage to the trifacial, and the effects are noted further in the special organs affected. Touching the cornea does not cause irritation and in some cases no tears are produced. The sensation of irritation from ammonia inhaled is wanting, and taste is defective over the anterior two-thirds of the tongue if the lesion is proximal to the sphenopalatine (Meckel's) ganglion. Trophic disturbances may ensue in the parts supplied, even from trivial injury.

Tic Douloureux.—This severe form of neuralgia is a most important affection of the trifacial nerve. The whole nerve or either of its branches may be involved in a painful spasm. Numbness over a portion of the field of distribution of the nerve may come and go for some time before the neuralgia develops. This occurs generally in one division, but shows a notable tendency to involve all sooner or later. With the supra-orbital form the pain is felt in the eye, as well as in the brow, and lacrimation or the sensation of a foreign body in the eye may be noted. The infra-orbital form gives rise to pain in the upper jaw and teeth. A characteristic of the disease in the lower branch, affecting the lower jaw, is pain in the tongue and the aggravation of the pain by eating. The respective branches become tender at the region of their exit from their foramina in the bone. Herpes is occasionally present. The pain may be constant, but the characteristic type is paroxysmal in nature. These paroxysms may be spontaneous, but are apt to be excited by the movements of the face, lips, and tongue. Spasm of the facial muscles (convulsive tic) accompanies the paroxysmal type, the spasms coming on with great suddenness and severity.

Diagnosis.—Pain in one or more of the branches of the trifacial, often intractable and paroxysmal, tending to spread to other branches, often accompanied by spasms, and not accompanied by anesthesia, nor by tendency to involvement of other nerves, as is seen in affections of the fifth nerve from pressure due to tumor, or other such lesion, presents a clear picture which can scarcely be mistaken. I have seen a hysterical type of pain in the inferior branch, without tenderness, paroxysms, or tendency to spread, and disappearing for some months at a time, with change of surroundings, of attendant, etc.

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PROGNOSIS.—The pain is likely to continue and spread to other branches, and many cases require operative measures upon the respective branches or the Gasserian ganglion. Even though relief be obtained, there is danger of relapse.

Seventh Nerve.—The facial nerve is almost wholly motor in function, and inervates chiefly the muscles of the face. The nerve is liable to damage at its nucleus, between there and the fallopian canal, in the canal, or after its exit therefrom. Since the nerve is more frequently paralyzed than any other nerve of the body its diseases are of importance. The central type of facial paralysis is due to lesions above the nucleus, and the lower part of the face is paralyzed upon the opposite side from the lesion, as in ordinary cerebral hemorrhage. The upper portion of the face, with bilateral inervation, escapes. A focal lesion in the pons, damaging the nucleus, is likely to cause facial paralysis upon the same side as the lesion and a paralysis of the arm and leg on the opposite side (crossed paralysis). Meningitis or other disease at the base of the brain may compromise the nerve, oftentimes in association with the sixth and eighth nerves, before its entrance into the canal.

In the great majority of cases the paralysis is a peripheral one (Bell's palsy), as shown by the absence of involvement of the sixth and eighth nerves, of hemiplegia, etc. The corresponding side of the face is paralyzed. The rheumatic neuritis, upon which the disease is believed to depend, probably interferes with the function through direct compression in the bony canal in many cases. A history of rheumatic tendency or of direct exposure to cold is commonly obtained. Taste is interfered with on the anterior two-thirds of the tongue, if the lesion be in the fallopian canal, owing to the compression of the chorda tympani which accompanies the nerve there. Fracture of the base of the skull, and middle ear and mastoid disease are common causes of facial paralysis.

SYMPTOMS.—The onset is generally a rapid one, and a slower onset speaks for the possibility of a gradual compression by tumor growth, etc., rather than for the less serious rheumatic involvement. Pain about the ear is not an infrequent prodrome, and fever may be present.

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The loss of facial movement upon the affected side is the striking diagnostic feature. On this side of the face the natural wrinkles are obliterated, and the angle of the mouth droops, the eyelids cannot be closed, tears trickle onto the cheek, the side of the face is dragged over by the contraction of the muscles on the sound side in making facial movements, and the forehead cannot be wrinkled upon the affected side, as in frowning. The reaction of degeneration and atrophy may be found in the paralyzed muscles. The course is ordinarily one to three months, with complete recovery, though in severe cases contractures upon the affected side may appear after four to six months, sometimes with twitching of the facial muscles.

Diagnosis.—This is easily made if the disease be thought of and the condition of the muscles tested by attempts to show the teeth, etc. The muscular contractures mentioned may be confusing and lead to an incorrect diagnosis as to the side involved unless the possibility of their occurrence is borne in mind. The central type in connection with hemiplegia has been considered. Taylor states the essential points in making the differential diagnosis between the central and peripheral paralysis as follows:

"In the central lesion there is no change in electrical reactions; the upper branches of the facial nerve are slightly involved, either due to the fact that there are special cortical centers for the different portions of the nerve, or, more probably, because the muscles which ordinarily act together are presumably inervated from both sides of the brain. The facial paralysis is usually accompanied by a homolateral hemiplegia. A crossed or alternating hemiplegia indicates a lesion in the pons below the crossing of the central facial fibers and above the crossing of the pyramid. The reflex conditions of the nerve are theoretically increased, but for practical purposes may be regarded as unchanged. In contrast to this series of conditions, lesions of the peripheral nerve, irrespective of special location, are, in general, as follows: Electrical alterations are always present, except in the mildest cases. All branches of the nerve are equally involved, and reflex activity is diminished, with ultimate muscular atrophy, if recovery does not take place." *

*Quoted from Osler.

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PROGNOSIS.—This is good in most cases, though the recovery may not be complete. Taylor states the matter as follows:

"A somewhat artificial distinction may be made between a mild, more severe, and a severe form of paralysis, depending upon whether the electrical reactions are normal or very slightly affected, with recovery in two or three weeks, or, in the second case, whether a partial reaction of degeneration is present, with recovery in from four to eight weeks, and finally, in the severe form, whether the reaction of degeneration is complete, with a duration of paralysis from three to six months. Naturally there are certain cases which do not conform to this classification, as, for example, those in which the paralysis lasts many months, or those in which the electrical reactions do not correspond with the apparent degree of paralytic defect." *

FACIAL SPASM (TIC CONVULSIF).—The facial nerve is peculiarly subject to spasmodic affections entirely apart from those noted in chorea and epilepsy, athetosis, etc. They occur most frequently after the beginning of middle life, and rather more often in women, and may result from a reflex irritation, especially from a painful tooth, causing spasm which later persists as a habit. Emotional movements, normal at first, may become habitual, especially if worry or anxiety be a factor. The orbicular muscle is often involved.

Symptoms.—The facial muscles involved contract suddenly and frequently, giving rise to sudden closure of the eye, raising up of the angle of the mouth, wrinkling of the neck, if the platysma be involved, and in fact producing the most various grimaces. The affection tends to become worse and to involve other muscles. Emotional excitement commonly exaggerates the spasms. It lasts indefinitely, but may intermit and disappear.

Diagnosis.—The grimaces of facial spasm, without pain, cannot be mistaken for the spasms of painful tic, and resemble nothing else. Herpes zoster of the interior of the auricle and the external auditory canal is believed by Hunt to be due to a herpetic inflammation of the geniculate ganglion, the nerve of Wrisberg, originating here, being assumed to be a sensory portion of the facial.

Eighth Nerve.—The auditory nerve has two divisions, the cochlear

* Quoted from Osler.

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or nerve of hearing, and the vestibular or nerve of equilibration. It emerges from the side of the medulla, but owing to its complicated functions has very intricate connections with other cranial nerves, and with the cerebellum. The nuclei in the postero-lateral regions of the pons and upper part of the medulla may be damaged by focal lesions of these regions. At its origin from the medulla, the nerve is subject to compression in aneurism, meningitis, and especially by fibroma of the sheath of the nerve.

Deafness, due to involvement of the cochlear portion of the nerve, may originate at almost any point from the cortical connections to the labyrinth, but it is due, in the vast majority of cases, to middle ear disease. Central lesions causing complete deafness of one ear must involve both sides. For the further consideration of this subject the reader is referred to the special works upon the ear.

Tinnitus Aurium.—This common and most annoying affection may be due to anomalies of circulation, as in anemia, and in conditions of increased blood pressure, aneurism, etc., to irritation in the auditory canal, as by cerumen; to over stimulation from loud noises; and to various disturbances of the middle ear, and of general nervous condition (neurasthenia, hysteria, etc.). Hyperacusis may be noted in hysteria, and occasionally in facial paralysis. Hallucinations of hearing result from irritability of the cortical center.

The affections of the vestibular nerve have been considered under the subject of vertigo.

Ninth, Tenth, and Eleventh Nerves.—The nuclei are in the postero-lateral portions of the medulla and are so intimately associated both anatomically and functionally that damage to one by focal disease is likely to affect the others to some extent. Because of the proximity of the vital centers in the medulla, acute disease, especially hemorrhage, is extremely likely to cause speedy death, through involvement of the respiratory centers and therefore exact diagnosis is impossible, and could be of no practical value. The other degenerative diseases already discussed under bulbar palsy may progress so slowly and be so exactly limited in scope as to afford opportunity for more detailed study.

The ninth (glossopharyngeal) nerve is the nerve of taste for the

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posterior third of the tongue, and innervates the mucous membrane of the mouth and pharynx. Damage to the nerve trunk would thus interfere with taste and the pharyngeal reflex. Isolated disease in the nerve is almost unknown because of its very close relations in every way to the tenth and eleventh nerves.

The tenth (vagus) nerve supplies through its motor portion most of the soft palate, larynx, trachea, bronchi, pharynx, esophagus, stomach, and the small intestine. Much of the sensory supply for these parts is also derived from the vagus, and a very extensive system of ganglionic communications with the fifth, seventh, ninth and twelfth cerebral nerves has been demonstrated.

The symptoms from its involvement are most varied; but because of the rarity of isolated affections most difficult for exact study.

The larynx and palate are weakened in their action in unilateral involvement, with nasal speech and difficulty in deglutition. The vocal cord upon that side becomes paralyzed and the heart may be slowed or hastened in its action. Vomiting and other gastric symptoms may be noted. Respiration is not commonly disturbed, unless the neural involvement be a bilateral one. The immense importance clinically of the paralysis of the recurrent laryngeal branches of the vagus should be noted. Because of their long course and exposed location, they are vastly more liable to damage from aneurism, tumor, adenitis, etc., than the superior laryngeal nerves. For the exact diagnosis of the many conditions dependent upon lesions of the various branches of the vagus, the reader is referred to the special works.

The eleventh (spinal accessory) nerve is accessory to the vagus, and supplies the sternomastoid and trapezius muscles. The shoulder droops and the head cannot be turned toward the opposite side. Spasm of the muscles supplied by the eleventh nerve causes spasmodic torticollis. If both nerves be paralyzed, the head may fall forward or backward, according to the extent of the paralysis in the different muscles. The nuclei are often involved in bulbar paralysis and other degenerative diseases.

Twelfth Nerve.—The twelfth (hypoglossal) nerve innervates the tongue, and the nuclei of the nerve are often early involved in degen-

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erative diseases. The tongue becomes paralyzed but is not disturbed as to the sensory functions by disease or injury of the nerve. Spasm may result from irritation of the nerve, or complete paralysis from bilateral disease, as in bulbar paralysis. Atrophy of the affected half of the tongue, with fibrillary tremors, is conspicuous in peripheral disease of the nerve. Spasm may occur in the tongue in epilepsy, chorea, and hysteria.

3. BULBAR PALSY

(*Glosso-labio-laryngeal Paralysis*)

Definition.—A degenerative disease involving the medulla and pons, and therefore the motor nuclei of the cranial nerves, with the exception of the first four. The sensory nerves escape. Progressive weakness and atrophy ensue, and the muscles involved show fibrillary tremor. The disease is closely associated with amyotrophic lateral sclerosis, and may occur in the beginning or well along in the course of that disease. Marked atrophy of the muscles of the lips, pharynx and tongue may be present. Wickman classifies bulbar paralysis as a form of anterior poliomyelitis.

Symptoms.—The speech is first affected, since the nuclei especially concerned in its production are likely to be first involved, those of the eleventh and twelfth nerves and the motor portions of the ninth and tenth. The letters requiring the use of the lips and tongue are the one hardest to pronounce (b, g, l, p, r). With increasing difficulty the speech becomes slow and labored, nasal in tone and difficult to understand. Trouble in eating and swallowing follows, and may force the patient to subsist on liquids and soft foods. Dribbling of saliva, regurgitation of food through the nose, choking, and loss of expression in the lower part of the face follow through involvement of the facial nerve. Respiration may be embarrassed, and the heart finally becomes rapid, weak and irregular in its action. The upper part of the face commonly escapes, but the ocular nuclei are occasionally involved. Sensory involvement is absent, and the mind remains clear and active for most of the course of the disease.

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The patient finally dies from exhaustion, from a deglutition pneumonia, or in a choking spell. The deep reflexes of the limbs are generally increased, and jaw-jerk and clonus of the lower jaw may be present, these cases being of the amyotrophic lateral sclerosis type. The atrophy of the tongue and lips, the marked fibrillary tremor, and the reaction of degeneration are characteristic. There is absence of the palatal, laryngeal and pharyngeal reflexes.

Diagnosis.—The picture given above warrants the diagnosis of bulbar palsy. The association with amyotrophic lateral sclerosis must be considered. In diphtheritic paralysis the history and the absence of paralysis of the tongue and lips are decisive. Pseudobulbar palsy, acute bulbar palsy, and myasthenia gravis are considered in the next section. The bulbar involvement in tabes, in the muscular dystrophies and that of childhood must be considered.

Prognosis.—The cases may linger for years, but the disease is finally fatal.

PSEUDOBULBAR PALSY

This disease results from a diplegia, two attacks of hemiplegia having occurred, usually some time apart, upon opposite sides, with the involvement of the limbs in an ordinary hemiplegic paralysis, perhaps greater upon one side than upon the other, with spasticity, Babinski phenomenon, etc. When the motor fibers on both sides have been interrupted by the disease, the functions of the muscles bilaterally represented in the brain and used in eating, talking, etc., are compromised, and the pseudobulbar palsy appears at once with the second hemiplegia. As in other cerebral hemiplegias of upper neuron type, atrophy, reaction of degeneration and fibrillary tremor are absent, distinguishing it from true bulbar palsy. Spasmodic involuntary crying and laughter are present in certain cases. Aphasia, hemianopsia, and other symptoms such as are often noted in hemiplegia may be present.

Diagnosis.—The history of two successive attacks of hemiplegia or of one attack involving both sides of the brain simultaneously, the sudden onset and the characteristic features of cerebral paralysis, rather than nuclear disease, suffice for the diagnosis.

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Prognosis.—This rests upon the same general basis as in hemiplegia plus the possibility of trouble from the difficulty in swallowing.

ACUTE BULBAR PALSY

This name is given to an acute involvement of the vessels supplying the bulb, generally by hemorrhage or thrombosis. The interference with the nutrition of the nuclei of the medulla brings on suddenly, sometimes with loss of consciousness, a set of symptoms closely resembling those of bulbar palsy. There are generally motor and sensory symptoms pertaining to the opposite side. There is often much amelioration of the symptoms within a few days. In the acute inferior polioencephalitis of Wernicke, the same general region is involved, and similar symptoms result.

MYASTHENIA GRAVIS

(*Asthenic Bulbar Palsy*)

Definition.—A disease characterized by the rapid exhaustion under use of certain groups of muscles, notably those controlled through the cranial nuclei, with rapidly diminishing reaction to the faradic current (myasthenic reaction), and of unsettled but obscure pathology.

Symptoms.—The one striking symptom is the rapidity of exhaustion of the muscles involved under normal use. Although the muscles of the eyes are often affected, and those of the limbs and trunk may be involved, the name, asthenic bulbar palsy, well indicates the general characteristics of the disease. The absence of atrophy, sensory phenomena, fibrillation, of change in reflexes and involvement of the sphincters, and of convulsions, is very striking. The normal or merely weakened function of the muscles on awaking, their rapid and even dangerous exhaustion, more or less complete restoration of function with complete rest, but final increase in symptoms, generally leading to death within two or three years, is sufficiently decisive as to diagnosis.

Differential Diagnosis.—The disease suggests Landry's paralysis,

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true bulbar paralysis, and anterior poliomyelitis, especially the rare cases with bulbar symptoms. The former is differentiated by the acute ascending type of paralysis, often of great rapidity of onset. Bulbar paralysis has been sufficiently considered. In anterior poliomyelitis, the paralysis is definitely organic, characterized by flaccidity, loss of reflexes and reaction of degeneration. Hysteria and especially neurasthenia may offer many more difficulties in differentiation. The exclusion of these affections depends more upon the careful consideration of the history and the evidence pointing to neuropathic or psychopathic conditions than upon the symptoms themselves.

Prognosis.—In general the outlook is very grave, but occasionally recovery occurs. I have still under observation a case which I saw with the late Dr. J. T. Eskridge, nearly 20 years ago, and which, aside from persistent weakness, made a fairly complete recovery.

4. SYPHILIS OF THE BRAIN AND CORD

Because of their intimate association in many cases it will be best to consider the specific affections of the brain and cord together. But a small portion of syphilitics (5 per cent.) suffer from invasion of the central nervous system. There are probably two factors which determine such invasion, personal or family resistance to the disease, and the type of infection. Many instances have been reported of whole families suffering from cerebrospinal syphilis in some form; on the other hand, of several individuals contracting syphilis from the same source a majority have, in certain instances, suffered from nervous involvement. It is probable that vigorous antisyphilitic treatment is of considerable value in avoiding later nervous manifestations, but of its utter futility in many cases all physicians have had evidence. It is too early to judge whether salvarsan will be effectual in this regard. Pathologically we may find a specific endarteritis; a chronic inflammation of the meninges with marked thickening in many cases; gummata; a fairly acute involvement of the cord or brain, virtually a myelitis or an encephalitis; or the slow changes thought to be due to the action of toxins upon

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the nervous structure, such as may be best seen in tabes dorsalis.

Symptoms.—It has been well said that one familiar with the diagnosis of all the manifestations of syphilis of the nervous system must know all the other diseases as well, since syphilis may mimic them all. We shall discuss the more typical manifestations only, premising the discussion with the statement that multiple lesions are the rule, and consequently the most varied symptoms may be present in an individual case.

MENINGITIS

A chronic type of meningitis at the base of the brain is very common, and often associated with a meningitis of the posterior aspect of the cord, in many instances constituting a meningoencephalitis, or a meningomyelitis as the case may be. Gummata may be present, often giving rise to localizing symptoms. Involvement of the sixth, the oculomotor and the optic nerves is found in about this order of frequency. The most typical manifestation of cerebrospinal syphilis is a unilateral oculomotor paralysis, but diplopia, from paralysis of one abducens, is nearly as characteristic, especially if it "comes and goes" with a tendency eventually to become permanent. The pupillary changes are strikingly characteristic, dilatation of one pupil, irregularity of the margin, disturbance in pupillary reaction, and eventually, in many cases, the Argyll Robertson pupil, being almost pathognomonic of syphilis. The involvement of the dorsal meninges gives rise to sensory phenomena, especially in the limbs, girdle sensation resulting from the irritation of the posterior roots.

In general we may expect to see associated with the strictly meningeal phenomena, further symptoms indicative of involvement of the cerebral tissues. Headache, insomnia, and vertigo are very characteristic. Later a drowsiness, not otherwise accounted for, should always excite suspicion. It often develops into a deep stupor, and complete dementia may result. Delirium, even violent, may be seen. Focal epilepsy, often succeeded by focal paralysis, results from some local lesion. Because of cerebral softening, from thrombosis of the arteries involved, hemiplegia or other type of

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paralysis is not infrequent, and should be suspected to be of syphilitic origin in the young. Symptoms indicative of brain tumor may arise from the development of a gumma. Myelitis is common as an early manifestation of the invasion of the nervous system, and may be acute or chronic. The lower dorsal or lumbar region is commonly affected, with loss of motor and sensory power in the legs, and of the functions of the bladder and rectum. Girdle pains are frequent from the associated meningeal involvement.

SPECIFIC SPINAL PARALYSIS (ERB)

"This is characterized, first, by the usual symptoms of spastic paraplegia, with its peculiar gait, carriage, and movements; second, by marked exaggeration of the deep reflexes, by muscular contractions which are slight as compared with the exaggeration of the reflexes, involvement of the bladder, a slight yet distinct disturbance of sensation, gradual onset and a tendency to improvement." (Sachs.)

Diagnosis.—In general we may state that the striking feature in the diagnosis of cerebrospinal syphilis is the multiplicity of the symptoms, and their apparent disregard of the customary relationship of symptoms to each other, this peculiarity depending upon the fact that the lesions are so much more scattered and irregular than in most other diseases that the symptoms must partake of the same peculiarity in arrangement. Variability, and especially improvement under treatment are further features of moment. There are three affections which partake to some extent of the peculiarity of syphilis, as to the bizarre distribution of the lesions: multiple sclerosis, tuberculosis of the nervous system, and general invasion by cancer or sarcoma. In all, the Wassermann reaction is negative (unless by coincidence) while the nystagmus, scanning speech, and intention tremor of the first, the more rapid progress of the second and its general resemblance to the type described under tuberculous meningitis, and the existence of known malignant disease in the third make the differentiation almost certain. The therapeutic test is often decisive.

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5. GENERAL PARESIS

(*Paralysis of the Insane: Dementia Paralytica*)

Definition.—General paresis is a degenerative disease involving primarily the cerebral cortex, but also the meninges, and extending to the cord as well, and characterized by a progressive failure of the mental faculties, progressive paralysis and terminal dementia.

The brain lessens in weight, the notable atrophy of the convolutions being apparent. The ventricles commonly contain an excess of fluid. The adhesions between the pia and the arachnoid and the cortex are characteristic. The cortical cells are found microscopically to be degenerated, the vessels are thickened and similar lesions are found in the cord. The spirochetes of syphilis have been demonstrated in the cortex.

The disease is seen in the male sex much more often than in the female, and often begins in the fourth decade. Since the introduction of the Wassermann test the opinion is gaining ground that the basis of the disease is always a syphilitic one, although hereditary nervous disease, trauma, alcoholism, worry, business and other overstrain, etc., undoubtedly play important parts. The white race is more susceptible to paresis than others. The time elapsing between the specific infection and the development of the disease varies from about five years to more than twenty.

Symptoms.—The disease begins insidiously in most cases, although the first recognition of its onset may be due to an epileptoid or convulsive attack, or a hemiplegia. Trauma may immediately precede the first manifestations. The average patient shows a gradual change of character, with irritability, neurasthenic symptoms, headache, insomnia, or possibly somnolence, depression, forgetfulness, lack of customary attention to business, to dress, and to the decencies of life. Alcoholism and sexual debauches, sometimes unknown before, are common. Although the patient may realize the change in his condition it is through the action of his friends generally that his case is brought to the attention of the physician. In many cases, however, this is not done until the period of delusions of

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grandeur sets in, in which extravagant ideas as to wealth, strength, power and importance are dominant. Almost complete irresponsibility is now noted.

As the disease advances the physical symptoms apart from the mental become more apparent. The tremor in the muscles of the face and muscles involved in speech becomes marked, and there is inability to pronounce many words of some little difficulty such as "artillery, "February," "truly rural." They are slurred over in an almost pathognomonic manner. The handwriting becomes unsteady, the words are omitted, run together or misspelled. Irregularity of the pupils and myosis are of frequent occurrence, and the pupillary reactions are decreased or lost. The typical Argyll Robertson pupil may be found. Fleeting diplopia is often noted and optic atrophy is not uncommon. Muscular weakness is marked. Increase in the knee-jerks, or increase on one side as compared with the other, is often found. Dizziness, and such incoördination of muscular action as to lead to an uncertain or staggering gait may be present.

Fig. 119.—Paresis, Expansive Form. Syphilis at 28. Onset of psychosis, gradual. Duration, 1 year. Mood, euphoric. Delusions, very extravagant Although a well-advanced case, the patient writes an excellent hand free from tremor. (Dr. H. Work.)

Dementia finally becomes complete and the paralysis progresses with it, the patient becoming at last bedridden, with loss of sphincter control and dying of exhaustion, uremia, pneumonia, or more typically in an apoplectic attack. Various trophic and vasomotor disturb-

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ances often appear in the late stages, such as bed sores, arthropathies, hematoma auris, etc.

Diagnosis.—The suggestion that the patient is "queer," so often made by the relatives, with history of change in character, the obvious defects in speech, the blank inattentive countenance, the inability to tell the commonest things, such as the age, year of birth, names of wife and children, or to add or to subtract small sums or spell any but the most commonly used names of states and cities, with the pupillary and reflex phenomena, and frequent delusions, make up a picture not easily mistaken. In neurasthenia there may be many suggestive signs but there are no real evidences of mental failure, but rather of exhaustion, and the Wassermann reaction is commonly absent. In certain cases the differentiation between general paresis and the so-called pseudoparesis, due to cerebral syphilis, is extremely difficult, and in fact the latter disease may develop into typical paresis. The characteristic psychosis is commonly absent in cerebral syphilis and the course is less steadily toward terminal dementia. Marked improvement under treatment is vastly more common in cerebral syphilis than in paresis.

Fig. 120.—Paresis, Demented Form. Syphilis at 21. Onset gradual. Duration, 4 years. Now in terminal stage. Demented, helpless, unable to speak and without control of the organic reflexes. (Dr. H. Work.)

The history generally suffices to distinguish multiple sclerosis,

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which has been considered in the differential diagnosis of cerebrospinal syphilis. The alcoholic pseudoparesis may present a dementia, but not the peculiar preliminary phenomena of general paralysis. The history of alcoholic abuse and delirium tremens, and the improvement under treatment are suggestive. Drug habits are often found in association with the alcoholism in these cases and complicate the picture of the disease.

Prognosis.—The inevitable tendency of paresis is towards death. The course varies from two to five years, occasionally to twelve or more when remissions prolong it. It must be stated, however, that occasional remissions lasting even many years are noted, during which the patient may be practically restored to health. Reported recoveries are open to gravest doubt.

6. MULTIPLE SCLEROSIS

(*Disseminated Sclerosis*)

Definition.—A disease of the brain and cord characterized by the presence of multiple areas of degeneration throughout these structures, with tumor, scanning speech, nystagmus, progressive weakness and spasticity.

The name expresses the chief elements in the pathology of the disease, namely, the presence of scattered nodular degenerative foci throughout the central nervous system. The characteristic histological change in the placques is the preservation of the axis cylinders with destruction of the medullary sheaths. The optic nerves and the anterior and posterior roots of the spinal nerves are often affected. It seems probably a developmental disease of the nervous system, though often apparently induced by exposure to cold, by acute infectious diseases, etc. Syphilis is apparently not causative. It is much more common in Europe than in America and is especially common in the great continental hospitals.

Symptoms.—The disease is most often seen in young adults. Owing to the diversity as to the location of the placques of degeneration, the symptoms vary extremely. In general, however, we may

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expect to find the symptoms enumerated in the definition above, and which are most characteristic.

The first symptom is likely to be a weakness in one or both of the lower limbs, often first noticed after exercise, and regarded as the result of excessive fatigue. Spasticity and ataxia soon develop, so that a staggering gait is produced. Less pronounced trouble of a similar nature may be noted in the arms. The spasticity may interfere more with the function of the limbs than either the ataxia or the weakness. The tendon reflexes are exaggerated, and ankle clonus and the Babinski phenomenon are commonly present. One side is often more affected than the other.

The peculiar and more or less characteristic intention tremor is likely to be noted early in the progress of the disease. It is a course tremor, four to six per second, appearing upon attempting to use the limb, and disappearing with rest. The face and tongue are often affected. The usual tests of raising a glass of water to the lips or trying to write bring it out plainly.

Nystagmus of the lateral variety is often present, and may be brought out by directing the eyes to one side, if not at first apparent. It may be of the rotary variety. Diplopia may be noted, and optic atrophy is not infrequent.

Scanning speech is a prominent symptom in half to two-thirds of the cases. It depends upon the difficulty which the patient experiences in pronouncing a given word or syllable, the separate definite effort requisite for each one being apparent. The speech is slow and finally becomes very indistinct. The respiratory movements may exhibit a similar "scanning." Numbness, tingling, girdle sensations, shooting pains and other sensory phenomena are often noted. As the disease advances bladder symptoms may appear and may lead to retention or incontinence. The bowel control is less often compromised. A moderate degree of mental impairment eventually becomes manifest and there is often a lack of emotional control. The course is a chronic one, but remissions may interrupt the usually steady advance of the disease.

Diagnosis.—The tremor, nystagmus, and scanning speech are easily noted and the association of spastic weakness of the limbs, in-

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creased reflexes, and optic atrophy, with the cord symptoms, suffices for the diagnosis.

Differential Diagnosis.—Hysteria has frequently been diagnosed in these cases, and may be a complication. What appears to be a functional paralysis of a limb, in a neurotic young woman, possibly with hemianesthesia, may easily be the beginning symptom of a multiple sclerosis, and should be viewed with suspicion. The occurrence of nystagmus, optic atrophy and the Babinski phenomenon excludes the purely functional disease. The tremor of mercurial poisoning is not accompanied by the other features of multiple sclerosis. The differentiation is very difficult, but fortunately the disease is rare.

Prognosis.—Permanent recovery probably never occurs, but remission in the course of the disease is not infrequent. Bramwell found the average duration of life to be slightly over ten years in a series of 96 cases, many of whom were still living at the time of the estimate, so that the total average duration would obviously be greater than this.

7. MIGRAINE

(*Sick Headache; Hemicrania*)

Definition.—This is an hereditary neurosis, characterized typically by attacks of unilateral headache, often of great severity, accompanied commonly by vomiting, and appearing at irregular intervals. Many irregular forms are seen.

Etiology.—Aside from heredity, no definite etiology has been established. Gout, eye-strain, gastro-intestinal upsets, and so-called auto-intoxication are frequently found in association with migraine, but no constant relationship to the attacks can be proven. The most reasonable view seems to be that a vasomotor disturbance, originated by many different sources of irritation, varying with different patients, and perhaps with different attacks, lies at the basis of migraine. The frequent concurrence of the attacks with the menstrual periods should be mentioned.

Symptoms.—The disease begins in youth in the great majority

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of cases. Females are rather more frequently affected. An aura, generally of visual type, with dazzling spots before the eyes, scintillations, optical illusions, etc., often accompanied by yawning, chilliness, tingling, anesthesia or other sensory phenomena, introduces the attack. Hippus may be present. Homonymous hemianopsia is not infrequent. After a few hours the preliminary symptoms disappear, and the headache begins.

The pain is generally first felt in the temple of one side, often but not always the same one, gradually spreading to the side of the head and face, and occasionally over the whole head. Tenderness to pressure often exists over the scalp. The distribution of pain and tenderness is in the field of the fifth nerve, and the ophthalmic branch is oftenest affected. The pain lasts from an hour or two to twenty-four hours, generally only a few hours. The patient commonly prefers to go to bed in a darkened room. Movement increases the headache and the patient especially avoids stooping or straining at stool. Noise and strong light are especially distressing. In severe cases mental effort is out of the question, while in mild ones it may temporarily suppress the migraine, though the headache often recurs with increased severity upon cessation of the effort. There is aversion to food.

In typical cases vomiting appears after some hours, often terminating the paroxysm. Bile appears if the emesis be long continued. Sleep may follow, and the patient may awake feeling fairly comfortable. From three to one hundred attacks may occur in a year.

Atypical Forms.—Many patients suffer with migraine in such unusual form that the disease is not recognized unless it be borne in mind that any of the symptoms of the typical attack may fail. Further, the same patient may at different times exhibit the utmost diversity as to the character of his symptoms.

Abortive attacks occur in which the prodromata mentioned appear but the symptoms then unexpectedly cease. The next attack may be typical. Between the usual paroxysms may occur "bilious attacks," which the patient learns to recognize as being representative of the disease. I have seen attacks of "cyclic vomiting" in a

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child of marked migrainous heredity, which I believe were manifestations of this neurosis, though no headache occurred. The eye symptoms alone may appear, or the paresthesia mentioned, often unilateral. Digestive phenomena may be noticed, or vasomotor changes, diarrhea, sweating, dryness of the skin, frequent urination, disturbances of sensation, etc.

Ophthalmoplegic migraine is accompanied by paralysis of some of the eye muscles, generally in the distribution of the third nerve. Ptosis with turning of the eye outward or downward is the common form, accompanied with diplopia and loss of reaction to light and accommodation. The ophthalmic branch of the trifacial may present some of the usual sensory phenomena of migraine in connection with the ophthalmoplegia. The eye palsy may pass off in a day or two, or last several days. It frequently occurs only with certain severe attacks, and generally not in the early attacks, but after years of suffering. The frequent recurrence of ophthalmoplegia is stated to lead to a permanent paralysis in rare cases, but other possible causes should be scrupulously sought in such a case. These attacks are thought by some authorities to be evidence that an increased intracerebral vascular pressure lies at the foundation of migraine.

Psychical Migraine.—The patient has attacks of confusion, depression, change of character, etc., perhaps not recognized as migrainous until after long study. Peculiar phobias, hallucinations, and even attacks of stupor are noted. I have repeatedly seen in a prominent physician attacks of aphasia lasting from six to twelve hours, replacing his ordinary sick headache.

The tendency of migraine to disappear at middle age is well recognized, and the hope of such disappearance is the greatest reliance of some patients with intractable forms.

Diagnosis.—The patient or his family has generally made the diagnosis, especially in the typical attacks of the hereditary type. The paroxysmal attacks, the preliminary symptoms, unilateral headache, vomiting, recovery after some hours, and a recurrence after a few days, weeks or months, are pathognomonic. Epilepsy presents only periodicity as cause for consideration in differential diag-

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nosis. The ophthalmoplegic attacks demand careful exclusion of organic causes of brain disease, but no difficulty is likely to arise. Hysteria and ordinary simple headaches occur in migrainous subjects. The influence of periodical drinking in producing attacks more or less similar to migraine, in those subject to the disease, should be noted. An affection developing after 45 or 50 years is rarely migraine, according to Allbutt, while a true migraine of earlier life rarely persists as such after this period.

Prognosis.—The disease does not apparently affect the expectancy of life, regardless of the suffering caused. Most patients find the attacks decreasing in frequency and severity, until they disappear, generally in the fifth decade.

8. EPILEPSY

Definition.—Spratling defines epilepsy as a "disease or disorder affecting the brain characterized by recurrent paroxysms which are abrupt in appearance, variable in duration, but generally short, and in which there is impairment or loss of consciousness together with impairment or loss of motor coördination, with or without convulsions."

Etiology.—Eighty-four per cent. of the cases originally occur before the twentieth year, with equal distribution between the sexes. The influence of trauma, alcoholism and syphilis renders males slightly more liable after that age. The disease is markedly hereditary, and alcoholism in the parents especially predisposes to epilepsy. Race and occupation are of little influence. Mental and nervous affections in the parents are frequently observed, and many of the stigmata of degeneration are observed in the children who are, or become, epileptic. Almost 8 per cent. of cases are stated by Spratling to be due to birth palsies. Infectious diseases, fright, pregnancy and other disturbing influences seem to have some effect in causing epilepsy in certain cases. The influence of eye strain has doubtless been overestimated by many writers.

Classification.—Perhaps the most satisfactory classification is into: (1) major epilepsy, (grand mal); (2) minor epilepsy, (petit mal);

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(3) psychic epilepsy. Three-fourths of all cases belong to the first division.

Symptoms.—Major Epilepsy.—In major epilepsy, in nearly half the patients, an aura occurs which may produce sensory, motor or psychic phenomena, or a mixture of them. The aura may consist of a peculiar sensation in the finger, perception of a bad smell, of strange sounds, or tastes, etc. Certain forced movements may precede the loss of consciousness, the epileptic cry, the fall, and the convulsions. The latter are at first tonic for several seconds or even one or two minutes, with rigidity, spasm of the respiratory muscles, pallor, redness, and then cyanosis of the face, fixed eyes and irresponsive dilated pupils. The sphincters often relax. The head may be turned to one side or drawn backward, and the limbs may be extended or flexed. The tongue is often bitten. The tonic spasm relaxes, and clonic convulsions occur, lasting perhaps as long as the tonic spasm, the limbs being thrown about, with spasmodic action of the facial and other muscles. Bloody froth often appears at the mouth, and ejaculation of semen may occur.

Fig. 121.—Imbecility (Epileptic). Age 15. Normal until 6 years of age. Has had a seizure almost daily since the 6th year. Helpless; untidy. (Dr. H. Work.)

With the subsidence of the clonic spasm coma appears in the severe cases, with stertorous respiration, and sleep, perhaps lasting for several hours thereafter. Vomiting, slight rise of temperature and polyuria, and even temporary albuminuria, may follow the fit.

Petit Mal.—In this form the loss of consciousness may be incomplete, and the convulsive movements so slight as to escape recog-

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nition in many cases. The patient often does not fall, and may pick up an interrupted conversation after the paroxysm. Momentary loss of consciousness, pallor, twitching of facial muscles, incoherence and automatic movements of various kinds may be noted. The patient may be unaware of the attack and the diagnosis may escape the physician for a long time unless, as often happens, the attacks alternate with the major variety.

Psychic Epilepsy.—In this variety certain psychic phenomena replace the motor manifestations described above (epileptic equivalents). Loss of consciousness is the essential feature, and may last from a few to twenty seconds or more. Slight vasomotor changes in the face with slight muscular twitching may be present. Hundreds of these attacks may occur in 24 hours. The conversation or work of the patient may be taken up without any interruption, except for the time lost, and the patient may be unconscious of the attack. Automatic movements may occur during the paroxysm, and epileptic ambulatory automatism is described. In this the patient may wander for hours, or even days, and may commit homicide, arson, or other extraordinary acts, and have no knowledge of them after return to the normal state. Acute maniacal attacks are stated by some authorities to represent the epileptic paroxysms in certain individuals.

In the status epilepticus, the paroxysms of grand mal may follow one after another without the regaining of consciousness for hours or days, hundreds of fits perhaps occurring. The patient often dies of exhaustion, or hyperpyrexia, generally after some hours of coma resembling that of uremia.

Jacksonian epilepsy, also spoken of as partial and cortical epilepsy, is not to be considered a true epilepsy, but the manifestation in certain motor areas of the irritation of some focal disease, with convulsions, generally clonic, of a hand, finger, foot, etc., resulting. Similar attacks may occur in paresis. Consciousness is not lost in most of the cases. The attack may last from a few seconds to several minutes. The importance of the careful study of these convulsive seizures in the localization of brain tumor, etc., is apparent.

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Epileptic attacks may come at intervals of several months, of weeks, or days, or several in a day. Nocturnal epilepsy is not uncommon, the attacks coming on in the night, and the patient being often unaware of their occurrence. Even the family and the physician may be in ignorance of the trouble until soiling of the bed be noted, or the night fit is discovered, or one occurs in the daytime. The possibility of burns, fractures, etc., as the result of the seizures should be noted. Scars upon the face, neck, hands, and tongue are very common. The bromid acne of old epileptics is seen with distressing frequency. If the disease dates from childhood the patient is often undersized, and the intelligence is sooner or later impaired.

FIG. 122.—EPILEPTIC INSANITY. Age 30. Convulsions since 11th year. Marked dementia for a period of 5 years. (Dr. H. Work.)

Diagnosis.—This is extremely easy in patients with well-marked attacks, if the physician has the opportunity of seeing one. The psychic and minor forms often pass for years without a correct diagnosis, chiefly from lack of care in investigation. If the comatose stage be brought to the attention of the physician, without the history of the convulsion, the scars, possibly acne, bitten tongue, frothing mouth, the absence of paralysis, and of signs of alcoholism, uremic coma, etc., will generally suffice if only epilepsy be considered.

The possibility of atypical epileptiform paroxysms for some months before the diagnosis of cerebral tumor becomes possible through the development of further symptoms, should not be forgot-

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ten. Paretic seizures must be borne in mind, but the diagnosis is easy after the attack if the case be carefully investigated. The absolute loss of consciousness in major epilepsy, the biting of the tongue and dribbling of urine differentiate it from hysterical convulsions.

Epilepsy is occasionally simulated, and certain "dummy-chuckers" succeed in deceiving physicians of some experience. One who was suspected of being an imposter even "threw a fit" in such a way as to fall more than twenty feet, breaking his arm, but convincing his attendant that he had true epilepsy. The imposter is rarely hurt in his fall, since he chooses the time and place. The thumb is clasped under the fingers in epilepsy, the cry is distinctive, the corneal reflexes are suppressed, the sphincters often relax, and the temperature is slightly raised, while none of these features pertains to the simulated disorder.

Prognosis.—Spratling estimates the curability of epilepsy at eight to ten per cent. of the cases. Certain traumatic cases are curable by surgical means, and antisyphilitic treatment restores a small number. The milder cases in general give a better prognosis than the severer ones. The tendency of psychic epilepsy to gradual development into petit mal or grand mal should be noted. Chronic dementia is the eventual condition of the bad cases, the patients dying commonly from some intercurrent disease.

9. PERIODICAL PARALYSIS

This is a rare family affection, characterized by periodical paralysis affecting the general muscular system, involving commonly the arms or legs, and occasionally all the muscles below the neck. Weakness and weariness may precede the attack. No cause is known. The paralysis often comes on during the night and may be complete in twenty-four hours. The faradic excitability of muscles and nerves is decreased or abolished.

After a day or two improvement begins and the patient is well in a few days. The attacks may occur every few days, and generally cease after middle age. Death may occur in the attack.

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10. DISEASES OF THE SPINAL CORD

Meningitis has been considered in connection with diseases of the brain.

MYELITIS

Definition.—The term signifies an inflammation of the substance of the spinal cord; but the various types of softening and destruction, especially from trauma, sepsis, etc., have been classed under this heading. The tendency is to a closer restriction of the term than formerly prevailed.

The inflammation may affect different portions of the cord as indicated by the use of the terms transverse myelitis, central myelitis, and disseminated myelitis. The disease process may be acute, subacute, or chronic. The type of myelitis found in syphilis is commonly a meningomyelitis, and a similar involvement of the meninges is found in bony disease, cancerous metastases, etc.

Acute Myelitis.—Etiology.—The disease is oftentimes of infectious origin, in connection with septic infections, gonorrhea, grippe, measles, typhoid, variola, etc. The method of origin may be by embolism, by direct extension from abscess or other focus, or through the lymph channels. The streptococcus and staphylococcus have been most often incriminated, but especial difficulties attend the study of the bacteriology of spinal diseases.

An acute toxic myelitis occurs rarely in pregnancy, in the same type of cases that show serious cardiac and renal involvement. This form may recover upon delivery and recur in a subsequent pregnancy. It is believed that certain inorganic poisons may cause a toxic myelitis. Syphilitic myelitis is far more frequently seen than other forms. It is more often found in males, in young adult life, and during the first three years of infection. It may occur in congenital syphilis. This form affects especially the mid-dorsal cord, while the infectious types are found in the cervical and lumbar regions as well. Alcoholism, fatigue, and exposure apparently contribute to the development of the specific form.

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PATHOLOGY.—The various types of inflammation may affect especial tissues, as the vessels, or the cord substance predominantly, or all of the tissues of a given area. The central portion of the cord may be affected, or a transverse section covering one or two segments only, or a longer portion. Involvement in two or more regions separated by sound tissue may be found. Various grades of infiltration, hemorrhage, softening and discoloration may be present. In the toxic forms the gross lesions are less notable, but degenerative processes are evident histologically. In the syphilitic form, the primary lesion is probably an arteritis, but cellular infiltration and the effect of the toxins of syphilis are added to those induced by the circulatory changes.

SYMPTOMS.—These depend rather upon the site and intensity of the inflammation than upon the cause. Fever and vomiting precede the attack in many cases. Pain in the back and various paraesthesias are often noted. The onset in the toxic cases is rather less distinct and characteristic than in the infectious ones, and in the syphilitic form there may be no warning symptoms. The effects, if the cervical cord be involved high up, may be of rapid development, and very serious, since the respiratory muscles may be completely paralyzed. If in the cervical enlargement, the common seat of cervical myelitis, motor and sensory paralysis of the upper limbs ensues, with spastic paralysis of the muscles of the body and lower limbs, more or less complete according to the degree of involvement of the cervical cord. Exaggerated reflexes and the Babinski phenomenon are present. The diaphragm escapes. Cutaneous sensibility is compromised below the level of the lesion. If destruction be complete, the motor and sensory paralysis is of course absolute, with flaccidity, incontinence of urine and feces, bed sores, distention of the abdomen, and usually speedy death. Pain is not a prominent symptom, excepting as the meninges and nerve roots are involved in the inflammation.

Dorsal Region.—Spastic paralysis exists below the site of the lesion if the damage be but partial, with contractures and exaggerated reflexes, or flaccid paralysis if the destruction be complete. Loss of sphincter control is likely to be noted in either case, and a girdle

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sensation near the level of the lesion, with anesthesia below. Because of the irritation of the nerve roots, generally from meningeal inflammation, a zone of hyperesthesia is found, corresponding to the upper level of the lesion. Since the inflammation often involves one portion of the cord more than another, the symptoms may vary from the picture given above. The motor conduction through the diseased segment may be impaired only, so that the patient may move the leg to some extent, or even walk with much difficulty, the weakness and spasticity being marked. The sphincters may escape. The involvement of the anterior region of the cord, by affecting the motor area, may produce chiefly motor symptoms, as in certain cases of tuberculous bone disease, damaging the anterior wall of the canal. The occurrence of marked pain suggests the involvement of the meninges, as in syphilitic meningomyelitis.

The lesion may possibly involve but one lateral half of the cord, producing, but generally incompletely because of lack of exact limitation of the lesion, the symptoms of Brown-Sequard's paralysis—loss of motor power of spastic type and impairment of muscular sense on the side of and below the lesion, loss of other forms of sensibility at the level of the lesion on the same side, and below this level on the opposite side. Lumbosacral involvement produces symptoms similar to those noted under dorsal myelitis, with lack of involvement of the abdominal muscles. The completeness of the sensory or motor paralysis, as in other locations, depends upon the destructiveness of the lesion in the cord, while the escape of certain hip muscles, for example, or their atrophic paralysis, while spastic paralysis exists below, is dependent upon the spinal segments involved. The lack of exact uniformity in myelitis is a striking feature of the disease. If partial recovery ensue, certain functions improve much more than others, and the clinical picture changes.

Acute ascending myelitis differs from the forms described only in the fact that the lesion tends to involve successively higher and higher regions of the cord, so that the symptoms of a lumbosacral myelitis are replaced by those of a dorsal localization, to be succeeded by an involvement of the cervical cord or even by that of the brain stem, as indicated by cranial nerve paralysis. Death is likely

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to occur through the damage to the segments controlling the respiratory muscles. The term disseminated myelitis indicates that the lesions are scattered through the cord, the superior lesion, however, dominating the symptomatology. The exact diagnosis is more common in the autopsy room than in the wards.

The symptoms of the toxic form are likely to be less complete than in the forms described, owing to the less complete destruction of the segments affected, and recovery is presumably more likely to occur. The symptoms of the syphilitic form demand further attention. Weakness, anesthesia and loss of bladder control appear without preliminary symptoms in a man supposed to be well, and perhaps disappear wholly or in part, to return after a few days. Every modification of this description is possible, through more or less sudden and complete destructive involvement of the different segments or parts of the segments. The presence or absence of spasticity, increased reflexes, contractures, retention or incontinence of urine and feces, bed-sores and other phenomena of myelitis is dependent upon the location and degree of inflammation, and the picture changes rapidly if marked improvement occurs under specific treatment, as is frequently the case.

Subacute and Chronic Myelitis.—Subacute and chronic myelitis differ only in the fact that they develop and progress more slowly than the acute form, and that they are less common. In many cases, the disease is rather a compression myelitis from bony injury or disease, or is syphilitic in nature. The terms have been loosely applied in the past. The subject is further considered under Injuries to the Cord.

Senile Myelitis.—This is dependent upon gradual decrease in the blood supply to the cord, owing to progressive arteriosclerotic changes, which eventually cut off the blood supply more or less completely. The symptoms are those of a mild and incomplete myelitis, often improving or getting worse as the lesions in the vessels change, or greater functional demand for blood occurs. There may be intermittence in the manifestations of the trouble, owing to the more or less complete cutting off of the blood supply (intermittent claudication), but the tendency as in other arteriosclerotic conditions is

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toward complete, obliterative endarteritis, with consequent loss of function in the parts supplied.

Syphilitic paraplegia, as described by Erb, differs from other types of chronic myelitis "in its specific origin, marked exaggeration of the tendon reflex as compared with the moderate degree of muscular rigidity, by the presence of bladder trouble long before the appearance of other symptoms, by the subjective character of the paraesthesias, and by the gradual development of the disease and the tendency to improve under treatment." The lesion is a meningomyelitis affecting especially the lateral aspects of the cord, but in certain cases the posterior surface as well, with resulting ataxia. A specific involvement of the arteries of the cord is thought to underlie the pathology of the disease. Pain may be absent. In this form, specific history, results of examination of the spinal fluid, Wassermann test and the results of specific treatment are sufficient for the diagnosis. (*See* Section on Syphilis of the Brain and Cord.)

CAISSON DISEASE

Caisson disease may appropriately be mentioned here. The "bends" is a disease occurring especially in those whose resistance is lowered by age or alcoholism, and who have been too rapidly "decompressed" on emerging from the caisson in which they have worked under a pressure of several atmospheres. Headache and pains in the limbs and abdomen are followed, after emerging from the chamber, by paralytic symptoms, generally in the form seen in myelitis, with sphincter and sensory involvement. The paralysis may be irregularly distributed, and recovery generally ensues, especially in the hemiplegic type. Coma is of evil significance. The post mortem examinations have shown nitrogen bubbles in the tissues of the cord in the recent cases, and areas of chronic degeneration in those dying late, virtually a myelitis. The cases may recover in from a few hours to a few days. If the lesions be more permanent in character, all the symptoms of a chronic myelitis appear and the usual chronic course may be anticipated.

Diagnosis.—The diagnosis of myelitis depends upon the more or

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less abrupt development of the symptoms, the presence of definite paralytic symptoms of the general type described and the absence of the signs of the spinal diseases with which it might be confounded.

The lightning pains, Argyll Robertson pupils, loss of knee jerks, and ataxia of tabes are wanting, and the dissociation symptoms of syringomyelia likewise. The peripheral distribution of the symptoms of multiple neuritis, tenderness of the muscles involved, abolition of the reflexes, and absence of the sphincter involvement are characteristic.

The cervical type of myelitis, if complete, causes paralysis of all parts below. The dorsal form involves only the lower extremities and the abdomen and lower thoracic regions, while in the lumbosacral form the latter localization is wanting. The varying degrees of destruction in the different segments influence the exact nature of the symptoms so profoundly that careful investigation of apparently contradictory features in different cases is often necessary.

All disseminated and acute ascending types differ only in the distribution and order of progression from the varieties described. Syphilis, senility, as expressed in arteriosclerosis, exposure after caisson work, etc., all require attention. Spinal puncture may be of service in several different types. All the symptoms of myelitis may arise from the pressure of a tumor in the spinal canal, or the development of a metastatic malignant growth. An incomplete paraplegia may develop as the effect of a patch of sclerosis in the cord in multiple sclerosis, but the ordinary signs of the disease should lead to its recognition.

Prognosis.—This depends upon the degree of destruction of the tissues of the cord, and the possibility of improvement by treatment, especially the antisyphilitic treatment. If the damage be complete and permanent from any cause, the patient may live till bed sores, exhaustion, or involvement of the respiratory muscles cause a fatal result. In any case recovery is likely to be more or less incomplete, some bladder disturbances or other evidence of lack of complete restoration being present.

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11. INJURIES TO THE SPINAL CORD

These occur most frequently as the result of fractures or dislocations of the spine, often in connection with gunshot wounds, falls, crushing blows, etc. The cord may be injured without coincident discoverable bony disease, and I have known it to be severed on one side by a knife wound so as to produce a typical Brown-Sequard paralysis. Two causes of traumatic paraplegia are sufficiently common to deserve especial mention, for I have seen many cases due to them. In the first, a railway section hand falls from the front of a handcar and is "doubled up" as the car passes over him, fracturing the spine and damaging the cord. In the other, a miner stooping in a tunnel is struck in the back by a falling rock from the roof of the tunnel, with localized crushing of the spine.

In general the cervical region is most frequently injured, the dorsal comes next in order, and the better protected and more massive lumbar spine escapes most frequently. The cord is likely to be crushed to the point of destruction in fractures and dislocations. It is thought that at times a partial dislocation of one vertebra may occur, the bone springing back into place, but the cord being damaged irreparably by the displacement. Dislocation at the atlo-axoid joint, with crushing of the cord and instant death, is not rare, and in medico-legal cases the cause of death may be obscure until a thorough examination is made. Thus in one case a drunken man fell backwards and struck his neck across the rail at the foot of a bar in a saloon; and in another, a gymnasium instructor threw his head violently backward in a supreme effort upon the trapeze. The lesion mentioned was found at the autopsy in both. The lower cervical vertebrae come next in frequency as to injury of this variety. Fracture of mild degree may occur without damage to the cord. In the cases which escape crushing there may still be a hemorrhage within the membranes of the cord, and multiple small hemorrhages in the latter may be found when there is little external evidence of injury.

Symptoms.—The trauma to the spine produces deformity with rigidity and pain, and in some cases compound fracture is evident upon observation. The symptoms in the nervous system arise from

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the cord injury, and are those of myelitis in cases where the severance or destruction is complete, and in accordance with the level of the lesion. Additional symptoms may come from the hemorrhage into the cord above the site of the chief lesion. If the destruction be but partial, as from small hemorrhages into the cord, the initial paraplegia gives way after a time to a less complete form with some return of motion and sensation, a partial restoration of the sphincter control, but with spasticity, increased reflexes and the Babinski phenomenon. In general the localization of the site of the lesion is to be made as in myelitis, for the symptoms are practically those of the non-traumatic cord diseases affecting the same area. The higher lesion in case of multiple severe injuries controls the symptomatology. The comparison of the motor and sensory features of a given case with a chart showing the localization of motor and sensory control should render an exact localizing diagnosis possible. The following diagram and chart are taken from Wilson:

THE LOCALIZATION OF THE FUNCTIONS IN THE SEGMENTS OF THE SPINAL CORD

Based upon the studies of Starr, Edinger, Wuhmann, and others.

SEGMENT	MUSCLES	REFLEX
I, II, and III Cervical	Splenius capitis, trapezius, hyoid muscles, diaphragm (C. III–V), sternomastoid, levator scapulæ (C. III–V)	Diaphragmatic.
IV Cervical...	Trapezius, scaleni (C. IV–T. I), rhomboid, diaphragm, teres minor, levator scapulæ, supraspinatus	Dilatation of the pupil (C. IV–VII).
V Cervical....	Diaphragm, rhomboid, biceps, supinator brevis (C. V–VII), teres minor, subscapularis, brachialis anticus, pectoralis (clavicular part), supra- and infraspinatus (C. V–VI), deltoid, supinator longus (C. V-VII), serratus magnus	Scapular (C. V–T. I), supinator longus (C. V), and biceps (C. V–VI).
VI Cervical...	Teres minor and major, biceps, supinator brevis, coracobrachialis, extensors of wrist (C. VI–VIII), infraspinatus, brachialis anticus, pectoralis (clavicular part), pronator teres, deltoid, supinator longus, serratus magnus (C. V–VIII), triceps (outer and long heads)	Triceps and posterior wrist (C. VI–VIII).

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Segment	Muscles	Reflex
VII Cervical..	Teres major, pectoralis major (costal part), pronators of wrist, flexors of wrist, subscapularis, pectoralis minor, triceps, latissimus dorsi (C. VI–VIII), deltoid (posterior part), serratus magnus, extensors of wrists and fingers	Scapulohumeral and anterior wrist (C. VII–VIII).
VIII Cervical.	Pectoralis major (costal part), latissimus, pronator quadratus, radial lumbricales and interossei, flexors of wrist and fingers	Palmar (C. VII–T. I).
I Thoracic....	Lumbricales and interossei, thenar and hypothenar eminences (C. VII–T. I)	
II to XII Thoracic	Muscles of back and abdomen, rectus abdominis (T. V–T. XII), transversalis (T. VII–L. I), erectores spinæ (T. I–L. V), external oblique (T. V–XII), intercostals (T. I–T. XII), internal oblique (T. VII–L. I)	Epigastric (T. IV–VII), abdominal (T. VII–XII).
I Lumbar.....	Lower part of external and internal oblique and transversalis, psoas major and minor (?), quadratus lumborum (L. I–II), cremaster	Cremasteric (L. I–III).
II Lumbar....	Psoas major and minor, sartorius (lower part), iliacus, flexors of knee (Remak), pectineus, abductor longus and brevis	
III Lumbar...	Sartorius (lower part), inner rotators of thigh, adductors of thigh, abductors of thigh, quadriceps femoris (L. II–L. IV)	Patellar tendon (L. II-IV).
IV Lumbar...	Flexors of knee (Ferrier), abductors of thigh, quadriceps femoris, extensors of ankle (tibialis anticus), adductors of thigh, glutei (medius and minor)	Gluteal (L. IV–V).
V Lumbar....	Flexors of knee (hamstring muscles) (L. IV–S. II), flexors of ankle (gastrocnemius and soleus) (L. IV–S. II), outward rotators of thigh, extensors of toes (L. IV–S. I.), glutei, peronæi	
I to II Sacral.	Flexors of ankle (L. V–S. II), intrinsic muscles of foot, long flexor of toes (L. V–S. II), peronæi	Foot reflex (S. I–II), plantar (S. II–III).
III to V Sacral	Perineal muscles, levator and sphincter ani (S. I–III)	Vesical (L. IV–V) and anal (S. I–III).

Prognosis.—The outlook is always serious. Laminectomy is of little value in most cases of injury to the cord, because the damage is already irreparable, and medical treatment is of little avail.

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12. HEMORRHAGE INTO THE CORD AND MEMBRANES

Etiology.—This may occur as the result of injury, accompanied or not with evidence of gross damage to the spinal canal. Bleeding into the substance of the cord especially may occur as the result of trauma, with rapidly developing symptoms, and yet with no evidence of fracture, dislocation or sprain in the spine. In death from violent dyspneic affections and in myasthenia gravis, capillary hemorrhages are found in the cord. Hemorrhage from arteriosclerosis with high vascular tension, so frequently seen in the brain, is rare in the spinal cord. Hemophilia and purpura are to be considered in the etiology of hematomyelia. The common cause is trauma, as in crushes, falls, and the injuries to the infant spine in difficult delivery. The increased blood pressure of severe muscular exertion, even in labor, may possibly induce vascular rupture. The hemorrhages may be multiple, or a single considerable focus may be found. The central gray matter is of loose texture, and the bleeding is likely to infiltrate this portion even for a distance involving several segments of the cord.

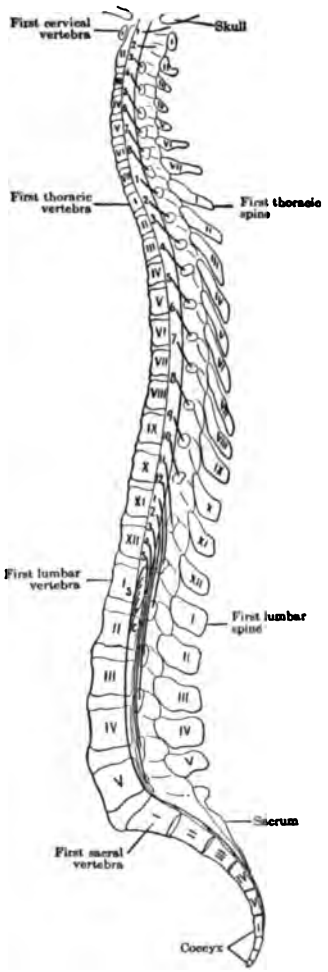

FIG. 123.—THE NERVE ROOTS AND SEGMENTS OF THE SPINAL CORD IN THEIR RELATIONS WITH THE BODIES AND SPINES OF THE VERTEBRÆ. (After Gowers.)

Symptoms.—These depend upon the location in the cord. Preliminary numbness and tingling are rare, the abrupt development of a complete paralysis such as occurs in a transverse myelitis at the same level being the usual manifestation of hemorrhage.

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Slow development of symptoms suggests a secondary hemorrhage. Pain may be present, and may be intense, radiating, or in the form of a girdle sensation about the trunk. Paralysis is generally complete below the point of the bleeding. The diaphragm continues to act if the lesion be below the fourth cervical segment.

In case the hemorrhage be slight, the central portions of the cord are more especially involved, the fibers for pain and temperature senses being compromised, with retention of the sense of touch, as in syringomyelia. Involvement of the anterior horns of the cord produces the atrophic type of paralysis, with reaction of degeneration. The signs and symptoms of an incomplete myelitis may be present, or a Brown-Sequard type, in case only one half of the cord be destroyed.

Course.—Absorption of the effused blood may result in a partial recovery, but complete restoration is not to be expected. Permanent paralysis remains if the response to electrical stimulation completely disappears. In severe types of hemorrhage, death may occur within a few hours, or in much the same manner as in complete transverse myelitis, which the cases so much resemble. The rapid and fatal course of high cervical hemorrhage should be noted.

Diagnosis.—This depends upon the common history of injury, the abrupt development of the symptoms, the rapid course, in the severer types, and the rapid improvement from partial absorption in the lighter ones. The localization in the cord may generally be quite closely determined.

MENINGEAL HEMORRHAGE

(*Hematorrachis*)

Etiology.—The causes in general are the same as in hematomyelia, trauma being the most common one. In the violent muscular contraction of tetanus, bleeding may occur into the canal outside the dura, and an aneurism may burst into this space. Rupture of a vessel of the pia mater may occur in violent forms of meningitis, and the cerebrospinal fluid may be discolored by the blood.

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Symptoms.—These result from the pressure upon the spinal nerve roots and the meninges and the cord. Pain, generally sudden and often violent, with tenderness of the affected portion of the spine, is the first symptom. The pain often follows the distribution of the nerves. Paresthesia and muscular spasm may be present. Shock and even loss of consciousness may be noted. The blood often sinks to the lower end of the canal, and causes sensory symptoms in the area supplied by the nerves originating here. The hemorrhage does not commonly damage the cord as does the corresponding lesion within the cord substance, though complete paraplegia may be present. After some hours the symptoms generally reach their height, and if death does not supervene from respiratory paralysis, when the hemorrhage is high in the canal, or from shock, gradual improvement may be expected after the phenomena of irritation from the effused blood subside.

After a few weeks more or less complete restoration may be hoped for, but in rare cases only can full recovery be expected under a period of many months, and permanent partial disability is not uncommon.

Prognosis.—This depends upon the extent and cause of the hemorrhage and its location. The predominance of symptoms of irritation of the nerve roots and meninges over those of structural damage to the cord itself, and the absence of complete paraplegia, severe shock, loss of consciousness, and respiratory involvement are favorable signs.

13. SPINA BIFIDA

This is a developmental defect involving failure of the vertebral arches to unite posteriorly. It is most common in the lower portion of the spine. If the dura only be pushed outward and distended by the spinal fluid (meningocele) the case may be amenable to surgical procedure and cure may result. Unfortunately the cord and spinal nerves are involved in the wall in most cases (meningomyelocele), the central canal of the cord being distended with fluid or the nerves being attached to the wall of the sac. These cases cannot be successfully operated upon; for though recovery may en-

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sue, hopeless damage results from the involvement of cord and nerve roots.

Spina bifida is often associated with other developmental defects, and many of the cases die within a few days after birth.

Symptoms.—None may be present in simple meningocele, the tumor being the only evidence of abnormality. Pressure upon the sac increases the cerebral pressure, and may be dangerous to life. The fontanelles bulge under this procedure. If the cord and the nerves be involved in the sac, irritation from handling may induce spasmodic contraction in the legs in the cases where paraplegia is not already present. If a local growth of long hair be found over the spine, search for spina bifida should be made, since it is a frequent accompaniment.

DISEASES OF THE CAUDA EQUINA

The spinal cord ends opposite the second lumbar vertebra, and the nerve roots passing downward to make up the lower spinal nerves, which come out at their respective foramina, constitute the cauda equina. Any of the processes damaging the cord or its meninges above this region may induce disease in these nerve roots. Pain may be felt in the lower abdomen and pelvis, and in the legs and feet, or hyperesthesia, anesthesia, etc., may be present. The distribution may be segmental, since each pair of nerves represents a segment of the cord. Motor paralysis is peripheral in type, for the nerve roots belong to the peripheral nervous system. Flaccidity, atrophy, and reaction of degeneration are then present, and the tendon reflexes are lost in the muscles supplied. Relaxed sphincters, contractures and bed sores are present in the serious cases.

14. VASOMOTOR AND TROPHIC DISEASES

A group of disturbances of function depends upon some disorder of the blood supply to a given part, the vasodilator or vasoconstrictor fibers failing to receive or conduct the proper impulses for the regulation of the circulation. Redness, pallor, gangrene, increase or decrease of secretion, anesthesia, paresthesia or trophic changes, espe-

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cially in the skin, nails and hair, result from the vasomotor disorder, either alone or in various combinations. Disease of the various parts of the nervous system may accompany the trophic and vasomotor features, or the latter may apparently be the predominating manifestations of the trouble.

A. RAYNAUD'S DISEASE

(*Symmetrical Gangrene*)

This is a trophic disease, dependent upon vascular changes, but without organic disease of the vessels, affecting chiefly the extremities, with ischemia, hyperemia and gangrene of the affected parts. The process may stop short of the destruction of the tissues.

The disease is a comparatively rare one. It occurs especially in hysterical and neurotic individuals, and particularly in cold and damp weather. Young women are most frequently affected.

Symptoms.—The first manifestation of the disease is the local syncope, generally affecting fingers or toes, the organs becoming pale, or bluish, shrivelled and cold (dead fingers). The involvement is generally symmetrical. Numbness, tingling and anesthesia are present, generally without notable pain, and without paralysis. After a time the ischemia may suddenly give way to hyperemia, every vessel is dilated and full of blood, throbbing may be felt, and the skin becomes red and very warm. In the stage of local asphyxia the skin becomes bluish from the intense venous congestion, the surface being cold from the stagnation of the circulation, and the parts being painful. If the spasm of the vessels continue, blebs may form and local gangrene may develop. Different fingers may be in different stages of the disease at the same time. Mild symptoms may occur for years, appearing and disappearing, without the advent of gangrene. In the more severe forms, gangrene of the pads or tips of the fingers ensues, and occasionally the tip of the nose and the ears may be involved. In the height of the disease it would appear as if the toes, for example, would be entirely lost from the extent of the gangrenous process, but as a rule the necrosis is much less than seems probable

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at this time. Pain is severe at this stage. Recurrences are to be expected. In the worst cases the hands and feet are eventually lost, with lesser damage to nose, ears, chin, eye-lids, lips, etc.

Amongst milder manifestations of the same vasomotor disorder, are chilblains, in which superficial necrosis may occur, and the "red hand" (beef steak hand) seen especially in young women.

Hemoglobinuria, either permanent or paroxysmal, may be present, especially in males. It occurs after exposure to cold, mental stress, etc., and accompanies the local changes in the extremities. Albumin may appear in the urine. Purpura and urticaria have been noted. Amblyopia, dependent upon changes in the blood supply to the retina, has been described. Transient hemiplegia, aphasia, or other evidence of localized spasm of the cerebral arteries has been observed in many instances. Epileptic convulsions may occur. It is well known that Raynaud's disease is not infrequent in various types of insanity. Inflammation of certain joints, a chronic arthritis, is occasionally present.

Diagnosis.—The diagnosis of Raynaud's disease is based upon the occurrence of the vasomotor changes indicated above, symmetrically distributed, and not dependent upon certain other well known causes of gangrene to be enumerated.

Ergot may cause symmetrical gangrene most closely resembling Raynaud's disease, but ergotism is practically unknown excepting as the result of the use of diseased rye in times of famine. The frequently symmetrical distribution of frost bites could not cause difficulty in diagnosis if the history of the case were investigated. The gangrene of diabetes is rarely symmetrical, and the presence of glycosuria is decisive. Gangrene from obliterative endarteritis causes the greatest number of errors in diagnosis, and the frequency of vasomotor changes preceding the gangrene adds to the difficulties. The generally advanced age of the patient, the absence of pulsation in the affected peripheral vessels, and the obvious arteriosclerosis are distinctive points. The frequent association of diabetes with the arteriosclerosis should be noted.

Erythromelalgia is closely related to Raynaud's disease, and will be discussed in the next section. In acrocyanosis there is a livid

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appearance of the extremities, with numbness and tingling, and the parts may undergo changes similar to those noted in Raynaud's disease with the exception of necrosis. In typhus and typhoid fevers, and occasionally in malaria, multiple areas of gangrene may be found, but not confined to the extremities. The necrotic manifestations of Morvan's disease are associated with other signs and symptoms of syringomyelia.

Prognosis.—The disease may produce terrible suffering and deformity, but as a rule life is not endangered. Recurrence is to be expected.

B. ERYTHROMELALGIA

(*Red Neuralgia*)

This is a rare chronic affection in which a foot or hand is painful, flushed and hot, the symptoms being exaggerated if the part hang down in such a way as to interfere with the return circulation. The congestion and pain may develop gradually or come on in paroxysms, and gangrene has been known to follow. The burning pain, throbbing and fever are to some extent relieved by elevation of the part.

The symptoms are generally exaggerated during hot weather. Sensation is not materially interfered with.

Pathologically the disease probably depends upon sclerotic changes in the vessels and a peripheral neuritis in combination, but the possibility exists that the cord may be involved. Raynaud's disease may develop.

C. ANGIONEUROTIC EDEMA

This is a disease characterized by the occurrence of local and transient edematous swelling, analogous to the lesion of urticaria, and occasionally called "giant urticaria." The lesions may develop internally as well, giving rise to colic or other manifestations of their presence. The swelling appears to be an exaggerated form of that seen in ordinary urticaria. The disease is not infrequently hereditary.

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Symptoms.—A painless swelling occurs suddenly, pale at first, perhaps flushed later, and involving most frequently the eyelid, tongue or lip, but not rarely the extremities or the laryngeal and pharyngeal regions. The danger in these latter cases lies in the possibility of mechanical obstruction of respiration, because of the swelling. The colic, nausea, vomiting and diarrhea occasionally noted signify the involvement of the digestive tract in a manner analogous to that discussed under "erythema with visceral lesions."

The mucous membranes are often involved in the swelling and the mouth may be closed for hours by the swelling. Hematuria, hemoglobinuria, and the passage of blood by the bowel may be noted.

The relations of angioneurotic edema to the closely allied erythematous diseases should be noted. (*See* Osler: "Visceral Lesions of the Erythema Group.")

D. FACIAL HEMIATROPHY

This is a rare disease, characterized by atrophy of the tissues of one side of the face. The disease is of trophic origin, and probably depends upon an interstitial neuritis of the trigeminal nerve. It commonly begins in childhood, and injury or slight illness may precede its development. It progresses slowly, the fat and the bony tissues being more involved than the muscles. The skin becomes atrophic and the hair may become white or fall out. Perspiration may be suppressed and the affected side may show a lowered temperature. From atrophy of the alveolar process the teeth may drop out and the tongue may be shrunken upon the affected side. Paresthesia may be complained of and twitching of the muscles may occur. It is possible for the disease to be bilateral. Trigeminal neuralgic pain may occur. Taste may be interfered with.

Diagnosis.—This is commonly easy if attention be paid to the difference in size of the respective sides of the face. The distortion of the face in wry neck and the deformity of facial paralysis should be considered. The involvement of the muscles in progressive muscular atrophy has been described.

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E. HEREDITARY EDEMA OF THE LEGS

This affection is of the familial type and characterized by persistent edema of the legs without known cause, and troublesome only because of the inconvenience of the swelling. The edema may suddenly increase in attacks accompanied by chill and fever.

F. SCLERODERMA

Definition.—An induration of the skin, either localized or diffuse. In the localized form, patches of hardening of the skin occur, ranging up to several inches in diameter, especially about the neck and breasts in women, persisting for years or disappearing in a few weeks. The skin affected is waxy and inelastic, without sensory change of note. The sweat secretion is suspended.

In the diffuse form the skin of the face or extremities becomes thick, hard and firm, cannot be picked up in folds, interferes with movement of the parts, and may be dry, glossy and smooth. Cyanosis occurs in certain cases and pigmentation in others. The disease may be of universal distribution and may last for months or years, arrest or recovery taking place. The fingers may be affected by a similar process (sclerodactyly), becoming shortened and atrophied, and the skin being pigmented. Cold weather affects the subject unfavorably. Scleroderma neonatorum is a rare manifestation of the same general process.

15. PROGRESSIVE NEURAL MUSCULAR ATROPHY

This type was first described by Charcot, Marie and Tooth, and is often spoken of as the peroneal type of muscular atrophy, because of the common early involvement of this group of muscles. It is an affection of childhood, without known exciting cause, and implicates chiefly, as one of the names suggests, the distal muscles of the lower extremity, although the disease may begin in the upper extremity. The hands and forearms are more often involved later. The upper muscles of both upper and lower extremities are commonly unaffected. The face, shoulders and trunk escape.

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The disease may affect several children in one family, and a hereditary tendency is not uncommon. Because of the weakening of the peroneal group of muscles talipes equinus and equinovarus are noted in many of the affected children. The gait becomes awkward because of the foot-drop, the feet being spread widely apart. Fibrillary contractions are present in the affected muscles. Sensation sometimes remains unaffected. The muscles show a decrease or loss of their electrical excitability. The tendon reflexes are commonly lost.

Diagnosis.—This depends upon the recognition of the hereditary tendency, the development in early childhood, the affection chiefly of the fore-arm and lower leg muscles, the presence of fibrillary contractions and absence of tendon reflexes, lack of sensory disturbances, and the slow course.

The differential diagnosis is discussed under progressive muscular dystrophy.

The disease shows no especial tendency toward death, and, after the atrophy reaches a maximum the patient may live for many years without material change.

16. PROGRESSIVE MUSCULAR DYSTROPHY

Definition.—This is a progressive wasting of the muscles, sometimes preceded by hypertrophy, oftentimes hereditary, accompanied by marked muscular enfeeblement, and characterized by primary changes in the muscular tissue. The muscle fibers may disappear in the extreme types. Atrophy of the cells in the anterior horns of the spinal cord and degeneration of certain peripheral nerves have been described in certain cases, but the notable changes are in the muscles themselves. In the pseudohypertrophic type there is increase in size of the muscle fibers with accumulation of fat cells.

The disease is transmitted through the female line as a rule, but males are more often affected. In a considerable proportion of cases no heredity could be traced. Some of the cases have followed typhoid and possibly other infectious diseases. In most cases the

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symptoms set in before puberty, and in nearly all in the first third of life.

Symptoms.—These relate to the weakness of the affected muscles, clumsiness in movement being first noted. This is the more prominent in case the pseudohypertrophy be present, since the child in the early stages may then present the appearance of great strength. The calves are especially involved, though frequently the muscles of the thighs, the glutei and the shoulder muscles participate in the hypertrophy. Wasting of other muscles occurs, generally sparing those in the distal portions of the limbs. In the trunk, the latissimus dorsi, the pectoral and the abdominal and lumbar muscles are weakened and there results the characteristic abdominal prominence and throwing back of the shoulders. The waddling gait is the result of the weakness, the patient bending the body laterally in order to swing the foot and leg forward. As the disease advances the child finally rises from the floor in the manner illustrated by Gowers—by turning on the face, raising the trunk and then supporting the hands upon the legs as the trunk is gradually straightened. The procedure is pathognomonic.

The hypertrophic muscles gradually waste, the general atrophy becoming most striking, and the weakness so great as to render the subject bed-ridden. The reflexes diminish and finally disappear. Fibrillary tremors are conspicuously absent. The sphincters are unaffected and no sensory symptoms are to be noted.

Certain results of the weakness of the atrophic muscles are deserving of mention. The scapulæ project ("winged"), and the shoulders fail to carry the weight of the body in the normal way if the child be lifted with one hand in each axilla ("loose shoulders"), because of the weakness of the musculature. The lordosis may be extreme. The enlargement transversely of the base of the neck, with flattening anteroposteriorly, as described by Marie, is fairly characteristic. Marked contractures are noted in the limbs in certain cases.

Slight mental enfeeblement, scleroderma and atrophy of bone may be present late in the course of the disease.

Although no sharp lines of demarkation exist between the differ-

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ent types of progressive muscular dystrophy, Erb's classification is a convenient one. Its features may be presented as follows:

1. Cases occurring in childhood:—

A. Hypertrophic

(a) The muscles are fatty (pseudohypertrophy).

(b) Real hypertrophy exists.

B. Atrophic

(a) Muscles of face are involved early (infantile form of Duchenne).

(b) Landouzy-Dejerine type. Facial involvement is absent.

2. Cases occurring in youth and adult age:—Erb's juvenile form.

It should be stated that, although most cases may be assigned to one of the classes given above, Erb admits the occurrence of great variations of type, and of transitional types. The face is said to be rarely involved in this country, but not uncommonly in France.

Diagnosis.—In the pseudohypertrophic form the diagnosis may be made from the characteristic gait, protuberant abdomen, and the method of rising from the floor. In the infantile form the involvement of the face and shoulder muscles, with difficulty in closing the eyes and mouth, and in moving the arm and shoulder, is characteristic.

The juvenile form of Erb commonly begins at or after puberty, involves chiefly the shoulder and upper arm muscles at first, but extends even to the legs, and with pseudohypertrophy in certain cases.

Differential Diagnosis.—This concerns chiefly progressive neural muscular atrophy. The two diseases may be thus contrasted:

	PROGRESSIVE MUSCULAR DYSTROPHY	PROGRESSIVE NEURAL MUSCULAR ATROPHY
Heredity	Frequently noted	Frequently noted
Age of onset..	Childhood and youth	Generally in childhood

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	PROGRESSIVE MUSCULAR DYSTROPHY	PROGRESSIVE NEURAL MUSCULAR ATROPHY
Parts chiefly involved ...	Shoulder, arm, face, trunk, neck, and limbs, especially proximally	Forearms and lower legs
Pseudohypertrophy	Present	Absent
Fibrillary tremors....	Absent	Present
Sensation.....	Unaffected	Often affected
Electrical excitability ..	Perhaps diminished but no reaction of degeneration	Markedly decreased

The characteristic distribution of the atrophy in multiple neuritis, with the marked sensory symptoms and steppage gait, and frequently the knowledge of the toxic or traumatic origin, are decisive.

The primary involvement of the muscles of the hand in spinal muscular atrophy occurring in adult life, the increased reflexes, fibrillary twitching, and reaction of degeneration prevent confusion in the differentiation.

Prognosis.— The disease is slowly progressive, death occurring from intercurrent disease or from exhaustion. The course is little influenced by treatment.

17. TUMORS OF THE SPINAL CORD

They are rare as compared with tumors of the brain. Although they may originate in the cord itself, the majority arise from the dura or from some of the other tissues serving to encase the cord. The symptoms depend upon the compression and destruction of the cord and not upon the nature of the tumor. Sarcoma, glioma, gumma, fibromyoma, and carcinoma are most frequently found. The frequency of involvement of different regions of the cord was in order

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from above downward—cervical, dorsal, lumbar, and cauda equina —in the fifty cases collected by Mills and Lloyd. The thoracic cord is nevertheless, according to most statistics, more frequently involved and the involvement more serious.

The symptoms are at first those of irritation of the meninges and the nerve roots, and later those of compression of the roots. The history of this mode of development is of prime importance. Pain from sensory root involvement, with various paresthesiæ, perhaps a girdle sensation, is followed by paralysis of certain groups of muscles, according to the segments affected, and by complete anesthesia of the region corresponding to these segments, and at times by the painful form known as anesthesia dolorosa. As the compression increases we may find the signs of a myelitis predominating, rendering the disease indistinguishable from the common forms of myelitis unless by the history, or by the local signs of bony or other disease of the spine, or history of syphilis, gumma or malignant growth. A laterally situated tumor may give a fairly accurate Brown-Sequard type of paralysis.

Diagnosis.—The history as noted above is of great importance. Sensory features are of much value when present, but they may be almost utterly lacking in the early stages, and paraplegia may ensue before any complaint of pain is heard. Yet the incidence of paraplegia after nerve root pains, in the absence of bony disease, is very suggestive of tumor. The diagnosis of gumma is to be made from the evidence of syphilitic infection and not from the character of the cord lesion. Sarcoma and carcinoma may be suspected if the original lesion be found elsewhere, but they may be primary in the spine. The malignant course of the affection is suggestive. Tumor may follow trauma. Tuberculosis more frequently involves the cord through the precedent bony disease. Meningeal cysts can scarcely even be suspected during life. The nature of the tumor is thus difficult of diagnosis. The location is dependent upon the evidence of involvement of the different segments of the cord.

Prognosis.—This depends upon the nature of the tumor, many being malignant and therefore inoperable, and upon the possibility of surgical removal. In doubtful cases exploration should always

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be done, for in no other way can the exact diagnosis be settled, and it offers the only chance for recovery unless early antisyphilitic treatment is able to clear up the effects produced by a gumma. Pain may be relieved by decompression even though the tumor itself prove to be inoperable.

18. POSTERIOR LATERAL SCLEROSIS

The tendency of late years is to consider the symptom-complex formerly described as ataxic paraplegia as the first stage of subacute combined sclerosis, complete spastic paraplegia and flaccid paraplegia representing the second and third stages (Russell) although ataxic paraplegia is also recognized as a chronic disease lasting many years.

We shall discuss both of the conditions mentioned, and also the similar cord lesions of pernicious anemia. A similar degenerative combined lesion is found in nearly half the cases of paresis and may appear in advanced tabes.

Etiology.—Posterior lateral sclerosis begins in middle life and affects the two sexes about equally. It is not commonly associated with a history of syphilis, but occasionally with that of some wasting disease, chronic diarrhea, prolonged suppuration, or other exhausting process. Simple anemia may be present, but in pernicious anemia a special type of degeneration is noted.

Pathology.—Sclerosis of the posterior columns is the most striking feature, resembling that of tabes, but associated with degeneration of the pyramidal tracts. In some cases, the direct cerebellar tracts and other portions are more or less affected. The involvement of the various columns may vary at different levels in the cord.

Symptoms.—Ataxic Paraplegia.—The disease begins in the second half of life, without obvious cause in most instances. Numbness and tingling in the legs, with stiffness, spasticity and ataxia are noted. Clumsiness and difficulty in raising the toes in walking are soon noted. The reflexes are exaggerated, and the Babinski reflex is present. The ataxia is so marked that tabes is commonly suspected. The feet are watched with the eyes, because of the ataxia.

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No sensory or sphincter troubles are present as a rule. The tabetic features of the cord involvement may be more pronounced in certain cases, so that lightning pains and bladder disturbances are not unknown. After many years the upper limbs may be affected, with similar increase in the reflexes, and ataxia.

Subacute Combined Sclerosis.—Russell divides this disease into three stages. The first is represented by the condition just described as ataxic paraplegia, excepting only that the trouble develops as a subacute rather than a chronic disease. It may even be announced by malaise, palpitation, fainting attacks, etc. It merges into the second stage, that of spastic paraplegia, quite abruptly in certain cases, after having run a course of weeks or months.

In the second stage the involvement of the posterior columns becomes more evident, with complete ataxia, loss of cutaneous sensibility, girdle sensations, lightning pains and loss of sphincter control. The exaggeration of the deep reflexes and the Babinski phenomenon are noted.

After some weeks the third stage or stage of flaccid paraplegia is reached, with muscular atrophy, loss of tendon reflexes, of cutaneous sensibility, sphincter control and faradic excitability of the muscles.

The cranial nerves are occasionally affected, convulsions or mental disturbances may occur and even trophic lesions. Some fever is present aside from that often due to cystitis, bed-sores, etc. The total duration of the disease in its several stages may be from a few months to even two or three years. The anemia of the later stages is often pronounced.

In pernicious anemia symptoms closely resembling those of the earlier stages of subacute combined sclerosis are not uncommon, varying as the posterior or lateral columns are chiefly affected. The patient becomes bed-ridden, but often rather from the anemia than the secondary lesions in the cord. Two features of great interest should be mentioned—the possibility of improvement or even complete restoration for a time under treatment, and the opportunity for confusion with the symptoms of a multiple neuritis from arsenic given therapeutically.

Diagnosis.—This depends upon the presence of a combination of

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the features of tabes and of lateral sclerosis in varying degrees in the same case.

Differential Diagnosis.—Disseminated sclerosis and myelitis are to be especially considered, the former rather in the earlier stages, the latter in the later. The history and the careful study of the characteristics of the two latter diseases should suffice for the differentiation.

Prognosis.—The outlook is bad in all cases excepting the type depending upon anemia, where at least temporary improvement may be hoped for.

19. FRIEDREICH'S ATAXIA

Definition.—This is a family affection, characterized by slowly progressive ataxia of the lower limbs, trunk and upper limbs, with decrease of power and loss of reflexes, but without sphincter involvement.

Etiology.—The disease is an abiotrophy, the nervous tissues involved lacking the ordinary vitality and breaking down. It occurs in several children of the same family in many instances, is occasionally hereditary, and is especially found in neuropathic families in which drunkenness, migraine, hysteria, insanity, etc., are present. Consanguinity has been noted in the parents in certain cases. The sexes are equally liable.

Pathology.—The cord has been found notably smaller than normal, the atrophy affecting especially the posterior columns. The cerebellum may be abnormally small. Under the microscope posterior lateral sclerosis is evident, the changes extending in some degree to the direct cerebellar and neighboring tracts.

Symptoms.—This disease commonly begins at five to fifteen years of age, unnoticed until the depression of an acute affection, for example, brings the ataxic symptoms to the surface. It is noted that the child has developed slowly, especially in the lower limbs, and has been slow in learning to walk. The gait is hesitating and irregular with unsteadiness and stamping action of the feet. The child falls often, yet stands with but moderate unsteadiness, not increased upon

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closing the eyes as in tabes. The lower limbs become weaker, and the reflexes disappear, excepting that the Babinski phenomenon may be present upon both sides. The ataxia and weakness extend to the trunk and arms, and complete motor incoördination finally develops. At this stage walking, standing or even sitting may become impossible, and difficulty of speech and nystagmus appear. Muscular atrophy and contractures in the extremities are late phenomena. The absence of sensory features and of sphincter disturbances is to be noted in most cases.

Congestion of the skin of the feet and legs, from vasomotor paresis, lateral curvature of the spine and talipes equinovarus are commonly present. In the foot deformity the great toe is hyperextended at the proximal joint and flexed at the distal one.

Diagnosis.—This is based upon the familial nature of the trouble, the ataxia and muscular weakness, beginning in childhood, generally advancing upward, loss of reflexes, except that of Babinski, foot deformity, nystagmus and lack of sensory and sphincteric involvement, and of optic atrophy and ophthalmoplegia.

Differential Diagnosis.—Locomotor ataxia, presenting the ataxia and loss of knee-jerks is suggested, especially the juvenile form. The family history, early development, with absence of luetic infection, lightning pains and paresthesias, bladder disturbance, Argyll Robertson pupil, and optic atrophy suffice for the differentiation.

Disseminated sclerosis is suggested in sporadic cases. It rarely develops in childhood, presents an intention tremor rather than a gross muscular incoördination, a spastic gait, with difficulty in raising the toes from the ground, and sharply increased reflexes. The intervals of remission contrast sharply with the progressive course of Friedreich's ataxia. The choreas offer distinctive points of differentiation but should receive consideration in diagnosis.

Hereditary cerebellar ataxia should be mentioned. It differs from Friedreich's ataxia in developing late in life, so that many of the patients have married and produced children. The hereditary feature is thus more evident than in the type of Friedreich. The symptoms are the same in both diseases excepting that in the cerebellar form there are increased reflexes and ankle clonus, increased

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muscle tonus, occasionally lancinating pains, ptosis or other evidence of paralysis of the ocular muscles, optic atrophy and even Argyll Robertson pupil. The deformities of the feet and spine are commonly absent. Many cases intermediate in type between the two forms have been reported. Both affections are abiotrophic in nature and variations in symptoms occur as one function or another of the nervous system is interfered with by the extension of the degenerative process.

Prognosis.—The outlook in both forms is bad, since the disease is steadily progressive. The patients become finally bed-ridden and die of exhaustion or intercurrent disease.

20. LANDRY'S PARALYSIS

Definition.—Acute ascending paralysis as described by Landry is a quickly developing flaccid paralysis, with loss of reflexes but without sensory involvement, spreading from the feet upward in a few days, and generally fatal. In scarcely any other disease has there been such diversity of opinion in recent years as to symptomatology and pathology. Multiple neuritis, poliomyelitis and ascending myelitis have been especially included in the purview. Very recently Wickman and others have stated definitely that Landry's paralysis is a form of acute poliomyelitis, and there is much evidence in favor of their view. (*See* Section upon that disease.) It seems best to describe the affection as it has heretofore been recognized, although further study may place it definitely under the classification mentioned.

Etiology.—The cases are rare, are not known to be influenced by seasonal changes, nor by previous infections, and occur most frequently in young adult males. Although the great majority of investigators have found no bacteriological infection, a micrococcus resembling the pneumococcus has been found in the blood several times, and Buzzard, in one case, found the same organism "in the loose vascular tissue forming the external layer of the spinal theca." The disease was transmitted to the rabbit. Other observers have failed in experimental inoculations. Further study is needed.

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Pathology.—Hyperemia of the cord is generally noted. The gray matter is congested and may show minute hemorrhages. The cells of the anterior horns and of Clarke's columns present changes generally involving loss of chromatic granules, these alterations being marked in the regions first affected, as judged by the point of beginning paralysis. Fatty changes in the myeline sheaths may be noted. The spleen and mesenteric glands are often found enlarged.

Symptoms.—Languor and malaise with paraesthetic phenomena in the limbs, and aching of the back, may precede the acute febrile onset. The motor paralysis commonly appears first in the feet and legs, and spreads upward, either steadily or by sudden advances, involving successively the trunk, arms, and head, and finally the cranial nerve area. Death usually prevents the latter extension through paralysis of the respiratory mechanism. The disease occasionally involves the arms or a cranial nerve first.

Aside from the motor paralysis with loss of reflexes, there are practically no symptoms in most of the reports, mentality, sensation and sphincter control being unaffected. The bladder may not be emptied well, from loss of power in the abdominal muscles. In four out of five cases* the bladder was involved, retention and incontinence being present in two cases each. In one morphin was given for the early aching in the back, and two others complained of pain in the feet and back.

In the few cases which recover, general atrophy of the muscles is found after a few weeks. Gradual recovery of muscular power and of normal reactions may be hoped for, and recovery has been complete in a few cases.

Diagnosis.—No other disease presents an ascending type of practically pure motor paralysis of such rapidity of development. In acute poliomyelitis the constitutional symptoms are generally more severe and the pain in the limbs more notable. While the paralysis is flaccid in both diseases, it is general in Landry's paralysis, while certain muscles or muscle groups are sure to escape or recover in poliomyelitis. In multiple neuritis the muscles of the limbs are affected much more prominently than those of the trunk. The peri-

* Hall and Hopkins: *Jour. Am. Med. Assn.*, Jan. 12, 1906.

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pheral regions of the limbs are especially involved, a rule which does not hold in Landry's paralysis. Although the deep reflexes are abolished in both affections, the abdominal reflex is often preserved in multiple neuritis. The sensory symptoms are often very marked in the latter disease.

Prognosis.—One of the five cases, which we reported, recovered, but with great muscular weakness persisting. Because of the confusion as to the diagnosis, statistics thus far are of little value, but very few cases of true Landry's paralysis recover. This contrasts sharply with the prognosis in multiple neuritis, in which recovery generally occurs, and in poliomyelitis, in which recovery with permanent partial paralysis is the rule. Death occurs in Landry's paralysis through involvement of the respiratory muscles or the bulb.

21. LOCOMOTOR ATAXIA

(*Tabes Dorsalis*)

Definition.—A chronic progressive disease, characterized pathologically by degeneration of the posterior columns of the cord, and clinically by ataxia, loss of knee-jerks, Argyll Robertson pupils, and various sensory phenomena. The disease is closely related to syphilis.

Etiology.—Tabes occurs most frequently in males, the black and yellow races being less subject to it. Syphilis is an undisputed antecedent in 70 per cent. to 90 per cent. of the cases. When we recall the frequency of innocent and unsuspected lues and possible failure of the Wassermann reaction, the instances in which locomotor ataxia develops without known syphilitic basis become less impressive. It is safe to act clinically upon the assumption that tabes is always a syphilitic process. It follows the specific infection after five years to twenty years in most cases, and may appear even in a year. It is thought that from 1 per cent. to 5 per cent. only of syphilitics develop the disease, and the contributory influence of a special susceptibility to syphilis, of overwork, of injury, etc., must be considered.

Pathology.—The essential lesion is a degeneration of the posterior

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columns of the cord, visible macroscopically when fairly developed. In the early stages mild meningeal inflammation may be detected over the posterior aspect of the cord. The posterior roots, generally of the lumbar and sacral regions, first degenerate. An ascending degeneration of the columns of Goll and Burdack extends finally to the posterior root system, including the cells in the posterior ganglia. According to some observers the process begins in the posterior ganglia. The pathological changes may extend into the medulla, accounting for the cranial nerve features of the disease. The peripheral nerves eventually share in the degenerative process, and other structures in the cord, even the anterior horns, may be occasionally involved, with resulting muscular atrophy, or other symptoms.

Symptoms.—The early manifestations of tabes are sensory in character and referred to the parts supplied by the lumbar roots first involved. Thus numbness and pain in the feet and legs, with lack of proper sensation, as in using the feet in walking, are likely to be the first symptoms.

Sachs states the symptoms in order of importance as follows, any combination being possible: (1) lancinating pains; (2) Argyll Robertson pupils; (3) loss of deep reflexes; (4) Romberg symptom; (5) girdle sensation, hyperesthesia and delayed sensation; (6) hypotonia of the muscles; (7) bladder disturbances; (8) ataxia, especially of lower extremities; (9) sexual weakness; (10) cranial nerve palsies, particularly ocular; (11) optic nerve atrophy; (12) visceral crises; (13) trophic disorders. In most cases the first three features mentioned, with some type of paresthesia, are present for some time before the full development of the disease.

The lightning pains are the most constant of the early symptoms, often of extreme severity, and felt in the legs and feet. Their darting nature is characteristic. They are much less common in the arms and trunk but may even appear in the face (tabes superior). The pains are more or less influenced by atmospheric changes, and are frequently regarded as rheumatic.

The Argyll Robertson pupil is present in most cases, the pupil reacting to convergence and accommodation, but not to light. But one pupil may show the reaction. Myosis, irregularity of the mar-

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gin of the pupil and disparity as to size should be noted, the two latter features being suggestive of syphilis, in a general way, but often present in tabes.

Loss of knee-jerk and Achilles tendon reflex may be demonstrated in most cases, and both should be investigated. The deep reflexes of the upper extremities are of less value because of their frequent absence in health. The knee-jerk is occasionally absent, or may be in some degree inhibited in otherwise normal individuals. The superficial reflexes remain normal.

Romberg's sign, loss of static equilibrium, with swaying on placing the feet close together, especially on closing the eyes, is nearly constant. It depends upon impairment of deep and superficial sensibility. This symptom is generally absent or slight in tabetics with early optic atrophy.

Alterations in sensation are common but not noted unless especially sought for in most cases. The tactile sensation is decreased in the feet, over the tibia, over the front and sides of the chest, and the ulnar distribution. The diminution in the perception of pain and of temperature changes, and delay in transmission are notable. Misinterpretation of the character of the sensation and allochiria may be discovered. The anesthesia or hyperesthesia in the breast region is very characteristic in many cases. The senses of position, pressure and muscular movement are impaired. As the disease progresses all forms of sensation in the locomotory apparatus are more or less impaired or destroyed.

The decrease in muscular tone is of importance, permitting too free movements of the affected joints, and still further impairing the patient's ability to walk or perform other movements. The ligaments are so lacking in tone that the joints may be overflexed or overextended, the muscular relaxation favoring these movements. The spine is excessively "loose" in movement, the knees permit the legs to curve backwards, or the thigh may be placed against the trunk with the leg still extended upon it.

The ataxia is the central symptom of the disease. It is almost constant in the legs, but comparatively rare in the upper extremities. It depends upon the impairment or loss of those sensations of pres-

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sure, position and movement, and normal relations to other parts, upon which the coördinated use of muscles for the movement of a given part depends. The rough strength is not impaired, but the muscles overact or underact because of the patient's inability to estimate properly the extent of the action required. The patient becomes clumsy on his feet and especially so in the dark, when he cannot correct by sight the failure in his knowledge of the position and movement of his feet. The typical tabetic gait develops, and the patient attempts to walk only with the feet spread widely apart to widen the base of support, or uses a cane. The knees are raised higher than normal in walking, and the feet and legs are thrown forward clumsily, while the patient inclines his head the better to watch the movements. The inability to ascend stairs safely is often notable.

The ataxia is so marked in advanced cases that the patient cannot even cross the legs with any degree of certainty, and is wholly unable to stand on one foot. If lying in bed he cannot place one heel upon the opposite knee, or perform any similar movement requiring coördinated muscular action. In superior tabes the inability to touch the nose with extended finger and to make the fingers meet properly in front of the body, demonstrates the ataxia. The closure of the eyes exaggerates the failure in coördination in all movements.

Sexual impotence is a very common feature in tabes and many patients first call upon a physician because of it. Many men are much depressed over the matter. Females are naturally affected to much less degree. Loss of bladder control is often an early and always an important symptom. Painful urination and dribbling are followed by retention in many cases and eventually the catheter is required. Too often cystitis and infection of the whole urinary tract occur, and many patients finally succumb to this infection. Constipation and occasionally loss of control of the rectal sphincter over loose movements may be noted. Ptosis and strabismus are common early symptoms of tabes, as they are of cerebral syphilis, and in any given case the diagnosis between these two depends upon the associated phenomena.

Transitory diplopia, due to paralysis of one external rectus is

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very characteristic of tabes. Complete ophthalmoplegia may be present. Optic atrophy probably occurs in 5 per cent. to 10 per cent. of the cases, and is the important feature in the so-called ophthalmic type of tabes. It occurs early, causes complete blindness, and is commonly accompanied by only imperfect development of the ataxic symptoms. The fifth and seventh nerves are but rarely affected. Owing to the involvement of the tenth and eleventh nerves, hoarse voice and attacks of dyspnea with stridor are occasionally noted. Aphonia from affection of the recurrent laryngeal nerve is a rare feature. A fairly developed bulbar paralysis with degeneration of many of the motor nuclei has been described.

Crises.—The occurrence of attacks of pain or disturbance of function in many different regions may be noted in tabes, and is of utmost importance to the internist because of the frequency with which the diagnosis has heretofore been overlooked. Gastric crises are the most common and the most typical. There is some ground for the statement of Sachs that "they constitute a *terra incognita* for the general practitioner and the specialist in gastric and intestinal disorders." The attack consists in a sudden development of intense neuralgic pain in the epigastrium, with vomiting, often lasting for hours, or even a day or two, and then ceasing, more or less regardless of the treatment employed. One patient required a half grain of morphin hypodermatically for relief, but insisted that he did not suffer pain, but an indescribable distress. Certainly pain may be absent. Intestinal colic and diarrhea may represent an intestinal type of crisis. Nausea may be almost the sole symptom in the gastric attack. The pain may be in the lower lateral chest regions rather than in the epigastrium. Laryngeal crises, with terrifying difficulty in breathing, stridor, cyanosis and even convulsions, are much less common. They pass off in a few minutes. Pharyngeal, rectal, vesicular, renal and testicular crises are described, and the clitoris is the seat of pain in a few instances. The so-called cardiac crises may be of true anginal nature. Arterial hypertension is not infrequent.

The internist may see a disproportionate number of cases presenting gastric and intestinal crises, since many such cases apply

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for relief under the impression that gall-stones, gastric ulcer or other strictly digestive disorder is present. Of 24 successive cases of locomotor ataxia which I reported some years ago, nine had gastric, and two intestinal crises, and one woman presented the laryngeal form. This woman had gall-stones proven at operation, but no gastric crises. Another woman with a specific history was operated upon for pyloric ulcer, and in addition to the ulcer obstructing the outlet, a duodenal ulcer was found. The relief from gastro-enterostomy

FIG. 124.—CHARCOT'S KNEE. Extensive bony deposits about the right knee joint. Note irregular and roughened outline of articular surface of joint; also posterior subluxation. (Dr. S. B. Childs.)

was immediate. She later developed tabes with typical gastric crises. A similar case was operated upon for pyloric ulcer with recovery. Five years later he reappeared with tabes, gastric crises of the most striking character, hyperacidity, and a perforating ulcer of the foot. In another man of 32, gastric crises had been present for four years, and a gastro-enterostomy had been performed by a Chicago surgeon, but with the frank statement to the patient that nothing abnormal had been found in the abdomen. The patient gained 40 pounds in a few months and obtained temporary relief from the attacks under

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vigorous antisyphilitic treatment. It is humiliating to state that the diagnosis is frequently made after a fruitless exploration.

Trophic Disorders.—Various disturbances of nutrition dependent upon the damage to the trophic fibers are found in tabes. The perforating ulcer of the foot is the most common, the ulceration eroding deeply into the ball of the foot and healing with great difficulty. The low condition of nutrition permits the smallest injury to spread, and the condition becomes decidedly serious, although often painless. The arthropathy of tabes affects the knee most frequently, but occasionally the hip, shoulder, elbow or other joints. The swelling is painless, the joint surface is denuded so that one may hear and feel the grating within, effusion of fluid often occurs, and osteophytes develop. The joint may be overflexed or overextended, and much deformity results. The weakening of the tissues of the knee and foot results in deformity when carrying weight, aside from that due to direct involvement of the bones. Painless fractures are not infrequent because of the lack of proper nutrition and strength of the bone and the disturbance of sensation.

Fig. 125.—Charcot's Disease of the Left Knee. Note destruction of the condyles of the femur, with extensive bony deposits on posterior part of joint, and underneath the patella as indicated by the arrows. (Dr. S. B. Childs.)

Local sweating (palms), pigmentation and painful herpetic eruptions are occasionally seen. Atrophy of certain muscles may be pres-

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ent, and may depend upon non-use, upon peripheral disease of the nerves, or upon extension of the degenerative process in the cord to the motor roots or anterior horns.

Psychic Phenomena.—Many tabetics are depressed, irritable, and despondent. It is very common to see some of the manifestations of cerebral syphilis in connection with the cord disease, the most frequently seen being paretic dementia. The close relation between the two diseases should be recognized. (Tabo-paresis.)

Various subvarieties of tabes are noted by different authors. Superior tabes refers to the involvement chiefly of the upper extremities. The juvenile form is especially found in the young and results from hereditary syphilis. An incomplete form may persist for years. In the sacral form the symptoms relate chiefly to the parts supplied by the lower spinal nerves, so that bladder and rectal involvement and disturbance of the legs are prominent.

FIG. 126 —BILATERAL INVOLVEMENT OF KNEE JOINTS IN TABES. (Charcot joints.)

Course.—The disease lasts from 10 to 20 or 30 years in average cases. It is so prolonged that many changes in the combinations of symptoms may occur, so that there is much variety in the symptomatology in different cases and at different periods. Unless intercurrent disease ends the course of the trouble, the patient generally becomes bed-ridden, and bed-sores and incontinence appear.

Diagnosis.—In typical cases the diagnosis is easy. The sensory symptoms in the lower limbs, especially the lightning pains, the

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ataxic gait, Argyll Robertson pupil, the loss of knee-jerks, irregular pupils, and bladder and sexual troubles suffice. The addition of other features already mentioned, as the case advances, renders the diagnosis still plainer. Strümpell says, "If the three symptoms, lancinating pain, loss of tendon reflexes (patellar and Achilles) and

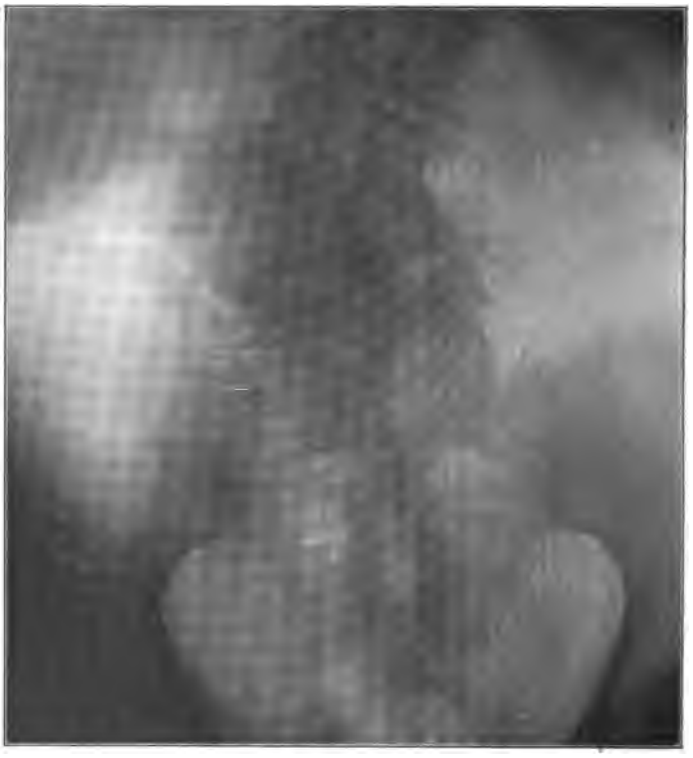

FIG. 127.—CHARCOT'S SPINE. Ostearthritis of the lumbar vertebræ in tabes. Condition verified at post-mortem. (Dr. S. B. Childs.)

stiff pupils are present together, then the diagnosis of tabes is absolutely sure even if all the other symptoms are absent. If only two of these symptoms are present, but the stiff pupils one of them, the diagnosis is practically certain."

The difficulty in diagnosis arises early in the case, when the usual signs and symptoms are not especially evident, and some unusual features attract the attention. Thus optic nerve atrophy,

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otherwise unexplained, suggests examination of the pupils, knee-jerks, etc. The visceral crises so simulate gastric ulcer, the more so because high gastric acidity is often found, or gall-stone disease, that many cases have come to me for diagnosis of a digestive condition, and already prepared to undergo operation. Many useless abdominal operations, because of failure to think of tabes, have been done in the past, even several upon one patient, as in a case reported to me. The examination of the pupils, knee-jerks, etc., and the result of the Wassermann reaction should prevent error.

Differential Diagnosis.—The consideration of the pupillary signs, reflexes, ataxia and other features should prevent error in the differentiation from the usual diseases of the cord. Syphilitic meningo-myelitis affecting the posterior aspects of the cord may give practically all the symptoms of locomotor ataxia, but with some symptoms of the active syphilitic process in addition. In ataxic paraplegia, the increased reflexes and lack of pupillary phenomena are notable. The especial difficulty in diagnosis lies in differentiating so-called "pseudo-tabes" or alcoholic multiple neuritis, which also presents loss of reflexes, ataxia and sensory disturbances. The history of alcoholism, the merely sluggish pupil reaction, instead of the typical Argyll Robertson pupil, the actual paralysis and atrophy of certain muscles, absence of sphincter troubles, pain upon pressure over peripheral nerves and the acuteness of onset distinguish the peripheral neuritis. Syphilitics are doubtless more liable to alcoholic neuritis than others. Arsenical and lead neuritis may require consideration. The differentiation from paresis takes into account the definite mental symptoms of the disease, the tremor of the lips and tongue, characteristic speech and general course. The tendency of either disease to run into the other must be noted.

Prognosis.—The disease may become arrested, but is incurable. Nevertheless the most troublesome symptoms may be so much alleviated that many patients continue with their life work for many years with comparatively little inconvenience. The amaurotic form is hopeless as to vision, but less severe in the other tabetic manifestations. The danger from urinary infection has been mentioned. Intercurrent disease often ends the course of the affection.

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22. ACUTE POLIOMYELITIS

(Infantile Paralysis)

Definition.—An acute infectious disease, affecting children especially, with flaccid paralysis, dependent upon the inflammation and subsequent degeneration of the gray matter of the cord.

Etiology.—The infectious agent is unknown. The disease appears about equally in the two sexes in children, and most frequently in the first five years of life. Amongst the less common adult cases males are more often affected. The hot summer months are especially favorable for its development. The disease varies much in prevalence in different seasons, and epidemics are not infrequent. It occasionally occurs in close connection with the infectious diseases. Probably trauma and exposure are of but little importance excepting as exposure and exertion may lower the bodily resistance. The occurrence of the disease in several members of the same family, and occasionally in pigs and chickens, points strongly toward its infectious nature. Flexner and Lewis have indeed been able to transmit the disease to monkeys, and infect other monkeys by way of the brain circulation and peritoneal cavity. The recent report that Rosenau, Anderson, and others have been able to transmit the infection from one monkey to another through the bite of the stable fly, Stomoxys Calcitrans, clears up the method of transmission.

Pathology.—In the acute stage there are found congestion of the meninges; the gray matter, especially of the anterior horns, is injected, and gross hemorrhages and softening may be demonstrated. Some round-cell infiltration is often noted. The white matter of the anterolateral columns is frequently damaged to some extent by the inflammation. The changes in the cord and brain stem are stated to be always more extensive than the paralysis would indicate.

If the examination of the cord be made years after the attack, the motor cells in the anterior horns are more or less completely destroyed and even absent in places, and actual cavities may be present. The fibroid changes resulting from the inflammation may cause shrinking and deformity of the cord. Secondary degeneration of

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the spinal and cranial nerves is found when the ganglion cells have been destroyed. The affected muscles are atrophied. It should be noted that an acute encephalitis may be caused by the same infectious agent that generally produces the disease in the cord. Paralysis of some of the cranial nerves is better known and is, in fact, a not very unusual phenomenon. The term acute poliomyeloencephalitis really defines the disease better than the ordinary one.

In view of the recent studies of this affection, we shall give Wickman's classification, but shall describe the ordinary form of the disease. The reader is referred to the special works for a more exhaustive study. Landry's paralysis, included here by Wickman, is described as has been usual heretofore under a separate heading.

Wickman's Classification

1. Ordinary spinal paralysis; anterior poliomyelitis.
2. Progressive paralysis, usually ascending, less often descending; Landry's paralysis.
3. Bulbar paralysis; polioencephalitis.
4. Acute encephalitis, giving spastic mono- or hemiplegia.
5. Ataxic form.
6. Polyneuritic; multiple neuritis type.
7. Meningitic form.
8. Abortive form.

Symptoms.—The disease begins with a mild febrile attack, without especial distinguishing features, and no hint of the diagnosis is generally obtained until the paralysis is discovered. The temperature may reach 100° to 103° and vomiting, delirium, and convulsions may be noted.

The paralysis generally appears in 24 to 48 hours. The lower limbs are commonly first affected, the arms not infrequently following, but a single leg may be the only limb affected. Pain is not a prominent feature of the disease, but the child resents being moved, and may cry with distress even at rest. I have known the pain in an adult to be severe enough to lead to a diagnosis of sciatica. At the end of the third or fourth day the constitutional symptoms have

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completely disappeared and marked improvement is noted in the paralysis by this time, especially in that of the arms if it be present. During the next few days the improvement continues, until, in an average case, the residual permanent paralysis is found to involve only certain groups of muscles, these being often in a single lower extremity, affecting the anterior tibial and peroneal groups by preference. The extensors of the hip are frequently affected. The asymmetry of the paralysis is fairly characteristic of the disease. A marked increase in the lymphocytes is described by Lucas.

FIG. 128.—RESULT OF ACUTE ANTERIOR POLIOMYELITIS. Paralysis of serratus magnus.

In the severe cases the trunk muscles are involved first, leading to the grave danger of bronchopneumonia. An extension of the process still higher may cause death in a day or two by paralysis of the muscles of respiration and deglutition, or with meningeal or bulbar symptoms, but these cases are rare.

The paralysis is of the flaccid type, with loss of reflexes, atrophy and reaction of degeneration. Growth of the bones is impaired in the affected limb, through loss of the trophic control, and the skin is likely to be blue and cold. Through the unopposed action of the normal muscle, various contractures occur, and talipes, scoliosis, lordosis, etc., may be the final result. The continuous growth of the normal tissues renders the deformity more striking.

No disturbances of sensation are noted, and the sphincters are unaffected. The improvement which invariably occurs in infantile

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paralysis may be considered at an end at the expiration of one and a half years, so far as nature's efforts are concerned. Epilepsy is an occasional sequel.

Diagnosis.—The disease occurs in children chiefly, with febrile symptoms at first, in the majority of cases, and extensive paralysis, improving greatly before the end of the first week, asymmetrical in distribution, flaccid in type, with absence of notable sensory symptoms, excepting the early tenderness and pain, and lack of involvement of the sphincters. No other disease fulfills all these conditions.

Differential Diagnosis.—The fulminant cases with meningeal symptoms are soon distinguishable by the paralysis. None of the diseases producing painful joints, such as rheumatism, rachitis, scurvy, and syphilis are attended by a true paralysis. Myelitis has commonly a symmetrical paralysis, with involvement of the sphincters. Multiple neuritis shows marked sensory disturbances and is especially much more likely to be painful, is slow in onset, symmetrical in distribution, and the nerves are tender. For a consideration of Landry's paralysis, which has many features in common with acute poliomyelitis, *see* page 464.

Prognosis.—The acute attack is not especially dangerous to life, unless the respiratory muscles be paralyzed. The outlook as to the paralysis after the first improvement, which always occurs if the patient lives, depends upon the degree of paralysis as estimated by the usual electrical reactions.

23. PROGRESSIVE SPINAL MUSCULAR ATROPHY

(*Chronic Anterior Poliomyelitis*)

Definition.—A chronic disease in which progressive muscular atrophy is dependent upon degenerative changes in the motor cells of the anterior horns and their peripheral processes.

Etiology.—The cause is unknown. Neither heredity, pregnancy, trauma, nor syphilis seem to be of importance in the causation. The disease appears generally in middle life, and the natural wear and tear upon cells of less than normal resistance may be the real explanation of its occurrence.

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Pathology.—Atrophy, degeneration, and even complete disappearance of the nerve cells of the motor nuclei in the anterior horns, and in the medulla in certain cases, are constantly found. Perceptible localized shrinking of the portion of the cord involved is apparent. The motor roots contain fewer fibers than normal. The white matter of the cord escapes in typical cases. If the degenerative process extend to the pyramidal tracts, the symptoms of amyotrophic lateral sclerosis develop, and Gowers believes the two diseases to be the same, excepting in the distribution of the lesions.

Symptoms (Aran-Duchenne Type).—Weakness and wasting of the muscles of the hands, especially the thenar, hypothenar and interosseal groups, are first noted, the shoulders, upper arms, and forearms being involved in succession and usually in this order. The right hand is first affected in most cases. Reflexes and the electrical reactions diminish and are eventually lost. As the disease progresses, the muscles of the neck, trunk, and lower limbs may be involved. The "claw hand," "monkey hand," and club-foot of different types develop. Fibrillary twitching is noted over the affected muscles, until the atrophy becomes intense. Head-drop and loose flail-joints show the weakness of the affected musculature. Sensory and sphincter involvement are absent.

In the upper-arm type the wasting first affects the biceps, deltoid, and scapular muscles. In another type, the lower limbs may be first attacked. Neurologists dispute as to whether the bulbar symptoms, when they occur, really belong to the spinal muscular atrophy or to that extension of the degenerative process which leads to amyotrophic lateral sclerosis; but of their occurrence eventually in chronic cases there is no question. The bulbar involvement may be the cause of death in those who escape the dangers of exhaustion, intercurrent disease and respiratory paralysis. Certain authors classify the more rapidly developing cases as subacute or chronic poliomyelitis. The muscular weakness in this type precedes the wasting, while in the true spinal muscular atrophy, in which the symptoms develop more slowly, the atrophy is the first sign of the affection, and weakness follows it. The diseases are essentially the same in all important particulars.

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The course of chronic spinal muscular atrophy is slowly progressive, but the patient may live for many years. In the type spoken of as subacute poliomyelitis, the course may be a more rapid and less even one.

Diagnosis.—The essential points in the diagnosis are the atrophy and weakness in the hand muscles, extending to the arm and other regions, with fibrillary tremors, loss of reflexes and electrical excitability, and absence of sensory and sphincter involvement.

Differential Diagnosis.—Amyotrophic lateral sclerosis is distinguished by the addition of the signs of involvement of the lateral tracts—spastic gait, increased reflexes, Babinski phenomenon, and ankle clonus—to those of the muscular atrophy.

FIG. 129.—PROGRESSIVE SPINAL MUSCULAR ATROPHY. About 12 years' duration.

Syringomyelia has the muscle-wasting but also dissociation of sensations, with the characteristic disturbances of pain and temperature senses and trophic troubles. The muscular dystrophies, myelitis, cervical pachymeningitis, and multiple neuritis all require mention, but the distinctive features of each suffice for the differentiation.

Prognosis.—The disease is rarely arrested and, so far as is known, never by medical treatment. The course may be expected to be a slowly progressive one, lasting from several to many years.

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24. AMYOTROPHIC LATERAL SCLEROSIS

Definition.—The definition of spinal muscular atrophy applies to this disease if we but add to it the spasticity and increased reflexes which arise from the involvement of the lateral columns in the same pathological process.

Etiology.—The cause is unknown. It is probable that, as in the case of spinal muscular atrophy, the cells involved fail in ability to stand the stress of life, and break down in middle age—an abiotrophy. Neither lead poisoning, alcohol, syphilis nor trauma are noted in the history of any considerable number of cases, and neither heredity nor occupation seems of importance. Males are affected slightly more frequently than females.

Pathology.—There is a degeneration of the motor tracts throughout their entire length, the cells in the cortex even being involved. The motor cells in the anterior horns, the anterior roots and peripheral nerves participate in the degeneration. The motor nuclei in the bulb are finally affected, giving rise to the symptoms of bulbar palsy. Intense atrophy of the muscles is noted.

Symptoms.—These commonly begin in middle life, exactly as in spinal muscular atrophy, with wasting, tremors, and weakness of the thenar, hypothenar and interosseal groups of muscles, these symptoms gradually spreading to the muscles of the forearm, upper arm, shoulder, neck, and trunk in many cases. The atrophy and wasting usually appear first in the shoulder muscles after the involvement of the hand. The legs are less severely affected, but weakness and spasticity are soon noted. The patient walks stiffly, and increased knee-jerks, patella and ankle clonus, and in typical cases the Babinski phenomenon, with spasticity in the upper limbs may be later in developing. Jaw clonus may appear. With the atrophy of the hand muscles, the claw hand and monkey hand are seen as in spinal muscular atrophy. The toes drag on the floor from the spasticity, and the patient stumbles easily from inability to raise his toes.

With the bulbar involvement the usual symptoms of bulbar palsy develop, and talking and eating become difficult, and death from choking is not unusual. There is no sensory involvement, and the

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sphincters generally remain normal. Mental failure does not appear until late in the disease.

Diagnosis.—This has been sufficiently discussed under spinal muscular atrophy, for amyotrophic lateral sclerosis merely adds spasticity of the limbs to the picture of that disease.

Prognosis.—The patients die in a few years, generally through the bulbar affection.

25. LATERAL SCLEROSIS

(*Primary Lateral Sclerosis*)

Definition.—A progressive degenerative disease of the pyramidal tracts, with spastic weakness and increased reflexes in the muscles of the limb.

Etiology and Pathology.—The cause is unknown. Degeneration in the lateral tracts is common, as a secondary process, in hydrocephalus and other cerebral affections, but the primary involvement only is to be considered, as the name indicates. Sclerosis of the lateral tracts affects first the thoracic and lumbar portions of the cord, is gradually progressive, and may eventually involve the entire motor system.

Symptoms.—The disease begins rather earlier than middle life in most cases, and frequently affects one lower limb before the other. Weakness in the muscles of the legs, spasticity and exaggerated reflexes, with the Babinski reflex, without sensory troubles, affection of the sphincters, atrophy or bulbar implication, distinguish the disease. The peculiar "clasp-knife reaction," in which the extensors suddenly straighten out the leg upon the thigh, or the "lead pipe rigidity," suggesting the difficulty experienced in bending the limb, and the "scissors gait," due to the spasm of the adductors of the thigh, are characteristic features. Because of the spasticity, the toes constantly strike the ground, and stumbling and wearing away of the toe of the shoe are observed. The preservation of the nutrition of the muscles is to be noted. The upper limbs are affected in less degree or escape entirely. The sclerosis may pass above the decussation,

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when jaw-jerk may appear, and involuntary movements of the facial muscles.

Several subdivisions are made by the specialists, but the essential features are as given above. A family form of an infantile variety is described.

Diagnosis.—This depends upon the exclusion of other processes than a simple primary sclerosis limited to the lateral columns, for the disease we are considering is rare in comparison with the number of affections in which the columns are diseased, either in conjunction with other parts of the cord, or as the result of a descending degeneration from the brain. The difficulties in the differentiation are such that the diagnosis during life is not grounded upon so sure a basis as in case of tabes, syringomyelia, etc.

The distinguishing features are weakness, stiffness and spastic phenomena in one lower limb, commonly extending shortly to the other, with scissors-gait, rigid muscles, and absence of sensory features and notably of atrophy.

Differential Diagnosis.—Secondary degeneration from cerebral lesions is commonly unilateral, though the opposite side may also be affected through a second attack (cerebral hemorrhage, etc.). The acute onset, presence of brain symptoms and the paralysis are distinguishing features. Arrested development of the lateral tracts, and their degeneration in connection with hydrocephalus or birth injuries are often found early in life, and may affect the upper limbs with the lower.

Tumor of the cord, compression in caries of the spine, combined sclerosis, multiple sclerosis, myelitis, amyotrophic lateral sclerosis, hysteria—all require differentiation. The evidences of disease of other portions of the cord, or stigmata of hysteria, should be found. Only in the cases lasting for many years without additional symptoms are we justified in the diagnosis of lateral sclerosis.

Prognosis.—The disease is incurable. The patient may become bed-ridden from the intensity of the phenomena; and contractures, even in the upper limbs, may develop. Bladder involvement may finally occur. The course may extend over half an ordinary lifetime.

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26. SYRINGOMYELIA

Definition.—This is a chronic disease characterized pathologically by the formation of cavities in the cord, and clinically by atrophy in the upper limbs, spastic phenomena in the lower, and by "dissociation of sensation."

Etiology.—It is more commonly met with in Europe than in America, where it is distinctly rare. It is more frequent in early adult life and in males. Congenital anomalies in the cord constitute probably the chief factor in its origin, but trauma and meningitis may be considered. Acromegaly has been found associated with syringomyelia.

Pathology.—In the cervical and dorsal regions of the cord is found a cavity containing clear fluid, and this cavity may extend upward or downward from the region of chief involvement. The gray matter of the cord is compromised by the cavity formation, which commonly lies behind the central canal, and extends in such a way as to involve the posterior columns in many cases, the lateral columns being affected rather by pressure than by cavity formation. The extent of the cavity varies at different levels and upon the two sides of the cord. The collection of fluid in the central canal is distinguished as hydromyelia, and this canal may not be involved in syringomyelia. The cord is much flattened by the pressure of the fluid.

The cavity formation is the result of the breaking down of gliomatous overgrowth. The possibility that a cavity may result from the breaking down of a hemorrhagic effusion in trauma, or of a tumor, must be considered.

Symptoms.—Owing to the variation in the size and location of the lesion and in the pressure effects produced by the accumulation of fluid in the cavity, the symptoms are extremely variable. The most characteristic features arise from the damage done to the fibers for pain and temperature which cross in the central gray matter, the region most often affected. The parts supplied by the fibers thus compromised then present a fairly normal tactile sensibility, but loss of sensation for pain and temperature (dissociation syndrome). The

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trunk or extremities may be affected, or the disturbance may be unilateral. Frequently the anterior horns and the lateral columns are involved, and atrophy, fibrillary tremors, weakness, spasticity and increased reflexes occur, dependent upon the parts of the cord chiefly involved.

The atrophy especially involves the upper extremities, the hand muscles of one side first, with extension to the arm and shoulder musculature as a rule. The legs may be similarly affected. The "claw hand" may develop, and fibrillary tremors and loss of reflexes in the paralyzed muscles finally appear.

From the damage done, more commonly by pressure, to the lateral columns, there arises a more or less complete and variable spastic paralysis. If the upper cervical segments are affected all four limbs may be involved, but it is more common for the arms to escape, the cord lesion being lower than the arm centers. The increased reflexes and spasticity in the lower limbs are notable, and the Babinski phenomenon is found.

In well-marked cases there also occurs a series of manifestations of the involvement of different fibers in the cord of which the following may be mentioned:

Spinal curvature and contractures of muscular origin; painless fractures; arthropathies; depression of the upper sternal region (thorax en batteau); chiromegaly—an increase in the size of the hand, often unilateral, and resembling the process in acromegaly; glossy skin, hypertrophy of the skin with fissures, dermatitis; changes in the nails; painless ulcerative lesions of the hands and fingers (Morvan's type); tremors, hyperidrosis; bulbar symptoms—atrophy of tongue or paralysis of the larynx from invasion of the bulb; loss of control of the sphincters; nystagmus, and ocular sympathetic paralysis from involvement of the cervical sympathetic.

Morvan's disease is a type of syringomyelia characterized by the extent and severity of ulcerative lesions of the hands and feet, a necrotic dactylitis.

Diagnosis.—This is often suggested by the occurrence of extensive injuries, burns, etc., of which the patient is unaware at the time of the injury, because of the *analgesia*. The patient who suffers an

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extensive burn of the back through accident and is not aware of it until the odor of burned flesh is perceived, as in one case, is presumably a subject of syringomyelia. The necessity of screening in radiators, hot water pipes, etc., in a given house is suggestive.

A systematic examination of the nervous system should be carried out. The disease is distinguished from amyotrophic lateral sclerosis and progressive muscular atrophy, in both of which muscular atrophy of the upper extremities occurs, combined with spastic paralysis of the lower in the former disease, by the distinctive features relating to the dissociation of sensations and the extent and severity of the trophic disturbances. Hypertrophic cervical pachymeningitis requires a careful consideration. The typical dissociation and the trophic lesions are absent.

Prognosis.—Although the process may become arrested, this does not result from medical treatment, and the outlook for recovery is hopeless. The course of the disease may run for many years provided death be not hastened by injuries with resulting trophic troubles.

27. CHOREA

SYDENHAM'S CHOREA

(*St. Vitus's Dance*)

Definition.—A disease chiefly of childhood, presumably due to the action of an infectious agent upon the nervous system, and characterized by involuntary muscular contractions and psychical disturbances.

Etiology.—The great majority of cases occurs between the ages of five and fifteen years, more frequently in females, and especially in families of neurotic disposition. Overworked, anemic and ill-fed school girls are especially subject to the disease, and it is definitely more common in the poorer classes. Negroes possess a certain relative immunity. It occasionally develops after scarlet fever and other infectious diseases, and is especially associated with acute articular rheumatism (25 per cent.), developing shortly after the attack

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in many cases. A severe form, often developing into the grave chorea insaniens, is found in young pregnant women, and 20 per cent. of these cases are fatal. The cessation of the choreic movements upon delivery or miscarriage is proof of the close dependence upon the condition of pregnancy. Epidemics of chorea may depend upon climatic influences. The occurrence of many cases in a school for girls should lead to careful differentiation of the true cases from those of hysterical imitation. Emotional influences, especially fright or mental stress, may immediately precede the development of the disease.

No definite proof of the dependence of chorea upon the supposed infectious agent of acute articular rheumatism or any other such agent has been brought forward, but it is probable that the disease depends upon the action of a bacterial toxin upon the nervous system.

Symptoms.—The cases may be classified as mild, severe, or malignant (chorea insaniens). Restlessness, peevishness, insomnia and frequently loss of appetite and indigestion are followed after a few days by irregular, purposeless movements, especially of the hands, with loss of power dependent upon loss of muscular control. The child cannot remain quiet. The movements of the hands, arms and face are generally more pronounced than those of the lower extremities. One side may be chiefly affected (hemichorea). The movements of the tongue, speech, respiration and other functions are interfered with through the irregular spasmodic action of the muscles involved. In certain cases a definite loss of power is present, especially upon one side (paralytic chorea). The movements cease during sleep in the mild cases. Embarrassment, nervous stress and the annoyance of being observed make the movements more frequent. There are no characteristic sensory disturbances. The psychic involvement may be anything from forgetfulness, irritability and minor disobedience in the ordinary cases to night-terrors, hallucinations, delirium and even stupor or dementia. The more serious of these complications point to the great gravity of the affection. The dementia may be permanent. The sphincters are not involved.

The most serious feature of the disease in many cases is the endocarditis, developing in from one-fourth to three-fourths of the

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cases. In 73 autopsies, 62 showed endocarditis (Osler), but these obviously included the more serious types. The mitral valve is especially affected, and many of the grave cases of disease of this valve are found to originate in chorea, or in those cases in which acute rheumatism has been present with chorea.

Course.—The average case lasts six to twelve weeks, but much variation from these figures may be found. Recurrence is not common.

Diagnosis.—The direct diagnosis is commonly made without difficulty by attention to movements of the general type indicated. The absence of the signs of organic disease is to be established.

Prognosis.—The outlook is good for recovery in cases of ordinary severity, but with danger from cardiac involvement. The possibility of recurrence must be considered. The mortality is 2 per cent. or 3 per cent. In the severe adult forms the mortality may reach 25 per cent.

HUNTINGTON'S CHOREA

(*Chronic Hereditary Chorea*)

Definition.—Huntington's chorea is an affection of adults, beginning in middle life, generally hereditary, with irregular choreic movements, and tending to terminal dementia. The disease seems to occur chiefly in certain regions, as on Long Island, where Huntington described it as having existed in certain families for four or five generations. He states that the families in general show neurotic tendencies. Almost every generation shows some of the cases, but if the chain breaks in a given family subsequent generations are free. Males are somewhat more liable to the disease. It has been stated to be due to sclerosis affecting the blood vessels supplying the motor cells.

Symptoms.—The motor manifestations are in the nature of choreic movements, at first confined to the hands and face, but extending to other regions with advance of years. The movements, while less rapid and abrupt than those of ordinary chorea, are wider in scope, but equally irregular and lacking in control. Terrible facial con-

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tortions result. When the legs become affected, the movements are so irregular as to produce an uncertain staggering gait. The speech becomes hesitating and difficult to understand because of the involvement of the muscles concerned. The reflexes are exaggerated, as a rule, and the strength is good. Sensation is not affected.

The psychic phenomena begin with irritability and depression, and suicide was common in the families studied by Huntington. After a few years a progressive mental deterioration sets in, finally ending in dementia. Delusions may occur.

Diagnosis.—Given the history of heredity, often difficult to obtain from the patient, the diagnosis is simple. Sydenham's chorea in adults and the senile chorea associated with arteriosclerosis must be considered.

Prognosis.—This is hopeless, the patients dying, after ten to thirty years, of exhaustion or some intercurrent disease.

OTHER SPASMODIC AFFECTIONS

Several other neuroses deserve mention—tics, habit spasm, saltatory spasm, etc.

Habit Spasm.—Simple tic, called also habit spasm and habit chorea, consists in the sudden brief contraction of a muscle or group of muscles, especially of the face, to some extent purposive in type and under the control of the patient. The spasmodic closure of the eye is the most frequent variety. The patient is relieved by the performance of the act but distressed by its suppression. In otherwise healthy individuals the affection is of little moment.

Convulsive Tic (Tourette's Disease).—This is a definite psychosis in which involuntary muscular movements affecting small or large groups of muscles, or generalized, are accompanied by the explosive ejaculation of certain words or phrases, perhaps obscene (copralia), or repetition of phrases (echolalia), or repeated imitation of movements (echokinesis).

A curious mental disturbance with strange impulses, ideas and obsessions may be present.

Jumpers.—This name is applied to those individuals suffering

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from a type of saltatory spasm, who jump as the result of the spasmodic contractions of the muscles of the legs. Echolalia and echokinesis often accompany the movements. In Java it is called latah and in Siberia, myriachit. In certain families, chiefly of French-Canadian descent, it occurs in Canada and in parts of Maine, and it is probably much more common than the ordinary text books would lead one to believe. The individuals spoken of amongst the lower classes as being "goosey" and who jump or utter cries upon being touched suddenly, in the ribs, for example, with the finger, with a sudden "s-s-s-t" on the part of the one touching them, belong to the class mentioned, and may be found in any considerable community. I know of several such subjects in Denver. Hysterical stigmata are frequently if not generally present.

Saltatory spasm may occur as an occupation neurosis in dancers.

The epidemic chorea (chorea major) of the middle ages, affecting many of the population at times of great religious enthusiasm, with dancing and strange gesticulations, was of hysterical nature. Something of the same general type has been noted in connection with protracted religious meetings in Kentucky and other parts of our own country.

Spasms may also occur in the face muscles, and in those of the tongue, larynx, palate, diaphragm (hiccough), neck (wry-neck), arms, etc.

Occupation Neuroses.—It has long been observed that those performing certain work (writing, typewriting, telegraphing, playing a musical instrument, milking, using certain tools in the arts, dancing, pitching in baseball, and even calling out certain phrases loudly, as in auctioneering) are subject to occupation neuroses. These involve fatigue of the muscles used, with aching and occurrence of cramps (tonic convulsions) and finally a motor paresis. The muscles may atrophy later. The cramps and tremor occur only upon attempting the habitual motion, and the muscles may be used in other occupations without difficulty. The attempt to use the corresponding group of muscles on the other side speedily sets up a similar condition there. Yet paralysis and atrophy in occupation neurosis *may* be due to a pressure neuritis. Neuralgic pains, anes-

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thesia, paresthesia and hyperesthesia are not uncommon. The psychic element in the development of the trouble deserves more consideration than many writers have given it.

The prognosis in occupation neuroses is not good as to recovery in the severe cases, the disease tending to return, even after months of rest and treatment, as soon as the same groups of muscles are called upon to perform the same actions.

Paramyoclonus Multiplex.—The affection described by Friedreich is characterized by clonic convulsions, sudden, and either constant or in paroxysms, affecting the muscles of the limbs or the entire body, but especially those of the legs. The eye muscles are exempt. The cases may originate after emotional disturbance, but no exact etiology or pathology is known. Adults are especially affected. Epileptic convulsions (myoclonus) occur in association with the disease in certain cases.

The prognosis is unfavorable.

Dubini's disease (electric chorea) found chiefly in Italy, presents unilateral choreic movements associated with fever, muscular atrophy and paralysis. It is thought to be of infectious origin.

28. HYSTERIA

Definition.—Hysteria is a functional disease characterized by a marked lack of self-control and often by simulation of other diseases. It is a definite disease, and should be recognized as such by the physician in his dealings with the patient and the family, for too often the idea is given out that the manifestations of hysteria are within the voluntary control of the patient. The lack of ability to exert the normal control over ideas, bodily functions, etc., is the essence of the disease. No pathological changes are recognized.

Etiology.—The disease is more common in races of Latin and Slavic extraction than amongst the Anglo-Saxons, but it is common all over the world. Young females are especially affected, but sturdy males may be subject to it. The extreme forms described by Charcot and other French authorities are rarely seen in this country. Heredity and a "neuropathic disposition" are of importance, and an emo-

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tional instability is present in most hysterical individuals even before the disease has definitely appeared. Fright, injury, disappointment in love and the various types of mental trauma are prominent causative factors. The influence of religious excitement, and of worry and introspection over often trivial sexual disturbances should be noted. Freud even believes that "trauma" in the sexual sphere in childhood is the definite cause of hysteria.

Symptoms.—Hysterical Stigmata.—Certain sensory symptoms of hysteria are so readily appreciated and of such importance in recognizing the degree of gravity of a given case that they deserve special consideration. The common hysterical hemianesthesia is more often seen upon the left side, and may be complete, involving the mucous surfaces as well as the skin and the special senses. The anesthesia commonly includes the senses for touch, pain, heat, etc., and the muscular sense may be affected.

The anesthesia is commonly complete, and exactly limited by the central line of the body. It may be transferred to the opposite side by suggestion. In this regard and in the fact that it fails to project beyond the median line or show the more marked peripheral loss of sensation or the motor affections, it differs from organic paralysis. The deeper tissues or even the nerve trunks may be affected. Anesthesia or hyperesthesia may affect but a single limb, or be of the stocking- or glove-shaped distribution, or occur in patches. Its bizarre distribution is an essential feature in distinguishing it from organic affections. The patient is commonly not aware of its presence until attention is called to it. Anesthesia dolorosa is not very common. Changes in the degree, type and distribution of the sensory paralysis are frequent, and intentional or accidental suggestion on the part of the attendant may have its part in modifying the phenomena, and even in producing them.

Headache and especially the so-called clavus, compared to the sensation of a nail driven into the top of the head, are often present. The points of ovarian tenderness, pressure upon which may induce the major hysterical attacks of Charcot, according to the French school, and tenderness of the breasts, spine, etc., or numbness and tingling sensations almost anywhere are often noticed. The hyper-

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algesias and neuralgias, enteralgia, cardialgia, etc., are very characteristic.

The special senses are often affected. The hysterical contraction of the visual fields, hemianopsia, ptosis, strabismus and even amaurosis and iridoplegia may be present. Deafness, loss of taste, loss of smell and aphonia are not uncommon. The feeling as of a ball coming up from the stomach to the throat (globus hystericus) is a common and distressing hysterical manifestation.

Motor Phenomena.—Tremors of the most varied type are common, often rhythmic, but at times irregular, and even choreiform. They may be local, general, bilateral, or of the intention type. They may disappear during sleep and are likely to be exaggerated by observation, or by attempts to control them. They may disappear if the attention of the patient be directed elsewhere.

The deep reflexes are commonly exaggerated, and false ankle clonus may be present. It is less regular in movement and more subject to change in character through attention, suggestion, etc., than the true clonus. It may last for many minutes. The Babinski phenomenon is regarded by most neurologists as of very rare occurrence in hysteria, if it really ever occurs. Diminution in the pharyngeal and corneal reflexes is very common, and when found in association with hemianesthesia and other phenomena of hysteria adds to the completeness of the clinical picture.

The motor paralyses of hysteria are of utmost importance. They vary greatly in completeness and distribution, duration and course. Perhaps 25 per cent. of hysterical patients show some form of akinesis.

Muscular weakness without definite paralysis is most common, but may easily develop into paralysis, especially under the influence of suggestion. About 50 per cent. of the paralyses are hemiplegic in character, generally more or less incomplete. The most common form is that in which the face escapes, but any variety may be seen. Monoplegia and paraplegia are also common. The sudden development of the paralysis is the rule. The absence of the Babinski reflex has been mentioned. The dragging of the leg contrasts with the swing of organic hemiplegia. The presence of other hysterical phe-

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nomena and the relief or transference of the paralysis by suggestion are of importance in diagnosis. Contractures may follow the paralysis, but may also develop in its absence. They may not follow the rule of the organic contracture as to type and may be absent during sleep. The giving of an anesthetic causes them to disappear.

Inferior paraplegia may follow the organic type or be present only when the patient assumes other than the horizontal position (astasia abasia). These types of paralysis may last for years, or disappear in a short time, even suddenly, and perhaps through sug-

FIG. 130.—SELF-INDUCED ERUPTION. Hysterical girl. (From the collection of Dr. A. J. Markley.)

gestion. The occurrence of facial, ocular, glossolabial and laryngeal paralyses and of pseudotabes should be mentioned.

Convulsions are a common feature of severe hysteria. Following a stage of irritability or depression, with palpitation and trouble in breathing, tonic convulsions appear, to be followed by irregular clonic convulsions. They are of the most varied and fantastic character —opisthotonus, emprosthotonus, pleurosthotonus, convulsive attitudes of entreaty, passion, imaginary struggling with an assailant, etc. The face may show something of the associated emotions. The convulsions partake of a dramatic character, totally wanting in those of epilepsy, uremia, etc. The absence of total unconsciousness, of

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loss of sphincter control, and of preliminary cry, frothing at the mouth, and biting of the tongue are conclusive against the diagnosis of epilepsy.

A stupid, fatigued condition follows, and certain of the patients pass into a cataleptic state.

An almost endless series of hysterical manifestations might be given. Aphonia has been mentioned. The voice may return under some special excitement or as the result of suggestion. Retention of urine is common, and the use of the catheter may accentuate the morbid conceptions connected with the function of urination and require its use for weeks. The phantom hysterical abdominal tumor, caused by contraction of the abdominal muscles, presenting resonance instead of flatness upon percussion, and disappearing under an anesthetic, should be noted. Various digestive symptoms,—anorexia nervosa, distention with gas, rumbling of gas in the bowels, merycism, sialorrhea and diarrhea should be mentioned, and the rare vomiting by the hysterical husband during his wife's pregnancy. Cough, sneezing attacks, dyspnea, anuria, local hyperidrosis, occasionally incontinence of urine, and even of the feces, and loss of flesh, also occur. Abundant pale urine is passed after the paroxysm.

Hysterical fever is recognized. No extraordinary temperature should be credited, excepting when the physician has taken the rectal temperature with a registered thermometer, *which he has held in place himself for the requisite time.*

The psychological features of hysteria may only be mentioned here. Amnesia, the dreamy hysterical state, somnambulistic phenomena, double consciousness, lethargy, and many other curious conditions are described. Extreme diversity, changeability, and openness to suggestion, with the presence of other marks of hysteria, should suffice for the diagnosis. Alcoholism and dementia precox deserve especial attention in the differential diagnosis.

Diagnosis.—Because of the diverse features of hysteria, its frequent close association with neurasthenia or other diseases, and the fairly close resemblance of the symptoms to those of almost every nervous disease, the diagnosis is often difficult. Attention to the differential features generally suffices for an absolute diagnosis.

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Attention should be given to the influence of youth and sex of the patient, the nervous predisposition, and the frequent occurrence of stress, trauma, etc., in the etiology. The bizarre nature of the pain, anesthesia, paralysis, intestinal symptoms, ocular disturbances, and other peculiarities of those affected with hysteria is to be noted. Variability, suggestibility, and removability by means of suggestion are found in no other condition. Neurasthenia is so commonly associated, especially in the traumatic cases, that allowance must be made for it. It has not the stigmata of hysteria. Epilepsy has been mentioned. If the patient bites the tongue, becomes absolutely unconscious, and loses control of the sphincters the disease is not hysteria. In the paralyses of hysteria, the absence of the features of organic paralysis is decisive. The paralyzed patient who is cured by fright, suggestion, religious excitement, etc., is suffering from hysterical paralysis. Many such, for example, are reported to have been cured by the stimulation and excitement of the San Francisco fire.

Prognosis.—The prognosis of hysteria is good as to life. Paralysis may recover after several years' duration. In no disease is the course and prognosis determined more by the manner of treatment. In difficult cases the physician should avail himself of the help of a specialist, for suggestion, hypnosis, re-education, Freud's analytical method and many procedures not usually within the scope of the busy general practitioner may be of utmost assistance.

29. NEURASTHENIA

Definition.—This term is used to designate a condition of "irritable weakness" in which marked nervous and physical asthenia, irritability, excessive fatigue after trivial exertion, and abnormal sensitiveness and restlessness are present without perceptible pathological changes in the nervous system.

The disease is very common in America, and indeed in every country where social conditions are such that the less robust members of the community are led to work beyond the limits of their strength, especially when under conditions in which nervous wear

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and tear are excessive. It may be the result of prenatal or inherited lack of resistance in the nervous system, too much internal friction in the operation of the machine, or starvation or intoxication of the nerve centers. The prominence of the mental element in the disease must not be underestimated.

Etiology.—Heredity is of prime importance. There is commonly found in the family history evidence of some form of nervous or mental weakness, the neurasthenia being one of the manifestations of it. Acute alcoholism in the parent at the time of conception, or acute disease in the mother during the pregnancy, may weaken the child's ability to stand strain in future life. Chronic alcoholism, syphilis, or other cause of tissue degeneration may contribute to the same end, and epilepsy, insanity, and hysteria may be found in the antecedents. The marked influence of mentality is emphasized by the fact that educated men and women suffer much more frequently than the ignorant, and that the disease often occurs in those doing severe mental work accompanied by worry or emotional stress.

Men are affected rather more frequently than women, probably because of being subjected to greater stress. The Jewish race is especially subject to the disease. The frequency of neurasthenia in those suffering from dilated stomach, often in association with pyloric obstruction, as in young women with gastric ulcer, suggests the important part sometimes played by chronic starvation. The influence of visceroptosis with failure to evacuate the large bowel properly on account of bad mechanical conditions should be suggested. Eye strain, bad sexual habits, the exhaustion of acute disease, etc., have much influence in certain cases. The prominent part played by trauma will be discussed in another section. The infrequency of the development of neurasthenia in men after forty without definite pathological basis, such as arteriosclerosis, syphilis, alcoholism, etc., should be mentioned.

Symptoms.—The prime manifestation of neurasthenia is the inability to stand stress without disproportionate fatigue. The first symptoms are generally slow in developing, excepting in the traumatic cases, and in them the soil has generally been well prepared before hand. The patient is unable to make the usual effort with-

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out becoming abnormally tired, is unable to concentrate his mind upon the task in hand, worries because he cannot do so, too often uses alcoholic stimulants, tea, coffee, or tobacco for relief, becomes unable to sleep, and fails in appetite and digestion. Thus a vicious circle is established. Morbid fears are added, and the physical weakness often becomes so marked that the patient takes to bed. Headache and over-sensitiveness of the spinal region become prominent features. The patient dreads some particular catastrophe which has been in general long familiar to his mind—the development of some chronic disease, common in his family, or which has affected several of his friends, or financial failure, loss of his position, etc. Palpitation, sudden flushing of the face, abnormally acute perception of the cardiac and vascular action, vertigo, various paraesthesias, choking sensations, tinnitus, indigestion, constipation, diarrhea, frequent micturition, intense exhaustion upon using the eyes, even very moderately, or, in men, after the sexual act, are frequent sources of complaint. Emaciation and anemia frequently develop. When a nervous patient habitually complains that he is not rested by his night's sleep, or especially that he feels worse in the morning than at night, he is approaching the borderline of the disease, if he has not already passed it.

The deep reflexes are generally increased, but no definite signs of organic disease are to be found unless in accidental association.

Sexual neurasthenia is so common in young men as to deserve especial mention. There is commonly a history of abuse in some form, and finally the symptoms of a gradually developing neurasthenia are colored by the sexual worries of the patient. The minutest symptoms are described and a condition of pitiable worry and introspection is not infrequent. Impotence, nightly emissions, premature emissions, and various departures from normal are often present.

Traumatic Neuroses.—Neurasthenia frequently follows trauma, but especial care must be used to differentiate the purely neurasthenic cases from those of hysterical or organic type, and from those in which malingering is the chief if not the only trouble. In general, we may assume that after severe trauma there are likely to be present, in varying degrees, actual organic disease, neurasthenic and perhaps

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hysterical developments, and in cases where the question of damage enters, a more or less unconscious exaggeration of the trouble. The frequency of neurasthenia after sudden and terrifying accidents or experiences, as in case of fright, when no possibility of actual physical injury from without exists, and when no possible collection of damages enters into the case, should prove that it is not necessary to bring in gross pathological changes from the injury, suggestion from the examining physician or others, hysteria or fraud, as explanations of the trouble. The frequent subsidence of the alleged serious symptoms after a financial settlement, on the other hand, shows that worry, suggestion and perhaps voluntary or involuntary exaggeration are always to be taken into consideration. Various types of paralysis, often with anesthesia, are common after trauma, but these are hysterical and not neurasthenic. The frequent association of the two conditions must be borne in mind. The symptoms may be those of almost pure psychasthenia, with such failure in mental processes as to unfit the subject for his work. General paralysis may follow a head injury, and must be carefully differentiated from neurasthenia.

The symptoms are commonly largely influenced by the location of the chief trauma. Injuries to the back and head are the chief sources of traumatic neurasthenia. In the first case, traumatic lumbago may be in part due to the actual damage to the muscles and ligaments of the spine. In the second, the slight changes in the brain due to concussion form a basis upon which a great variety of mental troubles develop—nervousness, insomnia, loss of memory, loss of power of concentration, irritability, etc.

The physician should endeavor to estimate in any given case the relative importance of the parts played by the physical injury, by hysteria, by malingering, by hypochondriasis, by suggestion, by hope of financial settlement, and by traumatic neurasthenia pure and simple.

Diagnosis.—This depends upon careful analysis of the symptoms we have discussed and the exclusion of organic disease and hysteria. The evidences of nervous exhaustion, of inability to stand stress of any kind without disproportionate fatigue, and the absence of any

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explanation excepting a purely functional one, with the associated symptoms described, form the basis upon which the diagnosis of neurasthenia must be made. Due weight must be given to the influence of the use of drugs, tea, coffee, tobacco, alcohol, to causes of malnutrition (gastric and intestinal diseases), etc.

Prognosis.—The outlook is good as to life, and, with proper treatment, as to recovery in time. Many neurasthenics, after reaching a certain point in the disease, go on for years doing a fair amount of work, but with continuous complaints and fears of permanent break-down.

Severe cases become bed-ridden for years, and tax the physician more severely perhaps than any other patients. If recovery ensues relapse is to be feared, if stress again becomes excessive. The prognosis is better in the cases following acute disease and trauma, when the original nervous status was fairly good and the cause a definite one, than in those with marked inherited nervous instability, and no very definite etiology.

30. PARALYSIS AGITANS

(*Shaking Palsy; Parkinson's Disease*)

Definition.—A nervous disease of later life, with muscular rigidity, weakness and tremor, masklike expression and characteristic gait.

The pathology of the disease is still obscure. The admitted changes are generally of a senile type. The disease may be hereditary, is more frequent in men, and begins as a rule after the fiftieth year. Fear, anxiety, and trauma are mentioned in the etiology.

Symptoms.—Shaking palsy commonly begins insidiously, intermittent tremor in one hand being the earliest manifestation of the disease. The right hand is oftenest affected, and the right leg may be involved before the opposite side. The tremor may affect the head and the tongue. Its rate is from five to seven oscillations per second—greater as the movements are less in magnitude. The thumb and fingers present the classical "pill rolling" movement, the

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forearm oscillating at the same time. The tremor is temporarily suppressed by voluntary effort, but recurs shortly, oftentimes exaggerated. It ceases during sleep. The muscular rigidity is as characteristic as the tremor, and may be noted in the absence of the commonly recognized symptom. It is especially noted in the muscles of the neck and back, and may be commonly demonstrated in the forearms as well. Because of it, the patient executes movements slowly, and with difficulty, and the stooping attitude and propulsive gait (festination) are due to it. The patient starts forward slowly and with difficulty, the steps then increase in frequency, but lessen in magnitude, until he stops for fear of falling forward, or possibly loses his balance and falls. Retropulsion and lateropulsion are commonly seen.

Weakness of the muscles is marked, though it must not be confused with inability to use the muscles effectively, because of the rigidity and tremor. This weakness does not attain the grade of a true paralysis, though the patient eventually becomes bedridden on account of it. The sphincters are not affected. The knee-jerks and other reflexes are often somewhat increased. A moderate degree of muscular atrophy may eventually occur. The muscles of the face fail to act normally because of the rigidity, and a peculiar and characteristic facial expression, or rather lack of expression, results. Winking is less frequent than normal. The voice is often high-pitched and monotonous, and finally becomes very indistinct. The mind remains clear, but dementia may eventually supervene, as in other senile conditions. Increased sweating, salivation, and flashes of heat or cold are often noted, and may be very distressing.

Diagnosis.—The rotatory tremor is not alone sufficient for the diagnosis, although very characteristic in most cases, but the association with it of the marked muscular rigidity, with resistance to passive movements, bent knees, stooping body, flexed neck, inexpressive face, subdued emotions, festination, and characteristic speech suffice. In the absence of tremor, the muscular rigidity is sufficiently characteristic to justify this diagnosis in the presence of some of the other signs and symptoms mentioned.

The tremor of Basedow's disease is accompanied by the other

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signs of the affection. That of multiple sclerosis is not accompanied by rigidity, and the scanning speech and nystagmus are characteristic. Senile tremor involves the head especially, and has no accompanying rigidity. The tremors of hysteria, traumatic neurosis, alcoholism, and the metallic intoxications are not accompanied by rigidity; and the age, history, and surroundings of the patient differentiate Parkinson's disease.

Prognosis.—Shaking palsy is a slow chronic disease, not especially tending to shorten life. Although the symptoms may be arrested, the tendency is to increase gradually, until the patient becomes helpless.

37. DISEASES OF THE PERIPHERAL NERVES

A. NEURITIS

Inflammation of a nerve is spoken of as neuritis. This inflammatory process may affect a single nerve, as from disease or injury, or many nerves, a multiple neuritis, as is seen in cases of poisoning by arsenic, lead, alcohol, etc. The motor, sensory, and trophic fibers may be compromised, so that excepting in the case of some of the cranial nerves, motor, sensory, and trophic phenomena may be expected if the function of the nerve is entirely suspended by injury or disease. In general, motor fibers in a nerve damaged by compression (pressure neuritis) are less resistant than the sensory fibers, so that motor paralysis predominates. Trophic and vasomotor phenomena may not be observed until after the motor and sensory paralyses have become fairly complete.

Etiology.—Diseases of the peripheral nerves may be due to trauma, to increasing pressure from cervical ribs, various growths, caries of the spine, deforming arthritis of the spine, to rheumatic, or other forms of neuritis, or to the toxic causes to be considered later under multiple neuritis. Many of the lesions of leprosy are due to peripheral neuritis of peculiar type.

Pathology.—The interstitial tissues of the nerve may be affected,—interstitial neuritis; or the myelin substance and axis cylin-

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ders,—a parenchymatous neuritis. All the tissues may be involved, as in most acute neuritides. The chronic types tend toward an interstitial form of inflammation, with secondary degeneration of the parenchymatous elements in the nerve tissue. If recovery does not ensue the fibers are replaced by cicatricial tissue. The peripheral portions of the nerve are most seriously damaged, but the nerve cells in the anterior horns and even in the cerebral nuclei may degenerate. In a severed nerve the peripheral portions, cut off from the central trophic influences, degenerate, while all of the central portion, excepting the part adjacent to the injury, remains normal. After trauma or toxic influences, if the cause be removed, perfect regeneration may ensue.

Symptoms.—Motor.—Complete interruption of the motor fibers of the nerve is followed by complete paralysis of the muscles supplied, neither reflex nor voluntary contraction being possible. Following this, there is loss of tone in the muscle, atrophy, change in the electrical reaction, with reaction of degeneration, and finally contractures from the succeeding fibrosis. If the muscle fibers completely degenerate, no response can be obtained to the galvanic current. The deep reflexes disappear because of the destruction of the normal muscle tone, upon the maintenance of which they depend. These features characterize lower neuron paralysis, and contrast sharply with those associated with paralysis of central type.

Sensory Symptoms.—These are much less sharply outlined than the motor phenomena noted after severance of a nerve, and the explanation hitherto has been that the nerves anastomosed in such a way as to prevent complete destruction of sensation. The explanation given by Head, which has been generally accepted, is that there are three systems of supply, and that severance of the superficial sensory nerves therefore fails to produce complete sensory paralysis. He states that certain fibers in the deep muscular nerves subserve deep sensibility, and that extensive anastomoses are present. Pressure and the movements of muscles and joints and the position of the limb are appreciated through these fibers. The so-called protopathic sensibility is concerned in the appreciation of painful stimulation of the skin, and extremes of heat and cold, while the *epicritic* sensibility

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cares for the lighter stimulation of the skin, as by touch, and the lesser degrees of change of temperature. Cutaneous localization is a function of this variety of sensation. The respective forms of sensibility under the three headings are bound up together, so to speak, and hence those under each heading go and come together with paralysis or regeneration. The three types are dissociated, and their nerves do not coincide as to their areas of distribution. After injury of a peripheral nerve the protopathic sensibility returns if the nerve regenerates in about one-half the time required for the epicritic sensibility (178 days for the one, 364 for the other, on the average). With a return then, of sensibility to painful impressions and to great heat and cold, protopathic sensibility is re-established, and with this the associated trophic influences again assume control, so that ulcerated surfaces which have long existed now heal readily. The function of the sensory fibers is often perverted after injury. If the proximal end of the severed nerve be pinched in scar tissue, the sensory fibers convey the impression of pain in the region of their peripheral distribution. Hyperalgesia, causalgia, various paresthetic phenomena, and spasms of the muscles in the affected area may be noted.

Trophic and Vasomotor Symptoms.—The atrophy of muscles cut off by nerve injury from their central trophic supply has been mentioned, but other tissues suffer as well, even the bone. The paretic dilatation of the superficial vessels from vasomotor paralysis, after nerve section, leads finally to a slow circulation and imperfect nutrition, with cyanosis and loss of normal temperature. The glossy skin described by Weir Mitchell, with shrinking of the subcutaneous tissues, retardation of growth of a limb, changes in the growth of the hair and nails, fragility of the bones, effusion into the joints and even ankylosis, are observed in certain cases of nerve injury.

B. MULTIPLE NEURITIS

(*Peripheral Neuritis; Polyneuritis*)

Definition.—Multiple neuritis is a term used to designate the inflammation affecting many peripheral nerves.

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Etiology.—Multiple neuritis is of toxic origin, but the poisons which may produce it are of extreme diversity. The most common cause is the too free use of alcohol. Arsenic, often used therapeutically, as in pernicious anemia and chorea, lead, often used externally, or as lead-and-opium pill for diarrhea, mercury, carbon bisulphid, carbon monoxid, phosphorus, copper, and ergot may also produce the disease. The long-continued use of sulphonal, and other hypnotics, and, as in one of my cases, of aspirin, and possibly of other drugs, should be noted in the etiology. Various infectious diseases may present polyneuritis due to their toxins, as diphtheria, typhoid, influenza, tuberculosis, small-pox, scarlet fever, etc. Beriberi is

Fig. 131.—Post-typhoidal Multiple Neuritis.

mentioned elsewhere. Cachectic diseases may be accompanied with peripheral inflammation of the nerves, as diabetes, cancer, syphilis, senility, etc. Finally the nerves may be directly invaded by bacteria, as in leprosy, in sepsis, and in gonorrhea. The disease is essentially one of adult life excepting as it follows the infectious diseases. Females are slightly more subject to it, especially to the alcoholic form. Overworked muscles, particularly in conditions of poor nutrition, are especially subject to paralysis from neuritis affecting their supplying nerves.

Pathology.—This is essentially a degeneration of the parenchymous tissues of the peripheral nerves, the marked interstitial inflammation of the other types of neuritis being absent. Although hyper-

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emic, swollen and tender to pressure in the acute stage, the nerves finally shrink and become firmer than normal. The changes in the cells of the anterior horns and in the cerebral cortex have been mentioned.

Symptoms.—It will best serve our purpose to describe the commonest type, alcoholic neuritis, and then speak of the variations from this in the other forms. The earliest symptoms are numbness and tingling in the fingers and toes. The occurrence of these phenomena in persons, especially women, known to use alcohol regularly and especially the stronger drinks, should excite suspicion at once, and particularly if morning vomiting or the mental impairment of chronic alcoholism are present. Then follow hyperesthesia, vague pains, worse upon exercise of the part, inability to carry out finely coördinated movements (buttoning the clothes), tenderness of the muscles to pressure, weakness, and finally definite motor paresis. The affection is bilateral and affects the upper less seriously than the lower extremities. The patient may be so paralyzed in a few days as to render rest in bed imperative. The paralysis may even be sudden in onset. The distal portions of the nerves and hence of the limbs suffer most seriously. The nerves of the trunk often escape. Cranial nerves are occasionally involved, especially the sixth, seventh, and third, and a central scotoma may signify an involvement of the optic nerve. The pupillary reactions are not affected, unless in rare instances. Tachycardia may signify involvement of the vagus. Wrist-drop and foot-drop are significant respectively of the predominant involvement of the ulnar and radial nerves in the upper extremities, and of the peroneal and anterior tibial in the lower. Steppage gait, the foot being thrown high to clear the toes, which touch the ground first, is characteristic. Cramps of the muscles may be noted, and tremor is not uncommon. With the flaccid peripheral type of paralysis are found muscular wasting, reaction of degeneration, and in advanced cases, contractures of the flexor muscles, holding the limbs, especially the lower ones, in a semi-flexed position. The deep and superficial reflexes are lost or very greatly diminished. The numbness, tingling, tenderness, and moderate pain of the early stages may be followed by spontaneous

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aching or burning pain of great severity, and greatly exaggerated upon handling. Women often cry out with pain if the feet and legs are carelessly examined, especially if the calf be pressed upon. The muscles may seem more sensitive than the nerve trunks, although the latter, if superficial, may be perceived by touch to be swollen and tender. Decreased sensibility to touch, and hyperalgesia, form a common combination in multiple neuritis.

Incoördination of the muscular movements is a striking feature of some cases (pseudo-tabes) and suggests locomotor ataxia, since the lower limbs are especially affected. In certain cases of multiple neuritis the motor or sensory features may assume an unusual prominence. Starr mentions bilateral facial paralysis and paralysis of the ocular muscles in alcoholic multiple neuritis, but they are of rare occurrence.

Vasomotor and trophic conditions, such as those mentioned in the last Section, are not uncommon. The sphincters are very rarely affected. Mental symptoms are common. Korsakoff's psychosis is characterized by the presence, with alcoholic multiple neuritis, of loss of memory, mental confusion, especially as to recent events, delirium, hallucinations, illusions, etc.

Course.—In a week or two the patient is likely to be at the height of the disease, and after two weeks to six weeks subsidence may be expected. The sensory symptoms disappear first, the paralyses persist for months, finally clearing up first in the muscles situated nearest the trunk. The knee-jerks may not reappear for years. Muscular contractures may delay full recovery indefinitely.

Prognosis.—This is generally good, provided the use of alcohol can be stopped. In very acute cases, death may result from the involvement of the respiratory muscles, of the heart muscle, or through vagus paralysis.

Diagnosis.—This will be discussed after a consideration of the other varieties of neuritis.

Other Types of Neuritis.—Arsenical Neuritis.—This form comes on slowly, and is most frequently seen as the result of long continued and often gradually increasing doses of Fowler's solution, or other arsenical preparations, as so often used in chorea in children,

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and in the blood diseases in adults. The epidemic in England in 1899 came from arsenic contained in the sulphuric acid used in making glucose, which in turn was used in the manufacture of beer. I have reported a case in which a saloonkeeper, who drank no alcohol of any kind but invariably drank soda-pop on convivial occasions, died of involvement of the vagus. The pop contained, according to the analysis of Dr. E. C. Hill, 1/60 grain of arsenic in each bottle. Wall paper and other manufactured articles often contain it and may become the source of arsenical neuritis. The paralysis may, as in the case of alcoholic neuritis, be chiefly motor, or chiefly ataxic (arsenical pneudotabes).

The most striking feature in these cases is the association of gastric and intestinal symptoms, with puffiness of the eyelids. The lower extremities are most seriously involved, and the muscular tenderness may be extreme. Erythema, cyanosis and sweating indicate involvement of the vasomotor fibers. A dark pigmentation of the skin, but without the affection of the mucous membranes, as in Addison's disease, may be present. Herpes zoster is not uncommon.

Lead Neuritis.—Although lead acts deleteriously on the central nervous system, as mentioned elsewhere, in the common form of lead poisoning peripheral neuritis is a prominent symptom. Lead colic commonly precedes the paralysis. The extensor muscles of the hand are especially involved, the supinator longus escaping. The feet are rarely affected, but the muscles supplied by the peroneal nerves are usually somewhat susceptible, the tibialis anticus usually escaping. The paralysis is chiefly motor, sensory and ataxic phenomena being unusual.

Neuritis may develop acutely, after carbon monoxid poisoning, commonly from inhalation of the water gas used for illumination, but even from natural gas in one case (Starr). The form arising from bisulphid of carbon, used in rubber manufacture, is slow in onset. Neither differs materially from alcoholic neuritis. The forms of multiple neuritis arising from trional, sulphonal, and antipyrin resemble mild cases of the alcoholic form.

Diphtheritic Neuritis.—This is much less frequent since the

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introduction of antitoxin. It occurs commonly in the third or fourth week. The common involvement of the palatal muscles leads to the theory of local poisoning of the nerve fibers of the parts adjacent to the seat of membranous deposit. The external muscles of the eye are often affected, and paralysis of accommodation is not infrequent. The arms are not commonly affected, and in case they are, the neuritis is of rather mild type. The involvement of the vagus, with vomiting, slowness of pulse, and finally tachycardia, cardiac dilatation, and death, is not infrequent. The danger of deglutition pneumonia in case of further involvement of the bulbar region should be noted.

Influenzal Neuritis.—Neuralgic phenomena are not uncommon in grippe, and a multiple neuritis similar to the mild alcoholic form occasionally follows. The upper and lower extremities may be affected. The neuritis occasionally noted in pulmonary tuberculosis, after variola, scarlet fever, and other acute infections, and in connection with diabetes, senility, etc., has no especial distinguishing features.

Diagnosis of Multiple Neuritis.—The diagnosis of multiple neuritis depends upon the demonstration of a peripheral paralysis, predominantly motor, sensory, or ataxic in type, affecting the peripheral distribution rather than the more central portions of the nerves, and commonly following some demonstrable toxic cause. This is most frequently chemical in origin (alcohol, lead, arsenic, etc.), or the result of an acute infectious disease (diphtheria, grippe, etc.).

Differential Diagnosis.—Much difficulty was formerly found in the differentiation from poliomyelitis. The distinguishing marks of the latter are the acute febrile onset, the lack of symmetry in the paralytic phenomena, the lack of sensory features, the pain being very much less prominent, the lack of especial involvement of the peripheral distributions of the nerves, and the rapid partial recovery, with permanent paralysis of certain muscles. Tabes is differentiated by its slower onset, the lightning pains contrasting sharply with the more or less continuous pain and especially with the tenderness of neuritis, frequent presence of sphincteric involvement, optic atrophy, trophic lesions, etc., and the absence of muscular paralysis,

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excepting in rare instances. Landry's paralysis is ordinarily very acute, and the sensory involvement is slight. The ascending character of the paralysis and the gravity of the disease, often fatal in a few days, are further points in the differentiation. The especial features, as to distribution of the paralysis in the neuritides of various origins, have already been discussed.

Prognosis.—This is ordinarily good if the distribution be confined to the nerves of the extremities, the danger lying in the affection of the vagus and other cranial nerves, with cardiac difficulties, or in respiratory complications. The probability that the neuritis will continue to extend after the poison has been discovered, and its use stopped, or after the first manifestation in the case of acute infectious disease, must be considered. After such extension, if the circulation and respiration be not compromised, recovery may be expected, but it requires many months before the muscles fully regain their strength.

32. THE CERVICAL NERVES AND CERVICAL PLEXUS

The cervical plexus is formed from the motor roots of the four upper cervical nerves. The phrenic nerve is the most important one given off from the plexus. This nerve may be compromised in the diseases affecting the anterior horns of the cord, but peripheral disease is commonly due to caries of the upper vertebræ, especially the third and fourth, or to syphilitic pachymeningitis. Direct trauma is rare, since its deep position protects it. The involvement of the posterior roots by the disease process may result in severe occipital neuralgia, the great occipital nerve becoming tender to pressure. Pain, tingling, numbness, and inability to move the neck muscles because of the pain produced are noted. The deep cervical muscles may be paralyzed if the damage to the anterior roots be extensive. If the phrenic nerve upon one side be disabled, as by tumor or involvement of its roots in caries, etc., the diaphragm is interfered with to some extent, but the symptoms do not commonly become noticeable unless both phrenics are affected. Dyspnea and cyanosis result, perhaps relieved shortly by the assist-

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ance of the accessory muscles of respiration. The paralysis of the diaphragm prevents the pushing down of the abdominal organs and respiration must therefore be thoracic in character. Coughing, sneezing, etc., are interfered with, and defecation may become difficult because of inability to compress the abdominal viscera. Hypostatic congestion of the lungs with its attendant dangers is commonly present.

Brachial Plexus.—This is formed from the anterior branches of the four lower cervical and the first dorsal nerves. The nerves given off from the plexus after the anastomosis of the fibers coming from the different roots, supply the shoulder and arm. Neuritis of the brachial plexus may be associated with a similar process in the cervical plexus,—a cervicobrachial neuritis. The upper or lower parts of the brachial plexus may be predominantly involved. The branches of the plexus may be affected by caries, tumor, rheumatic inflammation, trauma, etc. Amongst traumatic causes, subcoracoid dislocation of the humerus is the most common. In birth palsy the paralysis is generally of the upper arm type (that of Duchenne-Erb), and laceration or rupture of fibers of the component parts of the plexus may be commonly demonstrated. The type of brachial neuritis associated with the presence of cervical ribs,—a pressure neuritis,—affects especially the right arm, and predominantly in females. The symptoms are worse after exercise and in cold weather. Pain, especially localized along the ulnar distribution, numbness, coldness, and ischemia, with weakness and muscular atrophy, especially involving the muscles of the thumb, are noted. Spasm of the muscles involved may be present. A similar paralysis results from stretching the brachial plexus by holding the arm in a strained position in anesthesia. The lower arm type of paralysis (Klumpke) is present when the last cervical and first dorsal roots are especially affected, as by tumor in the neck or disease of the vertebral column. The Röntgen ray should be used in any case not entirely clear as to diagnosis. Atrophic paralysis of the muscles of the hand and forearm, with possibly the typical claw hand, may be noted, with sensory disturbances, especially in the distribution of the ulnar nerve. Pupillary symptoms may be present if the lesion involve

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the sympathetic fibers leaving the cord with the first thoracic root, and therefore in association with the lower arm type of paralysis, in which the eighth cervical and first dorsal roots are affected.

Severe pain is occasionally present, being often shooting and paroxysmal in character and aggravated by movement of the arm. Damage to the upper cords of the plexus gives rise to pain, especially in the neck, shoulder, and upper arm, and that to the lower cords, in the lower arm and hand.

Tenderness, especially of the nerve trunks, with vasomotor and trophic disturbances, is often present. Glossy skin and flaccid paralysis, with reaction of degeneration, loss of tendon reflexes and contractures, may be present in severe cases.

Long Thoracic Nerve.—The long or posterior thoracic nerve arises from the fifth and sixth cervical roots and supplies the serratus magnus muscle. It may be injured by carrying weights, or by pressure of the shoulder support used in the Trendelenburg position on the operating table. The especial sign of its involvement is the paralysis of the serratus magnus, with "winged scapula" as a result, particularly notable when the arm is moved forward to the horizontal position. Severe neuralgic pain may accompany the neuritis, the neck and shoulder regions being affected, but without sensory paralysis.

Circumflex Nerve.—This nerve is affected especially by trauma, notably in fracture of dislocation of the shoulder, by blows or falls upon the shoulder, or injury from pressure, as in deep sleep, or under anesthesia. I have observed it twice as a result of a fall forward from the back of a stumbling horse, the patient striking upon the deltoid region. The deltoid muscle is paralyzed, preventing abduction of the arm and permitting the humerus to drop, since the muscle normally keeps its head in apposition with the bone above. The arm cannot be lifted above the head. Anesthesia over the deltoid region may be demonstrated, and atrophy and reaction of degeneration may follow in severe cases. Especial care should be taken not to overlook a surgical complication of this type of paralysis, or a paralytic complication of this type in connection with injuries to the shoulder.

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Suprascapular Nerve.—The nerve is occasionally affected as the result of a local neuritis, especially in connection with trauma, weight-carrying upon the shoulder, or from injury during surgical operation. The supraspinatus and infraspinatus muscles are paralyzed, the inaction of the former permitting the humerus to fall away from its normal close relationship to the glenoid cavity, and the paralysis of the infraspinatus interfering with the outward rotation of the humerus. Anesthesia may be demonstrated over the scapula in some cases, but not with certainty as a rule. There may be pain in the shoulder girdle. The shoulder movements are naturally much interfered with by the muscular weakness.

Musculospiral Nerve.—This nerve is very liable to injury because of its exposed course around the humerus. In injuries to the shoulder joint, or from the use of a crutch, it may be damaged in the axilla, and even by long-continued abduction and extension during the use of an anesthetic. Pressure on the edge of the operating table, as the arm hangs over it, is another cause. The most frequent source of the neuritis is pressure upon the nerve in its course around the bone, as by the weight of the head in intoxication, noted in large clinics on Monday mornings because of the frequency of drunkenness on Saturday night. The French speak of it as "bridegroom's paralysis" and the Germans as "police paralysis," because of the supposed pressure of the bride's head and neck upon the arm of the intoxicated husband, in the first instance, and the pressure from the use of a stick inserted behind the back and through the arms after arrest, in the latter. Severe contraction of the triceps muscle may damage the nerve as it passes through that structure. Too tight bandaging, as with an Esmarch's bandage, or after fracture, may also set up a neuritis. From the number and frequency of the causes given, we find this to be the most commonly involved nerve.

Wrist-drop is a striking feature of musculospiral paralysis, with paralysis of the triceps, if the neuritis affects the nerve in the axilla. The forearm cannot be supinated, and perhaps not extended upon the arm. The grasp of the hand is weakened, because of the lack of normal antagonistic action of the paralyzed extensors, but may

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be nearly normal upon passive extension of the hand. Numbness and tingling may be present, especially notable in the dorsum of the hand upon the radial side. The bilateral character of the wrist-drop in lead palsy, and the escape of the supinator longus serve for the differentiation of this type.

Median Nerve.—This may be injured in crutch paralysis, but the common cause is trauma, as by cutting wounds upon the anterior surface of the wrist. Paralysis of the flexors of the fingers, of the pronator radii teres and flexor carpi radialis follows. Milkmaids and others overusing the flexors may suffer, and in some cases it is a result of a pressure neuritis. Some sensory disturbance on the radial side of the hand may be noted.

Ulnar Nerve.—This may be injured with the others mentioned from crutch paralysis, but more frequently in injuries about the elbow, its exposed position behind the internal condyle rendering it especially vulnerable. Ulnar neuritis may follow exposure to cold. Flexion of the wrist is interfered with, the hand being pulled to the radial side through the unimpaired action of the radial flexor. The grasp of the hand is practically destroyed, since nearly all the intrinsic muscles of the hand are innervated by the ulnar nerve. The movements of the thumb and fingers are much interfered with, the thenar and hypothenar eminences flatten, the bones and tendons of the hand show prominently, and a modified claw hand develops, the first two lumbricales escaping, and preventing the complete development seen in progressive muscular atrophy. Sensory disturbances may be present upon the ulnar side of the hand.

Musculocutaneous Nerve.—Paralysis of this nerve is much less common than that of the others discussed. It is generally the result of trauma. Paralysis of the biceps and coracobrachialis and partial paralysis of the brachialis anticus is produced, so that flexion at the elbow when the arm is supine is impossible, and is feeble and imperfect if the arm be pronated. Some sensory impairment may be noted upon the radial side of the forearm.

Neuritis of the Intercostal Nerves.—This may occur as a result of pressure from tumor, neuroma, fracture of ribs, etc. Pain occurs

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in the distribution of the affected nerve or nerves, but no paralysis of motion. The most important variety for the internist is the neuritis of the nerves upon the left side due to pressure of an aneurism of the descending aorta. Such a distribution of the pain should always call for a careful examination of the back with reference to this cause.

33. DISEASES OF THE LUMBAR AND SACRAL PLEXUSES

These parts are not often affected by trauma, but frequently by cancer, caries, or other diseases of the bony parts in relation to them. The fetal head may cause pressure during labor, the fibers which make up the external popliteal nerve being especially involved, owing to their greater exposure at the base of the pelvis. The symptoms of involvement of the plexuses are those of a more or less complete paralysis of the nerves given off, generally very irregular in its distribution, with slight or irregular sensory loss. These symptoms will be further considered in the study of the affections of the individual nerves.

Anterior Crural Nerve.—This nerve arises from the lumbar plexus and innervates the muscles which flex the thigh upon the trunk. Trauma, pressure by growth or psoas abscess, or neuritis may affect it, and injury in parturition is occasionally observed. Paralysis of the muscles mentioned, absence of knee jerk, and sensory disturbance along the inner side of the leg result from the inflammation of this nerve. Atrophy of the muscles may be marked. Pain is not often a prominent symptom.

Obturator Nerve.—Arising from the lumbar plexus, this nerve emerges through the obturator foramen. It supplies the adductors of the thighs and the muscle causing outward rotation, the obturator externus. The nerve may be compressed during labor, or by an obturator hernia or pelvic growth. The leg affected cannot be crossed over its fellow, although locomotion may not be seriously interfered with.

Sciatic Nerve.—Paralysis may result from fracture of the pelvis, tumor, or from severe sciatic neuritis. The injury during parturi-

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tion from pressure of the head upon the lumbosacral plexus, and the mild symptoms of pressure during the late stages of pregnancy, when the head has sunken into the pelvis, should be mentioned. A postinfluenzal sciatic neuritis is occasionally seen. The nerve of the infant may be injured by traction in breech delivery. The pain in the course of the nerve in appendicitis, from the backward pressure of the inflammatory mass, and occasionally in the case of ovarian cyst, should be noted. The nerve supplies the hamstring muscles, and its two branches, the internal and external popliteal nerves, supply the muscles of the leg, both flexor and extensor, and subserve sensation in all but the small portion supplied by the small sciatic and long saphenous nerves.

In sciatic neuritis the nerve may be tender to pressure, and palpably swollen. In the severe cases, the muscles supplied are so damaged in function that walking is possible only by using the stiffened limb as a support on that side, the quadriceps extensor serving to keep it extended. The muscles may be entirely paralyzed, and atrophy and the reaction of degeneration may even be present. Vasomotor changes in the skin, glossy skin, and a general anesthesia of the leg may be noted. The pain is apt to be constant and often severe, and muscular twitchings may add to the distress.

Sciatica or neuralgia of the sciatic nerve, although so closely related to true neuritis, may be more conveniently considered in the section upon neuralgia.

The lesser sciatic nerve may be compromised under the conditions mentioned as causing neuritis of the main trunk, since the two nerves emerge together through the sacrosciatic foramen. Since it supplies in part the gluteus maximus muscle, severe neuritis may prevent the patient from rising from a sitting position, to which action this muscle contributes. The associated inferior gluteal nerve may be involved with it. Anesthesia of the buttock and dorsal aspect of the thigh may be present.

External Popliteal Nerve.—This branch of the sciatic is especially exposed to injury behind the head of the fibula, as in fractures and dislocations in this region, from pressure of garters, the Esmarch bandage, from the use of stilts, and from working in a stooped

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position (potato pickers). In multiple neuritis from lead and alcohol and after infectious disease, it may be involved. The tibialis anticus, the peroneal muscles, and the extensors of the toes are paralyzed in neuritis of this nerve, the foot drops, and adduction of the toes results. The patient lifts the foot high in walking that the toes may clear the ground. Atrophy of the muscle, reaction of degeneration, and some sensory disturbances may be noted.

Internal Popliteal Nerve.—The nerve is well protected and rarely suffers injury. It supplies the muscles of the calf, and the sole of the foot, and neuritis therefore interferes greatly with walking, and prevents the patient from rising upon the toes. If the muscles be completely paralyzed, the action of the antagonistic muscles produces talipes calcaneus or talipes valgus. Claw-foot may develop. Sensory involvement may be noted upon the outer edge of the leg and foot; and upon the sole trophic disturbances are occasionally observed.

Meralgia Paresthetica.—In the region supplied by the external cutaneous nerve, on the front and outer side of the thigh, paresthesia, with slight pain, is occasionally noted. It is due in many cases to pressure from a truss or a corset, and in others to pinching of the nerve as it passes through the fascia, its course being a long one. The affection may be bilateral. It occurs in middle age, and especially in males.

Plantar Nerves.— Neuritis may occur in the plantar nerves from trauma, as by ill-fitting shoes, especially in walking upon rough surfaces, and particularly if the feet be chilled. The nerves upon the dorsum of the foot may be injured by pressure of the too tightly laced shoe. Pain, tenderness, inability to walk and even atrophy of the muscles affected may be noted. In Morton's disease the second digital branch of the internal plantar nerve is compressed between the ends of the first and second metatarsal bones, especially in those wearing too narrow shoes, and in the flat-footed. Other branches may be involved. The disease is a pressure neuritis, resulting from disturbed relations as to the position of the nerve and the bones of the foot.

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34. NEURALGIA

Definition.—By this term we mean a sensory disturbance of a nerve or its branches, with sharp spasmodic pain, and ordinarily without affection of the muscles supplied. Trophic disturbances in the skin are not unusual. Neuralgia differs from the inflammation of a nerve trunk, designated neuritis, in the absence of swelling and tenderness in the nerve, and of motor paralysis. The pain of neuralgia is less continuous than that of neuritis as a rule.

Etiology.—Neuralgia may result from a great variety of causes which operate to interfere with the functions of the nerve. General constitutional diseases, such as gout, malaria, anemia, especially the pernicious form, predispose to it. Congestion of the nerve trunk or local vascular disease producing starvation of the tissues may be operative. The presence of toxins from within, as in influenza, small-pox, typhoid, and other infectious diseases, and diabetes and nephritis, on the one hand, or from without, as in the use of arsenic, lead, alcohol, tobacco, morphin (especially as an abstinence symptom) or other poisonous drugs, on the other, may be the source of the affection. It not infrequently precedes the development of a neuritis, and may appear in the nerves which pass through diseased organs. The neuralgic pains of herpes zoster are associated with inflammation of the sensory ganglion, an infectious process, while non-infectious diseases of the ganglia may give rise to neuralgia of the painful facial type. Actual damage to the nerve trunk rather gives rise to a neuritis, but neuralgia may result before the lesion reaches the grade of a neuritis. Reflex neuralgia, as in the dorsal nerves from gastric disease, and in many other visceral disorders, is common.

The frequency of neuralgia in the states of disturbed nutrition associated with arteriosclerosis, and in organic nervous diseases, especially the late syphilitic diseases, and after exposure to depressing surroundings, and notably to cold, should be noted. Nervous, sensitive women are more subject to neuralgia than are males. Children are comparatively infrequent sufferers.

Pathologically there is little to say, since neuralgia is a symptom

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of sensory irritation, and the appearance of decided local changes in the nerve carries the affection into the domain of neuritis. The ganglionic changes mentioned pertain, however, to the neuralgias.

Symptoms.—Pain is the chief symptom upon which the diagnosis of neuralgia must depend. It is generally sharp, but intermittent in character, and commonly unilateral. The pain shoots along the course of the nerve in many cases, lasting a few seconds or longer, and is often succeeded by a dull aching or "full" sensation. The pain varies in intensity from a mild feeling of discomfort to unbearable agony. The distribution of the pain in the course of the nerve and its branches is characteristic.

The nerve may be tender upon pressure, and such pressure may instigate an attack. Reflex spasm of the muscles supplied by the motor centers most closely related to the sensory root affected is common in the severe types, as in trigeminal neuralgia. Movement of the parts, especially if sudden, may initiate an attack. The skin may be hyperesthetic. Pressure over the points of emergence of the branches of affected nerves is painful, as is especially noted in facial neuralgia.

Trophic disturbances are common, such as flushing, blanching, sweating, falling of the hair, premature grayness over the affected region, ulceration, as of the cornea in neuralgia of the ophthalmic branch, and herpetic eruptions, as in intercostal neuralgia. Thickening of the skin and even of the bones may result from severe and prolonged neuralgias, and muscular atrophy, general loss of weight, irritability, and the formation of various drug habits are to be feared. Suicide is occasionally attempted. The tender points described by Valleix are probably more often seen in neuritis than in the true neuralgias. Anesthesia, hyperesthesia, and paresthesia are common.

The disease may last a few days and disappear for months. In women, reappearance at the menstrual period is common. In general, those who suffer from neuralgia are liable to recurrence under similar conditions of stress whatever the nature of this may be. The neuralgias associated with chronic wasting diseases commonly continue until the end. The occurrence of herpes in connection with

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the attack leads us to expect a course of several weeks' duration. The persistence for years of pain in tic douloureux, with gradual increase in severity, is not uncommon.

Special Forms of Neuralgia.—Tic douloureux has been considered. (*See* page 412.) Starr, in 613 cases of neuralgia found the special distribution to be as follows: trigeminal, 315; sciatic, 194; brachial, 31; occipital, 28; intercostal, 19; lumbo-abdominal, 19; crural, 2; peroneal, 2; ulnar, coccygeal and plantar, 1 each. In general the trigeminal form is more common in women and the sciatic in men.

Brachial Neuralgia.—Neuralgia of the branches of the brachial plexus is more frequent in the male sex and affects predominantly the branches supplying the arm, although the chief seat of pain may be in the neck. Small punctured wounds in the forearm, the presence of cervical ribs, and overuse of the arm, as in piano playing and sweeping, are often of etiological importance. The nerves manifest tenderness, if pressed against the bone, and movements of the muscles of the arm initiate the attacks of pain. Because of non-use on account of the pain, atrophy of the muscles is not uncommon. The pain may be worse at night. Herpes, hyperesthesia, and glossy skin may develop.

The organic changes in the nerves which constitute a neuritis must be carefully excluded.

Cervico-occipital Neuralgia.—This is not very frequent. It may depend upon injury, as in weight carrying, upon pressure as in caries, etc., or develop upon a neurasthenic basis. The pain affects the branches supplying the neck and the occipital region, and may be bilateral. Tenderness may be found just posterior to the mastoid process. Dull, aching pain, with tenderness of the scalp, may be noted between the paroxysms of sharper neuralgic pain. The latter type may be initiated by combing the hair, moving the head, etc., and the head is therefore commonly held in a fixed position. Patches of gray hair in the distribution of the nerve are not infrequent as a result of the affection.

Intercostal Neuralgia.—The upper nerves, especially of the left side, are most frequently affected. Trauma, pressure from

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malignant growths, of exudate in arthritis, etc., should be considered, but the most frequent cause is the debility which predisposes to neuralgic affections in general. The frequency of intercostal neuralgia of the left side in those using too much tea, coffee, and especially tobacco, should be noted. The type affecting the breast in nursing women and during menstruation (mastodynia) should be mentioned Intercostal neuralgia is common in tabetic patients.

The external branches are most often involved, but pleurodynia from participation of the internal branches is not uncommon. The frequency of herpetic eruptions in connection with intercostal neuralgia (herpes zoster) should be noted. The lower intercostal branches are rarely subject to neuralgia. Tender points may be found under the scapula, in the axilla and under the breast. The suspicion of the existence of heart disease upon the part of neurotic patients with left-sided intercostal neuralgia is frequent enough to deserve mention. The skin is tender and hyperesthetic in many cases, and the body may be held rigid on this account. The diagnostician should especially take into consideration the following conditions:

Pleurisy.—The pain is acute, often localized, and accompanied with physical signs of intrathoracic disease.

Intercostal Neuritis.—Although it is difficult to determine in many instances where a neuralgia terminates and a true neuritis begins, the attempt should be made to differentiate between the neuralgic affection and that form of neuritis dependent upon pressure from aneurism, caries, arthritis of the spine, malignant disease, etc.

Angina pectoris and angina abdominis are of much greater severity than intercostal neuralgia. The special vascular features serve to distinguish them.

Pleurodynia is a neuralgia of the internal branches. The referred pains from disease of the heart, liver, and spleen should be mentioned.

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35. SCIATICA

The pain dependent upon neuritis of the sciatic nerve has been considered. The term sciatica should be limited to a neuralgia in this distribution, but the difficulty of exact delimination between the two affections is often very great. The affection is most common in adult males in middle life. Exposure to cold and wet, especially in those of rheumatic and gouty predisposition, is a common cause. Diabetics and alcoholics are especially subject to sciatica, and the disease may be bilateral in these patients. The influence of pressure and trauma in the causation of the disease may be seen in the occasional origin of sciatica from unusually prolonged riding, especially in cold, muddy seasons, as in the case of physicians with extensive country practice. I have noted several such cases, and believe that the cold and wet, the rough roads, the unusual hours, because of a combination of bad roads and increase in the amount of sickness, and the depreciation in general condition because of overwork under unfavorable conditions, should all receive consideration in the etiology. Mild types of sciatica may originate from sitting sidewise upon a hard seat, bringing too much pressure to bear upon the nerve of the side supporting the most weight, as in railway engineers. The frequent association of sciatica with hemorrhoids and with varicose veins of the legs should be noted. The pressure of varicose veins upon the nerve at the sacrosciatic foramen in those who work in the erect posture may be the cause of the pain. The fetal head, and ovarian tumors, a loaded rectum, or other source of pressure within the pelvis, may cause sciatica. The pressure of bony tumors, or of exudate, in case of ostearthritis, is more likely to cause a definite neuritis. Bilateral sciatic pain should always raise a presumption of some such cause affecting both nerves, or the branches making up the plexuses, and the changes which justify the diagnosis of a neuritis may generally be demonstrated after a time.

Symptoms.—The chief symptom of sciatica is pain along the distribution of the nerve or its branches. The onset is commonly gradual, the pain being noticed after unusual exposure or exertion. It is exaggerated by movement, especially by those motions which in-

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volve stretching of the nerve. I have known patients to eat in a standing position because of the increased pain of sitting down. The constant dull pain becomes sharp and paroxysmal, especially upon movement, and is worse at night as a rule. The pain is most severe in the region of the sciatic notch, and down the back of the thigh, but any branch of the sciatic may be chiefly affected. Points of especial tenderness exist near the posterior spine of the ilium, at the notch, in the middle of the thigh, and behind the head of the fibula and the external malleolus. In those common cases in which the external popliteal branch is felt to be distinctly larger than its fellow, organic changes in the nerve are to be assumed, and the diagnosis of neuritis rather than neuralgia should be made.

A herpetic eruption is common over the back of the thigh and the buttocks. The patient limps, moving the entire leg in a stiff and awkward manner, touching only the toes to the ground; he sits with the tuber ischii resting upon the edge of the chair, with thigh well extended. In severe and prolonged cases, but more especially of the neuritic form, a scoliosis of the lumbar spine develops, generally convex to the affected side, but occasionally in the reverse direction. The exact explanation is in dispute. Reflex twitching of the muscles of the leg may occur, and various paresthetic phenomena may be present. The development of anesthesia, marked atrophy, paralysis, and reaction of degeneration signify the advent of neuritic changes. The knee jerk is not altered in sciatica, and the absence of the Achilles reflex should be regarded as indicative of organic changes in the nerve.

Neuralgia of the sciatic nerve may last for weeks or many months and relapse is especially to be feared.

Diagnosis.—Neuritis of sacro-iliac or other origin should be assumed until positively eliminated. The changes which characterize sciatic neuritis, indicating an organic lesion of the nerve, have been considered. In hip disease the pain is notoriously felt at the knee, and upon the inner side, and the tender points of sciatica are absent. The hip joint is tender to suddenly exerted pressure, as by "bumping" the trochanters in such a manner as to transmit the force of the blow to the joint. The presence of shortening of the thigh,

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marked limitation of motion, and adduction with rigidity are decisive in favor of hip disease. The neuralgia of tabes is prone to affect the crural nerve, but in case of doubt, the ataxia, absent knee jerks, and Argyll Robertson pupils will be decisive. Sacro-iliac disease and osteoarthritis of the spine often cause bilateral pain in the sciatic distribution, but the local tenderness, deformity, rigidity, and limitation of motion are easily detected if only sought for. The loss of sphincter control, and the presence of paralytic and anesthetic phenomena distinguish lesions involving the cauda equina.

No examination of the patient is complete without careful examination of the spine, with flexion in all directions, and of the bones of the pelvis, examination of the interior of the pelvis by rectal or vaginal examination, and investigation as to the presence of tabes or other nervous affections. The possibility of mistaking the pain of intermittent claudication lies in the possibility of forgetting it, and not because of any resemblance.

Prognosis.—This is good as to recovery, but the time of recovery cannot be very definitely determined. Severe cases may last for months, and recurrence is very common. If dependent upon diabetes or other constitutional disease, the course may be very tedious. A majority of all cases recover in less than three months.

Other Forms of Neuralgia.—Coccygodynia, a painful neuralgic affection of the coccygeal region, is not infrequent in women. It is more frequent in those in whom trauma and possibly caries have affected the coccyx, and in the neurotic and constipated. In the traumatic neurosis following accidental injury, etc., this form of neuralgia is not uncommon. A large hysterical element may be present.

Neuralgia of the testis, prostate, ovary, neck of the bladder, or rectum is occasionally seen. The subdivisions of the larger nerves considered, and of the sacral and lumbar plexuses, and, in fact, almost any nerve, may be involved.

The main point in the diagnosis lies in the exclusion of organic affections producing pain.

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36. HERPES ZOSTER

The occurrence of herpetic vesicles in different types of neuralgia has been mentioned. Herpes zoster is to be regarded as an acute specific disease of the nervous system, occasionally epidemic, and generally showing a seasonal variation in frequency.

FIG. 132.—HERPES ZOSTER OPHTHALMICUS. (From the collection of Dr. A. J. Markley.)

The ganglia of the posterior roots of the spinal nerves, or the corresponding ganglia of the cranial nerves, show an intense inflammation, with infiltration with round cells, hemorrhages, and even necrosis, and a scar or cyst may remain as evidence of the intensity of the process. The near-by portions of the cord and of the peripheral nerves may be affected.

Symptoms.—Malaise and slight rise of temperature characterize

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the onset of idiopathic herpes. Pain and hyperesthesia over the region to be affected may precede the eruption for two or three days. On the third or fourth day erythema and a vesicular eruption follow, limited to one or several adjacent nerves in most cases. I have seen half the side of the chest covered with vesicles as thickly as in confluent small-pox.

The pain noted in the pre-eruptive period now becomes more severe, and is often described as burning in character. In children it may scarcely cause complaint, but in advanced years I have known it to cause death from exhaustion in the course of a few months. Loss of sensibility in the area affected is often permanent. Extensive scarring is common, especially when the vesicles have advanced to gangrene from the intensity of the inflammation. Some muscular paralysis is occasionally noted. In the ophthalmic division of the fifth nerve very troublesome vesicles may develop upon the cornea, with subsequent scarring. Marked adenitis is found locally in this variety.

Diagnosis.—This depends upon the recognition of the vesicles distributed along the course of the nerve. Error occurs chiefly from failure to note that the facial, occipital, brachial, lumbosacral, and other nerves may be affected by the same process so easily recognizable, often even by the laity, when the dorsal nerves are involved. The position of the patient with shingles may suggest the diagnosis, since the distress from the touch of the clothing may lead him to bend inward the affected side of the chest in such a way as to keep the skin free from the contact.

Prognosis.—This is good as to recovery, excepting in old and feeble subjects. The duration of the eruption is but a few weeks, but the neuralgic pain following may last several months. In young subjects it may subside almost with the healing of the vesicles.

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SECTION VIII

THE INTOXICATIONS

1. ALCOHOLISM

The ease with which alcoholic drinks are now obtained, and the stress of life with the corresponding demand for some agent which will serve to abate the hypersensitiveness of the over-strained nervous mechanism, account for the frequency of alcoholism in modern life. I am daily impressed with the number of individuals who resort to alcohol to obtain sleep, from which they are otherwise debarred because of worry over physical, domestic, or business affairs. A vicious circle is thus entered upon, since the causes for worry are likely to become thus accentuated, and more alcohol becomes necessary for the gaining of rest. Other potent agencies in establishing the alcoholic habit are the use of liquor for the relief of menstrual or other pains, the taking of patent medicines often containing a large proportion of alcohol, and the following of exhausting occupations with irregular hours of eating and sleeping.

Pathology.—Local effects are noted especially in the throat and stomach, while the liver suffers the changes of cirrhosis if strong alcoholic liquors, especially if taken upon an empty stomach, are carried directly to it through the portal circulation. Chronic nephritis is more frequent in alcoholics.

The heart shows various types of muscular degeneration. In those who drink great quantities of beer, dilatation and hypertrophy of the heart are noted. Chronic degenerative changes are found in the meninges and in the central nervous system, while acute degeneration is to be found in the affected nerves in the frequent peripheral neuritis. The arteries suffer sclerotic changes in alcoholics, and probably those of the brain and other viscera more often than the accessible vessels.

The influence of alcohol in decreasing resistance to acute infec-

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tious diseases, notably acute pneumonia and syphilis, and, through the introduction of delirium tremens as a complication, in rendering injuries and operations more serious, should be noted. Chronic alcoholism is perhaps the most potent influence in the extermination of decadent strains of mankind, since fewer children are born than normal, fewer of these survive, and these survivors are less able to support themselves well, and therefore transmit a feeble progeny.

Symptoms.—Acute Alcoholism.—The early exhilarative and confusional stages require no comment. Sleep follows, deepening into coma in extreme cases, but the patient may ordinarily be awakened, though often with difficulty. The flushed face, normal or slightly dilated pupils, regular pulse and respiration, odor of alcohol on the breath, and absence of signs of serious import commonly enable us to differentiate acute alcoholism readily from those conditions occasionally mistaken for it, notably opium poisoning, uremia, diabetic coma, and apoplexy. The patient recovers after some hours, complaining of headache, a dry mouth, bad taste, and frequently nausea and vomiting.

Delirium Tremens.—This psychosis may result from a protracted spree, but more commonly develops upon a basis of chronic alcoholism. The withdrawal of alcohol is frequently the provoking cause, especially in those attacked by acute disease or suffering severe injury. Those using the distilled liquors suffer more frequently than drinkers of beer and wine.

The patient is restless and irritable before the full development of the attack, and even if he falls asleep awakens often with a terrifying dream. Hallucinations follow, usually of some horrible character (the horrors); and marked tremor, insomnia, incoherence, cardiac oppression, aversion to food, and full-fledged delirium develop. The delirium may be violent, but is generally one of fear rather than of aggression. The pulse becomes rapid and feeble and great prostration appears, especially in the cases complicating acute febrile diseases. The patient may pass into a typhoid state with dry, brown tongue, and die from exhaustion.

Aside from true delirium tremens we may see alcoholic melancholia, commonly after a protracted drinking bout, or the furious

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maniacal state known as mania-a-potu. Before the full development of delirium tremens, the patient may be confused, semidelirious, and extremely irritable, although still up and about. His insomnia and anorexia portend trouble. The so-called serous meningitis, characterized pathologically by the "wet brain" may follow a severe attack of delirium tremens.

Chronic Alcoholism.—The effects of the habitual use of alcohol in large quantities, upon the kidneys, liver, vessels, etc., are described elsewhere. Of the general condition we shall treat briefly.

The patient undergoes a general degenerative change, moral, mental, and physical, and if not carried off by intercurrent disease, accident, or otherwise, alcoholic dementia finally ends the scene. The will is weakened, the moral sense is blunted, and the individual becomes unreliable, slovenly, forgetful, careless, subject to fits of anger, and, rather characteristically, of suspicions of his wife's faithfulness. The sodden countenance and the tremor are notable features. Symptoms proceeding from alcoholic cirrhosis, chronic nephritis, etc., commonly complicate the picture.

By dipsomania is meant the periodic inebriety which occurs in certain individuals, often otherwise of good habits, and thought by alienists to be somewhat related to periodical mania. Many brilliant men are subject to this infirmity, as to epilepsy or migraine. The chronic alcoholic who becomes intoxicated whenever opportunity offers degenerates steadily, while the dipsomaniac, who is given only to occasional sprees, may retain his mental and physical powers almost indefinitely.

Epilepsy is occasionally of alcoholic origin, while definite epileptiform convulsions are not rare in acute alcoholism. The true epilepsy is likely to be a manifestation of the degenerative brain changes of chronic alcoholism.

Hysteria and neurasthenia are frequent manifestations of the damage from habitual overuse of alcohol. In the asylums may be seen a considerable proportion of alcoholic dements, and a certain number of pseudoparetics, their condition being often confused at first with true paretic dementia. There may be recovery with cessation of drinking.

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Korsakow's psychosis is occasionally seen in chronic alcoholics suffering from multiple neuritis. Hallucinations, mental confusion, absurd fabrications with strange mental abberations, and disorders of memory are characteristic.

Diagnosis.—The diagnosis of the alcoholic diseases is commonly easy, yet it is notorious that many mistakes occur. Fortunately these are rather due to lack of care in most instances than to lack of sufficient distinguishing signs. If one approaches the case with the expectation of finding opium poisoning, uremia, diabetic coma, cerebral hemorrhage, fracture of the skull, or other form of organic disease, there is little danger of error. The delirium of acute diseases, especially of acute pneumonia, is frequently mistaken for acute alcoholic delirium, and many patients have been neglected because of insufficient examination of the chest under this assumption. The necessity of having in mind the possibility of delirum tremens in any case, regardless of sex or social status, when delirium and tremor occur together, should be mentioned.

Prognosis.—In chronic alcoholism the prognosis depends upon the extent of the structural damage already inflicted and the question of the continuance of the habit. Acute alcoholism offers a good prognosis. In delirium tremens the mortality goes almost hand in hand with the character of the complications, the simple cases commonly recovering.

2. OPIUM POISONING AND MORPHINISM

Acute poisoning is not infrequent as a means of suicide, and occasionally occurs as a result of accident. Initial excitement may be absent. Drowsiness deepening into coma, with congested, sweating, and finally cyanotic face, slow pulse and respiration, and contracted pupils, are characteristic. Convulsions may occur. The pupils may dilate as death approaches, and the pulse may become rapid and feeble.

Chronic opium poisoning occurs in those habituated to the use of the drug or its derivatives. The use of morphin, especially hypodermatically, in the white race, leads to the formation of an almost

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incurable habit, with a speed and certainty in marked contrast to the mildness of the addiction, caused by smoking opium, noted in Oriental races. The damage to the individual from the habitual use of morphin or opium is most marked upon the moral faculties; mentality is somewhat less affected, while serious organic changes develop but slowly. The serious danger in the habit lies in the temptation, commonly yielded to by the white race, to increase continually the dose, even to the point of several hundred grains daily. The danger is greater in the hypodermic use of the drug.

The patient soon exhibits evidence of an enfeebled will, loss of memory, insomnia, diminished energy, and especially blunting of the moral faculties. The mendacity of the morphomaniac is proverbial. The muscular strength decreases, and the patient loses weight, obstinate constipation is common, the appetite is poor, the skin is sallow, and the eyes lack lustre. A narcomania may develop in which the patient steals, lies, and commits arson or other crimes. Eventual emaciation is followed by cachexia, edema, albuminuria, delirium, and death.

Diagnosis.—Fortunately the history is commonly given. In other cases reasons for suspecting morphinism may be: (a) obstinate constipation, so that the feces must be removed mechanically from the rectum; (b) unusual variability as to the patient's appearance at different times—if the face be flushed, the pupils contracted, and the general appearance one of more than usual energy and contentment, as after the use of the drug, and a few hours later an opposite set of conditions obtains, we should suspect the habit; (c) extraordinary actions, not to be explained upon any other hypothesis—stealing, lying, or even prostitution to obtain the drug, or small amounts of money, are so frequent as to be cause for suspicion of the habit; (d) early loss of sexual power in man, and early menopause in women, are frequently due to morphinism.

By closely watching a suspect for some hours, either the conditions mentioned as occurring when deprived of the drug occur, or the patient makes some extraordinary effort to obtain it. In the case of one physician who was placed under surveillance by Dr. T. A. Hughes, 27 hypodermic syringes were found in a day's search

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through his belongings. The patient should be watched at night, since it is common to conceal the drug in the mattress, pillow, etc.

Examination of the entire body is necessary to detect the marks of the hypodermic needle. One physician under my care had the scars only about the ankles, which were black from numerous wounds. Abscesses are sure to develop eventually in these cases. The occurrence of periodical pain in the abdomen, of diarrhea, collapse, and even death when deprived of the drug should be noted. The addition of cocaine, chloral, or other drugs is so frequent in the history of morphomania as to require mention. The case of a feeble, crying baby relieved only by opiates should call for investigation of the mother's habits as to drugs.

Prognosis.—The habit should be treated only in institutions where every surrounding influence is under control, for failure is otherwise practically inevitable. Most of those cured eventually relapse. In the case of the physician, pharmacist, or nurse relapse is to be expected if the occupation be continued.

3. COCAINISM

The use of cocain, either as snuff, in solution, in tablet form, or hypodermatically has become alarmingly prevalent in the past two decades. It is especially used by those who have previously been addicted to morphin, and often for relief after a debauch.

The drug produces marked exhilaration, with temporary increase of mental and physical power, but perhaps more often a delusion as to such increase. The reported successful use of the drug hypodermatically in broken down race horses just before the time of the race, and the known effects of coca, as used in South America, justify the belief in the temporary actual increase of power from cocain.

The patient soon loses weight and strength, tremor develops, and hallucinations of various kinds, visual and auditory. The most characteristic feature is the feeling of bugs or worms under the skin, described by Magnan, and believed to be due to anesthesia of the nerve endings. Abnormal mental conditions are common,—depression, excitement, and a tendency to talk freely or to write letters. The men-

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tal processes are finally blunted, and delirium or delusional insanity may develop. The course is much more rapid than that of morphin addiction.

Diagnosis.—The patient's actions attract attention as being peculiar, and upon deprivation of the drug he is practically certain to make effort to obtain it. If the drug be taken by "snuffing," ulceration of the nasal mucosa may be found.

Muscular twitchings, delusions, hallucinations, convulsions, and coma may be noted. The marks of the hypodermic needle may be present.

Prognosis.—This is bad, since those recovering are extremely prone to relapse or to take up other drug habits.

4. ARGYRIA

Poisoning by salts of silver is much less frequently seen since the use of the drug for epilepsy and other chronic nervous diseases became obsolete. As a result a majority of the patients now presenting the general discoloration of the skin are well along in years, the drug having been taken several decades ago. The worst localized forms of discoloration have commonly resulted from the use of the newer preparations (argyrol, protargol), especially about the eyes and face. Hair dyes form an occasional vehicle for the introduction of the silver. The recent free use of silver preparations by injection into the urethra, bladder, bowel, etc., has been responsible for the development of argyria in a few instances.

As little as two drachms of silver nitrate has caused argyria, but as a rule this quantity may be exceeded before reaching the danger line. A half ounce has been given in the course of several months without unpleasant results. The discoloration may come on rather acutely after accidental poisoning.

The first sign of danger is the violet line upon the gum margin. If the administration be stopped at once no further trouble may be seen, but if the slightest discoloration of the skin appear it is likely to be permanent. The color varies from a slightly cyanotic hue to a deep slaty gray or bluish-gray, and is fairly characteristic. It is

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likely to become darker after the use of the drug is stopped, because of the unreduced silver salts still in the system. Ordinarily there are no symptoms present, the unfortunate discoloration being the sole manifestation.

Diagnosis.—This involves chiefly the distinction from cyanosis from heart or lung disease. Patients presenting the latter condition are decidedly ill, while the subject of argyria is often entirely well, aside from this trouble. The cyanosis from chronic intestinal disease (enterogenous cyanosis) must be considered.

The history of exposure in handling silver salts or their use therapeutically may ordinarily be easily obtained. In an extreme case it might be justifiable to excise a portion of the skin and test for silver by chemical means.

Prognosis.—The discoloration is permanent. The absolute necessity of avoiding the too free use of silver salts should be noted.

Of the chronic systemic poisoning by other salts, notably by tin, zinc, copper, manganese, and by brass and bronze, we possess too little knowledge to make their study advisable in this connection. Local irritation and discoloration are noted from certain salts of the metals mentioned. Further investigation is desirable.

5. MERCURIAL POISONING

Acute intoxication by mercurial preparations calls for but passing notice in this connection. Salivation is so commonly the most striking phenomenon that the physician should suspect mercury as its cause, even though no history of the use of the drug is apparent. Acute intoxication occurs from the use of mercurial ointment externally, bichlorid douches after labor, and even the insertion of an antiseptic tablet into the vagina, as well as the more obvious and common methods of administration.

Chronic mercurial poisoning is stated to be less common than formerly, largely owing to the use of other agents in certain industrial processes where mercury was formerly used exclusively. The use of metallic mercury in the making of thermometers and similar instruments, and the handling of the acid nitrate of mercury in the

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making of felt hats, offer the most common sources of mercurial poisoning at the present time. The prompt recognition of salivation when mercurials are given and the consequent withdrawal of the drug, prevent more serious poisoning.

Emaciation, anemia, chronic gastro-enteritis, with extensive fatty degeneration in various internal organs, are commonly noted. Neuritis of the general type seen in so many intoxications rarely or never occurs.

Symptoms.—Although the mercurial stomatitis is the most striking feature of acute poisoning, it may be entirely wanting in the chronic form.

Blackish discoloration of the teeth is often noted. Headache, depression, sleeplessness, and general debility are common symptoms. Tremor is an important feature, showing most clearly upon the attempt to perform delicate movements, and especially if under emotional stress. It may be absent during rest. The lips and face may be involved. Emotional instability is often marked. The speech may be so interfered with by the tremor of the mouth and lips as to suggest that of multiple sclerosis; and the vertigo, which may even cause the patient to fall, may add to the resemblance (Edsall).

The curious emotional disturbances in advanced cases have been considered as hysterical phenomena by some writers, but the present view is that they are entirely due to the toxic influence upon the nervous system. The patients become easily frightened, and they may be so utterly upset by trivial occurrences as to unfit them for the ordinary contacts of life. Dementia may supervene.

Bizarre motor and sensory disturbances may be noted. Localized choreiform movements, convulsive attacks, even of epileptiform type, spasm of various muscles, especially of the flexors of the forearm, ataxia, sensations of cold, and extreme sensitiveness to noise may be mentioned.

Diagnosis.—This depends commonly upon the suggestion of some type of poisoning and the knowledge that the patient has been exposed, either in his occupation or through the taking of medicines, to the action of mercury. The examination of the urine may be decisive through the detection of the poison. The frequency of acute

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nephritis in acute mercurial poisoning should be noted, and the chronic form may follow the acute.

Differential Diagnosis.—Lead poisoning presents its own history, its characteristic colic and neuritis, lead line and blood changes, and lead may be found in the urine, especially upon the administration of potassium iodid. The possibility of a combination of lead and mercury poisoning is to be remembered. Alcohol may also be a factor in cases of chronic mercurial poisoning. The history should be carefully investigated. While the tremor and mental conditions of the two states may present certain resemblances, the circulatory and digestive disturbances of chronic alcoholism are fairly decisive. Peripheral neuritis is almost decisive in favor of alcohol as at least the most active agent. Hysteria occurs typically in individuals differing so decidedly as to age, sex, and all surrounding conditions, and it is so well characterized by its emotional features, loss of pharyngeal and corneal reflexes, hysterical hemianesthesia, etc., that little difficulty is ordinarily encountered in its differentiation.

Paresis may be suggested. The common specific history, characteristic delusions, moral perversions, apoplectiform attacks, characteristic affection of speech, and the progress and outcome of the disease are commonly sufficient for its differentiation. Paralysis agitans presents a definite tremor, but the often unaffected mentality, the expressionless face, muscular rigidity, and festination are decisive. Multiple sclerosis presents a tremor, intentional in character, a characteristic speech, nystagmus, increased knee-jerks, spastic gait, and apoplectiform crises.

Prognosis.—This is good in early cases if exposure can be terminated. The tremor may persist. In advanced cases, especially if alcohol be used and the exposure continued, the outlook is unfavorable.

6. PLUMBISM

(*Lead Poisoning*)

The acute forms of lead poisoning are relatively less important than formerly, while the development of many industries in which

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lead is handled and the use of many articles in the household, which may be poisonous through containing lead, have raised chronic lead poisoning in importance.

Lead may be taken into the system in so many ways that no complete list of methods of intoxication could be given. Poisoning may result from inhalation of fumes or of dust, from ingestion of contaminated food or drinks, conveying the lead to the mouth upon unwashed fingers, from use of medicines containing lead (lead and opium pill for diarrhea), from hair dyes, rectal or vaginal injections, holding dyed silk in the mouth, etc. The methods of poisoning are so numerous and frequently so obscure that the diagnosis must often depend upon the symptoms and the finding of lead in the urine with but little dependence upon the occupation or surroundings of the patient.

Plumbism is more frequent in cities supplied with soft water than in those the water supply of which contains lime salts which deposit readily within the pipes. Carnivorous animals seem more susceptible than herbivora, probably because of their greater gastric acidity. The varying susceptibility of different individuals may to some extent depend upon the ability of the gastric secretions to properly dissolve lead salts entering the stomach.

Acute lead poisoning is comparatively rare, and perhaps most frequent from the accidental swallowing of soluble salts of lead. Vomiting, abdominal pain, black diarrheal stools, paralysis, syncope, coma, and convulsions may be present, and death not infrequently supervenes.

The most characteristic pathological feature of chronic lead intoxication is the peripheral neuritis, especially noticeable in the nerves of the forearm. The optic nerve may be degenerated, and the brain cells and those of the anterior horns may be affected. The blue lead-line at the margin of the gums is due to the deposition of sulphid of lead. A fairly characteristic stippling of the erythrocytes (basic granulation) is often present. Arteriosclerosis and chronic interstitial nephritis are common in advanced cases. Lead may be detected in the urine and feces for weeks after its administration is suspended.

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Symptoms.—The patient complains for weeks of debility, muscular weakness, and constipation. Headache and sleeplessness are common. Anemia gradually develops. Epigastric pain, often of great severity, the so-called "lead colic," often accompanied with precordial pain and generally without diarrhea or abdominal distention, is a characteristic symptom. Various myalgias may be present. The lead line is commonly noted. Persistent neuralgia should suggest lead intoxication.

Peripheral paralysis, more especially wrist-drop, is common in the cases passing beyond the stage of lead colic. Foot-drop is less frequent. Muscular atrophy and reaction of degeneration are present. The symmetrical involvement of the forearms and the escape of the spinator longus are characteristic of lead intoxication. Tremor and anesthesia, hyperesthesia, or paresis may be noted. A much more extensive peripheral neuritis may be present and a type of progressive muscular atrophy may be due to plumbism. Cerebral symptoms (lead encephalopathy) are not uncommon in severe cases. Convulsions are the most characteristic feature, and are said to be especially common in negroes. Delirium, coma, and aphasia may be noted. Epilepsy and insanity may occasionally follow. The frequency of neurasthenic and hysterical manifestations in these cases must not be overlooked. Paretic dementia may follow lead poisoning. It is stated by Edsall to be more rapid in development than the ordinary type, with less disturbance of speech, less moral degeneration, and a better prognosis, inasmuch as recovery may occur.

English writers have laid especial stress upon the association between lead poisoning, and gout upon the one hand, and arteriosclerosis and interstitial nephritis, upon the other. The latter association is frequent in this country. A marked increase in the vascular tension may be present.

The diagnosis of lead intoxication is probably not so frequently made in children as it should be. Turner and Gibson speak of the frequency of colic and cerebral symptoms, of pains in the legs, of the tendency to predominating involvement of the legs rather than of the arms, as in adults, of rigidity of the neck, retraction of the

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head and ocular symptoms. The lead line is less constant than in adults.

In the absence of a history of exposure, the finding of lead in the urine by chemical means may establish the diagnosis. Albumin is likely to be present in the severe and chronic forms.

Diagnosis.—The history, especially of colic or cerebral symptoms, often leads to the diagnosis. In every obscure case it is well to inspect the gums as a routine measure, when inspecting the tongue. The anemia, debility, scaphoid abdomen, coated tongue, lead-line upon the gums, rendered more distinct by inserting the edge of a white card beneath, wrist-drop, possibly foot-drop, tenderness of the nerve trunks and often of the joints, muscular weakness and flabbiness, basic granulation of the red blood cells, possibly ocular symptoms, arteriosclerosis, or loss of knee jerks, are commonly sufficiently decisive.

Differential Diagnosis.—The paralyses are to be distinguished from those due to trauma, uremia, alcoholic or other toxic substances, and those of post-diphtheritic origin. The bilateral involvement and the escape of the supinator longus and frequently of the long abductor of the thumb are characteristic of lead neuritis. Uremia is associated with definite history, signs and symptoms of nephritis, while the presence of lead in the urine, even though accompanied by a trace of albumin and a few hyaline and granular casts, points toward plumbism. The chemical test is decisive in favor of lead as against alcoholic and post-diphtheritic paralysis. In a typesetter with a lead line, albumin and casts, scanty urine, arteriosclerosis, increased blood pressure, headache and convulsions, the diagnosis of epilepsy had been made, followed by that of uremia, but it proved to be a lead encephalopathy.

Prognosis.—Mild and recent cases may be expected to fully recover. The severer paralytic forms mentioned are much graver. Convulsions and especially coma are serious. Optic atrophy and blindness follow in a large proportion of cases showing ocular symptoms. The prognosis as to the renal and vascular involvements depends upon their severity and the possibility of avoiding future poisoning.

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7. ARSENICAL POISONING

Acute intoxication is seen chiefly as a result of homicidal, suicidal, or accidental use of arsenical preparations, frequently white arsenic, though rat poisons, fly poisons, and various insecticides may be the cause.

Colicky pains, vomiting, and diarrhea with collapse and death may be noted. Arsenical neuritis may occur if the patient survive.

Chronic poisoning is less common than it was before the sources of intoxication were so well known, and before legal enactments prevented the free use of arsenic-containing dyes and pigments. Most of the cases under my observation have resulted from the prolonged use of Fowler's solution or other arsenical preparations, often after the patient passed from under the observation of his physician, in such diseases as pernicious anemia, chronic malaria and psoriasis. One physician died of arsenical neuritis who, at the time he came under my care, was taking medicine from two physicians in two different States for his severe asthma, without knowing the composition of either. I found that the liquid contained Fowler's solution, and the pills contained white arsenic. A saloon-keeper with multiple neuritis, also fatal, denied the use of any alcohol, stating that he drank only soda-pop. Each bottle contained 1/60 grain of arsenic, according to the report of Dr. E. C. Hill. It was doubtless derived from impure sulphuric acid used in generating the carbon dioxid.

Other sources of poisoning are common. The fumes from smelters, contaminated glucose used in brewing, as in the English epidemic, arsenical sprays used in gardening and fruit growing, various dyes, wall papers, arsenic used by furriers and taxidermists, etc., may be mentioned. The use of less toxic preparations of arsenic therapeutically promises greater freedom from poisoning through this channel. Food preservatives are practically free from this danger in recent years.

Symptoms.—The most frequent manifestations of chronic arsenical poisoning relate to the skin, while the most dangerous ones pertain to the peripheral nerves. Keratosis occurs, affecting espe-

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cially the palms and soles, with desquamation, even in large scales, and a certain tendency toward the development of epithelioma. Disfiguring pigmentation, occasionally mistaken for that of Addison's disease, brownish or yellowish in color, diffused or circumscribed, and darker near the joints and the portions of the skin naturally pigmented, is not uncommon. It may affect the mucous membranes. It persists in certain cases after the cessation of the use of the drug. Hyperidrosis, especially of the palms and soles, may be very annoying. Erythematous eruptions, erythromelalgia (often associated with multiple neuritis), glossiness of the skin, furuncles, acne, alopecia, puffiness about the eyes, and various other skin lesions are not infrequent.

Of the nervous symptoms, peripheral neuritis is the most frequent and distressing. It may occur a week or two after a single toxic dose, but is commonly seen as the result of the long-continued use of some arsenical preparation internally.

Disturbances of sensation, numbness, tingling, various paresthesias, and pain precede the motor paralysis. The pain may be very severe, both before and after the advent of the paralysis. Before it occurs the disturbed sensations in the extremities of patients suffering with pernicious anemia may be wrongly attributed to an arsenical neuritis, when due in fact to the cord lesions of the disease. The advent of pain points strongly toward toxic neuritis.

The lower extremities are much more often and severely affected than the upper, and the extensors more than the flexors. No other neuritis commonly presents so much tenderness in the nerve trunks as does that due to arsenic. A rude grasping of the calf muscles may cause the patient to cry out with pain. Atrophy of the muscles, reaction of degeneration, contractures and loss of knee-jerk may occur, and tabes dorsalis may be suggested. The trunk muscles and those of the thighs and upper arms commonly escape. The sphincters are not generally involved. The sensory function in the extremities may finally be as deeply involved as the motor. Mental failure, even dementia may develop.

Pharyngeal paralysis, ocular paralysis, and involvement of various cranial nerves may be present. In two rapidly fatal cases above

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mentioned the terminal symptoms were precisely those of diphtheritic vagus paralysis. Death commonly occurs as a result of increasing debility and cachexia in the severe and neglected cases, although a majority of the patients recover with little permanent disability if the poisoning has not progressed too far.

Diagnosis.—This depends upon the discovery of certain of the symptoms described, most commonly those of neuritic origin. If a multiple neuritis should develop in one not an alcoholic, and known to be taking any drug for chronic disease, arsenic should be suspected. It may be proven in the urine. Lead neuritis may commonly be excluded by the characteristic features already described. That of alcohol occurs only in those well habituated to drink, and the diagnosis may commonly be made with ease, if it be only considered. The possibility of the presence of any of the forms of infectious neuritis must be borne in mind, and the diagnosis may depend almost entirely upon the history.

Prognosis.—The milder cases, discovered before profound intoxication occurs, do well, recovery resulting after several months. The more severe ones may make an incomplete recovery, some permanent paralytic phenomena remaining. Mental involvement is of serious omen. A few cases run a rapid and fatal course.

8. PHOSPHORUS POISONING

The acute form is rare in this country, but it is still frequently seen in Prague, Vienna, and certain other continental cities, match heads being swallowed with suicidal or supposed abortifacient intent. The chronic form occurs with much less frequency in recent years, owing to the substitution of the almost harmless red phosphorus for the poisonous white and yellow forms, and the introduction of better manufacturing processes and better supervision of employees.

In the acute form vomiting, diarrhea, and gastric distress are present, often disappearing, to return on the third day with intense jaundice. Hemorrhages appear under the skin and mucous membranes and blood may be present in the vomitus and the stools.

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The aching in the muscles is thought to be due to hemorrhages into their substance. Profound depression, coma, and death follow in the severe cases. Violent delirium may precede the coma. The phosphorescence in the vomitus may be of diagnostic value. Leucin, cystin, and tyrosin have been found in the urine.

The liver enlarges during the acme of the jaundice, and may be noted to subside if recovery occurs. The resemblance of the symptom complex to that of acute yellow atrophy of the liver is so striking that some clinicians have even believed that the latter disease is merely a manifestation of phosphorus poisoning of unrecognized origin. Cerebral disturbances of acute yellow atrophy are much more severe.

Chronic Poisoning.—This commonly manifests itself as necrosis of the lower jaw, rarely the upper, with suppuration and separation of the necrosed bone. It occurs practically only in those with defective teeth.

Caries about the tooth extends until abscess formation, extensive necrosis, anemia, and sepsis develop. Tuberculous infection may occur and make rapid progress in the debilitated patients. Amyloid disease is an occasional result of the long-continued suppuration of the neglected cases. Meningitis has been noted. In European clinics one may see the terrible deformity which occurs as the result of extensive suppuration and necrosis, or as the effect of the extreme surgical measures necessary to stay the process. The odor may be atrocious in the neglected cases.

Diagnosis.—This depends very largely upon the history, that of suicidal attempt in the acute cases and of industrial exposure in the chronic. The differentiation of acute yellow atrophy depends upon the absence of history of poisoning, and upon the fact that the disease is not infrequently associated with surgical procedures or pregnancy; upon the greater prominence of the cerebral symptoms, and the more frequent finding of leucin and tyrosin in the urine. This disease has commonly no period of intermission corresponding to that between the gastro-intestinal irritation upon swallowing the phosphorus and the time of appearance of the muscle-aching, hemorrhages, the jaundice, and enlargement of the liver.

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An ordinary jaundice may precede the development of acute yellow atrophy.

The chronic form is recognizable by the history of exposure, and the knowledge that severe progressive necrosis of the jaw from other causes is rarely seen. The swelling and peculiar induration, and the finding of the ray-fungus serve to differentiate actinomycosis.

Prognosis.—The prognosis in the acute form is grave, a majority of the cases dying. If the stomach be washed out promptly and the symptoms begin to ameliorate after the first three or four days, recovery may be hoped for. In the chronic form the prognosis depends upon the timeliness of resort to surgical measures, for recovery often follows early intervention.

9. POISONING BY ILLUMINATING GAS

This has become relatively more frequent and important during recent years, because of the greater amount of carbon monoxid, the chief toxic agent in all such gases, contained in the water gas supplied in many communities. Because of the toxicity of this agent, and the comparative lack of offensive odor of the water gas, the danger of acute poisoning by inhalation is very great, while chronic intoxication is rarely seen unless in those whose occupation brings them into contact with the gas in the place of manufacture.

Haldane states that air containing 0.02 per cent. is toxic, and if the percentage rise to 0.05 per cent. it is highly dangerous. Poisoning most frequently occurs as the result of accident, though attempted suicide is a common and homicide an occasional source. The carbon monoxid given off from electrical furnaces, charcoal furnaces, from certain explosives used in mines, and occasionally from poorly arranged heating apparatus may cause poisoning. The products of combustion given off from the exhaust of gasolene engines contain a large portion of carbon monoxid, and the danger of working under an automobile while the engine is running, particularly in a closed garage, is well recognized. The danger is greater in case of comparatively perfect combustion, since no warning odor is then noted.

Pathology.—The action of the carbon monoxid destroys the abil-

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ity of the oxyhemoglobin of the red blood cells to carry oxygen and carbon dioxid. The blood assumes a cherry-red color, and bluish-red spots appear upon the neck, chest, thighs, etc. The viscera are reddish in color and spots of hemorrhage may be noted. Carbon monoxid is stated to have an affinity for hemoglobin 300 times greater than oxygen.

Symptoms.—Headache, throbbing of the vessels, vertigo, muscular weakness, nausea, vomiting, drowsiness, loss of control of the sphincters, and deep coma may be noted. Cerebral excitement is an occasional feature. Increased frequency of respiration and of the pulse is present. Muscular twitching may precede general convulsions. Cyanosis may be obscured by the reddish color of the blood. A moderate leukocytosis is common, a high one being of grave significance. If recovery occur a great variety of sequelæ may be noted. Amongst these may be acute bronchitis, bronchopneumonia, lobar pneumonia, amaurosis, neurasthenia, multiple neuritis, various paralyses, and grave mental disturbances, even dementia.

In chronic poisoning the symptoms are less sharply defined, but resemble in a general way those of mild acute cases. Anemia and slow pulse are said to be common.

Diagnosis.—The history of the case often suffices, especially if several individuals are affected. The peculiar reddish color of the face and lips is suggestive. The carbon monoxid in the blood may be demonstrated. The test most easily applied is that of Hoppe-Seyler; a sodium hydrate solution of 1.300 sp. gr. is added to the blood, and the resulting clot is of bright-red color, while it is greenish brown with normal blood. The spectroscopic test is decisive. In doubtful cases, these or other tests should always be employed.

Differential Diagnosis.—Alcoholism may often be recognized by the history, odor of the breath, etc., but the possibility of gas poisoning in addition must not be overlooked, either suicidal or through accident or inadvertence because of the intoxication. Uremia is associated with the chemical and microscopical findings in the urine characterizing nephritis, and the presence of edema and of the cardiovascular and retinal phenomena of the disease. Chronic poison-

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ing is difficult of recognition unless the source of the gas can be demonstrated.

Prognosis.—Patients commonly recover if discovered early and treated promptly. The possibility of death or disability from late sequelæ must not be disregarded, especially in those of advanced age.

10. AUTO-INTOXICATION

The term auto-intoxication should be limited to poisoning from faulty processes of metabolism. It is unfortunately, at present, a sort of a catch-all for ill-understood diseases showing no very positive diagnostic criteria.

Taylor gives an excellent summary of the endogenous intoxications in the following table:

- Endogenous Intoxications
  - Parasitic
    - Alimentary ...
      - Due to bacterial processes
      - Due to higher parasites, as vermes
    - Systemic ..... The infectious diseases
  - Metabolic
    - Oxidation .....
      - Suboxidation
      - Superoxidation
      - Insufficiency of oxygen
    - Distoxication
    - Overexertion
    - Retention intoxications ..
      - Retention of bile
      - Retention of perspiration
      - Retention of carbon dioxid
      - Retention of feces
      - Suppression of urine
    - Salts, acids, alkalies; acidosis
    - Fever
    - Infections
    - Neoplasms
    - Metabolism of protein .....
      - Cystinuria
      - Alkaptonuria
      - Uremia
    - Metabolism of nuclein .....
      - Gout
      - Oxaluria
    - Metabolism of carbohydrate.
      - Glycosuria
      - Diabetes
    - Metabolism of fats..... Acetone complex
    - Disease of special organs
      - Thyroid, adrenal, pituitary bodies
      - Pancreas, liver, etc.

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For an extended consideration of the subject his article may be consulted. Many diseases are more or less closely associated with definite departures from the normal in the process of digestion. Thus tetany in the adult is commonly found in those in whom dilatation of the stomach is accompanied by decomposition of the contained food. Tetany in children is not infrequently associated with acidosis, and the presence of excessive amounts of ammonia in the urine. Asthma dyspepticum is probably of toxic origin from some failure in the process of digestion. The assumption of auto-intoxication because of the increase of indican and the conjugate sulphates in chronic constipation seems unwarranted at present.

The occurrence of urticaria in persons subject to attacks of gastro-enteritis is common, and these attacks are thought to be due to intoxication of endogenous origin. In intestinal obstruction the toxic symptoms are associated with disturbances in the secretions of the upper intestines. The question of the dependence of digestive forms of neurasthenia, nervous dyspepsia, and certain anemias upon varying types of auto-intoxication is still unanswered.

RETENTION INTOXICATIONS

We stand upon firmer ground in the consideration of intoxication resulting from retention of waste products in jaundice, uremia, and in the suppression of perspiration. For a more extensive consideration of these subjects than is possible here, and of derangements of purin metabolism, acidosis, cystinuria, gout, diabetes, and many other conditions, the reader is referred to the special works.

11. FOOD POISONING

This may be endogenous, the poisons being natural to the substance eaten, as is muscarine in the mushroom, or exogenous, as in the case when otherwise wholesome foods contain mineral poisons, animal parasites, or the lower forms of vegetable life or their poisonous products.

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Mineral poisoning is not common through food, but lead and arsenic are occasionally ingested through contamination in various ways. Many of the cases thought to originate in the use of canned goods are in reality due to bacterial cause. The mineral intoxications are generally chronic and are considered elsewhere. Poisoning by animal parasites is considered in the appropriate section. The Trichinella spiralis and the cysticercus are the common agents in this country.

VEGETABLE POISONING

Poisoning through fungi is little known in this country. The ergot fungus, claviceps purpurea, growing upon diseased rye, formerly caused terrible epidemics in Europe (ergotism). Anesthesia, tingling, muscular spasms, and gangrene are the most prominent features.

Vetch poisoning or lathyrismus originates from a poison natural to the chick pea, flour becoming contaminated by the addition of the seeds in manufacture. Many epidemics have been reported from southeastern Europe, northeastern Africa, and especially from India. Pain in the back, tremor, fever, spastic paralysis of the legs, and even paraplegia may develop.

Mushroom poisoning is unfortunately common in this country, and is due to the eating of certain poisonous species which contain a virulent alkaloid, muscarine.

Solanin develops in potatoes that have sprouted, and may cause an acute gastro-enteritis with great prostration.

The development of beriberi in those living largely upon rice, from the grains of which the pericarp has been removed, is thought to be due to the deprivation of certain phosphatic elements, and not to an active intoxication.

In many instances poisoning has resulted from the development of bacterial toxins in beans, oatmeal, and other vegetable foods accidentally contaminated. The danger increases with the increase in the protein content of the food, a more virulent bacterial poison resulting under these circumstances.

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MILK POISONING

"Milk sickness," due to using products of cows suffering with the disease known as the "trembles," is considered elsewhere.

Because of the ease of contamination, its suitability for bacterial growth, and because it is commonly consumed raw, milk is perhaps the most prolific cause of food poisoning. The almost absolute safety of sterilized milk has led to its more extended use in recent years.

The milk may act as a conveyer of the contagion of scarlet fever, diphtheria, typhoid, and other diseases, but more commonly gives rise to acute intoxication because of contamination with the Bacillus enteritidis and other nearly related organisms. The danger is greater because of the lack of appreciable change in the infected milk. Milk-borne epidemics of scarlet fever seem to be especially virulent.

Many instances of poisoning originate from the use of ice cream, cheese, butter, custards, and other milk-containing foods. Vaughn leads us to believe that tyrotoxicon, which he first isolated, is not the most common nor the most virulent of the cheese poisons.

FISH POISONING

(*Ichthyismus*)

This may be due to the consumption of fish normally containing substances poisonous to the human being. The fugu poisoning of Japan and the East Indies is due to the physiological poison, fugin, found in the ovaries and testicles of certain species of tetrodon and diodon. The poison resembles curare in its action, and the mortality rate is very high in cases of poisoning by it.

Certain fish are poisonous only during the spawning season (pike, sturgeon), and others only when eaten raw, as may even be the case with cod fish.

Fish may convey bacteria, especially if eaten raw, but more commonly give rise to bacterial intoxication because of imperfect processes of preservation, the poison not being destroyed by cooking. Ptomains of great virulence may develop rapidly in decomposing fish,

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and may cause gastro-enteritis, vertigo, collapse, and even death. The consumption of fish from "blown" cans (swelled by the gases of putrefaction) has often resulted fatally. The poison may be a soluble one, or the various bacilli, especially of the colon and proteus groups, may be found.

Poisoning by Shell Fish.—Many cases result from the use of mussels and oysters. The poison may be merely carried by the shell fish, or may arise from beginning decomposition. Mytilotoxin is the name given to the virulent ptomain isolated by Brieger from mussels. It is not destroyed by the heat of cooking. The symptoms resemble those described under fish poisoning, but urticarial eruptions and attacks of dyspnea are especial features. It is well recognized that shell fish taken in water contaminated by sewage or otherwise are especially likely to be poisonous. The conveyance of typhoid by oysters is well known, and it is probable that other specific diseases may also be carried. Lobsters and crabs are occasional sources of food poisoning, especially when kept some time after being caught. The symptoms resemble those of fish poisoning in general. The canned articles may be perfectly preserved but be dangerous because of decomposition beginning after the cans are opened.

MEAT POISONING

Sausage Poisoning.—Because of the frequency of poisoning from sausages and the isolation of the B. botulinus, the specific cause in many instances, meat poisoning is often spoken of as botulismus. The meat may occasionally be infected at the time of slaughter, but the common infection is from without after the carcass is dressed, as in the process of cutting up. The B. para-typhosus, B. botulinus, B. enteritidis, the Proteus vulgaris, and members of the colon group are the chief agents of intoxication. The meat may give no evidence to the senses of taste or smell that it is not entirely wholesome. On the other hand, the consumption in all parts of the world of "high" game, in which putrefaction is well established, with almost entire immunity from evil results, is evidence that only in rare instances is the decomposition-process a dangerous one. Mutton is

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practically exempt from the danger of food poisoning. While thorough cooking renders meat safe so far as the danger of transmitting animal parasites goes, it may have no effect in the usual meat poisoning.

Symptoms.—These may be chiefly gastro-intestinal or predominently nervous. In the former case, nausea, vomiting, diarrhea, and intense dizziness with prostration are noted. In the latter, either alone or superadded to the above, we may note dimness of vision, diplopia, mydriasis, utter prostration, dyspnea, delirium, coma, and death. Recovery may ensue after weeks of illness.

Ptomain poisoning calls for no separate consideration, excepting for the remark that the name is used as a cover for all sorts of slip-shod diagnoses, varying from ruptured tubal pregnancy to perforative appendicitis. The diagnosis of ptomain poisoning should excite precisely the same suspicions in the medical mind that are suggested by the diagnosis of gastralgia, typhomalaria, etc. There was excellent justification in a recent case for my answer to the question, "What is the best treatment for ptomain poisoning?" namely, "the immediate removal of the appendix," for the patient had perished from an unrecognized appendicitis.

12. PELLAGRA

(*Maidismus*)

This disease has long been studied in Spain, Italy, and Roumania, occurring there in epidemics. Of late many cases have been found in the United States.

Etiology.—The cause is still in dispute, although intoxication from food prepared from Indian corn, especially if imperfectly ripened, is thought by many clinicians to be the source. Sambon suspects the sand-fly to be the carrier of a causative infection. The disease is apparently not contagious. Negroes are more susceptible than whites, and women than men.

Symptoms.—Stomatitis, with a very red tongue, is common as an early manifestation and may be the cause of very painful mastica-

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tion and deglutition. Diarrhea, often of great severity, with watery or bloody stools, may be present. Nausea and vomiting are frequent.

The most characteristic feature of pellagra is the erythematous inflammation of the skin of the backs of the hands and other uncovered portions of the body. The sharply defined and symmetrical areas become darker in color, rougher than normal, and desquamation, vesiculation, and formation of bullæ, and eventually of fissures

FIG. 133.—PELLAGRA. Case developed in Colorado. From the collection of Dr. A. J. Markley.)

mark the severer cases. The affected regions finally become red, dry, scaly, and indurated, though atrophy may be the terminal process.

Lassitude, irritability, depression, confusion, hallucinations, melancholia, and even dementia supervene in the severer cases. A considerable proportion of the cases of insanity in the Italian asylums results from pellagra, and many cases are reported from similar institutions in this country, especially in the Southern States. Spastic and paralytic cord phenomena are not unusual.

Course.—The disease may be acute or chronic, the former type running a rapidly fatal course in the severer cases, the latter tend-

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ing to recur annually, with gradual progression and eventual dementia in perhaps 10 per cent. or 12 per cent. of the cases.

Diagnosis.—Attention to the very striking skin lesions, the red tongue, digestive disturbances, and mental symptoms should suffice for the diagnosis. This fails more commonly from failure to think of the possibility of pellagra than from any especial difficulty in the differentiation.

Prognosis.—The great majority of the cases recover. Progressive mental impairment is of grave significance. The patients do not bear intercurrent disease easily.

13. BERIBERI

(*Kakke*)

This is a multiple neuritis especially common in Japan and the Far East, particularly in warm regions, frequently accompanied by dropsy and often fatal. It is due in most cases probably to a diet confined almost exclusively to polished rice, but a specific bacterial agent may also be implicated. The too exclusive use of white flour in the dietary of fishermen is thought to be a factor in the etiology.

It has been most destructive in Japan, the Malay archipelago, the Philippine Islands, and less so in Brazil and in the West Indies. Cases have been reported occasionally amongst the fishermen of Cape Cod, Massachusetts, for more than thirty years. Several outbreaks have been reported in jails, asylums, and prisons in the United States. A few cases come to this country from the military and naval forces in the Philippine Islands. The practical abolition of the disease by the substitution of whole rice for the polished variety, in which latter the phosphorus-containing pericarp is eliminated, does not necessarily conflict with the idea of the disease being of infectious nature, since the absence of the phosphates may favor the infection by reducing resistance to a specific germ.

Symptoms.—The period of incubation is unknown. The physicians dealing with beriberi in the East describe four forms as follows:

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(a) Rudimentary Form.—Catarrhal symptoms are followed by disturbance of sensation and loss of power, especially in the legs and feet. Pain, hyperesthesia, paresthesia, tenderness in the muscles, slight edema, dyspnea, palpitation, and abdominal distress are present. After weeks or months, the symptoms pass away, but relapse is to be feared.

(b) Dry Form (Atrophic Form).—The symptoms of the rudimentary type are modified in that edema is absent, but pain, muscular atrophy, paralysis, abolition of reflexes, and ataxia are prominent. All the extremities and even the face may be affected. The heart is always involved.

(c) Wet Form (Dropsical Form).—This is characterized by an exaggeration of the cardiac features, extensive dropsy of limbs, and general anasarca, and less pronounced neuritis. The paralytic features may not show until the dropsy subsides.

(d) Acute Cardiac Form (Pernicious Beriberi).—The symptoms of the rudimentary form are succeeded by acute cardiac asthenia, with death even in twenty-four hours. There is often a tendency for the disease to become chronic. It is this type especially which causes such severe losses amongst coolies in the plantations of Java.

Diagnosis.—This is easy in the regions where the disease is endemic, and in the patients recently arrived from those regions, if the possibility of it be borne in mind.

Differential Diagnosis.—I have known of difficulty in diagnosis between beriberi and alcoholic neuritis in a soldier returned from the Philippine Islands and accustomed to alcoholic indulgence. The dropsy was the most important feature in favor of beriberi. The acute tenderness in the leg muscles in arsenical neuritis should not be forgotten. The peculiar distribution of the paralysis in the neuritides of lead, arsenic, alcohol, etc., and in the post-infectious forms of multiple neuritis, with absence of dropsy and of history of exposure in the regions where beriberi exists, should suffice for differentiation.

The disease is extremely fatal in Java and other Eastern countries. Under favorable hygienic conditions recovery is the rule.

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SECTION IX

DISEASES OF METABOLISM

1. DIABETES MELLITUS

Definition.—A chronic metabolic disturbance in which glucose is excreted in the urine, even, in certain cases, when no carbohydrates are taken. The ingestion of large quantities of food and of fluids, the excretion of much urine, and emaciation are commonly noted.

Diabetes is apparently increasing in frequency in this country. Negroes are apparently less susceptible than whites. The Jewish race had a mortality six times as great as that of other inhabitants of Frankfort from 1873 to 1890, according to Wallach, and their greater susceptibility is well recognized everywhere. The better class of Hindus is especially subject to the disease.

The disease is not infrequently hereditary, and collateral branches of a family often suffer. Husband and wife are not rarely affected—conjugal diabetes. Obesity is not infrequent in diabetic families.

Men are more often affected, the incidence being probably fifty per cent. greater than in women. The sixth, fifth, and fourth decades present the greatest proportion of cases, in the order given. The well-nourished, and especially the obese, are especially susceptible (lipogenous diabetes), but fortunately the type is a milder one than that seen in thin individuals. Diabetes in the first two decades is especially severe.

The circumstances most favorable for the development of the disease are middle age, residence in a city, a strenuous life, especially if associated with worry and mental excitement, lack of exercise, and a well-provided table. Von Noorden believes that obesity in certain cases may be practically regarded as the first stage of diabetes, carbohydrates being converted into fat before the stage of excretion of sugar begins.

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Gout is not uncommon in the families or individuals suffering from diabetes. Local cerebral disturbances, as from gummata, probably account for most cases of diabetes associated with syphilis. Injury to the brain, cerebral hemorrhage, the development of a tumor, cyst, etc., especially near the floor of the fourth ventricle, may be followed by glycosuria. Trauma in any region of the brain, or severe bodily injury, may be the cause of diabetes, about six per cent. of the cases giving such a history. An individual predisposition doubtless exists in these cases.

Pancreatic Diabetes.—Complete extirpation of the pancreas in animals is followed by a permanent glycosuria, while if one-tenth the gland be left the sugar is excreted only after the ingestion of carbohydrates in quantities. The inference is that an internal secretion of the pancreas, a glycolytic ferment, is necessary for the conversion of carbohydrates, since the ligature of the pancreatic duct, with consequent prevention of flow of the pancreatic secretion, is not followed by glycosuria immediately. The frequency with which diabetes is found in patients in whom pancreatic calculi, cancer, interstitial pancreatitis, etc., are found, depends not upon the character of the lesion so much as upon whether chronic interstitial pancreatitis has existed, either primarily or secondarily. In this condition the involvement of the islands of Langerhans, either a hyaline degeneration or an atrophy, is the essential lesion, so far as we now know. In hemochromatosis, arteriosclerosis and other diseases in which glycosuria occurs, the essential pathology relates to a chronic inflammation of some type in the cells of the pancreas. After the administration of phloridzin, a definite renal diabetes occurs, but probably not otherwise.

Carbohydrate Metabolism.—The starches and sugars of the food are transformed into dextrose mainly, and this is stored in the liver and muscles as glycogen, to be reconverted when needed, and as glucose oxidized for the production of energy and heat. So long as the proportion of glucose in the blood remains at 0.1 to 0.2 per cent. no glycosuria occurs, but in the absence of the proper function of the glycolytic bodies, the proportion rises and glycosuria results. This cannot occur from a sudden excess in the starchy foods. Continued

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excess in either starches or sugars results in accumulation of fat. "Hofmeister's assimilation limit" refers to the amount of sugar that may be ingested at once without the development of glycosuria. With different sugars the limit lies between 120 grams (milk sugar) and 250 grams (glucose). A glycosuria occurring immediately after the ingestion of large quantities of starch constitutes presumptive evidence of the existence of a true diabetes.

Symptoms.—In many cases the onset of the disease is so insidious that it is discovered by accident, as so often occurs in examination for life insurance. In others, and especially in the young, the disease may begin abruptly, with abnormal thirst, abnormal appetite, emaciation, increased quantities of urine, etc. In many adults, the disease is discovered because of the complaint of the patient of furunculosis pudendi, eczema, gangrene of the toes, or other evidence of a serious disturbance of metabolism.

I have seen several instances in which the sudden development of diabetic coma led to the discovery of the disease, and a diabetic retinitis may in similar manner be the starting-point of the investigation. In the mild cases the sugar disappears from the urine upon the omission of the carbohydrates from the diet, while the severe cases excrete sugar upon a strictly protein regimen, glucose being produced from the body proteids in extreme cases. In general, fat diabetics offer a much better chance for improvement under treatment than lean ones. Great emaciation is much more constant in the young.

THE URINE.—Increased frequency of micturition is often the first complaint, and is associated with the increase of total quantity, which is a common characteristic of the disease. An increase from normal to three or four liters in the 24 hours is most common, but ten to twenty liters may be passed. The specific gravity is commonly between 1.030 and 1.045, but may reach even 1.070. The actual percentage of sugar varies from one to even ten per cent.

The urine is commonly pale and faintly greenish in color, and often of a sweetish odor, especially if acetone be present. Yet a small amount of sugar may be present in a concentrated urine of high color; and neither color, specific gravity, nor quantity of urine

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should prevent an examination of the secretion for sugar. The increase in the amount of urine depends upon the fact that the increase in the glucose content renders the blood hyperisotonic, so that it takes up fluid from the body, with consequent increase of the urine.

The percentage of sugar and consequently the total excretion should be calculated from a sample of the mixed twenty-four-hour urine, since the percentage varies at different times of the day. A decided increase occurs one or two hours after eating, and a decrease during the early morning hours.

The actual weight of sugar excreted varies from a few grams to 500 grams in ordinary severe cases, but in special instances two or three times this amount has been excreted in a day. The dependence upon diet of the amount of sugar excreted is very close. Acute disease, pulmonary tuberculosis and diabetic coma are often accompanied by a sharp decrease in the glycosuria.

Tests for Glucose.—The sugar in diabetic urine is practically always glucose, though levulose and pentose are occasionally found, perhaps in combination with glucose.

Fehling's test, or the Haines or Purdy modification of it, is the one most commonly used. The bismuth test is also easily applied. Under ordinary conditions the best plan in case of doubt is to apply the fermentation test. To be absolutely sure, one may test, at a temperature of 22° to 28° C., the activity of the yeast in a sugar solution in one tube, the yeast for the presence of fermentable material in it in another, and the urine with the same yeast in a third. If the yeast is good it produces gas in the sugar solution. If there is no sugar in the yeast, the second tube shows no gas or a negligible quantity. If this yeast produces no fermentation in the third tube, containing the urine, the urine contains no sugar. The simplicity and reliability of the fermentation test should cause it to be applied in cases of doubt and especially when the copper reduction in Fehling's test and other copper tests is doubtful.

The polariscope is often used for a quantitative test as well as qualitatively. The phenylhydrazin test offers no especial advantages.

Unfortunately the ordinary tests are subject to many errors. The most common source of trouble is the presence of an excess of uric

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acid, of kreatinin, or of alkapton. Conjugate glycuronic acid may be excreted after taking certain drugs and gives a partial copper reduction, and also reduces bismuth. The use of the fermentation test as described will prevent error.

Quantitative Estimation of Glucose.—The use of the common fermentation tube suffices for clinical work, the amount of gas given off being measured. If the amount of sugar be large, the urine must be diluted, and the resulting figures increased accordingly. The polariscopic method is much used in laboratories. Given the total amount of urine and the specific gravity of the total specimen, the amount of sugar may be approximated by deducting from the total solids, as determined by the ordinary formulæ, the seventy grams attributable to the urea, chlorids, etc.

The total phosphates and oxalates may be increased in the diabetic urine. Glycuronic acid may likewise be present in abnormal quantity. Albumin is often present and glycogen has been found. Air may be present in the bladder (pneumaturia) if yeast organisms or colon bacilli are present there. Fat may be found in the urine (lipuria).

More important is the presence of B-oxybutyric acid and its derivatives, acetone and diacetic acid. The finding of the latter substances is proof that the first-mentioned one is being formed in the body, important because of its relation to the development of diabetic coma. Acetone is exhaled with the breath, and its odor may even be detected in the adjoining rooms. The total ammonia of the urine is often increased from 0.7 gms. to 7.0 gms. in diabetes.

Casts are present in many of the cases showing albuminuria, depending upon the nephritis, and not upon diabetes. With the development of diabetic coma, Kulz pointed out the frequency of an enormous number of short hyaline and granular casts, probably dependent upon an acute toxic nephritis. I have seen 100 casts to the field under these circumstances. Their sudden appearance is of utmost gravity.

Thirst.—This is often troublesome, and a coated tongue is often associated with it. The patient may drink an ordinary pailful during the night.

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APPETITE.—This is generally increased, and may amount to a true bulimia. The patient, to avoid loss of weight from consumption of his own fats and proteids, must eat enough to supply the ordinary demands of the system and a sufficient excess to provide for the sugar excretion. If he eats great quantities of carbohydrates, their excretion as glucose leaves him still hungry, his tissue wants remaining unsatisfied. Hence the prescription in these cases of albuminous and fatty foods.

The digestion ordinarily remains excellent. Because of the absorption both of the nutritive elements and water from the bowel contents, constipation is the rule. A marked gingivitis, due to the favorable conditions for microbic growth, is very frequently present.

The red flush upon the face has been often mentioned. The skin is commonly dry and harsh, and the nutrition of the hair and nails suffers. Increased frequency of the pulse, increase of the tension, subnormal temperature, drowsiness, and irritability are common. Lumbar pain is often present. Loss of sexual power, amenorrhea and loss of knee-jerks are present in most severe cases.

Complications.—Because of the lowered power of resistance the diabetic is especially subject to various and serious complicating affections.

THE SKIN.—Probably the most frequent manifestation, next to the dry, rough skin already noted, is the pruritis about the genitals, especially in females, due to the irritation of the mucous membrane and the skin by the saccharine urine, and the growth of hyphomycetes in the layers of the skin. This is common and striking enough to lead to a suspicion that coma is of diabetic origin in any case presenting an eczematous rash about the genitals. A general pruritus occurs, doubtless due to the irritation of the nerve ends by the glucose in the circulating blood. Many skin diseases appear in diabetes, rather because of the lessened general resistance than because of any direct relationship. Xanthoma and purpura are not infrequent. The bronzed skin of hemochromatosis (diabéte bronzé) has been mentioned. Boils and carbuncles of streptococcic origin are common enough to suggest the examination for sugar in any case in which they are present. They occur especially over

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the thick skin of the neck, back, and buttocks. The carbuncle is not unlikely to prove fatal in an advanced case.

Wounds heal slowly, if at all, in advanced cases, the granulation tissue even sloughing. Because of the frequent presence of arteriosclerosis, gangrene, especially of the toes or feet, is common; and because of the lack of resistance of the tissues, calls for more radical amputation if any operation is advisable than in ordinary cases. In connection with the peripheral neuritis of the disease, perforative ulcers, often symmetrical, may be noted. Herpes zoster is an occasional feature.

Paronychia, clubbing of the fingers, edema of the feet and legs, and various other nutritional disturbances are occasionally seen.

Lungs.—Pulmonary tuberculosis is very common, advances rapidly, and has been the actual cause of death in nearly half of some reported series of cases. Pneumonia is common and is especially likely to be associated with abscess or gangrene of the lung. The lobar or bronchopneumonic form may be found.

Sexual Organs.—Amenorrhea is common in women, and impotence in men. Abortion is likely to take place if pregnancy occurs, and the diabetic symptoms are often exaggerated. The frequent presence of an eczematous eruption on the genitals in diabetes suggests the examination of this region in any case of doubtful coma.

Nervous System.—Diabetic coma develops in about half of the cases, and in those under 15 or 20 years of age is the common terminal event. It is especially common in those in whom rapid wasting occurs, and this being almost invariable in the young, the development of coma in children is not surprising.

The most frequent type of coma is that described by Küssmaul, in which the so-called "air hunger" is so marked a feature. Headache and vomiting often introduce it. The patient becomes dull mentally and finally passes into a deep coma. The characteristic feature of this form is the violent dyspnea, the respiration becoming deep and noisy, although perhaps not increased in frequency. The patients generally die in a day or two after the advent of the dyspnea. The pulse is rapid and feeble, and the temperature subnormal. It is in this type that the enormous numbers of the short

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hyaline and granular casts mentioned elsewhere are to be found. The breath has the odor of acetone, albumin, acetone and diacetic acid are commonly present in the urine, and B-oxybutyric acid may be found. Frerichs recognizes also an alcoholic form of coma, so-called from its resemblance to alcoholic intoxication, and the diabetic collapse believed to be due to myocardial weakness. Feeble pulse and lividity characterize this form, and neither acetone nor diacetic acid may be found in the urine.

The coma may develop suddenly as a result of some decided change in the condition or circumstances of the patient. An acute disease (pneumonia, carbuncle) may initiate it, or too radical a change in diet, especially to a proteid type, or excessive fatigue, the strain of surgical operation, or of chronic complications. Occasionally a mild abortive type of coma occurs and the patient recovers temporarily. As a result, presumably, of the acid intoxication, vomiting, pain, and incomplete intestinal obstruction have been noted. An examination for sugar, diacetic acid and acetone should precede any operative intervention in the supposed abdominal disease.

The coma is recognized to be due to the circulation in the blood stream of B-oxybutyric acid, and the term "acidosis" is used by many. The detection of diacetic acid and especially of B-oxybutyric acid in the urine is cause for grave alarm, although the development of coma may not occur for months. Coma from apoplexy or other cause may obscure the diagnosis of diabetic coma.

Peripheral Neuritis.—A mild variety of multiple neuritis is not uncommon, with the usual numbness, tingling, cramps, and neuralgic pain in the extremities, the latter fortunately not often severe. Sciatica may be present. Many of the skin complications of diabetes are dependent upon the neuritis, notably herpes, onychia, and especially perforative ulcer of the foot. The so-called diabetic tabes results from neuritis, the knee-jerks being abolished, and lightning pains being present. The ocular signs of tabes are not present. The possibility that perforative ulcer of the foot may be due to tabes or diabetes must be borne in mind and the urine carefully examined in any case.

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Paraplegia and hemiplegia, sometimes of toxic origin, have been noted, and a condition resembling paresis is occasionally seen.

SPECIAL SENSES.—Abscesses and boils about the eyelids are common. Diabetic retinitis and cataract are frequently present. The latter is found in probably 5 per cent. of the cases, and is often bilateral. In the ear, furuncles are common, and otitis media and mastoid complications may occur.

Diagnosis.—Diabetes may be suspected when the patient complains of unusual thirst or appetite, increased quantity of urine, a "sticky" urine, as when it has evaporated upon linen, or, as in babies, upon the floor, weakness, emaciation, recurring boils or carbuncles, genital eczema, or other of the symptoms mentioned. The diagnosis can scarcely be overlooked if the urine be examined, and the finding of sugar in routine examination is so frequent as to enforce the absolute necessity of the procedure. In case of doubt, several of the tests should be tried, especially the fermentation and polariscopic tests. If these be properly applied error is impossible. Many imperfect reactions, especially in the concentrated urines and in those of patients taking drugs, and due to uric acid, lactose, homogentisic acid, creatinin, alkapton, etc., are the basis of a false diagnosis of diabetes.

The real basis for the diagnosis is the finding of a considerable quantity of sugar for a long period of time. Two classes of patients are likely to attempt to deceive the physician, hysterical patients and men desiring life insurance, the former adding sugar to the urine and the latter substituting another's urine for their own. The hysterical women can be absolutely circumvented by washing out the bladder with salt solution and holding the catheter in place until sufficient urine passes for the chemical examination. In the insurance cases the urine must be passed in the presence of the examiner.

More difficulty arises in the diagnosis between alimentary glycosuria and other transient forms, and true diabetes. The temporary absence of sugar under strict dietary conditions does not invalidate the diagnosis of the latter, while the temporary presence of sugar under a diet rich in glucose, for example, by no means establishes it.

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The assimilation limit for glucose and for cane sugar lies between 120 and 200 grams for healthy adults, and the temporary appearance of glycosuria after taking such an amount or a lesser quantity of lactose and maltose is not pathologic. One patient of mine had glycosuria for more than a year, while drinking a pint of beer at bed time. It disappeared upon stopping the use of the beer without further treatment.

The transient appearance of sugar in the urine after head injuries, apoplexy, biliary colic, severe nervous strain, etc., is of little import. I have just examined a young woman who had as high as 10 per cent. of sugar during the course of an acute pancreatitis, from which she is now convalescent, the sugar being present now in mere traces.

Poisoning by morphin, nitrobenzole, carbon monoxid, amyl nitrite, hydrocyanic acid, etc., may give rise to a temporary glycosuria. Phloridzin causes the passage of sugar regardless of the character of the diet. Intermittent glycosuria often precedes diabetes, especially in those of gouty tendencies.

While diabetes may be present in a pregnant woman the possibility of the taking up of lactose from the milk in the breasts and its excretion in the urine should be remembered.

Prognosis.—In the young diabetes generally runs a rapid course (weeks or months), with death in coma as the final result. In general the less marked the hereditary predisposition to the disease, the later in life it begins, the better the patient retains his flesh and the more obese he is the better the prognosis, and patients may live for 20 or 30 years without very serious difficulty. The absence of acetone, diacetic and oxybutyric acid from the urine is of course favorable. Traumatic diabetes is of bad prognosis. The forms developing in pregnancy, or as the result of nervous shock or strain, or in combination with bad habits of eating or exercise may have a favorable outlook. The patient whose circumstances are such as to permit him to take the best care of himself has a decidedly better prognosis than others.

The so-called "bronzed diabetes" is considered under the title "Hemochromatosis."

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2. DIABETES INSIPIDUS

Definition.—A chronic disease characterized by great thirst and by the passage of large quantities of dilute urine, free from albumin, sugar and pathological sediment. No characteristic anatomical changes are found post mortem. Persistence of the condition distinguishes it from the temporary polyuria seen in hysteria, some other nervous affections and after fright, shock, trauma, etc. The disease is decidedly rare as compared with diabetes mellitus.

Etiology.—The disease occasionally develops in members of several generations of a family, and may be congenital. Three uncles of one subject coming to my notice suffered from D. mellitus, and others of the same family were phthisical. Bright's disease, gout, rheumatism and syphilis are frequently present in the ancestry. Males in early life are especially affected. It is an occasional feature of the pituitary type of infantilism.

The disease usually develops without known exciting cause, but exposure to cold, anxiety, trauma, acute disease, syphilis or disease of the floor of the fourth ventricle may be noted. The great frequency of cerebral syphilis as an exciting cause has been noted by many recent writers, and the not infrequent association of sixth nerve paralysis, choked disk and other cerebral lesions, often of luetic origin, is of great interest in this connection.

Symptoms.—The two striking symptoms are the polyuria and the incessant thirst. The urine may amount to 20 to 50 pints in the 24 hours. By temporary withdrawal of fluid from the body it may, for short intervals only, exceed the fluid intake. The appetite is commonly normal but may be increased. The skin and mucous surfaces are generally drier than in health.

Whether a given case is primarily one of polydipsia or polyuria can scarcely be stated, since the two features are so interwoven. If the supply of drinking fluid is cut off the patient may even drink his own urine, so intense is the thirst.

The Urine.—The amount is commonly 20 to 30 pints in the 24 hours, but may equal the weight of the subject. It is pale, perhaps bluish, of a specific gravity of 1.001 to 1.005, and contains generally

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a slight excess of total solids. No abnormal sediment is found. Inosite is not infrequently present in traces. The advent of glucose may eventually transform the case to one of diabetes mellitus.

Course.—Emaciation finally develops and the secretion of saliva and sweat decreases though it may be many years before the nutrition fails materially. An uncontrollable diarrhea may be a terminal event. A subnormal temperature is characteristic. Terminal pneumonia is often noted. Otherwise the patients may become comatose as death approaches.

Diagnosis.—From D. mellitus it is distinguished by the constant low specific gravity and the absence of sugar. The occasional transformation of the insipid form to true diabetes must be noted. Hysterical polyuria is temporary, but the urine presents practically the same features as in D. insipidus. The characteristic hysterical manifestations are diagnostic.

The polyuria of chronic nephritis is distinguishable by the presence of albumin and casts, even though they be temporarily absent, and by the cardiac, vascular and ocular features of nephritis. The association of suppurative processes and enlargement of the liver and spleen should prevent error in those cases in which the urine of amyloid disease presents mere traces of albumin and but scanty sediment. Intracranial disease, especially tumor, hemorrhage, and syphilis in the region of the medulla may be accompanied by polyuria, but the cerebral features are predominant. The frequency of brain syphilis in D. insipidus has been mentioned. In abdominal disease, hydronephrosis, and in convalescence from typhoid and other acute diseases, polyuria may occur, but is transient and accompanied by the features of the disease upon which the polyuria depends. Malingering may easily be excluded by efficient supervision of the patient.

Prognosis.—The disease may last fifty years, and recovery may occur. Great improvement results from antisyphilitic treatment in certain cases, even though the polyuria continue. Death may result from the progress of the lesion upon which polyuria depends. A rapid course with death from some intercurrent affection is not uncommon.

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3. GOUT

This is a disease in which, because of a disturbed metabolism affecting especially the nitrogenous elements, uric acid in excess is found in the blood stream. The chief manifestation clinically is the arthritis, distinguished by a deposit of sodium biurate crystals in the peri-articular tissues.

Gout is doubtless becoming more common in America with the changing social conditions, but it is still rare in the country districts where hard physical labor and absence of over-feeding and steady drinking are the rule. A failure on the part of the physician to distinguish gout from chronic rheumatism and arthritis deformans is a further factor to be considered in any statistical inquiry.

Etiology.—Heredity is the most important single feature. In England a majority of all cases give a history of a gouty ancestry. Futcher states that the proportion of acquired gout in the United States is much greater than the figures would indicate. Transmission is through the male line especially, though unaffected females often transmit the tendency. Gout is practically never of the acquired form during the first two or three decades.

Steady use of the alcoholic drinks—malt beverages, wines and distilled liquors, stated in order of their noxious influence—is of great importance. It is thought that beer is the chief factor amongst the alcoholic liquors in this country. The ingestion of food of whatever variety beyond the amount called for by the physical work performed is of even greater importance etiologically than the use of liquor. The over-use of nitrogenous foods is perhaps less deleterious than formerly believed, the total intake being of greater importance. Given gouty heredity, a dislike of active exercise, a good appetite for food and malt liquors, with ability to gratify it, and a constipated habit, and the escape from gout is almost a miracle. Yet gout occurs in the poor, as Osler has noted, under a "combination of poor food, defective hygiene and the consumption of excessive malt liquors." This form is comparatively common in American cities. The native American who supports himself in the country by manual labor is practically immune. Lead poisoning, perhaps because of its

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tendency to limit proper elimination because of a complicating chronic nephritis, is to be found in the antecedents of many gouty patients, especially in England.

When the metabolism is in shape to invite an attack any disturbing cause may constitute the exciting agent, as a slight injury or an unusually hearty meal. Many middle-aged men may be met at the dinner table who avoid champagne and certain other wines at certain times because of having suffered previous attacks of gout from their use.

Pathology.—We know that gout is associated with certain faulty nutritional changes, so that uric acid is produced in excess and not properly eliminated, and that sodium biurate crystals may be found about the affected joints and in the tophi. Further study is necessary before we can give any more exact statement.

Symptoms.—Acute Gout.—This often comes unannounced in the night in a well-nourished middle-aged man of previous good health. He suffers intense pain in the metatarsophalangeal joint of the great toe, most frequently upon the right side. The joint becomes slightly swollen, red, shiny and tender, the temperature rises moderately, and a feeling of malaise is present, and perhaps of anorexia. The intensity of the pain lessens during the morning hours, but the day is an uncomfortable one. The pain returns with the night and the opposite joint or other joints of the foot may be involved. After several days the attack gradually subsides, itching and desquamation occur, the swelling slowly disappears and with it the physical and mental depression. Full restoration to health is not long delayed in those otherwise healthy, and the patient may feel better than for months. Recurrence may be noted in a few weeks or months, or may be delayed for even many years.

During the acute stage a sharp polynuclear leukocytosis may be present. Suppuration is said never to occur. Albumin and sugar may be found temporarily in the urine.

Many attacks are preceded by restlessness. Great irritability, pains in the joints, an acid dyspepsia, or an acute bronchitis may precede the outbreak.

Chronic Gout.—The acute attacks recur with increasing fre-

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quency, and affect a greater number of joints, but rarely involving the hip, shoulder or elbow. The absorption of the biurate deposits about the affected joints fails, and gradually increasing deposits are noted, the so-called joint tophi. Similar deposits occur along the line of the tendons in many cases, in the ear and the eyelid, and less frequently in the laryngeal cartilages and those of the nose. The deposits about the joints give rise to marked deformity. The "knobby" hands of the inmates of soldier's homes, poor houses, etc., are gouty in origin. The whitish color of the chalk stones eventually shows through the atrophic skin. The deceptive redness, simul-

Fig. 134.—Gouty Hands.

ating an acute inflammation and suggesting the presence of an acute abscess, should be mentioned. Fever may be absent.

The appearance of imminently impending suppuration may exist for a year and then disappear, or slow necrotic changes may uncover the deposit of urates, the needle-shaped biurate crystals being readily found under the low power of the microscope.

The joints may give rise to audible and palpable crepitus. The arteries gradually become more sclerosed, with increased blood pressure and hypertrophy of the left ventricle. The urine presents the characteristics of chronic interstitial nephritis. Muscular cramp, indigestion and a sallow complexion are frequently noted. Death

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eventually results from uremia, pneumonia or an acute inflammation of one of the serous membranes. Many patients, however, attain old age, even though invalided for half a life time by their disease.

Irregular Gout.—Many symptoms classified under divers headings are observed in members of gouty families, often in those never presenting symptoms of typical gout. The French consider many of the chronic eczemas to be of gouty origin, especially the forms that develop after middle age and resist treatment. The nails are often fluted.

The typical "bilious attacks" with coated tongue, foul breath, and constipation are most common in those of gouty predisposition. Chronic bronchitis and emphysema are frequent in these individuals. Migraine, neuralgia and especially sciatica should be mentioned. Itching of the feet at night is common. Scleritis, iritis and glaucoma, and gouty pharyngitis are not rare. With the cardiovascular lesions may be found anginal attacks, aneurism and arteriosclerosis. Myocarditis may occur. The frequency of chronic interstitial nephritis accounts for the fact that a majority of the gouty patients die uremic. Oxaluria and renal stone occur. The gouty urethritis is rare.

Retrocedent Gout (Visceral Gout).—The sudden appearance, often coincident with the disappearance of acute gouty manifestations, of grave visceral derangements, is now regarded as being most often of uremic origin. Abdominal pain, vomiting, diarrhea, collapse and death may be seen, or precordial pain with dyspnea and irregular heart action, or delirium and coma.

Diagnosis.—The acute manifestations of gout are generally easy of diagnosis, the patient being commonly aware of the nature of the attack. In the absence of previous attacks and with involvement of many joints, acute articular rheumatism is suggested. Inquiry as to heredity and habits of work, drinking and eating may establish the diagnosis. The sudden onset, especially in the joints favored by gout, and the intensity of the pain are suggestive. The lack of effect from salicylates and the frequent prompt relief by colchicum, should be taken into account. The presence of uric acid in the blood

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serum and the diminution in the urine during the acute attack are of value.

Chronic Form.—The diagnosis is easy after the characteristic tophi and deformities of the joints occur, and error is rare in proportion to the care used to find the tophi. Diagnosis fails because of neglect to think of gout rather than from lack of diagnostic data. In case of doubt a suspicious nodule upon the ear should be punctured and the characteristic crystals sought with the microscope, for they are of course absent in rheumatic and fibroid nodules, sebaceous cysts, etc.

A polyarthritis without fever is generally gouty in origin. The X-ray shows masses of gouty deposit in certain cases, but unfortunately not in those where the deposit is limited to the articular cartilage.

Much difficulty may occur in differentiating between gout and arthritis deformans. The latter disease is common amongst the hard-worked and poorly-nourished, especially females. Hereditary transmission is not uncommon. Ulnar deflection of the fingers is frequent. Atrophy of the interossii is common, and Heberden's nodes are often present. They are, perhaps, an occasional feature in true gout. Osteoarthritis, enlargement of the joints, atrophy of bone, with more or less characteristic deformities, speak for arthritis deformans. The spindle-shaped fingers of this disease are almost pathognomonic. The rapid pulse, sweating hands and feet, the patches of pigmentation upon the face, are rarely noted in gout. The X-ray is of great value.

The diagnosis of irregular and retrocedent gout depends chiefly upon the obtaining of a satisfactory history of gout in the individual or in his ancestors. No diagnosis of visceral gout should be made until after exclusion of uremia as a cause of the symptoms. Less credence than formerly is given to uric acid as the direct cause of a multitude of human ills, and some satisfactory evidence of hereditary taint or of the presence of the tophi or of definite attacks of gout should be sought before making a diagnosis of the irregular forms of the disease.

Prognosis.—The appearance of an attack of gout leads us to ex-

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pect subsequent attacks. If they fail to occur it is generally because of a realization on the part of the patient of the necessity of changing his manner of life from that indicated above as predisposing to the disease, rather than because of the effect of medical treatment. The acute attack of gout is rarely fatal. The fatal result in chronic gout is due rather to arterial, cardiac and renal changes than to the articular manifestations of the disease, regardless of the amount of suffering or disability these may entail.

4. OBESITY: CORPULENCY

Definition.—A disorder of nutrition characterized by the deposit of an amount of fat abnormal for the individual concerned. Great latitude must be given to the definition.

Etiology.—The condition is often hereditary, probably in a majority of the cases, and especially in women. Anders finds that gout is especially frequent in the ancestry of the obese. Feebleness or cessation of the sexual activities is frequent in the disease.

Males tend to accumulate fat between forty and fifty years of age, while in females the tendency shows itself a decade earlier. Fat babies may continue to gain fat, but more often the tendency disappears in childhood, perhaps to reappear several decades later. A special characteristic of obesity in middle life is the accumulation of fat in and about the viscera. The protuberant abdomen of the beer drinker is largely due to the presence of a very fat omentum. Those whose fat tends to decrease with the atrophic processes of age live more comfortably than those with the opposite tendency. As in gout, a good appetite and a repugnance to vigorous muscular exercise are predisposing factors.

The anemic type of obesity is more common in the female, dependent upon the lessened powers of oxidation, with consequent accumulation of fat. The plethoric form is more common in man. The effects of alcohol in lessening oxidation, with consequent obesity, are naturally more often observed in the male sex. The terminal hydremic form mentioned by certain authors more commonly follows the anemic type.

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Obesity depends in the end upon the ingestion of too much starch, sugar, fat and protein, probably generally in the order named, with lack of sufficient physical exercise to burn up the fuel ingested. Alcohol, especially beer, is an added factor in many cases, and the drinking of much fluid is often to be noted. It is notorious that many fat people are small eaters, but the accumulation of fat is prima facie evidence that the nutritional income is too great and the outgo too small, whatever the exact figures may be. An enforced sedentary life, as from sickness or accident, frequently from anterior poliomyelitis, often predisposes to obesity. The limitation of exercise in fattening animals used for food, and the old custom of bleeding them, thereby lessening their oxidizing capacity, may well be noted.

The accumulation of fat locally, as upon the buttocks of Hottentot women, the breasts of the women of certain races, and in the omentum of beer-drinkers should be noted.

Symptoms.—These depend chiefly upon the greater amount of work demanded of the heart because of the greater bulk to nourish and to move, the lessened ability of the heart to do its work because of the hampering effect of the fat it must carry with it in its movements, and the interference with its work due to encroachment upon its working space by the accumulated fat in and upon the surrounding organs. Marked dyspnea upon exertion is the most striking symptom, with unusual fatigue, if the attempt be prolonged. These symptoms are much more prominent in the anemic form than in the plethoric.

Individuals of the latter type may be thoroughly energetic and efficient for many years, until arteriosclerosis, myocarditis, or acute infection supervenes. Subjects of the anemic type are less vigorous and resistent, but both are looked upon as poor risks by the insurance companies.

Diagnosis.—The chief difficulty is in deciding where obesity begins. Edema and interstitial emphysema need only be mentioned. The latter is produced artificially by the injection of air subcutaneously in the fat subjects of the dime museum.

Myxedema has been mistaken for obesity; but the mental con-

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dition, firm, dry, inelastic skin, alteration of facial lines, etc., should prevent error.

Prognosis.—This is less favorable in the anemic and markedly hereditary forms. The plethoric type is commonly amenable to great improvement if the patient will obey rules as to diet and exercise. If exertion be followed by symptoms of cardiac weakness, the outlook is bad, and these patients are likely to die eventually of some arteriosclerotic, myocardial or renal complication. Acute disease and surgical operations are badly borne.

FIG. 135.—OBESITY WITH HERMAPHRODITISM. Rudimentary male organs, but female appearance.

Adiposis Dolorosa.—Dercum described certain cases in which localized accumulations of fat occur, spontaneously painful, or tender to the touch, more often in women of middle age, accompanied with neuralgic pains and excessive irritability, and frequently with atrophy of the thyroid gland. Interstitial neuritis may be present. The pituitary body and the column of Goll have shown lesions in certain cases.

Lipomata are merely localized accumulations of fat, oftentimes following a slight injury (bee-sting) and of importance because of mechanical inconvenience chiefly. In ordinary obesity there may

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be local accumulations of fat, the adiposis tuberosa simplex of Anders.

Lyon makes the following classification of fatty deposit:

"(1) Dercum's syndrome ('adiposis dolorosa'); (2) simple adiposity or obesity; (3) nodular circumscribed lipomatosis, solitary, multiple or symmetrical; (4) diffuse symmetrical lipomatosis, including 'fat neck' (Madelung); (5) neuropathic edema, pseudoedema, pseudolipoma, lipoma; (6) 'adipositas cerebralis,' including Froehlich's syndrome."

5. RICKETS

(*Rachitis*)

Definition.—A condition of impaired nutrition in children due to improper diet, and manifested chiefly by changes in the cartilages and bones. Pathologically there are found an increased proliferation of cartilage cells with imperfect bony transformation. The changes are most marked at the junction of the epiphysis with the diaphysis of the long bones.

Etiology.—It is a disease essentially of malnutrition, and is especially to be feared when the mother has been ill-fed and ill-housed, and when the infant is subjected to the same evil conditions. Syphilis is a possible contributory factor only, in the opinion of most authorities.

The disease is one of crowded cities with wretched social conditions and is thus more common in Europe than in America, and in those American cities with a larger tenement population than in others. It is almost unknown in rural America. It is found at its worst in localities where poverty, dampness, darkness, poor ventilation, cold, filth, ignorance, syphilis and the worst social conditions in general are present. It is difficult to say how much racial influences are operative because of the many other circumstances to be taken into consideration. In general a considerable altitude is believed to be prejudicial to the development of rickets but no great city with the evil social conditions mentioned lies at any great ele-

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vation. The disease is rare in Denver (elevation 5,280 feet) as compared with other American cities.

Age and Sex.—Rickets is chiefly a disease of the first two years of life, roughly corresponding to the time of first dentition. The sexes are equally affected.

Diet.—The final and essential cause of rickets is an improper diet, the deficiency of fat in such form as to be available to the child being the most important single feature. The disease is very rare in breast-fed infants, excepting under circumstances which justify the assumption that the milk is of poor quality. The low percentage of lime salts, proteids and of sugar in many artificial foods is of importance, but the presence or absence of available fat is the supreme dietetic consideration.

Symptoms.—Rickets develops insidiously, generally during the first dentition, with the signs of indigestion and impaired nutrition. The baby is restless and irritable, and less playful than usual. The sleep is disturbed, and fever appears, with night sweats. The most characteristic feature in many cases is the sweating about the head, with the appearance of a wet spot on the pillow during sleep. The frequent occurrence of respiratory disease in rickety children is associated to some extent with the uncovering at night, due to feverish restlessness. Delayed dentition is almost constant. The child appears fat in many cases, but is pale. He objects to being handled because of a general tenderness, and is disinclined to crawl or walk, since such exercise is painful. The anterior fontanelle is commonly more widely open than normal. The weakness of the muscles, from malnutrition and disuse, combined with the general tenderness, leads to the so-called "rachitic pseudo-paralysis." The bony changes manifest themselves by the development of knobby enlargments of the ends of the ribs, the rachitic rosary, easily palpable, and in thin children visible. The eversion of the lower ribs permits the spleen and liver to be felt more easily than in health. The epiphysis at the lower end of the radius enlarges, the femur, tibia and ulna being most frequently affected after the radius, and the other long bones still less frequently. A moderate kyphosis is not uncommon.

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In approximately half of the cases of considerable severity greater or less bending of the long bones occurs. The forward and outward curvature of the tibia is most characteristic. In creeping babies the curvature of the bones of the forearm is to be noted. All the remaining long bones may become bent. The varying effects of muscular action, of pressure from without and of weight carrying must be considered in studying the causation of various deformities.

The bony deformities may appear in exaggerated form because of the laxity of the ligaments characteristic of rickets, this looseness permitting an abnormal motion between the various bones.

The deformities of the head, chest and pelvis should be further considered. The failure of closure of the anterior fontanelle has been mentioned and is due to failure in normal formation of bone. The head is commonly larger than in normal infants. The typical rachitic skull is that known as "caput quadratum" (hot cross-bun head), the top being flattened, and the head showing an abnormally quadrangular surface when viewed from above. The bone is thickened in places, but so soft that the veins of the scalp lie in the channels palpable to the finger.

The bones of the skull may be soft and yielding (craniotabes) but the flattening of the occiput seen in bottle-fed children is not necessarily rachitic. Pigeon-breast is common though not at all exclusively a manifestation of rachitic changes. Harrison's groove, a continuation downward and outward of the sulcus due to the sinking in of the ribs and the projection of the sternum, is often present.

The affection of the bones of the pelvis shows but little in babyhood, but many of the cases of deformed pelvis seen in later life, especially the flattened pelvis and the generally contracted variety, are late manifestations of the rachitis of infancy. The slight enlargement of the liver and spleen, flatulent distension of the abdomen, slight anemia, slight leukocytosis in certain cases, retarded growth, arrest of development of certain limbs from sclerosis of the bones after the epiphyseal disease has become quiescent, the tendency to convulsions, and the occasional occurrence of tetany and

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laryngismus stridulus should be mentioned. The urine shows nothing characteristic.

Diagnosis.—In well-marked cases the diagnosis is easy. In case of doubt the X-ray may demonstrate the deformity and lack of proper ossification early in the disease. The occurrence of sweating and fever, tenderness, fretfulness, disinclination to creep or walk, pseudo-paralysis, delayed dentition, persistence of an open anterior fontanelle, beading of the ribs and other deformities, in infants ill-fed or living under bad hygienic surroundings, leaves no room for doubt. Syphilis, osteomalacia, infantile paralysis, spinal caries, and hydrocephalus may need to be considered, but the diagnosis can scarcely remain in doubt if they be thought of.

Congenital Rachitis.—European authorities recognize a type of rachitis found at birth, complete antepartum fracture of the long bones being a common manifestation.

Late Rachitis.—It would probably be more correct to speak of recrudescent rather than late rachitis in considering the form occurring in children between the ages of nine and fourteen. Deformities similar to those of ordinary rachitis may persist.

Prognosis.—The lighter forms recover under better hygienic conditions and proper feeding and medication, often without deformity, while in the severer types the deformity persists. Death is likely to be due to bronchitis or bronchopneumonia, laryngismus stridulus, convulsions or other complications rather than to the original disease.

6. SCORBUTUS

(*Scurvy*)

Definition.—Scurvy is a nutritional disorder, due chiefly to improper food, and presenting anemia, swollen and bleeding gums, hemorrhages under the periosteum and elsewhere, and marked debility. It will be considered under two headings: first, ordinary scurvy of adults; second, infantile scurvy.

Etiology.—Whatever be the exact cause of scurvy, the striking feature in all cases is the absence from the dietary of fresh fruits

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and vegetables, or of unsalted meat, as in the case of those (Arctic explorers, etc.) living upon a meat and fish diet. The view is becoming more commonly adopted that a proper alkalinity of the blood cannot be preserved in those deprived of fruits and vegetables and also of fresh meats, since these are the articles of diet furnishing "an excess of bases over mineral acids." Wright found a striking reduction of the alkalinity of the blood in scurvy, which disappeared as recovery ensued. It is very probable that a specific infection becomes grafted upon the "acid intoxication," but we have not sufficient proof to be able to affirm it.

The parts played by anxiety, imprisonment, starvation, exhaustion, home-sickness, etc., should not be underestimated. The disease is more common in cold climates and in cold weather, at sea than on land, and amongst male adults. The improvement of dietary conditions upon the sea has rendered the disease rare excepting as it occurs in beseiged cities, amongst travelers and explorers cut off from civilization, in improperly fed babies, and in adults who cannot or will not eat a proper diet. I have seen the disease in an eccentric dyspeptic who, amidst the unparalleled abundance of good food of the State of Kansas, lived for months upon crackers and canned tomatoes.

The disease begins insidiously. The patient complains of debility, and soon lassitude and apathy are pronounced. Pallor, dyspnea, palpitation, loss of appetite, diarrhea, or occasionally constipation, are succeeded by more characteristic symptoms. The gums become swollen and spongy, bleed easily, and the teeth become loose or even drop out. The tongue swells and becomes red or heavily coated. The breath is foul, and submucous hemorrhages occur in the mouth. Dysenteric discharges from the bowel may follow the diarrheal trouble. Petechiæ appear, first upon the legs, especially their outer aspects. Sub-periosteal hemorrhage, and hemorrhage into the joints and from the nose, lungs and digestive tract supervene. Hematuria may occur.

Edema of the legs, ulceration over the sites of slight injuries, extensive swelling about the joints, necrosis of bone, separation of the epiphyses from the shafts of the long bones, profound anemia,

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retinal hemorrhage, gangrene of lung, insomnia, blindness, delirium and death are features of the worst types of scurvy.

The urine shows no very characteristic changes, unless a secondary nephritis develops. The blood shows the changes of a secondary anemia, with leukocytosis only as the result of some complication. The temperature is often subnormal, but a complication (bronchopneumonia) may cause fever. Permanent ankylosis of the large joints may follow the scorbutic involvement.

Diagnosis.—In epidemic and endemic forms the known circumstances as to diet and general conditions render the diagnosis easy and certain. The debility, anemia, swollen and bleeding gums, hemorrhages, edema, and the improvement upon the use of proper food are sufficiently characteristic. In isolated cases we must differentiate:

(a) Mercurial Salivation and Cachexia.—The known use of some mercurial, and salivation, frequent diarrhea, and lack of dietary limitations found in the history of scorbutus suffice.

(b) Acute Lymphatic Leukemia.—The bleeding and ulceration about the gums and the mouth may simulate scurvy, but the predominance of large mononuclear lymphocytes in the blood is characteristic.

(c) Purpura.—The gums are not affected as in scurvy, and there is a lack of the characteristic history and surroundings of the latter disease. Abundant subcutaneous hemorrhages are more characteristic of purpura. The prompt improvement upon the giving of proper diet does away with any possible doubt as to the diagnosis of scurvy.

INFANTILE SCURVY

(*Barlow's Disease*)

This is a disease chiefly of artificially fed infants, characterized by many of the same features clinically that have been studied under scurvy of adults. The changes differ from those noted in rickets, but infantile scurvy is prone to develop in rickety children.

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Etiology.—Curiously the disease is more common amongst infants of the well-to-do, more often fed upon artificial food, and more strictly limited in variety. It develops generally between the sixth and fourteenth months. In Griffith's series 60 per cent. had been brought up upon a proprietary food, often with the addition of sterilized milk, 19 per cent. on the latter article alone, 9 per cent. on condensed milk, while the remainder had been fed on breast milk, pasteurized milk or raw milk.

Symptoms.—The baby is generally fretful and cries upon being handled, the lower extremities being especially tender. They are often held in the flexed position, and the baby screams upon any attempt to extend them. The gums may be injected and swollen, but definite scorbutic changes are not noted until some of the teeth appear, and then they are less characteristic than in adult scurvy.

Most striking are the swellings due to subperiosteal hemorrhage in the lower end of the femur or upper end of the tibia. The forearms, scapulæ, etc., may be involved. The skin over the swellings is glossy, tense and edematous, exquisitely tender, and cutaneous hemorrhages may appear. Crepitus from fracture or separation of the epiphysis may be noted. A pseudoparalysis may be present, the legs lying motionless in an everted position.

Hemorrhage into the orbit may occur, giving rise to proptosis, and ecchymosis about the eyelids or elsewhere may occur. The depression of the entire sternum from loosening of the articulations between this bone and the ribs, as described by Barlow, is not common. I have seen the skull "knobby" from the development of hematomata in various regions, presenting a most grotesque appearance.

The mucous surfaces rarely bleed, but hematuria is not uncommon. The rise of temperature in infantile scurvy is generally slight. A moderate anemia, generally of the chlorotic type, is present, more marked if extensive subperiosteal hemorrhages have occurred. Leukocytosis points to a complication. Hutchison found no alteration in coagulability of the blood.

Diagnosis.—The chief element in the diagnosis is the remembrance of the possibility of the disease in an infant. The fretfulness of the baby, the tenderness of the legs, and the screaming upon

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examination, the bony swellings, gum changes, and the dietary features are characteristic. In cases of doubt, the rapid improvement upon giving orange juice and other proper articles of diet is conclusive.

Differential Diagnosis.—Rickets must be carefully considered, and especially as the two diseases may be associated. The bony changes described under rickets are very definite, and differ greatly from the subperiosteal swellings of scurvy. The petechiæ and the spongy gums of scurvy are equally characteristic. In purpura subcutaneous hemorrhages occur, but the more characteristic features of scurvy are absent. Rheumatism, periostitis, syphilis, pseudoparalysis, infantile paralysis and acute lymphatic leukemia, all have features so characteristic as to be unmistakable if thought of and carefully studied. Hutchison speaks of the possibility of mistaking hemorrhage into the orbit and proptosis from scurvy for chloroma and sarcoma. The absence of further signs of scurvy with the presence of an excess of lymphocytes in chloroma and the presence of other evidence of malignant growth in sarcoma should make differentiation possible.

Prognosis.—This is good if only the disease be recognized early and properly treated. In neglected cases death often supervenes from bronchopneumonia, diarrhea or general exhaustion.

7. OCHRONOSIS

Definition.—A disorder of metabolism, found most frequently in Germans, with pigmentation of the skin, darkening of the cartilages and fibrous tissues, and characterized by the excretion of dark urine, containing alkapton or phenol derivatives.

Etiology.—One group of cases is definitely due to chronic carbolic acid intoxication, as from long continued (3 to 24 years, Beddard) external application. In another there is a congenital and even hereditary disorder of metabolism, with excretion of homogentisic acid. On exposure to the air, the urine darkens, the condition being known as alkaptonuria.

Symptoms.—The cartilages, tendons, and fibrous tissues in general are darkened, and show through the skin in lean individuals. The skin becomes almost black in certain cases, especially over the face

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and hands. The bladder is irritated by the strongly acid urine, and in the urine is found an excess of bladder cells and leukocytes. Aside from the occasional arthritis associated with the disease, there is no interference with health.

8. HEMOCHROMATOSIS

This rare condition is found chiefly in males, and commonly in cases of diabetes. The skin and internal organs are of a striking bronze color, the pigment being derived from the iron of the blood.

In the diabetic cases the discoloration gives rise to the name "bronzed diabetes." My case, while traveling in Europe, was continually asked, because of his deep brown color, if he was not of Indian blood. A hypertrophic cirrhosis of the liver is a part of the disease. The course is rapid in the cases with diabetes, though the pigmentation may exist several years before the advent of glycosuria.

9. AMYLOID DISEASE

(*Amyloidosis*)

Definition.—A disease secondary to long-continued suppuration and to syphilis, characterized by the deposition of amyloid matter in various viscera, and in the walls of the arteries.

Etiology.—In most cases long-continued suppuration precedes the development of amyloid disease, although the pus may not have escaped externally. Chronic pulmonary tuberculosis, tuberculosis of bone, and syphilis, especially involving the bones, are most common antecedents. The recognizable amyloid disease of the viscera often appears after years of suppuration.

Amyloid disease is most common in young adult males, in whom the favoring precedent conditions are most frequently found.

Symptoms.—These are those of the extensive changes induced in the whole organism by the serious suppurative disease which lies at the basis of the trouble. Advanced fibroid tuberculosis, syphilitic disease of the spine or the sacro-iliac joint, old empyema, tuberculosis, cold abscesses, etc., give rise to the most prominent features of the case, the amyloid disease of different organs being secondary to

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the deposit of the amyloid material in the smaller arteries affected. The patient often shows an advanced cachexia before the amyloid complication is recognized.

KIDNEY.—This organ is the one most frequently involved. The amyloid process may be secondary to chronic parenchymous nephritis. The large, firm kidney shows upon section the mahogany color in the iodin test, the straight vessels and the Malpighian tufts reacting most perfectly.

The urine is oftentimes increased in quantity, pale, with low specific gravity. The albumin may be a mere trace, or in considerable abundance. Hyaline, granular and fatty casts may be abundant, and the amyloid reaction may be found upon the application of the iodin test. The very refractile casts called by many "waxy casts" often show the reaction. Drospy may be noted. The vascular, retinal and cardiac features of chronic interstitial nephritis are not present unless the amyloid disease has involved a contracting kidney. The diagnosis depends rather upon the history of the associated symptoms than upon any characteristic features referring to the kidney.

SPLEEN.—This organ is often much enlarged (sago spleen) with rounded edges, but without tenderness. There are no characteristic symptoms.

LIVER.—This organ becomes immensely enlarged in well-marked cases, the edges being thick and rounded, and the abdomen protuberant over it. There are no characteristic hepatic symptoms. The diagnosis depends upon the associated conditions.

INTESTINES.—The whole tract may be involved. The disease is unrecognizable excepting for the persistent diarrhea which eventually develops in well-marked cases. The absence of hemorrhage in the stools, of pain and of tenderness over the abdomen are characteristic features. The recognition of the precedent disease and of the involvement of the liver, kidney and spleen render the diagnosis possible in certain cases.

Prognosis.—This is ultimately bad, largely because of the disease upon which the amyloid degeneration depends. The patient may live for years if the original trouble becomes quiescent.

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SECTION X

DISEASES OF THE DUCTLESS GLANDS

1. DISEASES OF THE THYMUS GLAND

The thymus is found to be atrophied in certain marasmic conditions but no definite changes are known to be associated with the process. It is enlarged in some cases of epilepsy, acromegaly, Addison's disease, myasthenia gravis, and especially exophthalmic goiter. The narrowing of the anteroposterior diameter of the upper part of the chest by an enlargement of the thymus may give rise to obstruction through pressure upon the trachea, with stridor, or actual thymic asthma in the more severe cases. The gland has been removed with recovery.

The most important and interesting condition of the thymus is that form of enlargement associated with lymphatism—the so-called status thymicolymphaticus. The lymph glands are enlarged and there is an increase in the lymphoid marrow of the bones. The heart and blood vessels are under-developed while the spleen and thymus are enlarged. General lack of development of the body is noted, and the subject is notably lacking in resistance to even the minor strains to which his system may be subjected. The instances in which infants have died from the injection of antitoxin, from slight shock or injury or after trivial disease, have been attributed to lymphatism. In young adults, death under anesthesia or from slight operation may result, and several deaths have been reported in connection with bathing or falling into the water. The theory that death is caused by a toxemia, due to a sudden overproduction of the internal secretion of the glands mentioned, seems to be most acceptable, although a mechanical action of the enlarged thymus upon the trachea has been thought possible.

Diagnosis.—The subjects are commonly anemic and of flabby appearance, often somewhat obese. The discovery of the enlarged

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accessible lymph glands should lead to careful examination for splenic enlargement. A considerable hypertrophy of the thymus may be demonstrable by careful percussion of the upper sternal region, the dulness being greater to the left and movable upwards by forcible over-extension of the head. The possibility of the not uncommon substernal thyroid, and of enlarged tracheobronchial glands must not be overlooked. The thymus may give a shadow on the X-ray plate, and may occasionally be felt above the sternum. Actual flattening of the trachea has been observed in thymic asthma upon laryngoscopic examination. Osler mentions the occasional presence of marked lymphocytosis.

2. DISEASES OF THE THYROID GLAND

Aberrant Thyroids.—Much difficulty arises through non-appreciation of the fact that the visible and palpable gland in the neck may not at all represent the totality of the thyroid. Thus I have seen Graves' disease fail of diagnosis because the goiter was entirely substernal—the so-called "diving goiter." In another case, a trained nurse, complaining of severe attacks of suffocation, had a small central cystic goiter, insignificant in appearance, and, upon superficial examination, of little consequence. Dulness over the manubrium led me to insist upon operation, and Dr. Leonard Freeman found a large substernal goiter, which had caused all the symptoms. Lingual, mediastinal and pleural thyroids may exist, and are prone to cystic degeneration.

Congestion of the Thyroid.—The extreme vascularity of the gland renders it subject to changes in volume through circulatory influences. Thus, in fright, after severe exertion and from mechanical compression of the vessels of the neck, enlargement may occur. The demand for its secretion at puberty and at the menstrual period doubtless causes the common enlargement associated with these states, which is believed to be vascular in origin.

Inflammation of the Thyroid.—Thyroiditis is a comparatively rare affection, and is most often seen in connection with the specific fevers, sepsis, peritonitis, etc. I have seen it as a complication of a mild pelvic inflammation.

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In most instances the inflammation is a simple one, with fever, enlargement of the gland, pain, redness and tenderness. In certain cases especially of septic nature, the process advances to suppuration, even with destruction of the entire gland.

In the severe forms, pressure upon the veins of the neck induces marked cyanosis. Respiratory difficulties and dysphagia may appear. The sclerotic type of thyroiditis described by Riedel may resemble malignant disease in the rapidity of its growth, and the character of the pressure symptoms induced. Simple adenoma is not infrequent.

Tuberculosis, syphilis, actinomycosis, and echinococcic disease may affect the gland. Both cancer and sarcoma are occasionally observed and either may be primary or secondary, and of almost any type. Metastases are frequent.

A. GOITER

(*Bronchocele*)

Definition.—An enlargement of the thyroid gland. In general the term may apply to any form of enlargement but is better limited to the chronic form, found more or less commonly everywhere, but more abundantly in certain mountainous districts.

Etiology.—No complete knowledge is available upon this point. It is occasionally congenital. It is much more common in young females than in other individuals and may be found in almost any climate and at almost any elevation. The seashore furnishes the least morbidity. In certain epidemics an infectious cause has been suspected but not proven.

Pathology.—The entire gland may be affected, or either lobe or the isthmus alone, or an accessory thyroid. In simple goiter, there is a hyperplasia of the glandular tissue (parenchymatous goiter), usually associated with increase in the colloid, vascular and connective tissue elements. The large, irregular goiters are commonly cystic, the cavities containing colloid material and often bloody extravasation. Calcification may occur, especially in the chronic fibrous type.

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Symptoms.—The majority of goiters present no especial symptoms and many are discovered by accident, for in the greater number of cases the enlargement is trivial. It is only when a considerable increase in size occurs that pressure symptoms develop. Aside from the deformity, most of the symptoms are due to the pressure mentioned.

Most frequent and important are the symptoms arising from tracheal compression. The elastic rings of the windpipe withstand pressure from without up to a certain point, when they tend to flatten. After such deformation occurs, great danger exists, since a slight increase of the pressure may practically obliterate the lumen of the trachea. The central cyst, and the substernal goiter are most dangerous in this regard. Cough, dyspnea, stridor, hoarseness, dysphagia, cyanosis, and even suffocation may be noted. The symptoms may arise purely from mechanical compression of the trachea, or from the added influence of pressure upon the recurrent laryngeal nerves. The heart may be affected through vagus involvement, and dilatation is not infrequent. Pressure upon the sympathetic may affect the vasomotor apparatus with pupillary changes, increase in sweat-secretion, etc.

Sudden changes in size of the goiter may occur from congestion and from hemorrhage within the gland, and either may be dangerous if the degree of compression be near the danger limit. In one case of great dyspnea coming on during labor, I advised non-interference until after the delivery, but death from an enormous hemorrhage into the gland took place during the temporary absence of Dr. H. R. McGraw, the attendant, before labor was completed. A slower increase in size suggests the advent of malignant changes.

Diagnosis.—This is easy in simple cases, the shape of the tumor and its mobility with the thyroid cartilage in deglutition sufficing. If the goiter be small, and yet severe suffocative attacks occur, percussion of the manubrium may demonstrate a mass beneath, and surgical exploration becomes imperative in the grave cases. The X-ray may be of service.

Prognosis.—This is good in many cases of simple goiter—in the young especially. It is better in the endemic types if the patient can

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leave the district in which it has originated. Death from pressure should be averted by early surgical intervention.

B. EXOPHTHALMIC GOITER

Definition.—A disease due to excessive action of the thyroid gland, or a perverted secretion, characterized typically by goiter, tachycardia, exophthalmos and tremor.

Etiology.—Females are affected more frequently than males, the ratio being probably 6 or 8 to 1. It is a disease of young adult life. Several cases may be noted in one family. Worry and nervous strain, fright, and mental shock undoubtedly have some influence.

Pathology.—The disease is now regarded as the result of thyroid intoxication, this position being strengthened by the production of most of the symptoms by the overuse of thyroid extract. The remarkable results obtained through lessening the blood supply by ligation of arteries or by extirpation of a portion of the gland are also to be considered.

Symptoms.—The four cardinal ones are goiter, tachycardia, exophthalmos and tremor, but one or more may be absent. On the other hand, fever, emaciation, general nervousness, diarrhea, anemia, moist skin, and various other features may be present. The disease may be acute or chronic.

Goiter.—The disease may develop in the ordinary goitrous subject. The gland is but moderately enlarged in a majority of cases, and the enlargement may be symmetrical or otherwise. Typically, it is a parenchymatous overgrowth, but the gland may be fibrous, cystic, etc. The pulsation in the thyroid may be easily felt and often seen, and a loud murmur, often double, is found upon auscultation.

Tachycardia.—This is so constant a feature that its discovery should always suggest the possibility of Graves' disease. The pulse rate rises to 90-120-140, or even much higher. Attacks of palpitation with a feeling of suffocation are frequent. The peripheral arteries are relaxed, the blood pressure may be low, capillary pulsation and venous pulsation may be noted, flushing and sweating are common, and the patient feels the pulsation of the vessels and the pound-

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ing of the heart under excitement. The heart is commonly somewhat enlarged, hypertrophy being the rule, often followed by dilatation. Hemic murmurs, and those of leakage from muscular insufficiency, due to exhaustion and anemia, are common. Acute dilatation of the heart may occur.

Exophthalmos.—This is the most striking feature of Graves' disease, but is frequently wanting and generally late in appearance. The eyeballs protrude, so that the lids cannot be completely closed in severe cases. It may be unilateral. Subsidiary phenomena are known as:

(a) *Graefe's Sign.*—The upper lid does not follow the eyeball downward as in the normal eye.

(b) *Stellwag's Sign.*—The palpebral fissure is wider than normal, exposing the sclera above and below the cornea.

(c) *Moebius' Sign.*—The power of converging the eyes is impaired.

The patients wink less frequently than in health and a spasmodic contraction of the upper lid often occurs. Ulceration of the cornea may develop.

Tremor.—This is fairly constant—a fine tremor of a rapidity of 8 or 10 to the second. With the arms held unsupported from the body and the fingers outspread it is easily detected.

Marked muscular weakness is present, the dynamometer showing a loss of three-fourths of the muscular power in many cases. The muscles may even be atrophied or paralytic. The patient may fall from giving way of the legs. The skin offers a decreased electrical resistance because of its moist state. The patients are markedly neurasthenic as a rule. A troublesome and uncontrolled diarrhea may last for a year or two. Moderate anemia is common and an increase in the mononuclear cells is frequently noted.

Emaciation is the rule. The temperature is generally slightly elevated over long periods of time. Albumin and sugar not infrequently appear in the urine. Pruritus, edema, vertigo, scleroderma, and pigmentation are not infrequent, and the hair may be lost.

Various complications may occur, without apparently having any very close relationship to the disease. Myxedema may follow Graves'

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disease. Terminal dementia is occasionally noted as in two of my cases.

Course.—This is generally chronic, but the disease may appear and disappear quickly. A course of one or two decades is not infrequent.

Diagnosis.—This is easy in the typical cases, but often difficult in those in which one or more of the characteristic symptoms are wanting. Many incipient cases are treated as cases of tachycardia until goiter or exophthalmos develops. Many others are classed under the elastic term "neurasthenia" for a long time, or the diarrhea is treated as an independent affection. Because of the comparative constancy of tachycardia and tremor in the symptom-complex, the physician should always look for any further signs of Graves' disease upon finding either of these.

Prognosis.—The patients, unless operated upon, commonly die after some years of cardiac exhaustion, tuberculosis, inanition, etc. The results in the hands of skillful surgeons are so infinitely better than those from medical treatment that operation should be considered in all serious cases.

C. HYPOTHYROIDISM

Definition.—A condition in which, owing to the inactivity of the thyroid gland, the affected child fails in development (cretinism), or the adult patient suffers from a mucoid infiltration of the subcutaneous tissues and blunting of the intellect (myxedema).

Surgical removal of the thyroid, or its destruction through atrophy or suppuration, may bring on the conditions known as operative myxedema or cachexia strumipriva.

D. CRETINISM

This is due to congenital maldevelopment of the thyroid, or atrophy, as after one of the infectious diseases. Only a fibrous remnant may remain, though a definite goiter, devoid of true glandular tissue, may be present. The disease is sporadic in America, but endemic in parts of Switzerland and in other localities.

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Symptoms.—In the congenital form, it is noted during the first year that the baby fails to develop, either physically or mentally, as it should normally do. The tongue protrudes, the tissues of the face thicken as in the myxedema of adults, the bony development is defective, the abdomen is pendulous, and the hair coarse and scanty.

FIG. 136.—CRETINISM. No. 1, 9 years of age; No. 2, 7 years; No. 3, 8 years. Nos. 1 and 3 are sisters. No. 2 has been under treatment for one year. Her mother had exophthalmic goiter when the child was born. (Dr. J. W. Amesse.)

At the time when normal infants begin to talk and notice their surroundings the cretin shows the nondevelopment of speech and of intellect. The nose becomes flat and thick, supraclavicular "pads" develop, the lips are thickened, saliva drools from the mouth, and the delayed teeth decay early. An anteroposterior curvature of the spine may be noted. A marked pallor of the skin is common. The mus-

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culature is poorly developed. The sporadic and endemic types developing later in infancy have the same general characteristics as the congenital type, but are ordinarily less severe in the manifestations. The patients may grow up with small stature, feeble physical development, and impaired mentality.

FIG. 137.—CRETINISM. No. 2 of preceding figure after two years of thyroid treatment.

Diagnosis.—Typical cases are recognizable at a glance. The imperfectly developed cases may yet suggest the diagnosis through the peculiar facies, impaired mentality, absence of thyroid, or, in certain cases, presence of a goiter and imperfect bony development.

Prognosis.—Without the specific treatment the outlook is hopeless as to recovery, the symptoms commonly becoming more marked as the years of childhood pass. Death commonly occurs from intercurrent disease during early adult life.

E. MYXEDEMA

Through loss of the thyroid function in adults myxedema develops. Women are affected about 6 or 7 times as frequently as men. The disease occurs mostly in mid-life, and may be transmitted through the mother. A curious relationship exists to goiter and Graves' disease, different members of the same family suffering from the different affections, or myxedema developing in those who have suffered from simple or exophthalmic goiter through destruction of the function of the gland.

Symptoms.—The disease commonly develops slowly, taking years

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even in certain cases for the complete evolution. The thyroid gland is commonly atrophied. Although the blunted mentality, forgetfulness and malaise may be present, the condition of the skin is the first feature to call attention to the diagnosis in the average case. Many cases are mistaken for nephritis because of the thick, edematous-appearing skin. The swelling does not, however, pit upon pressure, and the skin is peculiarly firm, dry, and inelastic. The lines of expression in the face are obliterated and the features appear "coarser." The hair is likely to be coarse and dry. Over the clavicles the thickening gives rise to the so-called "clavicular pads." The reddish patches on the cheeks contrast with the generally sallow color. From lack of sebaceous secretion and the accustomed perspiration the skin of the hands and wrists often becomes cracked and roughened. The patients complain of being cold in the ordinary temperature of the house, and the bodily temperature is often subnormal. The slowness of movement and of the mental processes becomes more marked, the patient becomes irritable, listless, drowsy, and even demented. The speech is slow and difficult to understand. Headache, lacrimation, deafness, tinnitus, marked anemia, constipation, albuminuria, glycosuria, hemorrhages, and dilatation of the heart are occasional symptoms of the disease.

F. CACHEXIA STRUMIPRIVA

This presents the features of myxedema, differing only in originating from actual removal of the gland as by operation. If a portion of the thyroid be left or an accessory thyroid exist, no symptoms develop. Since this has been well recognized the disease has become uncommon.

Diagnosis.—The one thing most necessary for the diagnosis of myxedema is to think of the possibility of its existence. In the early stages the diagnosis is often impossible, but with the development of the symptoms mentioned, and especially in the absence of the chemical and microscopical signs of the suspected nephritis, the difficulties should disappear.

Prognosis.—Myxedema commonly grows progressively worse un-

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less treated by thyroid medication in some form, although some improvement may be noted in the warm season. Spontaneous recovery may ensue. The average duration is stated to be from 5 to 7 years.

3. DISEASES OF THE PARATHYROID GLANDS

Near the inner edge of the lateral lobes of the thyroid lie several minute ductless glands (typically four) containing epithelial cells with large nuclei. Although no direct studies of their internal secretion have been possible thus far, it is well recognized that they have an important bearing upon calcium metabolism. The not infrequent occurrence of tetany after the earlier thyroid operations is now known to have been due to destruction of these minute glands, while its occurrence in the absence of operative intervention has been thought to be due to the pressure of the goiter. Heubner believes that convulsive disorders of infancy are associated with diseases of these bodies. The known development of tetany after their removal, within 2 to 5 days, and its amelioration by the administration of calcium salts, or by injecting an emulsion of the glands, warrant us in attributing tetany to disturbance of their function.

A. TETANY

Definition.—A disease due to disturbance of parathyroid metabolism, and characterized by spasms of the muscles of the extremities and irritability of the nerves.

Etiology.—The most typical cases are those following removal of the glands in operation upon the thyroid. In Vienna and other European cities many cases are seen in shoemakers and other workmen, especially in the winter season, leading to the belief that it may be an infectious disease. In dilatation of the stomach and other digestive disorders, especially in children, it may occur, and in some of the acute infectious diseases, after poisoning by chloroform and other agents, in uremia, and in Graves' disease and other nervous affections.

Trousseau recognized its frequency in pregnancy and lactation (nurse's contracture).

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Symptoms.—The characteristic feature is a muscular spasm, tonic, bilateral, affecting especially the flexor muscles of the hands and feet, and resulting in the production of the "pen holding" position in the former case, and the Talipes equinovarus position in the latter. More extensive flexion of the arms and legs may occur. The spasm may last a few minutes or an hour. Trismus and risus sardonicus occur when the jaw muscles are affected, and spasm of the larynx, diaphragm, or muscles of the chest is occasionally noted. Triboulet believes that glottic spasm may be the only evidence of tetany, and that it may be fatal. Painful nystagmus is occasionally present. These spasms may be induced by irritation, as by the galvanic current (Erb's sign) or by tapping the nerve, as the facial, when the jaw muscles are affected (Chvostek's sign), or by compressing the arteries and nerve trunks of the arm (Trousseau's sign). The sensory nerves are found to be abnormally excitable upon application of the mild current, pain or paresthesia resulting. The essential feature in all these tests is the abnormal irritability of the nerves and muscles involved. Moderate constitutional reaction with fever and increased rapidity of the pulse may be noted, but consciousness is not affected unless in the rare instances in which transitory delusions have been reported.

Course.—The spasms may recur several times a day for months, and relapses may take place in successive years. The prognosis is ordinarily good, but in certain grave cases spasms recur with such frequency and violence that death eventually results.

Diagnosis.—This fails oftener in this country from lack of familiarity with the disease than because of failure of sufficient signs and symptoms for the diagnosis. In gastric diseases and after thyroid operations the attendant should be especially alert, and the occurrence of cramps in the muscles as described suggests the diagnosis. Hysterical pseudotetany must be considered, but the presence of the stigmata of hysteria and the absence of the characteristic reactions as described above should suffice.

Prognosis.—The prognosis in cases of gastric origin is bad unless surgical relief be possible. If all the parathyroids have been removed in the operation of thyroidectomy a fatal result may occur.

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4. DISEASES OF THE SPLEEN

The occasional absence of the spleen, its transposition in situs viscerum inversus, the frequent presence of accessory spleens in the folds of the omentum, and the fact that good health is possible after complete splenectomy should be mentioned.

Movable Spleen (Lien Mobilis).—This is not infrequent in conjunction with visceroptosis, the gastrosplenic ligament being elongated, either congenitally or through traction by the weight of the enlarged organ, or by peritoneal adhesions, etc. The spleen may be displaced suddenly in trauma. It is to be noted that nearly all movable spleens are enlarged.

Symptoms.—The displacement of the organ may be wholly unrecognized, or painful, heavy, dragging sensations may be complained of in the left side. Occasionally pressure of the enlarged organ may interfere with the action of the bowels, or even the bladder. The pedicle may become twisted, giving rise to symptoms analogous to those more frequently seen in the strangulated ovarian cyst.

The spleen may commonly be detected by attention to its location, mobility, shape, and especially by the presence of a distinct notch or notches on the border. The absence of the dulness in the normal location, and the presence of the X-ray shadow in an abnormal region may be of assistance. If the organ be bound down by adhesions or deformed by tumor growth, etc., the diagnosis is more difficult.

Rupture of the Spleen.—This may occur from trauma, even in the normal state, but the spleen is commonly enlarged as a precedent condition. The enlargement may be due to malaria or typhoid, or the rupture may occur through weakening of the tissues by abscess or infarction. Hemorrhage and sharp pain may follow the rupture, and the diagnosis is based upon these features, with the pallor, collapse, and accumulation of blood in the peritoneal cavity. The knowledge that the organ was enlarged or diseased would add to the probability of the diagnosis.

Prognosis.—The outcome is commonly fatal, excepting as this may be averted by prompt surgical intervention.

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Acute Enlargement of the Spleen.—The acute splenic tumor in infectious disease is so commonly recognized as to require only brief mention. The organ is palpable in most cases if materially increased in size, is slightly painful upon pressure, and the notch may occasionally be felt. Aching pain is sometimes present, presumably from stretching of the capsule. The descent of the spleen during inspiration may be noted. Even expert percussion may establish only a presumption of splenic enlargement, because of the air-containing viscera around it. Palpation is generally requisite to establish the diagnosis with certainty. Pulsation may be felt in rare cases, or even be visible.

Chronic Enlargement of the Spleen.—This condition is commonly a part of some definite disease, such as malaria, leukemia, pseudoleukemia, hepatic cirrhosis of various types, Banti's disease, erythremia, pernicious anemia, kala-azar, etc. Thrombosis of the portal vein may cause great enlargement, and primary endothelioma is a rare cause. Minkowski's splenomegaly with acholuric jaundice is a chronic familial disease, characterized by slight jaundice, great enlargement of the spleen, with presence of urobilin in the urine, without bile pigment, and without serious impairment of health in many cases.

Tumor, Cyst, Infarction, and Abscess of the Spleen.—Tumors are rare, either primary or secondary. Fibroma, gumma, angioma, lymphangioma, lymphadenoma, primary endothelioma (Gaucher), carcinoma, and sarcoma may appear. Excepting in the case of secondary growths the exact diagnosis can scarcely be made during life.

Cysts may be simple, containing blood, serum or lymph; parasitic, generally echinococcic; or dermoid. Infarction of the spleen follows embolism and thrombosis in the various septic diseases, notably septic endocarditis, and may result from venous thrombosis in rare instances. The occurrence of sudden pain followed by swelling and tenderness of the spleen, and by audible friction in some cases, may lead to the diagnosis.

Abscess may follow septic infarction, with exaggeration of the symptoms noted above under infarction. Abscess may also arise by extension from neighboring structures and may even be primary in

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rare instances. Perisplenitis, general peritonitis, rupture into various organs, even the lung, may eventually result.

PROGNOSIS.—The outlook in tumors and cysts depends upon the character of the growth. In simple infarction it is good, while in septic infarction and abscess it is decidedly serious.

A. BANTI'S DISEASE

(*Splenic Anemia*)

Definition.—A disease characterized in the beginning by splenomegaly of unknown causation, later by a secondary type of anemia, and finally by ascites, jaundice, and cirrhosis of the liver. The term Banti's disease is properly applied to the terminal condition.

Etiology.—This is unknown, though a chronic intoxication of some type is thought to be probable. Malaria is frequently mentioned in the history. That the later developments of the disease are dependent upon the splenic involvement seems established by the cure of the disease in many instances by splenectomy. Males are more frequently affected and especially in the first forty years of life. A considerable proportion occurs in children, if we are to accept Osler's classification of infantile splenic anemia under this heading.

Pathology.—The essential changes in the spleen are enormous enlargement, marked fibrosis, capsular thickening, enlargement of the splenic vessels, and proliferation of endothelial cells in certain cases. The liver is slightly enlarged in early stages through passive congestion, an atrophic cirrhosis being the final stage.

Symptoms.—The earliest feature is the enlargement of the spleen, and this may be the sole manifestation of the disease for several years. The organ is smooth and insensitive, and reaches the size of a large leukemic spleen, in many instances filling the left side of the abdomen. The notches may be felt. Perisplenitis may give rise to tenderness, and aching pain may result from infarction.

ANEMIA.—The second manifestation of the disease is commonly the anemia, but this feature is regarded as of less importance than

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formerly, since it may be very late in appearance and not then of great severity. It is of the usual secondary type, the hemoglobin averaging in the neighborhood of 50 per cent., the red blood cells about three to four millions, the color index being therefore low; the white cells average about 4,000. A moderate leukocytosis may be persistent, however, and is common in the presence of complications. The differential count shows nothing characteristic.

HEMORRHAGES.—Although epistaxis, ecchymoses, and other forms of bleeding may be noted, the characteristic type of hemorrhage is that from the stomach. It occurs in about half the cases, may be very profuse, may recur over a period of many years, may be accompanied by melena, and may prove fatal. It commonly proceeds from varicose veins of the stomach or esophagus, and may lead to the diagnosis of ulcer.

JAUNDICE.—This is seen in only a small proportion of cases, more especially those presenting hepatic cirrhosis, though not infrequent without the hepatic involvement. In the latter cases, it is presumably due to the circulatory changes in the portal system.

ASCITES.—This may be expected if the liver becomes involved, but may occur as the result of the anemia and enlargement of the spleen, with consequent disturbance of the circulation. Dropsy of the extremities may supervene.

Slight fever, albuminuria, and pigmentation of the skin have been observed.

Course.—It is most important to appreciate that the splenomegaly may last for years before the advent of anemia. The latter may be fairly acute, but is more commonly mild and chronic in nature, with exacerbations and remissions. Fully-developed Banti's disease is not very frequently seen.

Diagnosis.—This depends upon the association of the secondary anemia with the primary enlargement of the spleen, care being taken to exclude those forms of splenomegaly mentioned on page 599. During the stage of simple splenic enlargement the diagnosis is impossible, while the full picture of Banti's disease is easily recognized. The splenomegaly of leukemia and of pernicious anemia may be easily identified by the study of the blood. The enlargement in the

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infectious diseases, syphilis, the various hepatic cirrhoses, in portal obstruction, and from malignant disease should be considered. The diagnosis of gastric ulcer has been erroneously made because of the frequent hematemesis in certain cases.

Prognosis.—The disease is curable in most cases by splenectomy. Without this it runs a chronic course, with death from anemia, exhaustion, or intercurrent disease.

5. DISEASES OF THE PITUITARY BODY

(*The Hypophysis Cerebri*)

The hypophysis cerebri is a small gland divided into an anterior and posterior lobe. The former lobe produces an internal secretion of the utmost importance in the growth of the body, and intimately correlated in its effects with the secretions of other glands. The posterior lobe is thought to assist in the regulation of carbohydrate and fat metabolism. Owing to the fact that tumor growth, especially from adjacent growths or disturbance in circulatory conditions, may involve one or all parts of the gland, the manifestations of the disease of the hypophysis are most varied. Cushing classes them under the head of dyspituitarism, and conditions of increased or decreased influence of the secretions are recognized under the terms hyperpituitarism and hypopituitarism. In most cases, however, no sharp distinction is possible.

A. ACROMEGALY

This constitutes the best defined condition resulting from perversion of the internal secretion of the hypophysis, and is presumably due to hyperactivity of the anterior lobe.

Definition.—Acromegaly is a disease dependent upon perverted pituitary function, and characterized by gigantism, if this perversion becomes operative in youth, and by an overgrowth of the face and extremities if the cause comes into action after ossification of the epiphyses has occurred.

Etiology.—The disease occurs slightly more often in females, and

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generally in the third decade. Many of the subjects are of large stature, 20 per cent., according to Sternberg, being "above six feet in height when the symptoms begin, while 40 per cent. of giants are acromegalic." The disease may be hereditary, and frequently goiter, trauma, nervous shock, etc., are thought to have some influence in the etiology.

Pathology.—The most interesting feature is the enlargement of the hypophysis, due most often to hyperplasia or adenoma, but occasionally to malignant growth. The brain may suffer locally from the pressure of the enlarged gland. The bones, especially of the face and extremities, are thickened, the changes affecting especially the natural bony prominences. Kyphosis of the upper spine is common. Definite exostoses may be present on the skull, on the bones of the hands, etc. The thickening of the skin and soft tissues adds to the deformity due to the bony enlargement. A general splanchnomegaly may be present, the liver, spleen, heart, and kidneys being of unusual size. The external genitalia may be enlarged, but are not infrequently atrophic, as in a case recently observed.

Symptoms.—Attention is first attracted by the increase in the size of the face and hands, and the enlargement of the bones of the skull, giving an uncanny appearance in well-marked cases. The enlargement and projection of the lower jaw, separation of the teeth, thickening of the ears and eyelids, enlargement of the nares, increase in the size of the tongue, gigantic development of the hands and feet, with thick nails and coarse skin, are characteristic. The patient requires large sizes in hats, shoes, and gloves. Enlargement of the bones of the chest may be noted, and of the shoulders, knees, and ankles. The forearms are commonly unaffected and contrast strangely with the massive hands. The atrophy of muscle which often occurs is directly associated with the development of the kyphosis mentioned, and is largely responsible for the bending forward and downward of the head. Because of the increased size of the hypophysis, the sella turcica is enlarged, headache results from the pressure, as in brain tumors in general, and the patient often becomes irritable, somnolent, or even demented. Because of the proximity of the optic chiasm, interference with vision is common, especially optic atrophy

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and bitemporal hemianopsia, the latter being very suggestive. Other cranial nerves may be involved. Exophthalmos may occur. The epistaxis which is often noted is due at least in part to the circulatory disturbances from pressure. Amenorrhea is frequent in women, and loss of sexual power in men. Glycosuria is not infrequent. Because of the involvement of the tissues of the larynx, the speech is often indistinct and lowered in pitch.

Course.—This may be anything from a rapid one in the malignant type of cases to a variable one, with remissions of even years in duration, or a chronic course, with a length of half a lifetime or more. The latter is the most frequently met with. Many very atypical cases are reported. Epilepsy, goiter, and myxedema are not infrequent complications.

Diagnosis.—This depends upon the recognition of the features related to gigantism mentioned, in association with certain symptoms indicative of involvement of the brain in the region of the hypophysis, the frontal headache, eye signs, mental symptoms, and involvement of other cranial nerves being of especial value. In many cases the course is so slow that years elapse before the diagnosis becomes clear. Myxedema must be carefully differentiated. The definite enlargement of the sella turcica as shown by the Röntgen ray is of great importance, and the bony changes in the extremities are well demonstrated by this means.

Prognosis.—Cushing and others have reported cases much benefited by surgical intervention. The glandular therapy of the disease has heretofore been in the utmost confusion, no suitable preparations of the different portions of the glands nor directions for their use having been available. The situation seems likely to improve. Aside from these considerations the outlook is sufficiently indicated above.

B. DYSPITUITARISM

The more important conditions other than frank acromegaly are classified by Cushing as follows: (1) "Cases of dyspituitarism in which not only the signs indicating distortion of neighboring

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structures, but also the constitutional effects of altered glandular activity are outspoken." "Neighborhood signs" are notable,—changes in configuration of the sella turcica, as shown by the X-ray, signs of pressure upon adjoining cerebral nerves, especially the first, second, third, and fifth, spastic phenomena indicating involvement of the crura cerebri; "uncinate fits," psychic disturbances, epistaxis, cerebrospinal rhinorrhea, or tumor projecting into the pharynx. The accompanying constitutional effects may be of any type.

(2) "Cases in which neighborhood manifestations are absent or inconspicuous." These are the cases most amenable to improvement from surgical intervention.

(3) "Cases in which neighborhood manifestations are absent or inconspicuous, though glandular symptoms are pronounced and unmistakable."

The only change anatomically demonstrable may be the slight enlargement of the pituitary fossa, as shown by the X-ray. Most acromegalics and many giants fall into this class. If the anterior lobe be especially affected, disturbances of growth are found, while alteration of the function of the posterior lobe may lower the limit of assimilation of carbohydrates, generally a result of hypersecretion, or produce greatly increased carbohydrate tolerance, a result of deficient secretion, with hypophysial adiposity as a result, and sexual infantilism. Hydrocephalus may produce hypophysial symptoms from interference with the entrance of the secretion of the posterior lobe into the cerebrospinal fluid. In pregnancy, after injury, in certain cases of arteriosclerosis of the cerebral arteries and in various other conditions transient changes in hypophysial secretions with various symptoms may be noted.

A very brief résumé may be presented (after Cushing) as follows:

(1) Hyperpituitarism.

A—before ossification of the epiphyses,—giantism, Typus Launois.

B—after ossification,—acromegaly, Typus Marie.

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(2) Hypopituitarism.

A—originating in childhood, adiposity, with persistence of skeletal and sexual infantilism,—Typus Froehlich.

B—originating in the adult,—sexual infantilism of the reversive form.

(3) Dyspituitarism

"Mixed or transition cases, exhibiting some features of both stages." The Brissaud type of infantilism probably belongs under this heading.

C. INFANTILISM

Osler's definition is "the failure of the appearance of the primary and secondary sexual characteristics, together with the retention of the mental and bodily condition of childhood." His classification will be followed.

(1) Cachectic infantilism, following any serious chronic disease, notably congenital syphilis. Heart disease in infancy, hookworm infection, malaria, and alcohol may interfere very seriously with growth.

(2) Idiopathic infantilism (Lorain type). The figure resembles that of a child only in size, the form, intelligence, and the development of sexual organs, excepting as regards the beard, pubic, and axillary hair, being practically normal. The subject is an adult in

FIG. 138.—INFANTILISM. Age 18 years. Lorain type. Height and weight, those of boy 9 years of age. Mentality normal. Note yardstick.

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miniature. The cause is presumably a perversion of pituitary function.

(3) The Hormonic type: (a) Thyroid type (*see* Cretinism).

(b) Froehlich type (*see* Dystrophia Adiposogenitalis); marked by great obesity and genital hypoplasia (*see* Diseases of Pituitary Body); the Brissaud type of infantilism, with "a round chubby face, underdeveloped skeleton, prominent abdomen, large layers of fat over the whole body, rudimentary sexual organs, no growth of hair excepting upon the head, and absence of secondary dentition," is believed to be due to dyspituitarism. Seven per cent. of this type show the urinary changes of diabetes insipidus.

(c) Pancreatico-intestinal type, associated with deficient pancreatic function, and loose, fatty stools.

(4) Progeria, characterized by incomplete development and premature senility. Fibroid changes in the kidneys and arteries are found post mortem. The presumable disturbance of some internal secretion responsible for the condition has not been elucidated.

6. DISEASES OF THE SUPRARENAL BODIES

A. ADDISON'S DISEASE

Definition.—A disease depending upon cessation or perversion of the internal secretion of the suprarenal capsules, commonly in association with tuberculosis or atrophy of these glands, or due to degeneration in the chromaffin system, and characterized by marked asthenia, gastro-intestinal irritability, and, in typical cases, by pigmentation of the skin and lowered blood pressure.

Etiology.—The disease is a rare one, but probably a considerable number of cases without pigmentation die without a correct diagnosis. Two such instances have fallen under my notice in the post mortem room. The disease is one of early middle life, and males are more often affected. Traumatism of the back has been noted in a few cases. Anything predisposing to tuberculosis may act to produce the disease. In one of my cases one kidney and its adrenal were removed for tuberculosis, and six years later Addison's disease de-

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veloped, extensive tuberculosis of the remaining adrenal being found at the post mortem. A few cases have followed tuberculosis of the vertebræ.

Pathology.—The common pathological finding is a fibrocaseous tuberculosis of the glands, often in association with tuberculosis elsewhere. Simple atrophy may be the only demonstrable lesion. Cancer is occasionally found, and interstitial hemorrhage rarely. The semilunar ganglia may be destroyed by pressure or inflammation, while the adrenals are unaffected. The chromaffin cells of the medullary portion of the gland, and those in other regions as well (ganglia of the abdominal sympathetic system, Zuckerkandl's bodies, carotid glands), fail in the elaboration of the internal secretion, epinephrin, necessary to the maintenance of a proper blood pressure, and connected in some obscure manner with changes in the pigment of the skin.

Symptoms.—These are chiefly those enumerated by Addison, —anemia, debility, feeble action of the heart, irritability of the stomach, and pigmentation of the skin.

The disease develops insidiously, an increasing languor being first noticed. Nausea, vomiting, and complete anorexia, occasionally with diarrhea, develop, and the skin becomes darkened, either locally or generally. The disease may come on acutely, all of the characteristic symptoms developing after shock or depressing emotions.

(1) Asthenia.—The languor mentioned as the earliest symptom is dependent upon the marked muscular and cardiac asthenia. The patient complains of being exhausted after crossing the room, even, and finally from turning in bed or raising the arm, even at a time when the muscles are still firm. The heart-action is enfeebled, with increased frequency of the pulse, and the blood pressure is so lowered that it becomes apparent to the examining finger (70 to 80 mm. of Hg.). Dyspnea, palpitation and syncope frequently follow slight exertion. Vertigo and headache are often mentioned.

(2) Pigmentation.—This fails in approximately one-fourth of the cases. It varies in color in different cases in an extraordinary manner,—gray, brown, chocolate, bronze to almost black. The exposed parts are often most deeply discolored, while the naturally

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pigmented areas,—areola of the nipple, the axillæ, genitals, the parts exposed to pressure, like the prominences over the bones, the waistband, etc.,—are often discolored. The mucous membranes are commonly involved. Almost pathognomonic are the small black spots occasionally seen over the face and lips, giving an appearance as if numerous minute black moles had developed. Areas of vitiligo are occasionally noted.

Gastro-intestinal Symptoms.—Nausea, vomiting, and anorexia are commonly present, and excessively distressing. Diarrheal attacks are less frequently met with. Abdominal pain is occasionally noted, at times with retraction of the belly, even suggesting peritonitis. On the other hand, cases have been reported in which appetite and digestion remained good until the disease was advanced in its course. Anemia is not common, the blood picture being normal in most cases, though the hemoglobin may be moderately diminished.

Pain in the back, amenorrhea in women, slight enlargement of the spleen, moderate emaciation, subnormal temperature, increase in the urinary pigments, convulsions, and coma are present in certain cases.

Death may occur in an attack of syncope or from increasing asthenia.

Diagnosis.—This is easy in typical cases, the pigmentation, weakness, low blood pressure, and digestive symptoms being characteristic. Increasing weakness, marked anorexia, and abnormally low blood pressure should suggest a diagnosis, and suffice for it in certain cases. A positive tuberculin reaction would strengthen the position in a doubtful case.

Increasing attention has been given in recent years to the different varieties of pigmentation of the skin, and this sign, without the presence of asthenia and gastro-intestinal symptoms, is of little importance, since it may be due to other causes. Osler mentions the discoloration of abdominal tumors, peritoneal tuberculosis, pregnancy, hemochromatosis, vagabond's disease, ochronosis, melanotic cancer, exophthalmic goiter, and certain cases of gastric ulcer, scleroderma, arteriosclerosis, chronic heart disease, and pernicious anemia.

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Arsenic and silver may produce discoloration, occasionally mistaken for that of Addison's disease. The "liver spots" of constipated individuals, and the discoloration from the presence of many comedones are also mentioned, while unexplained pigmentation may occur in otherwise healthy persons.

Marked improvement from the administration of the adrenal preparations, or epinephrin, will strengthen an otherwise uncertain diagnosis, but such improvement rarely occurs. The diagnosis in cases of vitiligo with marked pigmentation between the leukodermic spots depends upon the association of asthenic, gastric, and circulatory disturbances.

Prognosis.—The disease is commonly fatal, the course lasting from one to three or four years, but occasionally much longer, or even but a few weeks. A few recoveries have been reported, especially under suprarenal therapy, and remissions in the course are not infrequent. The non-pigmented cases are stated to be of more rapid course than others, and this coincides with my experience.

Hemorrhage into the Adrenals

This rare affection is characterized, in typical cases, by the severity and suddenness of its onset, violent pain in the flanks and loins, vomiting, convulsions, collapse, and death within two or three days. A resemblance to the cases of acute pancreatitis is suggested. Purpura may occur. The diagnosis has thus far been made in the post mortem room, as in the only case which I have seen.

Tumors of the Adrenals

Carcinoma and sarcoma occur. Hemorrhage into the tumor with formation of cysts is often noted. Metastasis is frequent, commonly in the flat bones. In the cortical tumors, excessive development of the genitals, hair, and fat were noted by Bullock and Sequeira. Exophthalmos and diffuse involvement of the liver have been noted. The tumor is commonly thought to be one of the kidney in the early stages at least.

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Hypoplasia and Hyperplasia

With the former have been found imperfect development of the brain, and of bone, retarded sexual development, and hypoplasia of the vascular system. Persistent low blood pressure may be noted.

With the latter may be found precocious sexual development, although in certain cases, with increase in the cortical tissues, defective development of the genitals has been observed. Compensatory hypertrophy of the other gland may be found if one be diseased, or a similar hypertrophy of the chromaffin system elsewhere.

B. ACUTE ADRENAL INSUFFICIENCY

Sergent and others have called attention to the cases of acute adrenal disease, in which the entire course may be but a week or two in duration. They resemble the usual cases of Addison's disease in other respects. Acute insufficiency may also appear after, for example, a surgical operation, and be relieved by a single administration of adrenalin. Sergent's symptom, so-called, consists in the appearance of a white line upon the skin of the abdomen after gentle stroking with the fingertip. It disappears in three to six minutes.

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SECTION XI

DISEASES DUE TO PHYSICAL AGENTS

1. HEAT STROKE: INSOLATION

Several different conditions are grouped under the general heading. It seems best to divide them into (A) heat exhaustion and (B) heat stroke.

The conditions prevail especially when the summer temperature has risen to a point well toward the normal body heat. At such times those exposed to direct heat, whether in the sun's rays or indoors, as in sugar refineries, boiler-rooms, etc., especially when the air is well saturated with moisture, so that the perspiration of the body is not evaporated, may be attacked. Alcohol predisposes to the disease. Horses and other animals are often attacked in large cities. In the elevated regions of the temperate zone sun-stroke is practically unknown, the rarity and dryness of the atmosphere serving to prevent the abnormal rise of body heat. I have never known a case in Colorado in an experience of 30 years.

Heat exhaustion is characterized by collapse, with rapid and feeble pulse and a cool skin, and often a slightly subnormal temperature. Mental confusion and delirium may be noted. The patient commonly recovers with removal to more favorable surroundings unless some depressing chronic disease has weakened his resisting powers. A peculiar and violent muscle spasm is occasionally seen in metal workers, cooks on dining cars, and others exposed in certain occupations to continuous heat.

Insolation is more especially the result of direct exposure to the sun's rays, and those chiefly suffer who are compelled to make violent exertion, as in the case of soldiers on the march, when hundreds may fall out in a day. The wearing of tight clothing cuts an important figure here. The colored race enjoys a considerable immunity, and

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children are rarely attacked. There is some tendency toward recurrence upon subsequent exposure to heat.

Symptoms.—There are frequently headache, dizziness, abdominal cramps, nausea, vomiting, and weakness. The temperature rises to a point above that commonly noted in the acute infectious diseases, namely, to 105°-110°, or even 114° F. Even higher figures are given. A common temperature is 105° to 108° F. Consciousness may be retained throughout the attack in mild cases, but the severe ones are accompanied by complete coma. The patient may be stricken as with an apoplectic attack. Cyanosis and marked dyspnea characterize the asphyxial type. I have seen convulsions and loss of control of the sphincters. Muscular twitching and delirium are frequently noted.

Persistent headache is common as a sequel. If it be severe and continuous for months or years afterward, it is generally due to the chronic meningitis which occasionally results. The victims of insolation do not bear exposure to heat well, becoming restless and uncomfortable when the thermometer reaches a point indicating danger. Definite loss of memory and general mental impairment are not infrequent, and insanity may develop.

Diagnosis.—Cases of insolation are so likely to be grouped together at periods of notably high temperature that diagnosis is generally easy, and especially so if the history of exposure to heat be known. Alcoholism and poisoning by morphin or opium present no such rise of temperature. Cerebral hemorrhage, unless in the pons, uremia, and diabetic coma, likewise lack the high temperature of insolation, and each has its distinguishing marks. If the possibility that a supposed case of sun-stroke may be anything else, or be complicated by any of the conditions mentioned, be considered, and the distinguishing signs of these conditions be sought for, error can hardly occur.

Under the term siriasis, Manson classifies certain severe types of heat stroke which he believes to be due to a micro-organism which develops only under conditions of great heat. The cases described are similar to the asphyxial types mentioned.

Prognosis.—The milder cases with no excessive rise of tempera-

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ture and without loss of consciousness recover. Those at the other extreme, suddenly stricken comatose, are of extreme gravity. A fair proportion of the cases presenting unconsciousness and a temperature of 107°-108° F. recover. I have known a patient to walk out of the hospital in 24 hours apparently fully recovered after coma, convulsions, and a temperature of 110.5° F.

2. ELECTRIC STROKE

With the increased use of electric power, accidental injury has become very common, while lightning stroke and the execution of criminals by electricity give further opportunity for the study of the subject. In severe lightning stroke it is probable that the heart and respiration are arrested instantly. Exposure to a current of 500 volts is often fatal, while ten times this strength may be withstood, depending upon the character of the contact, moistness of the skin, etc. Extensive and destructive burns are common features of these cases.

A fatal current of perhaps several thousand volts produces violent contraction of all the muscles, and immediate unconsciousness. Soon the respiratory center ceases to act, the heart action being more perisistent, yet smaller currents may cause the arrest of the heart's action, with fibrillary tremor of the muscle and suspension of the circulation. Gordon states that the continuous current requires a higher voltage than the alternating to arrest the heart's action, while the latter current produces less deleterious effects upon the nervous system than the continuous form.

Exposure to non-lethal currents may produce only temporary syncope. Unfortunately a great variety of functional nervous and mental symptoms may follow such exposure. Neurasthenia, hysteria, epileptiform seizures, transient symptoms of bulbar involvement, and various psychoses should be mentioned.

Prognosis.—After exposure to high voltages death is commonly instantaneous. With lesser currents the danger of fatal result is small, but the frequency of the complications and sequelæ mentioned should call for a guarded prognosis as to complete recovery.

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3. MOUNTAIN FEVER

This is a designation formerly used in the Rocky Mountains for the mild types of enteric fever often encountered there. The introduction of the Widal test has rendered the name obsolete.

4. MOUNTAIN SICKNESS

This is an effect of overexertion in combination with the effects of rarified air in high altitudes, rarely being experienced under 8,000 or 10,000 feet. I can testify to the severity of the headache. Vertigo, a feeling of intense exhaustion, violent dyspnea, dizziness, palpitation, thirst, and occasionally nausea and vomiting are noted. At elevations of 12,000 or 15,000 feet hemorrhage from the ears, eyes, and nose has been rarely noted. Sivel and Croce-Spinelli lost their lives in a balloon at an altitude of about 8,600 meters, and of course without notable physical exertion. Intense cold was doubtless a factor in producing death. The occurrence of marked symptoms of mountain sickness at far less elevations is attributed to the violent exertion of mountain climbing. Horses and mules are said to suffer from the disease. While seated in the saddle I have heard and felt the heart beat of the horse when he was stopping for rest every 50 or 60 feet, on account of the elevation and the steepness of the trail, but I have no personal knowledge of further symptoms in animals. Horses and men native to the Rocky Mountains work at altitudes up to about 12,000 feet with some inconvenience, but without sickness, so far as my own experience of 30 years in this region enables me to judge.

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SECTION XII

DISEASES OF THE MUSCLES

1. MYOSITIS

Definition.—An inflammation of the voluntary muscles. It may be acute, subacute, or chronic, and may go on to suppuration or not.

A suppurative or infective form has been described by Miyake, and is especially common in Japan. The disease comes on suddenly with high fever, induration, and suppuration of the muscles, and frequently general sepsis, unless drainage is efficient. The Staphylococcus aureus is found in most of the cases.

FIG. 139.—MYOSITIS OSSIFICANS IN THIGH—POST-TRAUMATIC. Note elongated shadow below the center of the shaft. (Dr. G. H. Stover.)

Dermatomyositis.—The skin overlying the muscles affected is also involved. The muscles are firm, infiltrated with serum, with increase in the interstitial tissue and fatty degeneration. The disease so closely resembles the myositis of trichiniasis that differentiation can be made only by microscopical examination.

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Polymyositis Hemorrhagica.—This form resembles the last mentioned variety, excepting that hemorrhages occur in and about the muscles affected. Purpuric manifestations may be noted, and death often occurs.

Myositis Ossificans.—This may occur as a local disease affecting a single muscle or a group of muscles, or as a generalized process, progressively involving many muscles with the formation of bony deposits in their fasciæ and tendons and in the ligaments. Young boys are most commonly affected. Congestion of localized areas is followed by bony formation, the nodules becoming harder, and exostoses developing nearby. The joint movements are much restricted. Various deformities, especially microdactylism of the thumbs and great toes, are commonly present.

2. MYALGIA

(*Muscular Rheumatism*)

Definition.—A painful affection of the voluntary muscles and their fibrous structure and attachments, of unkown pathology. It is commonly believed to be a neuralgia of the sensory nerves in the muscles.

Various names designate the affection as it involves different locations. The most common form is the ordinary lumbago, involving the muscles of the loins; while torticollis, pleurodynia, omodynia, cephalodynia, etc., are less frequently noted.

The fibers of the affected muscles are said to be swollen and to undergo a granular change. Nodular masses were noted by Strauss and may be palpable. Atrophy occurs from disuse in long-standing cases and a proliferation of fibrous tissue may be noted.

Etiology.—The rheumatic and gouty subject is predisposed to myalgia. Heredity is of some importance. One attack renders one more liable to others. Severe muscular labor, especially with exposure, is frequently mentioned in the history. Laborers who do much stooping, are exposed to the weather, and who may become chilled in riding, as section men upon the railways, railway firemen,

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etc., are often affected. Middle-aged men and old men are the most frequent sufferers.

The immediate exciting cause is frequently a short exposure after being heated, and especially after severe exertion. Acute torticollis frequently comes on through exposure at an open window.

Symptoms.—The disease is often acute, but may become subacute or chronic. Myalgia is a local affection and the general health is not directly disturbed. In occasional cases loss of appetite and even slight rise of temperature may be noted for a day or two (33 per cent. of Leube's series).

Pain upon motion is the primary symptom and it may be anything from a dull aching pain to intense agony, utterly abolishing the power to voluntarily contract the muscle. A dull, aching soreness may be the only symptom if the parts be at rest, but firm pressure causes increased pain. The onset may be instantaneous, as when lumbago comes on when one stoops to pick up a shoe, etc., and the attempt to straighten the back may be wholly unsuccessful.

Lumbago.—This is the most frequent and probably the most disabling variety of myalgia. Movement of the spine, especially turning movements, are very painful. The regaining of the erect posture after stooping is almost impossible in some cases.

Torticollis.—The ordinary stiff neck (acute wry neck) is common, especially in the young. The sternomastoid and often adjacent muscles are involved, and those of the posterior region of the neck may participate. Because of the pain upon attempting to turn the head the entire body is rotated instead. Subsequent attacks may be expected in many of the cases.

Pleurodynia.—This is more common upon the left side and may produce agonizing pain, checking respiration and other movements instantly. The pain upon involuntary movement of the muscles, as in sneezing, etc., may be excruciating.

Cephalodynia, Etc.—The muscles and fasciæ of the scalp and the face may be involved, often unilaterally. In omodynia the deltoid is involved. Abdominal rheumatism affects the muscles of the abdominal wall. Dorsodynia affects the muscles of the back. A rheumatic myositis may involve the muscles of the extremities.

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Diagnosis.—This is based upon the presence of pain upon muscular movement without other explanation. The history of previous attacks, of exposure, of heredity, etc., is of value.

Differential Diagnosis.—Neuralgia presents painful points, and the increase of pain upon muscular movements is often striking. It also tends to be more paroxysmal in nature. Pleurisy is commonly accompanied by a higher temperature than pleurodynia, by cough, and by physical signs pointing to changes within the chest which do not belong to myalgia.

No diagnosis of lumbago should stand for a moment without careful investigation of the naked back. If possible, the patient should be required to "bump down" upon his heels and to bend the spine in every direction for the purpose of excluding spinal disease, especially caries and osteoarthritis. The neuralgic pains arising from the pinching of the intercostal nerves in these affections are commonly treated as myalgic until their continuance leads to a careful examination. Unilateral spasm of the lumbar muscles and tenderness of the vertebræ upon pressure or upon jarring them are further points of differentiation. In not a few cases diagnosed as lumbago the finding of a shower of calcic oxalate crystals in the urine clears up the diagnosis, the kidney irritation from this source being the explanation of the pain.

In similar manner no diagnosis of abdominal rheumatism should pass unless after the most careful exclusion of tenderness and rigidity about the gall-bladder, appendix, and pylorus, and careful consideration of the other abdominal and pelvic diseases. I do not recall having been forced to make a diagnosis of this condition, since some intra-abdominal disease or definite affection of the nerves of the wall could be demonstrated to my satisfaction in every case.

The dermatomyositis of Unverricht is characterized by fever and prostration and locally by redness and hyperesthesia of the skin. Sore-throat and enlargement of the spleen are features of the disease and hemorrhages have been noted. The disease is more common in women.

Prognosis.—In the acute type of myalgia recovery may be looked for in a few days. Many subacute attacks last for weeks and some

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become chronic, lasting perhaps a whole winter, and frequently recurring under the next favorable set of circumstances. The disease does not dispose to serious organic changes nor tend to shorten life.

3. MYOTONIA

(*Thomsen's Disease*)

This is a rare congenital and familial disease affecting males predominantly, and characterized by tonic spasm of the muscles on attempting voluntary movements. It has been especially studied in Scandinavia and Germany. The pathology is still unsettled.

Symptoms.—The striking feature is the cramp of the muscles on attempting to make ordinary voluntary movements, especially notable after a period of rest of the muscles. The muscles of the limbs are especially affected. They may become enlarged as the result of the overuse. The spasm renders the use of the muscles, as in walking, very difficult, the gait being slow and stiff, but after a short time the movements become normal, the trouble reappearing after the next period of rest. Nothing is found on further examination, excepting frequently a slight increase in the deep reflexes, and the "myotonic reaction,"—an increased contraction to the constant galvanic and to the interrupted faradic current. Mental feebleness is not uncommon.

4. AMYOTONIA CONGENITA

This rare disease, described by Oppenheim, is best set forth in the description of Collier and Wilson: "A condition of extreme flaccidity of the muscles, associated with an entire loss of the deep reflexes, most marked at the time of birth and always showing a tendency to slow and progressive amelioration. There is great weakness, but no absolute paralysis of any of the muscles. The limbs are most affected; the face is always exempt. The muscles are small and soft, but there is no local wasting. Contractures are prone to occur in the course of time. The faradic excitability in the muscles

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is lowered and strong faradic stimuli are borne without complaint. No other symptoms indicative of lesions of the nervous system occur."

The course of the disease is a slow one, tending to spontaneous improvement.

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SECTION XIII

DISEASES OF BONES AND JOINTS

I. ARTHRITIS DEFORMANS

Definition.—Arthritis deformans is a chronic deforming affection of the joints, non-suppurating, with well-recognized structural changes, but of uncertain etiology. A multiplicity of names has been used, but we may better adopt the noncommittal one given until a deeper knowledge is gained concerning the etiology and pathology of the disease. We may at once state that arthritis deformans is well differentiated from the recognized bacterial arthritides, from gout, from traumatic arthritis, from the affection secondary to tabes and other

FIG. 140.—RAREFYING OSTEITIS OF THE BONES OF THE HAND AND LOWER END OF THE RADIUS AND ULNA. Contrast the deformity in this hand with that shown in atrophic ostearthritis, Figure 143. (Dr. S. B. Childs.)

nervous diseases, from the hemorrhagic type (scurvy, hemophilia) and the forms, perhaps not bacterial, seen with certain acute diseases.

Pathology.—The changes are believed to begin in the synovial membrane, and to extend to the cartilages, with chronic degenerative changes, erosion, and atrophy, at times ulceration, and with eventual

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atrophy of bone in certain cases, and a proliferation in others. The production of bone may extend to the structures around the joint. A villous arthritis may be present, and the villous growths may become hardened, even ossified, and, separating from their attachments, become loose bodies in the joints. Because of the tendency of the changes to become arrested at any point, the utmost variability as to pathological findings may exist in different cases.

FIG. 141.—RAREFYING OSTEITIS OF THE HUMERUS IN A WOMAN, AGED 58. Note the irregularity of the cortex and the loss of the normal lime salts in the shaft. Contrast this plate with the plates showing Paget's disease, Figures 149 and 150. (Dr. S. B. Childs.)

The periosteal thickening at the point of attachment of muscles may undergo ossification, and the muscles become atrophic and even fibroid. Contractures may be present and dislocations at times result. Effusions occur, especially in the more acute cases, the joint fluid being occasionally hemorrhagic, but generally sterile. The swollen, injected synovial membrane may have a velvety appearance, suggesting tuberculosis of the joint. The erosion of the cartilage, the rarification of bone, with atrophy in atrophic cases, and the thickening, with bony outgrowths in the hypertrophic cases, are characteristic.

Etiology.—Some obscure disturbance of metabolism presumably lies at the foundation of the disease. Trauma is occasionally noted. The affection is much more frequent in the female sex, unless the

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cases of spondylitis are included. Including these, the sexes are about equally affected. A large proportion of cases begins in the first half of life. Race seems to be of little effect. Indoor life apparently predisposes to the disease, in spite of the relatively less exposure involved. But few definite results have been attained thus far in the studies of the effect of heredity, previous disease, etc.

Symptoms.—The onset is generally gradual, but it is occasionally mistaken for acute articular rheumatism because of its acute onset, as in one of my cases. Lack of usual flexibility of the joints, pain

FIG. 142.—RAREFYING OSTEARTHRITIS WITH RAREFYING OSTEITIS. (Not Paget's disease.) Courtesy of S. Fosdick Jones, M.D. Photo by T. R. Love, M.D.

after unusual exercise, "cracking" upon motion, stiffness after rest, moderate limitation of motion, slight fever, increased frequency of the pulse, frequent restlessness at night, and a failure in general condition are usually observed. Still observed a marked arrest of bodily development in cases originating before the second dentition.

PAIN.—This varies greatly in different cases, being practically absent in some, present only on motion in others, intermittent in still others, and so acute and continuous in certain cases as to lead to the formation of the drug habit. This is perhaps most frequent when the spine is involved. Darting pains in the wrists and hands are common. An associated neuritis may give rise to pain over the distribution of a given nerve, often of a severe character.

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Swelling.—This is present in most joints affected at some stage of the disease. The synovial swelling and effusion cause marked enlargement and deformity in many cases. The change in form noted in the "spindle-shaped" fingers is due to inflammation and edematous infiltration of synovial membrane, capsule, ligaments, etc.

Distortion.—The joints may become much misshapen through effusion, atrophy, hypertrophy, relaxation, spasm, dislocation, or distortion. The ulnar deviation of the fingers is pathognomonic, and is often associated with hyperextension of certain phalanges.

Temperature and Pulse.—A rise of one or two degrees of temperature over long periods of time is not uncommon. The increase in the pulse rate to 90 or 100 or slightly above these figures is nearly constant.

Heart and Lungs.—Cardiac murmurs are not infrequent, but are more often arteriosclerotic rather than of acute endocarditic type. Chronic bronchitis is not unusual and chronic tuberculosis is occasionally noted.

Spleen and Glands.—Both are enlarged in a considerable proportion of cases, especially in the younger ones, and more especially in the arthritides of children (Still's disease).

Skin.—The English authorities have laid much stress upon the pigmentation which occurs upon the face and neck and occasionally upon the arms and hands. Profuse sweating is common, and the hands and feet are often of icy clamminess. Cyanosis may be noted. Subcutaneous nodules similar to those of acute articular rheumatism are not uncommon, especially about the forearms and hands. A moderate anemia is often present, and albuminuria is found in many cases. The deep reflexes are often increased. The disease shows such variety as to acuteness, number of joints involved, atrophy, hypertrophy, and general features that no exact classification is possible. Certain general types may be mentioned.

Varieties.—The most common type is that characterized by the presence of Heberden's nodes,—"the little round knobs" at the terminal phalangeal joints, so often seen in those at or beyond middle age, especially females. The thickening involves the synovial tistues at first, but eventually results in periosteal thickening, bony

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deposition, and considerable deformity of the joints. The disability is not commonly extreme, but considerable disturbance of sensation, generally short of actual pain, is often present.

FIG. 143.—ATROPHIC OSTEARTHRITIS OF THE PHALANGES IN BOTH HANDS. The arrows point to areas of necrosis. Note characteristic deformity of the fingers. One finger and part of the metacarpal bone have been amputated. (Dr. S. B. Childs.)

The polyarticular atrophic form is much less common, and may be found in the young. The hands and wrists are especially prone to be attacked, and marked disorganization, loss of cartilage, and atrophy of bone, with fibrous ankylosis may be noted. The patients are often very ill, and the progress may be very rapid, with grave outlook.

MONARTICULAR FORM.—This is more often seen in those beyond middle life, the shoulder and hip being especially involved, but generally in association with slighter changes in other joints. Pain, marked disability, and striking atrophy of the muscles, with oftentimes hypertrophic changes in or about the joints, and occasionally a complicating neuritis, are notable features.

HYPERTROPHIC FORM (Osteoarthritis).—The Heberden's nodes represent the slightest possible involvement under this head. The changes affect especially the cartilage and bones, and muscular

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atrophy is less marked than in many forms of arthritis. One joint may be involved, as one hip (Morbus coxæ senilis), but many joints are affected in most individuals suffering from the disease, the shoulder, hip, knee, sacro-iliac joint, and those of the spine most commonly. General symptoms are not marked. The spinal form, spondylitis deformans, is the variety of most interest to the medical man, because of the frequency of error in diagnosis. Many such cases are treated as myalgia, sciatica, etc., before the correct diagnosis is arrived at. The spinal form may occur alone, or associated with other joint changes, and it is common to have one sacro-iliac joint, one hip, or one shoulder involved, or both hips, both shoulders, etc.

FIG. 144.—ARTHRITIS DEFORMANS, WITH NUMEROUS JOINT MICE. (Dr. G. H. Stover.)

Hypertrophic arthritis is chiefly a disease of the last half of life. The disease is less acute and accompanied by less increase in pulse rate and temperature than some of the other forms. There may be no rise in temperature over long periods of time. The general condition is often but little affected and there may be little destruction of the joints, the changes being chiefly those of stiffness from bony deposits. The name "poker back" refers to the stiffness of the spine from the latter occurrence. In other cases the interarticular cartilages disappear and the vertebræ become fused together.

SPINAL FORM.—The spinal form causes pain in the back and oftentimes along the course of the spinal nerves, perhaps more along one side, because of their being compromised by the pressure of

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exudate and deformity. The arms and legs may be affected through similar irritation of the nerve roots involved (sciatica, etc.). The spine is stiff primarily from muscular irritation, but later from actual bony changes. The restriction of motion is well seen if the patient be required to pick up an object from the floor, or to move the spine forward, backward, or laterally. The movement is often completely abolished. Neck rotation is impossible in the severe types. The breathing may be affected by the ankylosis of the ribs at their origin from the spine. Kyphosis is common.

FIG. 145.—HYPERTROPHIC OSTEITIS. (Case of Dr. S. Fosdick Jones.)

In the affection of the hip, there are stiffness, pain, muscular atrophy, muscular fixation, limp, shortening of the leg, limitation of motion through bony deposit, increase of knee-jerk, and perhaps grating of the joint if fixation has not taken place. The diagnosis of sciatica is too often made even after well-marked bony changes have occurred.

The affections of the knee and other joints are of much the same general character. The temporomaxillary articulation is not infrequently locked by bony exudate and causes great distress. In the knee the bony enlargement and effusion give rise to much deformity even in children.

STILL'S DISEASE.—Arthritis deformans may begin during the first few years of life, as described particularly by S. O. Still. The especial features are the enlargement of the spleen and the lymph glands, great thickening and deformity of the joints, many being

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usually involved, with rather less of the bony and cartilaginous changes characteristic of an arthritis deformans in adults. Recovery may occur.

Diagnosis.—The spinal form seems more frequently than the others to follow gonorrhea, tonsillitis, and other infectious diseases, and a separate classification is made by some authorities. Yet the Röntgen ray features, clinical signs, and post-mortem findings are often indistinguishable.

FIG. 146.—CHARACTERISTIC APPEARANCE OF THE WRISTS, HANDS AND FINGERS IN STILL'S DISEASE. (Dr. S. B. Childs.)

The Röntgen ray is of great service, showing the bony and articular changes decisively in many cases. Joint tuberculosis in children may require careful differentiation, and even inoculation experiments. In general chronic joint changes with absence of known infection, and of suppuration, and with the characteristics de-

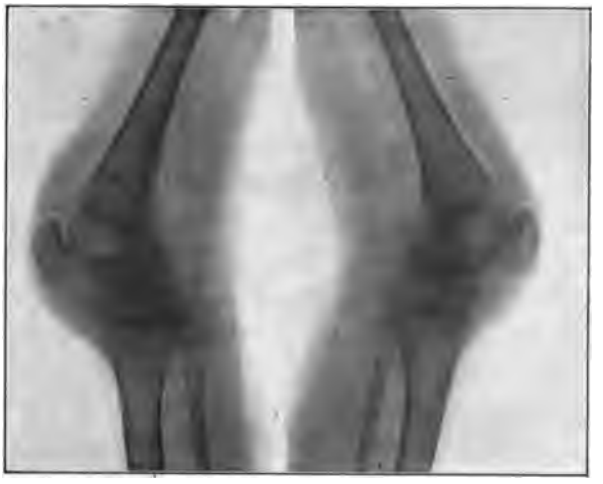

FIG. 147.—CHARACTERISTIC APPEARANCE OF THE KNEES IN STILL'S DISEASE. Lateral view. (Dr. S. B. Childs.)

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scribed above, justify the diagnosis of arthritis deformans. The most important procedure in diagnosis for the medical man is to strip the patient and examine the back, hip, shoulder, or other part involved, for there is commonly no lack of objective data for a correct diagnosis if a careful search be instituted. It is imperative that such an examination be carried out before making a diagnosis of sciatica, lumbago, neuralgia, etc.

Prognosis.—In general it is serious, progressive joint destruction being only too common. If a definite cause can be found and removed, as chronic tonsillitis in the case of spinal arthritis, the prognosis may be excellent. Early and careful diagnosis, including a study of the etiology, and persistent skillful treatment do much to modify the general serious prognosis of arthritis deformans in certain cases.

Goldthwait and others have demonstrated that surgical intervention may greatly improve the outlook in many of these cases, affecting especially the larger joints.

2. HYPERTROPHIC PULMONARY OSTEARTHROPATHY

Definition.—A disease characterized by symmetrical enlargement of the bones of the fingers and toes, and often of the long bones, and commonly associated with chronic disease of the lungs.

Etiology.—The common predisposing diseases are bronchiectasis, pulmonary tuberculosis, empyema, chronic bronchitis, and congenital heart disease. Other chronic diseases within the chest, even malignant disease of the mediastinum, may be accompanied by the bony changes, and Wynn has seen them in hypertrophic cirrhosis of the liver.

Pathology.—The changes in the bones are much more easily recognized and definitely known since the use of the Röntgen ray. A thickening of the periosteum, even a definite periostitis, may be demonstrated. The absorption of toxins has been thought to cause the periosteal changes.

Symptoms.—The fingers, toes, metacarpal and metatarsal bones, and even the lower ends of the forearm and leg bones may be tender

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and painful. Oftentimes the thickening which characterizes the disease comes on insidiously, and the physician notes the gradually increasing enlargement of the affected bones and the marked clubbing of the nails. The hands and feet may be so enlarged as to suggest acromegaly. Arthritis and atrophy of the neighboring muscles, and kyphosis of the lower spine have been described.

FIG. 148.—CLUBBED FINGERS OF COMBINED PULMONARY TUBERCULOSIS AND HEART DISEASE.

Diagnosis.—The disease is secondary to the visceral changes described above, and much variation exists in the manifestations in different cases. In the presence of the marked lung conditions the enlargement of the hands, feet, and bones of the forearms and lower legs is characteristic.

3. OSTEITIS DEFORMANS

The disease described by Paget and now known by his name is characterized by enlargement of the bones of the head and of the clavicles, kyphosis of the upper half of the spine, softening and curving forward of the bones of the lower limbs, and, less frequently, deformity of other bones. It is very rare.

It occurs more often in males than in females, and in the latter half of life. It is occasionally hereditary, and is commonly accompanied by marked arteriosclerosis, but no definite etiology is known.

Pathology.—The bones of the skull are greatly thickened and the shafts of the long bones, especially the femora and tibiæ, are similarly affected. Although soft in the early stages, the bony tissue

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commonly becomes very solid as the disease progresses. A rarefying osteitis is often present in certain bones or portions of them.

Symptoms.—The skull, from the bony deposit upon its exterior surface, becomes enlarged and frequently nodular in contour. Vague pains, commonly attributed to rheumatism, are felt in the extremities, and the legs become bowed anteriorly, shortened in consequence, much thickened, and are weak and clumsy, in spite of the massive bony development. The stature is shortened through the kyphosis as well as through the curvature of the legs. One of Osler's patients lost 13 inches in height. Certain cases are characterized by unusual pain, especially at night, and by soreness in the extremities. The arms appear too long, as in ordinary cases of tuberculosis of the spine with kyphosis. Marked muscular atrophy may eventually appear, accentuating the muscular weakness of the earlier stages.

FIG. 149.—PAGET'S DISEASE OF BONE. Postero-anterior view of the right femur of a young woman 20 years old. Note the high position of the great trochanter, the elongation of the neck, the increased size of the entire bone with the exception of the head, and the rarefying osteitis. (Dr. S. B. Childs.)

The affection described as Leontiasis ossea, characterized by hyperostosis of the skull, is closely related to Paget's disease, if not identical, at least in certain cases. The condition is also described under the term megalocephaly.

Diagnosis.—This depends upon the recognition of the deformity in the skull, described as "triangular with the base upward," the shortening, bowing, thickening, and weakening of the legs, and possibly involvement of other bones. The affection of many bones is often of importance in making the diagnosis, although at times only the skull or the tibia of one leg may present characteristic

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changes. The diagnosis in these cases may have to wait upon further involvement. Even the pathologists dispute over certain cases post mortem, so that one need not be surprised that the diagnosis clinically may be long in doubt.

Prognosis.—The disease comes on slowly and may be a decade in reaching its full development. It does not especially tend to shorten life, although the arteriosclerotic changes constantly associated with it, the interference with the action of the lungs consequent upon the deformity of the chest, or the pressure upon parts of the brain by the bony changes in the skull may tend to shorten life.

FIG. 150.—PAGET'S DISEASE OF BONE. Postero-anterior view of the left femur. The same characteristics of the disease are shown as in the right femur. The greatest convexity of the shaft shows the results of a fracture. (Dr. S. B. Childs.)

4. FRAGILITAS OSSIUM

This term has been applied to two separate conditions. In the first, better termed osteogenesis imperfecta, such fragility of the bones of the fetus exists that multiple fractures occur *in utero,* with deformity of the limbs and malformation of the skull. In the rare cases that survive birth, recovery may occur.

The second condition, described also as Lobenstein's disease and as osteopsathyrosis, is marked by abnormal lack of resistance in the bones of the adult, so that fractures occur upon the slightest provocation. Even a hundred fractures have been recorded in a single individual, healing readily and often causing little pain. The common cause of a spontaneous fracture of a single bone is osteosarcoma. If multiple fractures occur, with little or no injury, as in chewing food or turning in bed, the diagnosis of osteopsathyrosis may be made.

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5. OXYCEPHALY

(*Steeple Head*)

Definition.—A cranial deformity, dependent upon premature union of the sutures of the skull, especially the coronal and sagittal sutures, with growth of the head upwards as development proceeds.

Description.—The cases are rare, but are not uncommonly seen in the eye clinics of Vienna, where they appear because of the optic atrophy and occasional exophthalmos consequent upon the increasing pressure of a growing brain confined in a prematurely ossified skull. Nystagmus is often present. The trouble is noted at birth in most instances, but may not be apparent until the early years of childhood. Headache and loss of smell may be added to the symptoms mentioned. Intelligence may not be impaired. The hairy scalp seems perched upon the top of the skull. The complexion is often sallow and muddy.

Diagnosis.—This depends upon the characteristic steeple-like deformity of the head, and the damage to the first and second cranial nerves incident to the growing pressure as the brain develops.

Decompression has been suggested.

6. ACHONDROPLASIA

(*Chondrodystrophia Fetalis*)

This is a disease of fetal life in which the epiphyseal cartilages fail in their function, premature union of epiphysis and diaphysis occurs, and the limbs in consequence fail to develop properly. Dwarfism results, and shortening and deformity relating to the arms and legs, while the head and trunk may be entirely normal.

Etiology.—Heredity has been noted, but nothing definite is known of the causation of the disease.

Pathology.—The essential feature is a dystrophy of the epiphyseal cartilage, preventing the formation of bony tissue at this point, and consequently interfering with the growth of the shaft of the bone.

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Symptoms.—Many achondroplasiacs are still-born or die in infancy. If the subject survive his first years, he may live out a normal life. He is recognized by the extreme brevity of the limbs, while the head and trunk are practically normal, or the former even enlarged. The proximal bones of the limbs, both upper and lower, are more markedly shortened than the bones of the forearm and lower leg. The arms hang away from the body, the short, spreading fingers giving the deformity spoken of as "trident hand." The fingers reach but little further than the brim of the pelvis.

The curves of the legs are often exaggerated. The coarse features, depression of the root of the nose, lordosis of lumbar spine, contraction of the pelvis, lax joints, and frequent macrocephaly are characteristic. Intelligence is often above the average. Many court dwarfs have been achondroplasiacs.

Diagnosis.—This is often to be made at a glance, the short stature (less than four feet) and the disproportional size of the head and trunk as compared with the limbs, being very striking. The cases are easily distinguished from those of infantilism, because of the disproportion existing between the limbs and the trunk.

Prognosis.—The few achondroplasic dwarfs that survive infancy may live out an ordinary lifetime unaffected by their disease.

7. INTERMITTENT HYDRARTHROSIS

This is a recurring type of acute swelling of one or several joints coming on at intervals of a few weeks to a few months, often associated with hysterical features, and occasionally with angioneurotic phenomena. Pain is present and the joints are stiffened for the time. As in angioneurotic edema, the attacks are likely to recur indefinitely in spite of treatment.

8. OSTEOMALACIA

Definition.—This is a chronic disease in which bony deformity occurs with bending and at times fracture because of softening from decalcification.

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Etiology.—The disease occurs especially in young women, under conditions of poor nutrition, and in association with pregnancy and lactation. No definite cause has been demonstrated.

The earthy salts disappear from the bones in great part, the Haversian canals becoming larger than normal. With the decalcification the bones give a lighter shade with the X-ray. The earthy phosphates are increased in the urine and the bones become so soft as to be easily bent. The pelvic bones are especially involved.

Symptoms.—Pain is the first symptom and may be evoked by pressure upon the affected bones. Deformity affects especially the pelvis, but often the chest, with shortening of the stature. The gait becomes "waddling," because of the defective pelvic support, and is further compromised if the bones of the lower extremity are affected. Because of the spinal deformity, pressure upon the cord may be present, with motor or sensory symptoms, and the organs within the chest may be compressed.

The disease may last for several years with improvements and remissions, and occasionally recovery under treatment. Death generally occurs from exhaustion, bed-sores, or intercurrent disease.

9. CHRONIC RHEUMATISM

It is customary to describe a chronic articular rheumatism separate from arthritis deformans, and presenting definite joint changes, which exclude myalgia from consideration. It is not to be assumed that it has any close relationship to acute articular rheumatism.

Definition.—Chronic articular rheumatism is a chronic disease of the joints of elderly persons, with thickening of the synovial membranes and capsule of the joint, and wasting of the neighboring muscles, with pain, stiffness, and disability. Erosions and adhesions about the joint are described. The disease is more common in elderly females. Exposure, injury, poverty, and hardship are contributory causes. Heredity may be a factor.

Symptoms.—Pain, notably affected by changes in the weather, and worse in the morning; stiffness which abates in some degree with exercise, and tenderness of the affected joint, with swelling,

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disability, and weakness from muscular atrophy, are the leading features of the disease. Severe exercise of the affected joints causes an exaggeration of the symptoms on the next day. Crepitation may be audible and palpable. Single large joints (shoulder) may be involved, or several large or many small ones. Anemia and general debility are to be looked for. Cardiac murmurs may develop, though it is likely that they are of atheromatous origin in many instances.

Prognosis.—The cases may live for years, but complete recovery is not to be expected.

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