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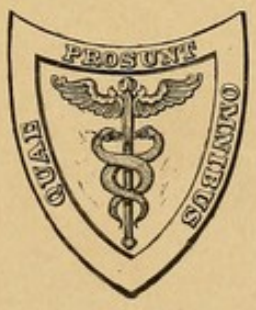
SURGICAL DIAGNOSIS

BY

EDWARD MARTIN, M.D.

PROFESSOR OF CLINICAL SURGERY IN THE UNIVERSITY OF PENNSYLVANIA

Illustrated with 445 Engravings and 18 Plates in Colors and Monochrome



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TO

J. WILLIAM WHITE, M.D., PH.D., LL.D. (EDIN.)

JOHN RHEA BARTON PROFESSOR OF SURGERY IN THE UNIVERSITY OF PENNSYLVANIA

IN RECOGNITION OF HIS SKILL AS A SURGEON AND HIS ABILITY AND DEVOTION AS A TEACHER

THIS BOOK IS DEDICATED

BY THE

AUTHOR

PREFACE.

THE simplicity and safety of surgical intervention are, as a rule, proportionate to timeliness in diagnosis. This, in turn, is usually dependent upon the judgment of the general practitioner, who is, as a rule, the first to see the patient and should, therefore, be qualified to determine at the earliest moment when surgical treatment is required. The practitioner cannot be expected, however, to acquire such a knowledge of the probabilities deducible from general symptoms and of the variations from type as is necessary to establish the final diagnosis. This can be gained only by a conscious or subconscious grouping of the clinical features of many similar cases.

The proof of the advantage of early diagnosis is afforded by the lessened mortality which is found to result from such diagnosis in every department of modern operative surgery. This is in part due to more perfected technique and more rational after treatment, but mainly to the simplicity of earlier operation. To this element is also due, almost entirely, the larger percentage of radical cures.

Partly from custom, but mainly because of examination requirements, it is the habit of teaching institutions to impress upon the minds of their students the symptom-complex of the completely developed disease. Such clear mental pictures are highly desirable from many points of view, but since action is often deferred until the picture is complete, they may work to the detriment of the patient. It too often happens that when the disease is so fully developed that the diagnosis can be made beyond doubt, the time for surgical intervention is past. If, for instance, a cancer of the breast is not recognized as possibly or probably such until the dense induration, skin adhesion, nodular lymphatic glands, and cachexia prove its nature, the only possible result accruing to the patient is the knowledge that she will have but little time to live and that she will suffer much. There are many affections, the neoplasms constituting the most conspicuous examples among these, in which an assured diagnosis other than by operative means is impossible at the time it is likely to be serviceable. It seems reasonable to hope that death or crippling or disfiguring deformity from surface or orificial malignant neoplasm may become even more rare than are now those monstrous growths which illustrate the text-books and frequent the clinics. This end will have been attained in part when it becomes generally recognized that the diagnosis of malignancy should be formulated by wide removal and microscopic examination of any persistent outgrowth, infiltration, or ulceration which is not certainly benign. The

gross deformity of Pott's disease, the crippling ankylosis of coxalgia, the life-long pain and disability following bone and joint traumata too often represent sequelæ which could have been averted but for a too faithful adherence to the rule of formulating the diagnosis and directing the treatment only upon the basis of a complete symptomatology.

It is, therefore, in the interest of early diagnosis in its relation to helpful and curative surgery that this book is written. Consequently, stress is laid mainly upon symptoms of major and deciding moment; or, when such are absent, upon the operative and laboratory means by which a conjecture may be transformed into a probability or a certainty.

In the section devoted to Laboratory Diagnosis, Dr. Wârfield T. Longcope has presented, with a moderation highly creditable, a statement of the help that may be given the surgeon by those who work with the microscope, culture media, and test-tube.

Dr. Henry K. Pancoast has shown in his chapter on the *X*-rays in Surgical Diagnosis both the value and the limitations of a method which, because of its efficiency, is now as essential to the surgeon in his examination of patients as is the anesthetic in his operations upon them. Dr. Pancoast's outline drawings of negatives in his possession constitute the most complete series of *x*-ray fracture pictures yet published.

In the chapter devoted to Gynecological Diagnosis, Dr. Brooke M. Anspach has admirably described in detail the methods found most serviceable in his hospital and private practice.

Dr. Theodore H. Weisenburg has based his chapter on the Diagnosis of Nervous Affections upon a wide experience with those diseases of the nervous system in which surgical intervention must be considered.

Such merit and accuracy of statement as may be found in the section devoted to the Eye are due to the criticisms and suggestions of Dr. George E. de Schweinitz.

E. M.

PHILADELPHIA, 1909.

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SURGICAL DIAGNOSIS.

CHAPTER I.

LABORATORY DIAGNOSIS.

By WARFIELD T. LONGCOPE, M.D.

EXAMINATION OF THE BLOOD.

At the present time our knowledge of the chemistry of the blood and blood serum is not sufficiently advanced to offer much aid in the practical study of a patient. In certain conditions a spectroscopic examination of the blood may reveal the presence of an abnormal substance, such as carbon monoxide hemoglobin. Until more knowledge has been accumulated, too, regarding the variations in the reactions of the blood, estimations of the alkalinity cannot prove of much value.

On the other hand, a determination of the coagulation time of the blood may be of great importance. To a surgeon who is about to operate, a knowledge of the fact that the formation of a blood clot is delayed twenty or thirty minutes may obviate an unpleasant experience. To estimate the coagulation time of the blood, Wright's tubes may be used, but the new instrument devised by Boggs is much simpler in application and probably more accurate. The most common condition in which the time of coagulation shows the greatest diminution is jaundice, especially when incident to chronic pancreatitis; in severe cases the blood may remain fluid after withdrawal for fifteen to twenty-five minutes. It must be remembered that in hemophilia, a disease which offers great dangers to the surgeon, the coagulation time of the blood may not be decreased.

The estimation of the hemoglobin, a procedure which may be done with the greatest ease, will decide quickly whether or not the patient has an anemia, and combined with an enumeration of the red blood corpuscles may give much information. In many of the acute infections, in chronic suppurative conditions, in cachexias due to malignant growths, in cirrhosis of the liver, and in Bright's disease, there is always more or less secondary anemia, with a greater loss proportionately in the amount of hemoglobin than in the numbers of red blood cells. Immediately after an acute hemorrhage the blood picture may be very nearly normal, for the absorption of fluid from the blood is so great that the loss of the formed elements is not obvious. Later, a loss in hemoglobin, relative to the size of the hemorrhage, and a less marked reduction in the red cells

become evident. When small but frequent hemorrhages take place the diminution of hemoglobin and loss of red blood corpuscles progress slowly, but finally the blood picture may reach that of an extreme grade of anemia. The anemia in the above condition is due either to an actual loss of red blood cells through hemorrhage or to a destruction of red blood cells in the circulation through the action of some toxic or poisonous substances. Smears from the blood show that the red blood cells are small and pale (Plate I). There may be some irregularity in size and shape of the cells, but this is not usually marked. Except in the severest secondary anemias, nucleated red blood cells are not numerous, and almost always when present they are of the normoblastic type.

Progressive pernicious anemia is to be sharply differentiated from the great group of secondary anemias. The exact cause of pernicious anemia is not known, but its mode of origin is different from that of the secondary anemias, inasmuch as the anemia is not alone due to a destruction of red cells in the circulating blood, but to an injury of the vital tissue which forms the red blood cells for the body—the bone marrow. The red corpuscles in this disease fall relatively lower than the hemoglobin, so that the hemoglobin index is above 1. The leukocytes are decreased. Microscopically the red blood corpuscles show great irregularity in size and shape (Plate II). Many of them are much larger than normal. Nucleated red blood corpuscles are found, sometimes in great numbers, and the megaloblasts are often more plentiful than the normoblasts. The blood picture serves to distinguish cases of pernicious anemia from severe secondary anemia, which may accompany hidden carcinoma of the internal organs, or follow repeated losses of small amounts of blood.

Great importance has been attached, within recent years, to estimations of the white cells or leukocytes of the blood. In dealing with this subject it must be remembered that the leukocytes play a very definite part in the economy of the body, and, so far as we know at present, are principally concerned in protecting the organism against injurious agents, among which are certain pathogenic bacteria.

The knowledge that the numbers of these cells in the circulating blood may vary greatly from normal, in many acute diseases, and even in some chronic affections, has been of much assistance in the diagnosis of certain conditions. Under normal circumstances the variation in the numbers of the leukocytes is not very great, and we can consider 7000 to 10,000 leukocytes per c.mm. within the normal limits. When the leukocytes are increased, perhaps to 15,000, to 20,000, or to 50,000 per c.mm., we speak of the condition as leukocytosis; and when they fall below the normal limit, the condition is known as leukopenia.

Several varieties of leukocytes go to make up the total number of these white cells, and of all the leukocytes, the polymorphonuclear neutrophilic leukocytes are the most numerous. They form 70 per cent. to 72 per cent. of the cells. Next in numbers are the small lymphocytes, which make up 22 per cent. to 25 per cent. of the cells. The large lymphocytes and

Fig I

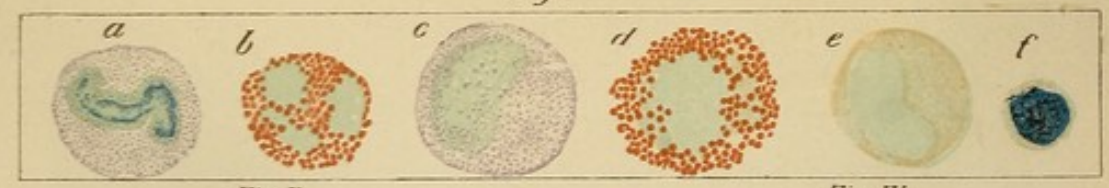
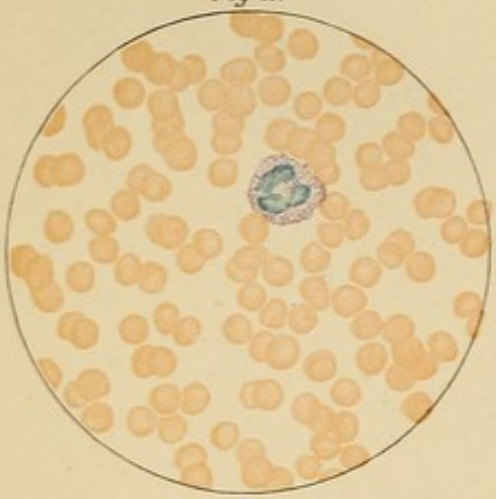


Fig II.



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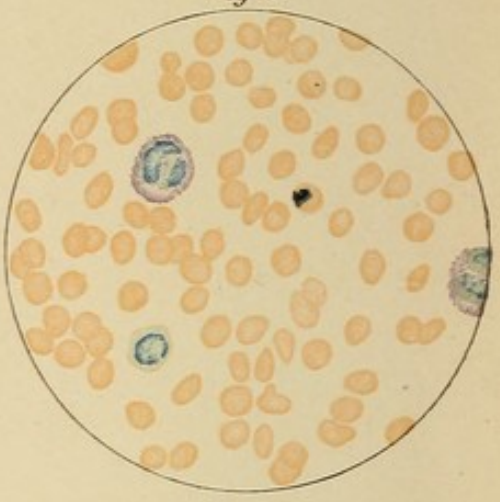

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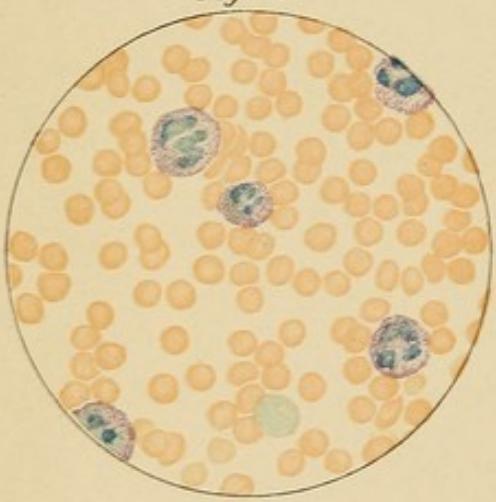

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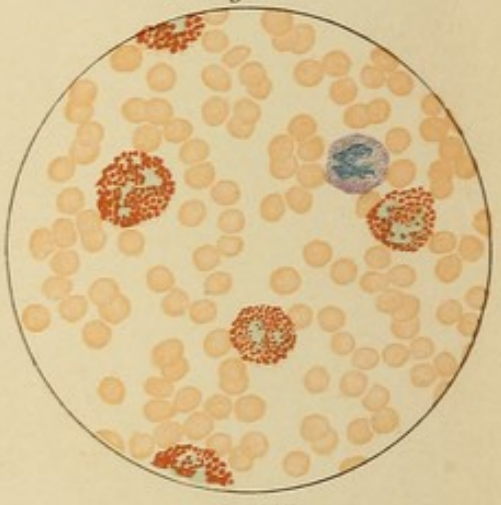

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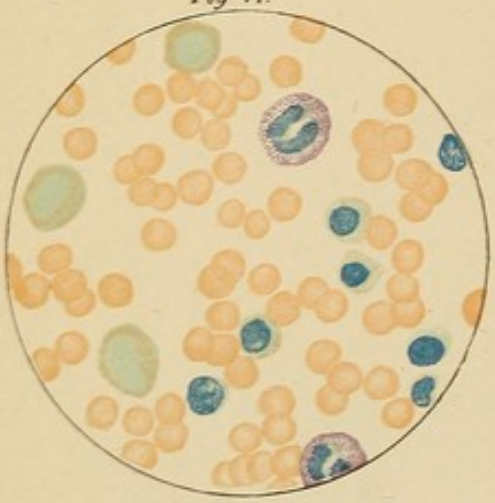

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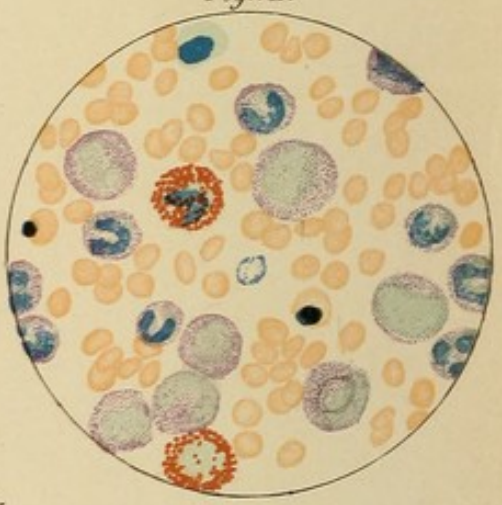

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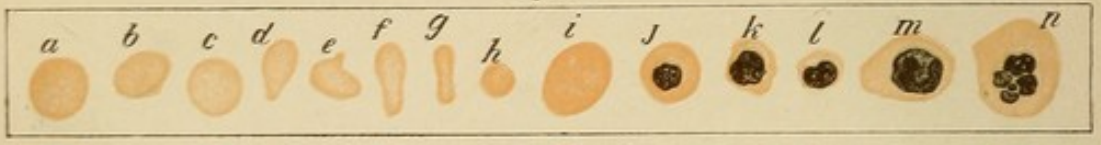


DRAWN BY J.N.Z. CHASE

PLATE I

BLOOD.

(Ehrlich triple stain.)

(Prepared by Dr. I. P. Lyon.)

Fig. I. TYPES OF LEUCOCYTES.

a. Polymorphonuclear Neutrophile. *b*. Polymorphonuclear Eosinophile. *c*. Myelocyte (Neutrophilic). *d*. Eosinophilic Myelocyte. *e*. Large Lymphocyte (large Mononuclear). *f*. Small Lymphocyte (small Mononuclear).

Fig. II. NORMAL BLOOD.

Field contains one neutrophile. Reds are normal.

Fig. III. ANÆMIA, POST-OPERATIVE (secondary).

The reds are fewer than normal, and are deficient in hæmoglobin and somewhat irregular in form. One normoblast is seen in the field, and two neutrophiles and one small lymphocyte, showing a marked post-hæmorrhagic anæmia, with leucocytosis.

Fig. IV. LEUCOCYTOSIS, INFLAMMATORY.

The reds are normal. A marked leucocytosis is shown, with five neutrophiles and one small lymphocyte. This illustration may also serve the purpose of showing the leucocytosis of malignant tumor.

Fig. V. TRICHINOSIS.

A marked leucocytosis is shown, consisting of an eosinophilia.

Fig. VI. LYMPHATIC LEUKÆMIA.

Slight anæmia. A large relative and absolute increase of the lymphocytes (chiefly the small lymphocytes) is shown.

Fig. VII. SPLENO-MYELOGENOUS LEUKÆMIA.

The reds show a secondary anæmia. Two normoblasts are shown. The leucocytosis is massive. Twenty leucocytes are shown, consisting of nine neutrophiles, seven myelocytes, two small lymphocytes, one eosinophile (polymorphonuclear) and one eosinophilic myelocyte. Note the polymorphous condition of the leucocytes, *i.e.*, their variations from the typical in size and form.

Fig. VIII. VARIETIES OF RED CORPUSCLES.

a. Normal Red Corpuscle (normocyte). *b, c*. Anæmic Red Corpuscles. *d-g*. Poikilocytes. *h*. Microcyte. *i*. Megalocyte. *j-n*. Nucleated Red Corpuscles. *j, k*. Normoblasts. *l*. Microblast. *m, n*. Megaloblasts.

PLATE II

FIG. 1

Pernicious Anæmia.

The field shows marked anisocytosis and poikilocytosis: M^1, young megaloblast (early generation); M^2 M^3 M^4, later generations of the megaloblast series; *S S S*, "stippled" red cells; *R*, ring body (nuclear remnant ?); *L*, lymphocyte.

FIG. 2

Pernicious Anæmia. (Actual Field.)

Field showing less poikilocytosis than Fig. 1: M^1, young megaloblast; M^2, megaloblast of later generation; *T T T*, etc., transitional erythroblasts, not typical either of the megaloblastic or of the normoblastic series; *S*, "stippled" erythrocyte; *P*, polynuclear neutrophile; *L*, large lymphocyte.

transitional cells form 3 per cent. to 5 per cent., the eosinophilic leukocytes 2 per cent. to 4 per cent., and the basophiles 0.5 per cent.

In the commoner forms of leukocytosis these cells do not increase proportionately. One form predominates above all others, both relatively and in actual numbers, and this form is the polymorphonuclear leukocyte. The reason for this is not far to seek. If one injects a culture of some bacterium, such as Staphylococcus aureus, into the peritoneal cavity of a rabbit, the polymorphonuclear leukocytes pour from the bloodvessels of the mesentery into the peritoneal cavity to protect the body against the toxic action of the bacteria. So many leukocytes leave the blood stream that for a short time the numbers of white cells in the peripheral circulation are actually diminished. But the body soon feels the need of more leukocytes. Great quantities of these cells are required in the peritoneum, and they must reach the peritoneum from their point of origin through the blood stream. New leukocytes, therefore, are rapidly formed in the bone marrow and poured in great numbers into the circulation, whence they find their way to the peritoneum. This generous supply of cells circulating through the bloodvessels produces the leukocytosis.

If, now, a culture is chosen which is extremely virulent, and if this is inoculated into the animal in great quantity, the rabbit may die very soon and without the appearance of a leukocytosis. The explanation of this fact is found in the severity of the intoxication. The body cells, including those which form the leukocytes, are so badly injured by the bacterial toxins that leukocytes cannot be formed readily; not only is it impossible for the body to furnish leukocytes in excess of what is required, but it cannot even produce sufficient numbers to combat the infection.

It may readily be seen that leukocytoses cannot be considered by rule of thumb. When great quantities of leukocytes are required for some purpose in any part of the body, the body cells do their best to produce leukocytes in excess of what is actually needed, and the number of these cells increase in the blood.

Though it is impossible to draw definite conclusions from the grade of leukocytosis, still certain general principles may be followed in those infections where a leukocytosis usually occurs. If the patient is not very sick and the leukocytes are only slightly increased, we may assume that the infection is mild and great numbers of leukocytes are not required for protection. If the patient is very ill and the leukocytes are high, the body is probably reacting well against the infection, but if the patient is very ill and the leukocytes remain low, the reaction of the body is poor and the ultimate outlook is grave.

A leukocytosis may be physiological or pathological. Physiological leukocytoses occur after heavy meals, when the white cells may increase 30 per cent. to 40 per cent., and after excessive exercise and cold baths. During pregnancy the leukocytes increase 50 per cent. to 80 per cent., while in the newborn the leukocytes may be three to four times their normal number in the adult.

Pathological leukocytoses occur in a great variety of conditions, and

certain diseases are almost always accompanied by a leukocytosis. Among these conditions may be mentioned pneumonia, rheumatic fever, epidemic meningitis, septicemia, erysipelas, scarlet fever, and tetanus. In practically all forms of pyogenic infections and purulent inflammations there is a leukocytosis of varying degree, and sometimes a leukocytosis which is quite high. In localized acute inflammations a leukocytosis is the rule, and it is sometimes surprising to find what a marked leukocytosis accompanies a comparatively mild infection. A small boil may give rise to a leukocytosis of 20,000 to 25,000 cells per c.mm. Purulent inflammations of the pleura, the pericardium, and the peritoneum are usually accompanied by a great increase in the leukocytes. In empyema it is not uncommon to find a leukocytosis of 20,000 to 50,000 cells per c.mm. The same is true of acute purulent inflammations of the gall-bladder and such internal organs as the liver, kidneys, and brain.

In appendicitis the leukocytes may vary considerably, depending upon the stage of the disease. With acute catarrhal conditions the leukocytes, if increased at all, are very slightly elevated; in the acute suppurative stages there may be a moderate leukocytosis (15,000 to 20,000 leukocytes per c.mm.), or as the process continues a very high grade of leukocytosis (30,000 to 40,000 leukocytes per c.mm.) may develop. As is true in all infections, the desperate fulminating cases may show but a slight rise in the leukocytes. When the process becomes chronic the leukocytes may be normal, and even though there is a localized abscess, provided it is walled off, the leukocytes may be scarcely above the normal limits. This, too, is true of all chronic localized inflammations. During the active stage of the infection, new leukocytes are constantly required at the seat of trouble and are constantly kept high in the circulating blood; but in an old walled-off abscess no leukocytes are required of the body, and there is, therefore, no increase of the cells in the blood.

Though the presence of a leukocytosis may aid in the diagnosis of certain conditions, the discovery of a leukopenia may be equally helpful in clearing the diagnosis. Just as certain diseases are characterized by an increase in the leukocytes others may be recognized by a decrease. This is particularly true of typhoid fever, and the knowledge of this fact may serve to differentiate this disease from certain acute infections which it may so closely resemble. Another very important fact which must be borne in mind when one is dealing with typhoid fever is that secondary acute inflammations, such as pneumonia, subcutaneous abscesses, osteomyelitis, cholecystitis, and peritonitis, complicating typhoid, may give rise to only a slight leukocytosis, which is in no way comparable to the leukocytosis occurring in such acute infections alone. Whereas, the leukocytes in croupous pneumonia usually average 15,000 to 30,000 cells per c.mm., and may be much higher, in pneumonia complicating typhoid fever the leukocytes may number only 8000 to 12,000. If one takes into account the usual leukopenia of typhoid fever (3000 to 6000 leukocytes per c.mm.), this represents an increase in the leukocytes of the blood, but is insignificant as compared with the leukocytosis seen in croupous pneumonia itself.

When a perforation of the bowel takes place in typhoid fever there may be a transient increase in the leukocytes, and in rare cases the leukocytosis is high. More commonly the white cells increase to 10,000 or 12,000, and then, particularly in unfavorable cases, their numbers fall rapidly. Often in quickly fatal cases it is impossible to detect any definite rise in the leukocytes, and the leukopenia becomes steadily more pronounced until death.

In tuberculosis a leukocytosis makes its appearance only when a secondary infection is engrafted upon the original process.

A few non-inflammatory conditions may give rise to a leukocytosis, and unless one is cognizant of this fact, confusion may arise. Acute hemorrhage is followed by a leukocytosis which is often very pronounced, and the leukocytes may reach as much as 20,000 per c.mm. Less marked leukocytoses are seen after intoxications by certain drugs, such as phenacetin and antipyrine, and after chloroform narcosis. Occasionally a leukocytosis develops during the course of such malignant tumors as carcinoma and sarcoma.

So far we have considered only the leukocytoses which are characterized by an increase in the polymorphonuclear neutrophilic cells, but it is also possible to have a leukocytosis due to an increase in the eosinophile leukocytes. Eosinophilia occurs in a number of conditions. It is most marked in trichinosis and in infections by certain intestinal parasites, particularly the ankylostoma duodenale. Eosinophilia may also appear during certain stages of bronchial asthma, and may be present in pemphigus and some varieties of skin diseases.

The study of the white cells of the blood in the diseases which we have mentioned so far, though it may suggest or aid a diagnosis, is not essential for the diagnosis. In a few diseases the diagnosis cannot be made without a blood examination.

The diagnosis in leukemia must rest entirely upon a study of the blood. There are two main forms of leukemia, lymphatic leukemia and myelogenous leukemia.

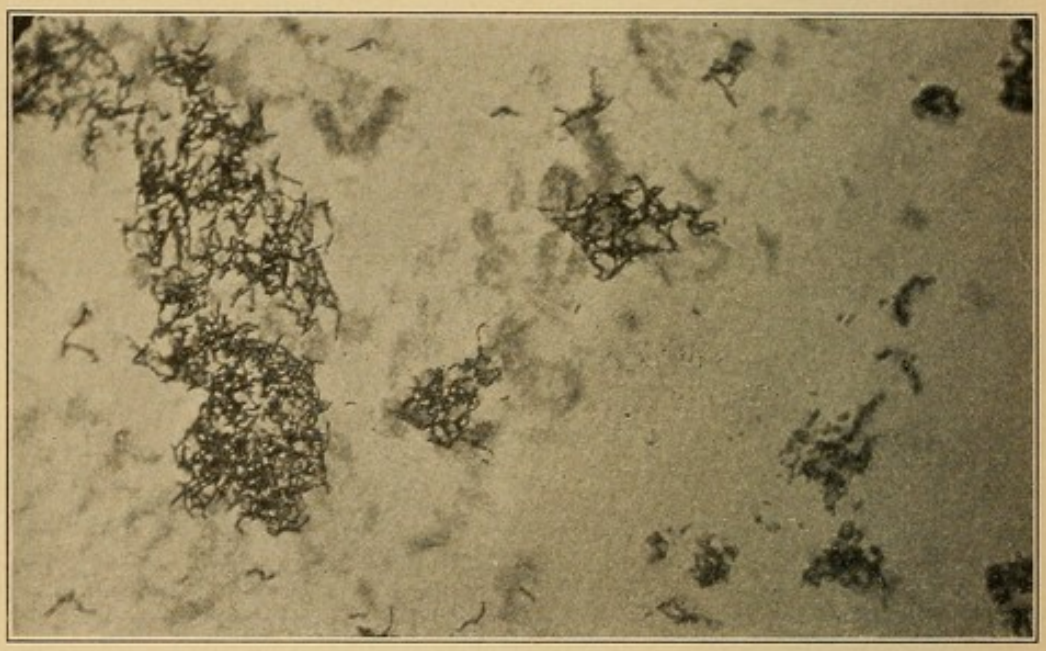
Lymphatic leukemia may again be divided into two types, the acute and the chronic. In acute lymphatic leukemia the clinical picture is usually that of an acute infection with fever and general prostration. The lymph glands are not enlarged, as a rule. The leukocytes are increased. They may number 50,000 to 200,000 or more. The stained smear shows an enormous preponderance of a form of large lymphocytes. The chronic variety is characterized by an enlargement of the lymph glands and spleen and by a leukocytosis in which the white cells may reach from 100,000 to 500,000 per c.mm. In smears the cell which forms from 80 per cent. to 95 per cent. of all the white corpuscles is the small lymphocyte. In both types the red blood corpuscle and hemoglobin may be decreased, but anemia is usually most marked in the acute leukemias.

Myelogenous leukemia is characterized by enlargement of the spleen, and sometimes of the lymph glands, with, again, a great increase in the numbers of white blood corpuscles. Anemia is also present, and the

proportion of white and red cells may be 1 to 5 or 1 to 3, or even 1 to 1. The stained smear shows a variety of cells which are not normally found in the blood. Neutrophilic and eosinophilic myelocytes, cells which normally are seen only in the bone marrow, form a large percentage of the cells. Nucleated red blood corpuscles may also be seen in large numbers. A blood examination is imperative in every patient who has marked enlargement of the spleen and general marked enlargement of the lymph glands.

Besides the examination of the formed elements of the blood, one may obtain much information through other methods. It is known that when a culture of a given bacterium, for instance the typhoid bacillus, is injected in non-fatal doses into an animal, the serum of that animal gradually develops the property, when brought into contact with a suspension

Fig. 1



Positive agglutination reaction.

of cultures of that specific organism, of causing the bacteria to clump together in great masses. This is known as agglutination, and the serum may develop such high agglutinative properties that it will be active when diluted 100, 1000, or even 10,000 times. During the course of typhoid fever the serum develops the power of agglutinating the typhoid bacillus, and this specific agglutinative reaction (the Widal reaction) is made use of for the diagnosis of this disease. In order to say certainly that the Widal reaction is positive, the blood serum of a patient, diluted at least fifty times and better one hundred times, must stop the motion of the typhoid bacilli and cause them to form well defined clumps within one hour (Fig. 1). The reaction is rarely present before the second week of the disease, and may be delayed until the end of the third or fourth week. Serum from patients suffering from certain other bacterial infec-

tions, such as Malta fever or tuberculosis, may develop the power to agglutinate the infecting organisms, though the reaction which is of most practical importance is that occurring in typhoid fever.

Another very valuable serum reaction for diagnosis is the complement deviation method of Wasserman. By a technique which is complicated and much more elaborate than that of the Widal reaction, it is possible to obtain this deviation of the complement of the blood serum in a large percentage of syphilitics. The reaction usually fails when the patient has been treated for some time by antisyphilitic measures. The reaction depends upon the union of a specific antibody present in the serum of the syphilitics with a so-called antigen which is present in tissue richly infected with Spirocheta pallida. Recently, lecithin has been substituted for the syphilitic tissue. During the union of the antibody and antigen the thermolabile complement of serum is absorbed. The same method of diagnosis has been applied to the serum of typhoid and tuberculous patients, an extract of the typhoid bacillus and tuberculin being used as antigen.

More accurate information may be received in systemic bacterial infections from blood cultures. Small amounts of blood may be readily withdrawn by means of a syringe from the veins at the elbow, and cultures may be made from this blood on different media. This method is of great value for diagnosis in the early stages of typhoid fever, when typhoid bacilli may be obtained in 80 to 95 per cent. of the cases. Septicemia due to the pyogenic cocci or other bacteria may often be discovered by this means; or when the diagnosis is suspected it may be confirmed and the nature of the infecting organism accurately determined.

Finally, it is necessary to mention the aid which may be given by an examination of the blood for parasites. The discovery of the malarial plasmodia may explain the presence of alarming chills, while it is not necessary to emphasize the importance of a search for the embryos of Filiaria sanguinis hominis in cases of lymph scrotum and chyluria, for Spirillum obermeieri when relapsing fever is suspected, and in rare instances for trypanosomes.

EXAMINATION OF THE URINE.

Under normal conditions an adult passes from 1500 to 2000 c.c. of urine in twenty-four hours. This quantity varies slightly in health, according to the amount of fluid taken into the body or the amount of fluid lost through sweating, etc. Under pathological conditions the amount of urine may vary enormously. It is increased in diabetes mellitus and diabetes insipidus, in certain forms of chronic nephritis, and in certain nervous disorders, while the amount is decreased principally in acute nephritis and certain forms of chronic nephritis.

In recurring occlusion of the ureters through any cause, or in certain forms of hydronephrosis, the quantity of urine may vary from time to time. The periods in which the ureters are partially blocked are char-

acterized by decreased urinary secretion, while relief of the block is followed by marked and often sudden polyuria.

The specific gravity of the mixed twenty-four-hour urine from healthy persons usually lies between 1015 and 1020. After the drinking of much water or beer the specific gravity may fall to 1002, or after excessive sweating rise to 1035. As a general rule, in diseased states the specific gravity of the urine varies with the quantity of urine excreted. A concentrated urine has a high specific gravity, while in polyuria the specific gravity is low. There is one glaring exception. In the marked polyuria of diabetes mellitus the specific gravity is greatly increased, and may be 1040 to 1050.

The urine from a normal person is quite transparent and varies in color from a pale yellow to a dark amber. On standing, a flocculent cloud forms, which is composed of mucus enclosing a few cells. A precipitate of urates or phosphates or a growth of bacteria may cloud the urine diffusely. Certain characteristic changes in the color are seen in disease. In febrile states the urine becomes dark yellow or reddish; blood, of course, imparts a red, smoky appearance, while bile produces a yellow or greenish tinge, particularly noticeable in the foam. Besides these commoner causes, certain drugs give rise to colored urine. Injection of carbolic acid, hydrochinone, and salol produce a dark brown or olive-green urine; rhubarb and senna give a yellow color, due to chrysophanic acid; santonin gives either yellow or green; while methylene blue produces a deep blue or green coloration.

The reaction of freshly voided normal urine is slightly acid, due to the presence of several acid salts, the most important of which is diacid sodium phosphate. The acidity varies in health according to the type of diet, becomes more marked when there is increased consumption of proteid, less marked on a vegetable diet, and during different periods of the day. Immediately after meals the acidity is lowest. The acidity is diminished or the urine becomes alkaline under a variety of circumstances, but most noticeably in the condition known as phosphaturia, or when it is mixed with blood or alkaline secretions, or when alkaline fermentation takes place anywhere in the urinary tract. The alkaline reaction, if it is due to ammonia, is caused by a growth of certain forms of bacteria. On standing, urine from normal individuals tends to become alkaline through bacterial fermentation.

Increase in the acidity is rare, though it may occur probably as the result of a neurosis, and cause symptoms of cystitis. Cryoscopy, or the determination of the freezing point of the urine, may give information concerning the activity of the kidneys. A freezing point above 0.9° indicates low molecular concentration, and shows that the functional activity of the kidneys is interfered with. The value of this method for determining the relative activities of the two kidneys from an examination of the urine obtained by ureteral catheterization is not unquestionable.

The presence of albumin in the urine is spoken of as albuminuria, and the commonest and most important form of albumin found is serum albumin. The finding of albumin in the urine may denote that the

kidneys have failed, at least partially, in their function as filters, thus allowing the passage of albumin from the blood (renal albumin), or it may point to the presence of blood or pus in the bladder or kidneys or an admixture of seminal or prostatic fluids with the urine (accidental albuminuria).

If the albumin is renal in origin, it is safe at least to suspect disease of the kidneys. There is, however, a group of very interesting cases in which albuminuria may occur in persons enjoying apparently perfect health. This physiological albuminuria may occur under a great variety of circumstances. Albuminuria may be present in the urine of healthy pregnant women, in men after severe exertion, as in bicycle riders or football players, after mental exertion, cold baths, and certain other conditions. It is still dubious as to whether the cyclical and orthostatic albuminurias are truly functional, and appear in persons who have healthy kidneys.

Albuminuria occurs in most febrile diseases, when there is a degeneration of the epithelium of the renal tubules, in acute and chronic congestion of the kidneys, as in heart disease, and in all forms of acute and chronic nephritis. In certain forms of acute nephritis the albumin may be present in large quantities and measure as much as 1 to 2 per cent. when estimated in the Esbach tubes, whereas in certain forms of chronic nephritis there may be only 0.1 per cent. to 0.5 per cent., or the albumin may only be present in traces. In amyloid diseases 2 to 3 per cent. of albumin may be present in the urine.

In suppurative conditions of the kidneys the albumin comes both from the red blood cells and leukocytes of the pus, and from the kidneys themselves. Albumin is present in considerable quantity, and usually amounts to more than 0.1 per cent. In inflammatory conditions of the bladder, however, though albumin is practically present in every severe case, it rarely exceeds more than 0.1 per cent. to 0.15 per cent. in amount unless blood is present. If, therefore, in acute inflammatory conditions of the urinary tract the amount of albumin in the urine, which does not contain blood, exceeds 0.2 per cent., one may suspect immediately that one or both kidneys is involved.

Though peptones and albumosis may appear in the urine when there is long-continued suppuration in one part of the body, the presence of these bodies is not of any great diagnostic significance.

On the other hand, the presence of Bence Jones' body, which is now known to be related more closely to the albumins than albumoses, points at once to a disease of the bone marrow, and suggests above all other things, those curious tumors called multiple myelomata. The body has been found once, in another disease, namely, lymphatic leukemia.

Nucleo-albumin, a body allied to mucin, has no practical significance. Unless the test for albumin is carefully made, nucleo-albumin may be mistaken for true serum albumin.

Fibrin is found in the urine very rarely, and is usually associated with chyluria, a condition arising during the course of certain cases of filariasis, and in diphtheritic inflammation of the urinary tract.

Abnormal excretions of glucose may occur in two great classes of cases: (1) Persons suffering from a definite disease, diabetes mellitus, and (2) persons who have transient glycosuria.

The constant presence of sugar in the urine means diabetes mellitus. In quantity the sugar may vary from traces to 10 per cent. During twenty-four hours a patient may excrete 200 to 300 grams of glucose. In mild cases the glucose disappears or decreases markedly when carbohydrates are excluded from the patient's diet. If this does not occur the prognosis is bad.

Transient glycosuria may be of no moment. It may occur after ingestion of sugar in abnormal amounts, in certain diseases or injuries to the nervous system and digestive tract, after insults or injuries to the liver, after fracture of the long bones, after ether anesthesia, in exophthalmic goitre, and after the use of certain drugs. Injuries to the pancreas may give rise to glycosuria, while in certain diseases of the pancreas, such as severe chronic interstitial pancreatitis, glycosuria may at first be transient and later become constant.

Acetone is found in the urine in many conditions, but has most significance in diabetes mellitus, when its presence may indicate approaching coma. It appears also in fevers, during starvation, after a purely proteid diet, in the cachexias due to malignant tumors, after chloroform narcosis, in auto-intoxications, certain digestive disturbances, and cyclic vomiting.

Diacetic acid occurs under much the same conditions as acetone, and has the same significance in diabetes mellitus.

β-oxybutyric acid occurs in diabetic coma, and its presence in the urine in any quantity in diabetes mellitus signifies almost certainly approaching coma.

When blood appears in the urine, one speaks of hematuria; when the coloring matter without the cells is present, the condition is known as hemoglobinuria. In hematuria the blood may come from the kidneys, the ureter, the bladder, or the urethra.

Renal hematuria may be caused by injury to the kidneys. It may appear when there is a stone in the kidney, in acute inflammation of the kidneys, during the course of acute or chronic nephritis, when the kidneys are the seat of tumor growth, especially hypernephroma, in purpura hemorrhagica, in chronic passive congestion of the kidneys, after carbolic acid poisoning, occasionally in acute infectious diseases, such as typhoid and smallpox, occasionally in leukemia, or finally, in parasitic disease of the kidneys. There is, besides, a primary renal hematuria, the cause of which is not definitely determined. Acute inflammation of the ureter (often caused by the passage of a stone), bladder, prostate, and urethra may cause hematuria. Tumors of the bladder frequently give rise to severe hematuria.

Hemoglobinuria is seen after the ingestion of certain poisonous substances, such as potassium chlorate and pyrogallic acid, after the transfusion of foreign blood, or even after the transfusion of large quantities of blood of the same species, in extensive burns, in black-water fever, and in the curious condition termed paroxysmal hemoglobinuria.

Melanin in the urine may point to the presence of a melanotic tumor of the kidney.

The bile pigment, bilirubin, is found in the urine when there is obstruction to the bile passages, and is, of course, always present in jaundice. Indican and indigo are found in excess in the urine during excessive putrefaction of proteid material in the intestinal tract. Indican in the urine occurs during interstitial disturbances and particularly in obstruction. When the obstruction is in the small bowel, the amount of indican is much greater and appears much sooner than when the obstruction is in the large intestine. Leucin and tyrosin are the decomposition products of albumin and are found in the urine, and in such destructive lesions of the liver as acute yellow atrophy.

The color reaction described by Ehrlich as the diazo reaction may be obtained in at least 95 per cent. of all cases of typhoid fever. Unfortunately the reaction is not specific, for it may occasionally be noted in the urines from cases of tuberculosis, pneumonia, septicemia, and carcinoma.

The test devised by Cammidge is said to be specific for diseases of the pancreas, and is thought to be especially valuable for the diagnosis of chronic inflammation of the pancreas.

Bacteriology.—The urine in the normal bladder is sterile, but since it forms a good culture medium, soon after it is passed bacteria rapidly develop in it. During the course of certain bacterial diseases, in which there is a septicemia, the infecting bacteria may be eliminated in the urine. When the bacteriuria is renal in origin, the organisms most commonly found are typhoid and colon bacilli. The typhoid bacilli can be grown from the urine in 20 to 30 per cent. of cases of typhoid fever. The bacilluria may continue for some time after convalescence, and it may be present without setting up a cystitis. Bacteriuria may also be persistent in cases of localized infection of the prostate and posterior urethra.

Cultures from the urine from cases of inflammation of the urinary tract may help to elucidate the condition. The bacteria which are most commonly associated with cystitis and inflammation of the ureters and kidneys are Bacillus coli, Bacillus proteus, staphylococci, streptococci, pneumococci, gonococci, and the tubercle bacillus. If the urine contains pus which is sterile and in which no bacteria can be seen with ordinary stains, tuberculosis may be suspected. Great care should be observed in differentiating the tubercle bacillus from the smegma bacillus. To make a positive diagnosis, the urine should be inoculated into guinea-pigs.

Parasites of Urine.—In echinococcus diseases of the kidneys or bladder the urine may contain echinococcus hooklets or scolices. Chyluria may be associated with filariasis, so that if chyluria is observed in any case, the urine, but more especially the blood, should be searched carefully for filaria embryos. The diagnosis may be made solely by this means.

The urine in Egyptian hematuria often contains the eggs of the parasite Distomum hematobium, which produces the disease.

EXAMINATION OF THE FECES.

The frequency and the amount of defecation in health vary so greatly with the individual and depends upon so many factors that departures from normal are often not noted until they have become pronounced.

The consistency of the fecal mass depends upon the amount of water which it contains. An increase of fluid may be caused either by an increased exudation or transudation from the intestinal mucous membrane, or by decreased absorption of water by the intestinal walls. An exudation of fluid takes place in inflammation of the mucous membrane, while decreased absorption may occur when peristalsis is for any reason increased.

Some information may be gained from the color of the stools. Variations in color may depend upon (1) digestive secretions; (2) food residue; (3) discharges from the intestinal mucous membrane; (4) accidental ingredients, such as drugs.

The secretion which is of most importance in giving a color to the intestinal contents is bile, and the coloring matter is a derivative of bilirubin, namely, hydrobilirubin or urobilin. After the first few months of life, biliverdin and bilirubin are not present in the normal stool.

If the stools are free from bile pigmentation, a condition which occurs in complete occlusion of the bile ducts, they exhibit a pale color, the typical clay-colored stools.

In many diarrheas the stools may contain bilirubin, owing to the fact that the stool is so rapidly carried through the intestinal canal that there has not been time to convert these substances into hydrobilirubin. These pigments give to the stool a yellow color and in infants the frequent admixture of biliverdin with the bilirubin gives to the stool the characteristic green color. The green stools of infants may also be dependent upon the growth of such chromogenic bacteria as Bacillus pyocyaneus.

The food residue has also much to do with the color of the stools. With a vegetable diet the stools are usually lighter in color than with a meat diet, whereas a milk diet produces a yellow or greenish-white stool. The coloring matter of certain fruits may give a dark-brown or greenish-black color to the feces, which without careful examination may be mistaken for digested blood.

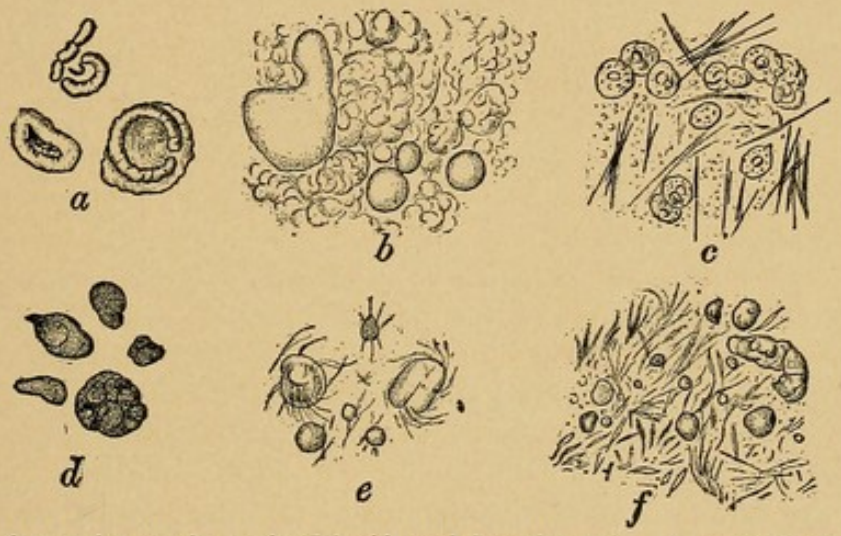
Such discharges from the intestinal wall as mucus, pus, and serum rarely produce any definite coloration, though large quantities of mucus may impart a glassy or glistening appearance to the stool. Blood always changes the color of the stool if present in any quantity. The color depends much upon the length of time the blood has been in the intestines, and varies from bright red in fresh hemorrhages to a tarry black in old hemorrhages.

Among the drugs, bismuth is the most important coloring agent. After the use of this drug the stools are colored gray or black from the presence of bismuth sulphide.

Small amounts of fat demonstrable microscopically either as neutral fat or as fatty acid crystals may appear in the stools in a number of conditions. Large amounts of fat in the form of fatty acid crystals give to the evacuation an exceedingly pale color, while neutral fat may be present in such quantities that the stool is surrounded or covered with a yellow oily substance.

When the flow of bile into the intestinal tract is cut off, a large percentage of the ingested fat is not completely split up, and the stools may contain great quantities of fatty acid crystals (Fig. 2). When the absorption of fat is impeded by blocking of the intestinal lymphatics, such as may occur in tabes mesenterica, fat may also be present in the feces. A very important condition in which fatty stools may appear is disease of the pancreas. Fatty stools are by no means constantly seen

FIG. 2



Forms of fats and soaps in stools (Schmidt and Strassburger). *a*, soaps; *b*, casein and fat globules; *c*, fatty acid needles and leukocytes; *d*, yellow calcium soap; *e*, fatty acid crystals projecting from fat droplets; *f*, fatty acid and soap needles and scales from an acholic stool.

in cases of chronic pancreatitis or in obstruction of the pancreatic duct, but they may occur, and the amount of fat may be large. Free fat may be passed in great amounts in chronic pancreatitis, surrounding the stool or covering it like melted butter.

In alcoholics the stools may also be pale, due partly to the presence of fat, but principally to the transformation of the normal coloring matter, hydrobilirubin, into a colorless substance.

Visible mucus may appear in the stool in various forms of catarrhal inflammation of the intestines. Typical long shreds, membrane-like pieces of mucus, or even casts of the intestines may be found in the stools in mucous colitis. Small glairy pieces of mucus are found in great amounts in diphtheritic dysentery and in amebic colitis. In both diphtheritic dysentery and amebic colitis the bowel movements may be composed almost exclusively of mucus, blood, leukocytes, and bacteria,

The presence of blood in the stools points naturally to a hemorrhage. Large hemorrhages may come from bleeding hemorrhoids, newgrowths

of the intestines, such as papilloma or carcinoma, and bleeding typhoid, or rarely tuberculous ulcers. Hemorrhages into the stomach caused by gastric ulcers, cirrhosis of the liver, or splenomegaly may be evidenced by the passage of copious bloody stools.

By the newer methods of examination of the stools for occult blood, small quantities not recognizable by any other means may be detected and the presence of some form of ulceration of the gastro-intestinal tract determined. By this means it can be shown that the stools contain occult blood in many cases of typhoid fever, in ulcerations of the intestines due to intestinal parasites, in many acute inflammations of the intestinal tract, in ulcerating tumors of the large and small bowel, and in ulcers of the stomach.

When an abscess ruptures into the intestinal tract, pus visible to the naked eye may be passed by the bowel. If the pus is evacuated into the bowel high up, it is usually mixed with feces, and when it is passed has undergone such alterations that it is rarely recognizable, except by the microscope. Great numbers of leukocytes may be found in the feces in various forms of intestinal ulceration, due to newgrowths, typhoid fever, or tuberculosis and amebic or bacillary dysentery. In acute forms of amebic dysentery, as well as bacillary dysentery, small masses of pus may be seen by the naked eye, mixed with mucus or blood.

Occasionally small particles of a tumor are discovered in the feces, and when carcinoma of the intestines is suspected a careful search of the feces may show bits of tissue which on microscopic examination prove to be masses of newgrowth. If one is successful in finding such particles, the correct diagnosis can be arrived at with certainty.

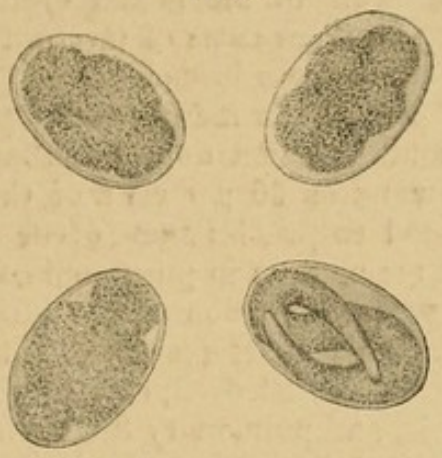
Gallstones, pancreatic stones, and intestinal stones are occasionally found in the feces. Since gallstones are quite frequently passed in the feces, an examination of the stools should be made in all cases of suspected cholelithiasis. The presence of cholesterin in a stone stamps it as coming from the gall-bladder. Pancreatic stones are rare. They may be identified by the fact that they are composed of calcium carbonate. The enteroliths are formed principally of phosphates.

Bacteriological examination of the stool is attended with many difficulties, though it may aid materially in the diagnosis of an intestinal disease. In typhoid fever, typhoid bacilli may be grown from the stools in quite a large proportion of cases. It should be remembered that patients may continue to eliminate typhoid bacilli for months or years after an attack of typhoid fever. It is probable that in the chronic bacillus carriers the bacilli come really from the gall-bladder, which acts as a reservoir and allows of the entrance of innumerable typhoid bacilli into the intestinal contents. Tubercle bacilli are found in the stools of persons suffering with tuberculosis of the intestinal tract, but the finding of tubercle bacilli is not diagnostic of intestinal ulceration, since bacilli which have been swallowed with sputum may be found in the feces.

In amebic dysentery the amebæ are most numerous and most readily seen in bits of mucus.

The diagnosis of an infection of the intestines by a parasite may be made solely upon the discovery of ova of the parasite in the stool. In

FIG. 3



Eggs of parasites. Uncinaria americana.

cases of anemia the stools should always be examined for parasites. The parasites which most commonly cause severe anemia are Ankylostoma duodenale, Bothriocephalus latus, and Paramecium coli (Fig. 3).

EXAMINATION OF THE SPUTUM.

An examination of the sputum may be of material benefit in assisting in the diagnosis of a few conditions which are treated by the surgeon, but is principally valuable in offering an aid to the better understanding of certain surgical complications.

The quantity of the sputum may be quite small in many pulmonary conditions, but occasionally large amounts are expectorated in twenty-four hours. This is seen particularly in certain forms of chronic bronchitis, in bronchorrhea, sometimes in pulmonary tuberculosis, in bronchiectasis, gangrene and abscess of the lung, perforation of an empyema or of an amebic abscess into the bronchi, and with pulmonary hemorrhage.

The color of the sputum varies greatly according to the disease. In pneumonia, especially during the early stages, it has a rusty brown tinge. Sputum containing pus has a yellowish white or greenish tinge; when mixed with blood, it is red; and in jaundice it is yellow or green, due to the presence of bile pigments. In anthracosis the sputum is colored black or gray. The prune-juice sputum is typical of the discharge of an amebic abscess into the bronchi.

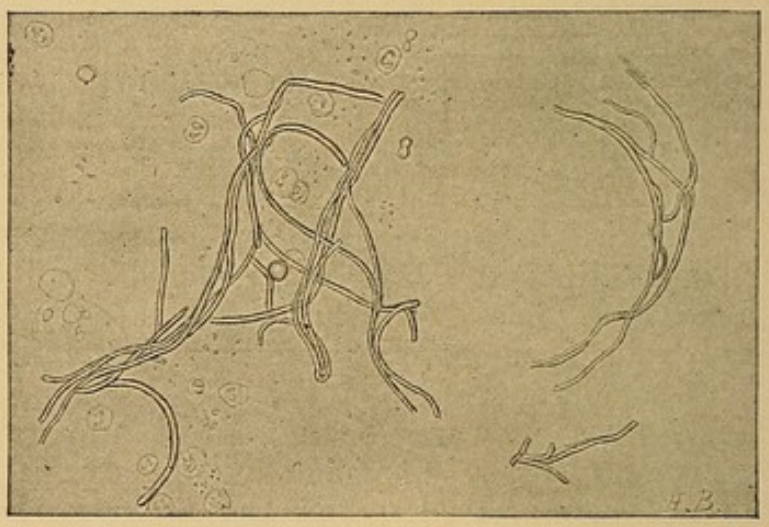
The odor of the sputum in certain cases of pulmonary tuberculosis, in abscess and gangrene of the lung, and putrid bronchitis is extremely foul.

Macroscopically one may distinguish mucus by its stringy, glairy appearance, and pus by its opaque yellowish or greenish look. Varying quantities of blood are seen in the sputum in pneumonia, in pulmonary tuberculosis, in heart disease, and in infarction of the lung. In the last

two conditions large quantities of blood may be expectorated. In conditions such as abscess and gangrene small particles of lung tissue may be found which appear as white, green, or blackish particles. Curschman's spirals, readily visible to the naked eye, are present in cases of bronchial asthma. Fibrinous casts of the bronchi may be found in that condition known as fibrinous bronchitis.

Microscopically the presence of many polymorphonuclear leukocytes gives evidence of an acute inflammation of the bronchi or alveoli. In bronchial asthma as many as 60 per cent. of the leukocytes may be eosinophilic. Red blood corpuscles may occur in many conditions. They may be found in the sputum in pneumonia, especially in the early stages, in heart disease, in infarction of the lung, in abscess, and in gangrene, and in pulmonary tuberculosis. Elastic fibers signify that alveoli or bronchi are being destroyed, and may be found in abscess, gangrene, bronchiectasis, and pulmonary tuberculosis (Fig. 4).

Fig. 4



Elastic tissue from lung. × 400.

Charcot-Leyden crystals are seen in the sputum in bronchial asthma when they are found associated with the eosinophilic leukocytes. Fatty acid crystals are often seen in abscess and gangrene of the lung. More rarely leucin and tyrosin or hematoidin crystals are found.

Two animal parasites are occasionally seen in the sputum. When an amebic abscess of the liver ruptures into the lung, amebæ may be found in the sputum, and their discovery will clinch the diagnosis. In parasitic hemoptysis, ova of the lung fluke, or Distomum pulmonale, the parasite which causes the disease, is present in the expectoration.

The presence of tubercle bacilli in the sputum means pulmonary tuberculosis, and naturally in every case suspected of having tuberculosis the sputum should be searched most carefully for these bacteria. Repeated examinations in many instances are necessary to demonstrate their presence.

The presence of great quantities of pneumococci in the sputum is

evidence of pneumonia or of some pneumococcal infection of the respiratory tract. In influenza, both acute and chronic, the sputum may be loaded with influenza bacilli. A diagnosis of infection by this organism may be made from an examination of the sputum. Less frequently the Friedländer bacillus, Aspergillus fumigatus actinomyces, the glanders bacillus, and the bacillus of plague may be found in the sputum. No conclusions can be drawn from finding of the ordinary pyogenic cocci.

EXAMINATION OF THE GASTRIC CONTENTS.

Except for the information gained from a general or perhaps, in cases of poisoning, from a chemical examination of the vomitus, a study of this material gives but little definite knowledge concerning the main underlying disease. By general inspection one may determine whether the vomitus contains bile, blood, or undigested material. The odor will indicate roughly the presence of certain drugs or poisons, and a chemical analysis will yield accurate information.

In the examination of the test meal we are especially anxious to know the total amount of acid, the amount of free hydrochloric acid, the amount of pepsin present, and as to whether lactic acid is or is not present.

Under normal conditions, as the tests are carried out with the Ewald meal, the total amount of acid in the gastric juice varies between 30 to 70 (0.11 to 0.26 per cent.), while the amount of free hydrochloric acid varies from 0.05 to 0.2 per cent.

In a general way one may say that the total amount of acid is increased in gastric ulcer (in which condition the free hydrochloric acid is also increased), in simple hyperacidity, in certain nervous conditions, and in the early stages of chronic gastric catarrh. The acidity is decreased among other conditions in many anemic states, in certain gastric neuroses, in the later stages of chronic gastric catarrh, and in many cachexias. Free hydrochloric acid is found wanting in gastric cancer, in certain severe infectious diseases, in pernicious anemia, and in achylia gastrica.

Lactic acid is found in carcinoma of the stomach, and combined with the lack of free hydrochloric acid, is very suggestive of this disease.

The presence of occult blood in the test meal or in vomited material may be significant of one of several conditions. Hemorrhage into the stomach may occur in gastric ulcer, carcinoma of the stomach, cirrhosis of the liver, or splenomegaly; but before one can draw any conclusions from the finding of occult blood, it is necessary to exclude with great care any admixture of blood from the mouth, gums, or from slight abrasions of the esophagus or gastric mucosa when the stomach tube is used. Of great importance is the examination of any small bits of tissue which may occasionally be found in the stomach washings. In cancer of the stomach, small particles of the tumor may be washed away during lavage, and by a microscopic examination of these particles it is possible to establish the diagnosis of carcinoma.

A microscopic examination of the test meal will reveal starch granules,

a few epithelial cells, fat droplets, yeast fungi, and bacteria. The large bacteria, the Oppler-Boas bacilli, are associated with the presence of lactic acid in the stomach contents, and their presence suggests carcinoma. Both fresh and old blood may be seen, especially in carcinoma and gastric ulcer. Great numbers of leukocytes may be seen in certain cases of acute gastritis or when a carcinoma is breaking down and undergoing secondary inflammatory changes.

The presence of food eaten the day before the stomach is emptied by the tube points to retention which may be due to pyloric stenosis, gastroptosis, or dilatation.

EXAMINATION OF TRANSUDATES, EXUDATES, AND SECRETIONS.

Collections of transudated fluid removed from the pleura, the pericardium, and the peritoneum have much the same characteristics. They usually are clear yellow, of alkaline reaction, and contain albumin. In pleural transudates there may be many endothelial cells in the centrifugalized sediment, but leukocytes are scarce or absent. A true transudate is always sterile.

Inflammatory exudates vary in character according to the infecting agent which produces them. Exudates caused by the pneumococcus, the staphylococcus, the typhoid bacillus, and the tubercle bacillus often present different characteristics. The exudate produced by the streptococcus, staphylococcus, pneumococcus, and sometimes by the typhoid bacillus is frankly purulent. The fluid is thick and white or yellow in color. Microscopic examination shows that by far the greatest number of cells are polymorphonuclear leukocytes, and smears stained in gentian violet will reveal the infecting microörganisms in great numbers. Some exudates due to the pneumococcus and typhoid bacillus are seropurulent or truly serous, containing comparatively few cells. If the specimen is centrifugalized, however, in the sediment it will be found that the cells which are present are of the polymorphonuclear variety. This is an important differential point in deciding as to whether a serous or serofibrinous exudate is tuberculous or not.

Tuberculous exudates are almost always serofibrinous in character, though they may contain varying amounts of blood, while rarely the presence of large quantities of cells gives them an opaque appearance. It is exceedingly difficult to demonstrate the tubercle bacillus in such exudates. The inoculation of animals will give positive results, and occasionally the method of examination designated inoscopy, in which the fibrinous coagulum is digested, the digested fluid centrifugalized, and the sediment stained for tubercle bacilli, will show the presence of bacilli. But a simpler method of differentiation is based upon the type of cell which is present in these exudates. It has been stated that in exudates caused by the pyogenic cocci, the polymorphonuclear leukocyte is the typical cell. In tuberculous exudates this cell is comparatively scarce, and the majority of elements are mononuclear cells. In tuberculous exudates 90 to 95 per cent. of the cells may be small mononuclears.

True hemorrhagic exudates are seen principally in tuberculosis and carcinoma or sarcoma. Though a general carcinosis or sarcomatosis of the pleura or peritoneum may and often does give rise to hemorrhagic exudates, in certain cases the aspirated fluid may be serous in appearance. The presence of definite tumor cells in such exudates will lead to the correct diagnosis.

The examination of the spinal fluid may be carried out in much the same manner as the examination of exudates from the pleura, pericardium, and peritonum. The spinal fluid from normal individuals contains only traces of albumin and but few cells, not more than 2 to 7 leukocytes per c.mm. The exudates are serous, serofibrinous, seropurulent, purulent, fibrinopirulent, or hemorrhagic. The meningococcus gives rise to a serous, seropurulent, or fibrinopurulent exudate. The characteristic cell is the polymorphonuclear leukocyte containing the infecting microorganism. The meningococcus can be demonstrated in coverslips. The pyogenic cocci produce purulent exudates, and the typhoid bacillus usually serous exudates.

In cases of tuberculous meningitis the spinal fluid is quite characteristic, and is serous, serofibrinous, or rarely seropurulent. The type of cell which is found is the same as that seen in pleural or pericardial exudates—the small lymphocyte. But in the spinal fluid tubercle bacilli may be demonstrated in practically every case by an examination of the filmy fibrin clot which forms in most fluids withdrawn from the meninges of cases of tuberculous meningitis.

For the Wasserman reaction in the diagnosis of syphilis, or the more recent reaction described by Noguchi, the spinal fluid is even more useful than blood serum. The spinal fluids from 70 to 80 per cent. of cases of tabes and dementia paralytica give a positive reaction.

It is almost impossible to draw any conclusions from the presence of blood in spinal fluid. Bloody fluids may be found in cases of cerebral hemorrhage, but it is so difficult to exclude blood which may be due to the puncture itself, that the withdrawal of bloody fluid from the spinal canal can have no significance.

EXAMINATIONS OF SECRETIONS, FLUIDS FROM SCARIFIED SURFACES, ETC.

The examination of any abnormal secretion will always be of some aid in determining the character of the pathological process. By the finding of gonococci in the urethral or vaginal discharges the diagnosis of gonorrhea can be made unhesitatingly (Fig. 5). In discharges from the ear, the eye, and the nose careful examination will determine the nature of the infecting organism, and if one desires to treat such chronic suppurative conditions with vaccines, it is positively essential that an accurate diagnosis of the infecting bacteria should be made, and that the vaccines should be prepared from growths of exactly the same organism which causes the trouble in that particular patient. By making smears from

an anthrax pustule the disease may be diagnosticated with certainty. The typical bacilli are often found in great numbers in coverslips.

Since the discovery of the Spirocheta pallida a very valuable method is now at hand for the early diagnosis of cases of syphilis. The spirochetæ are found in the chancre and in practically all the secondary lesions of syphilis (Plate III). To demonstrate these organisms, it is necessary to scarify superficially the surface of the chancre, mucous patch, condyloma, or skin lesion, prepare coverslips from the exuding serum, which contains little or no blood, and stain by the method of Giemsa or Goldhorn, or by the newer silver method described by Stern. Smears may be prepared and stained in the same way from the aspirated juice of an enlarged lymph node. The spirochetæ may be present in fairly

FIG. 5

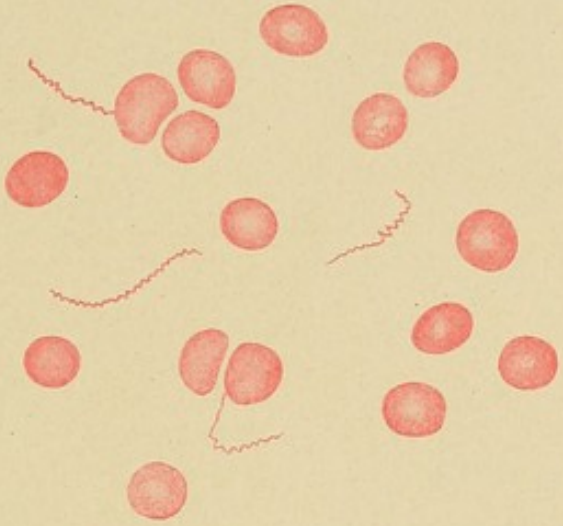
Gonococcus in pus cells. × 1100 diameters. (Park.)

large numbers, but frequently they are scarce and must be searched for with pains. If Spirocheta pallida can be demonstrated, the diagnosis of syphilis is assured. One must always use the greatest caution in differentiating Spirocheta pallida from Spirocheta refringens, which is frequently found in non-specific ulcers and erosions of the external genitalia.

A method which is even more valuable, since it is more rapid, is to examine fresh material obtained in much the way as described above, under a microscope furnished with the new form of condenser that throws the rays from a powerful artificial light across the field of the microscope. With this transillumination the spirochetæ appear as brilliant twisting spirals upon a black background.

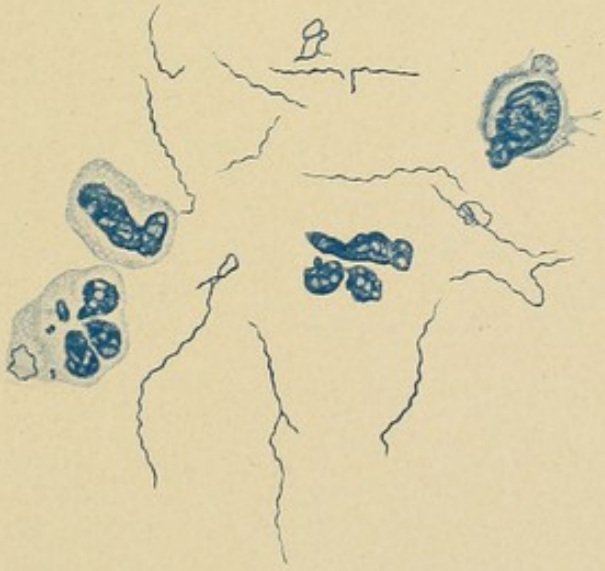
PLATE III

FIG. 1



Spirochæte Pallida. Smear from Hard Chancre. Giemsa's stain. × 1000. (Osler.)

FIG. 2



Spirochæte Refringens. Smear from Chancroid. × 1000. (Osler.)

CHAPTER II.

THE APPLICATION OF THE X-RAYS IN SURGICAL DIAGNOSIS.

By H. K. PANCOAST, M.D.

The maximum efficiency of the *x*-rays is attained and the minimum danger incurred only when the apparatus is thoroughly modern and skilfully handled and the results are interpreted by one familiar with its workings and trained by a large experience to recognize the correct meaning of the different shadows.

With very few exceptions the skiagraphic examination is preferable to that by the fluoroscope. The latter, even in the hands of those expert in its interpretations, is often misleading.

The risks involved in the radiographic examination are now so slight that they may be practically disregarded.

BONES AND JOINTS.

The interpretation of radiographs taken for the detection of affections of the bones and joints involves a knowledge of the normal appearances and variations in conformation of bones and joints and a clear conception of epiphyseal development and union in relation to age.

Fractures.—When the ordinary and diagnostic symptoms of fracture are present, the *x*-rays are serviceable in accurately determining the nature and extent of the deformity, the interposition of soft parts, the presence or absence of comminution, or the antecedent pathological condition predisposing to a break.

When the usual signs of fracture are indistinct, or cannot be elicited because of tenderness and great swelling, the *x*-ray examination is indispensable. Under this heading may be classed most incomplete and impacted fractures, all those lying in the joint or near it, fractures of the carpal bones and proximal ends of the metacarpals, of the tarsals and metatarsals.

Examination of a patient suffering from injury in the neighborhood of a joint cannot be regarded as complete until it has been supplemented by the information gained by the skiagraph. Many of the bone lesions cannot possibly be diagnosticated in any other way, and in some, as instanced by an impacted fracture of the femoral neck, manual diagnostic efforts are distinctly contra-indicated.

The *x*-rays give, without pain or added trauma, complete information in regard to the presence of fracture, its seat, its nature, and the direction and degree of deformity.

When a skiagraph is taken for diagnostic purposes, all dressings should be removed, if this be practicable, since all are obscuring to an extent, and some unexpectedly so to the inexperienced. Thus, lead water, bichloride of mercury solution, iodoform, ointments containing metallic salts, starch bandages, and plaster all interfere with the production of clear pictures. Nevertheless, the best interests of the patient may require a picture to be taken under circumstances other than those most favorable. Though clear definition is essential to the determination of certain bone lesions, it is not usually required in the gross diagnosis of fracture.

In cases of fracture without adequate cause the *x*-rays afford the only means of framing a diagnosis of the underlying bone affection, as, for example, cyst, central sarcoma, or chronic osteomyelitis.

In cases of delayed union or non-union with inconclusive clinical symptoms, the *x*-rays are diagnostic, showing the presence or absence of bony callus between or around the ends of the fragments. As lime salts are practically absent in fibrous union, there will be no shadow, such as that cast by bone in the process formation. Moreover, the skiagram will often show the cause of non-union.

For the purpose of affording protection to the physician who first sees a case of injury about a joint which may be associated with fracture of the bone, a skiagraphic record is of cardinal importance, since subsequent disability, common even in bone injuries properly treated, is inevitably attributed by the patient to negligence on the part of his physician. If an *x*-ray picture taken during this period of continued crippling and, sometimes, well-founded discontent exhibits a deformity or a chronic arthritis incident to an unrecognized fracture, the patient will probably find twelve of his peers convinced by such a picture of his right to redress. Nor will the profession at large consider that the patient's interests have been intelligently conserved by the doctor who has failed to utilize the only means by which an accurate diagnosis can be made.

As to the method of examination, whenever possible the plate should be taken from at least two directions, the exposures being at right angles to each other, or nearly so. A single good picture may entirely fail to show a fracture in which there are obvious deformity and crepitus. The regions in which single view pictures have been most misleading are the elbow, the wrist, the knee, and the ankle. Oblique fractures of the long bones, even with obvious deformity, occasionally give in a single view picture the appearance of complete continuity.

In some regions it is impossible to take pictures from two directions and in others it is extremely difficult. The region of the shoulder and upper portion of the humerus can be skiagraphed in the anteroposterior direction only. When the elbow is dressed in a flexed position, the lateral view alone is possible. The pelvis and most of the spine cannot be satisfactorily examined laterally. The upper six cervical vertebræ can be, however, and the picture thus afforded is usually much more satisfactory than the anteroposterior one. Lateral views of the hips and the upper portion of the femoral shaft are impossible.

Both anteroposterior and lateral radiographs are important in demon-

strating fractures of the humeral condyles. The lateral picture best shows injuries of the olecranon and the coronoid process, and supracondyloid fractures. The side view is the essential one for all fractures of the patella, os calcis, and astragalus.

It should be a general rule to make comparative radiographs of the bones and joints of the healthy side unless the diagnosis is obvious. This is especially important in the joint lesions of young people.

The direction of the two views taken should be as nearly as possible in the same plane and at right angles to each other, and the tube should be placed as nearly as possible over the seat of injury. If the source of rays be unintentionally or carelessly so placed as to throw distorting shadows, marked deformity may appear in the plate when it does not exist in fact.

Epiphyseal Separations.—These injuries will not show in the skiagraph unless there be associated bone lesion or pronounced displacement. The evidence obtained by comparative pictures of corresponding portions of the opposite side is often at least suggestive. Negative results in these cases are not conclusive.

Fracture of the ossified epiphysis or extension from the diaphysis into the epiphyseal line, with or without epiphyseal separation, is, however, readily shown.

Inflammations.—Acute suppurative periosteitis, osteomyelitis, and epiphysitis should be recognized by the clinical symptoms and receive proper treatment before the bone changes are sufficiently pronounced to produce a characteristic *x*-ray picture.

Chronic Osteomyelitis.—In chronic osteomyelitis necrosed bone throws a less dense shadow than the surrounding structure. The sequestrum, when separated, appears as a loose fragment surrounded by a clear area representing the cavity in which the dead bone lies. The shadow of an involucrum will be shown as soon as the deposition of lime salts begins.

In pyogenic osteomyelitis chronic from the start, with the process comparatively extensive, the shadow of the affected portion of the bone, which is the seat of a rarefied osteitis, will appear decidedly less dense in the skiagraph than that of the surrounding osseous structure in which both condensation and thickening are likely to have taken place. This condition of rarefied osteitis must not be confused with the appearance observed in the cancellous ends of bones near joints exhibiting lesions of chronic arthritis, or the similar appearance developed after prolonged fixation of the joint, such, for instance, as is needful in the treatment of fracture.

In the type of chronic osteomyelitis characterized by local abscess formation, often termed Brodie's abscess, and located in the upper extremity of the tibia, the lesion can usually be readily detected and accurately localized by means of a radiograph (Fig. 6).

Tuberculosis.—Tuberculosis can be detected as soon as bone disintegration has progressed far enough to cause an appreciable difference in the density of the shadow of the affected portion. Hence, as the process of caseation and softening is essentially slow, the diagnosis as to the seat

of disease and its extent can be made by the *x*-ray before softening has taken place, and at the time when clinical diagnosis is more or less uncertain.

The accurate localization of the seat of invasion is of cardinal importance from the standpoint of treatment. In tuberculous disease involving the carpus and tarsus, the skiagraph will show whether it is distinctly limited to one of the small bones, as an osteitis, or to the joint structure, as an arthritis; or whether the disease is more widespread.

In the late stages of tuberculous infiltration characterized by extensive osteomyelitis, with necrosis, the *x*-ray picture, while showing the lesion, in no way indicates its tuberculous nature.

FIG. 6

Superficial "Brodie's abscess" head of tibia of male, aged twenty years. Radiograph indicates exact location of lesion.

Syphilis.—In addition to the demonstration of the seat, nature, and extent of the syphilitic bone invasion, the skiagraph has a distinct diagnostic value in that it may identify the lesion as one of syphilis, and, moreover, may picture the traces of former lesions of a similar nature.

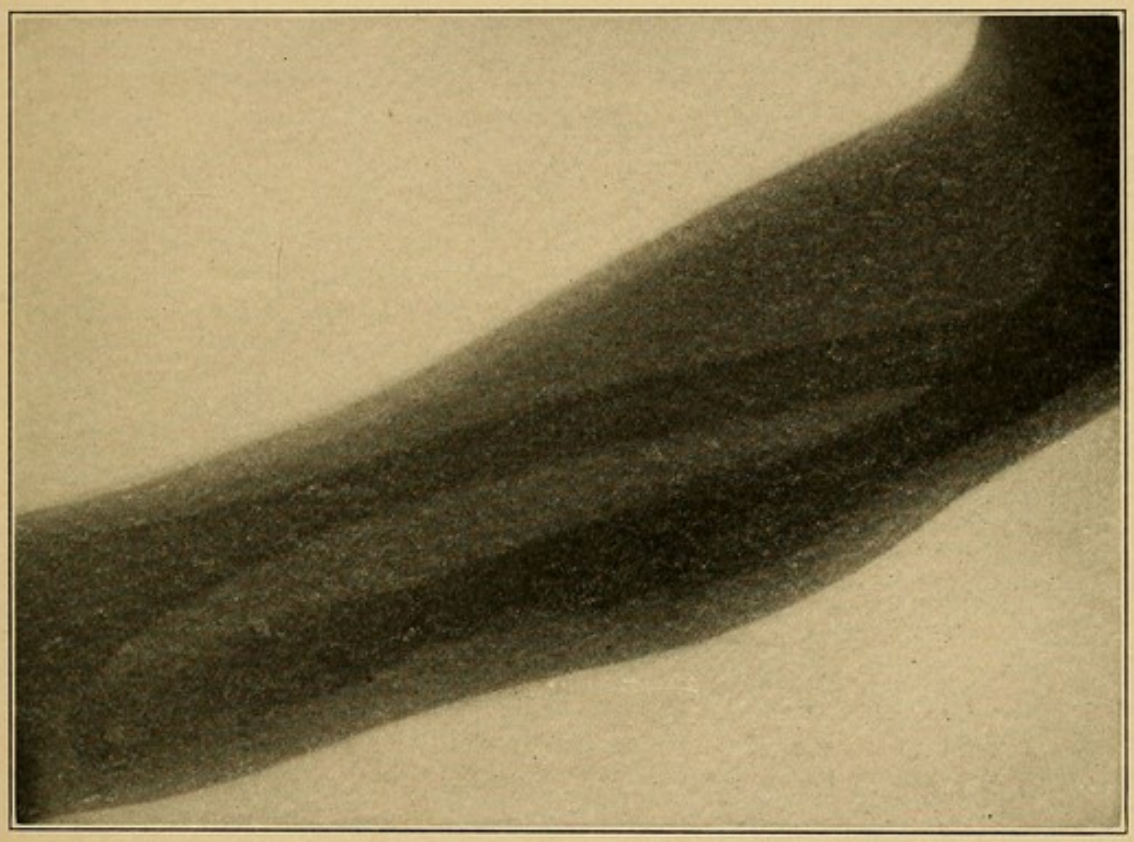
There are two distinctly different appearances found in the skiagraphs of bone lesions of acquired syphilis, dependent upon whether the process is essentially one of destruction or of proliferation.

In the typically active lesion, the periosteal gumma, there will be shown a shadow of the swollen periosteum and usually of the soft parts as well. Later, the evidence of osseous degeneration is afforded by a roughened surface indicating a superficial caries or a deeper or more extensive area

of distinctly rarefied or even necrosed bone. Necrosis is unusual, since one of the most characteristic features of syphilis is that a large portion or even the entire shaft of the long bone may become extremely rarefied without actual necrosis taking place.

As in all other chronic bone inflammations, there is an accompanying condensation of the surrounding structure, the shadow of the bone immediately around the localized lesion appearing denser than normal in the later stages of the affection. This proliferative process is especially evident on the surface (Fig. 7), and the subperiosteal new bone formation will be observed in the form of nodes and osteophytes in the case of localized lesions, or of a considerable general thickening if the process be extensive.

FIG. 7



Syphilitic osteomyelitis involving nearly entire shaft of ulna in a girl, aged sixteen years. Note coincident rarefying osteitis and subperiosteal newgrowth.

The distinction between chronic syphilitic osteomyelitis and that due to other infecting agents is based mainly on the extensive rarefaction and the superficial thickening without necrosis.

Bone *sarcoma* in its usual form resembles syphilis only in its earliest stage. The less malignant and less common type of sarcoma, associated with more or less new bone formation, may sometimes lead to error, though the bone formation produces an appearance quite unlike that characteristic of syphilis. *Periosteal* sarcomas are more likely to lead to mistake from the *x*-ray standpoint, since the appearances they present are not uniformly so typical as those shown by the central growths.

Osteitis deformans, which may present a picture closely resembling that of syphilis, is rarely accompanied by the superficial localized bony outgrowths observed in the latter disease.

Post-typhoidal osteitis may resemble the early stage of gumma, but the raised periosteum is but little thickened, nor is the surrounding osseous structure markedly condensed.

In *hereditary syphilis* the skiagram is less characteristic. Usually the seat of the osseous lesions aside from dactylitis is at the epiphyseal junction with the bone shaft, a locality in which an *x*-ray examination is unsatisfactory during infancy. Serration, irregularity, and broadening of the diaphysis where it joins the cartilage, or enlargement of its entire extremity, accompanied by sclerosis and condensation, may be shown. A similar appearance may be seen in rickets, but here the widening is closely limited to the extreme end of the diaphysis and is not accompanied by sclerosis or serration.

In syphilitic dactylitis the diaphysis is greatly thickened throughout, or there is more or less widespread necrosis, with perhaps a tendency to the formation of an enveloping involucrum.

Miscellaneous Pathological Conditions Peculiar to Bones.—**Osteitis Deformans.**—The characteristic skiagraphic features of this condition are the uniform enlargement of a large portion or the entire shaft of the affected long bone or bones, accompanied by a marked condensation or sclerosis of the compact structure. At first the thickening is especially noticeable as involving the compact portion, and it may encroach upon the medullary canal. The latter, however, is usually rendered more perceptible through contrast with the extreme density of the compact structure. The medullary cavity obviously shares in the enlargement in some instances. Occasionally, when the bones have assumed tremendous proportions, in late stages of the disease, the central cavity has undergone an extreme degree of hypertrophy, even surpassing that of the compact structure, accompanied by enormous thickening of the normally thin walls. This process involves the cancellous ends as well, and the correspondingly enlarged medullary spaces give to the entire bone somewhat of a multilocular cystic appearance. At almost any stage of the disease the skiagraphic appearance is usually sufficiently characteristic for diagnosis of the condition.

Acromegaly.—The skiagraphic picture of the bones in this condition shows nothing but uniform hypertrophy.

Achondroplasia.—The skiagraph shows the typical appearance of the long bones—the abnormally short and slender diaphyses or shafts and the relatively large epiphyses or ends, which are, however, actually normal or nearly so in size and development, while the shafts are deficient.

Fragilitas Ossium.—The most noticeable skiagraphic feature in this condition is the extremely rarefied appearance of the long bones, especially at their extremities, arising from the imperfect ossification of the bone trabeculæ characteristic of the disease. The extreme rarefaction extends into the shafts far beyond the normal limits, showing the reason for the frequency of fractures.

Rickets.—The skiagraph has little value in the examination of the bones during the active stage of this disease.

In connection with the deformities arising from the disease, especially from the standpoint of the surgeon, the skiagraph is of great value, since the exact seat and extent of deformity can then be determined. After the application of the retentive dressing it is an easy means of determining whether the proper relations have been preserved. The nature and extent of rachitic deformities of the pelvis in pregnant women can readily be demonstrated by the *x*-rays.

FIG. 8

Osteosarcoma of shaft of tibia in male, aged twenty-five years. Sarcomatous degeneration of previous osteoma.

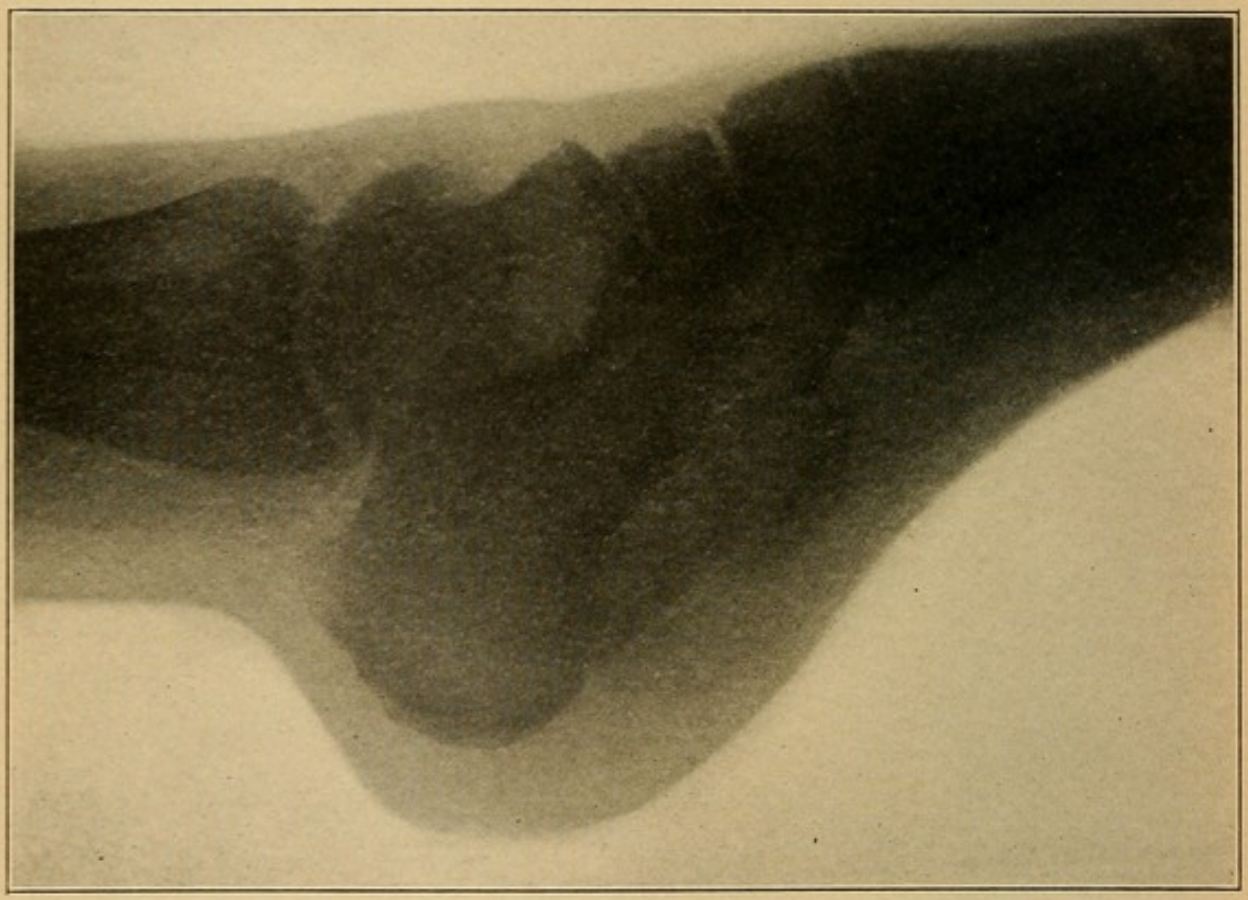
Tumors of Bone.—The appearance of each of the more common tumors is sufficiently characteristic to make the *x*-ray examination a fairly reliable means of determining the exact nature and the origin and seat of the growth.

Sarcoma.—In the periosteal form the skiagraphic appearance is not so distinctly characteristic as in the central variety. If the diagnosis of sarcoma is fairly well assured, the skiagraph will easily determine which of these two varieties is present (Fig. 8).

In the early stage of a periosteal growth its shadow will probably be in evidence, but there is nothing typical in the slight bony destruction accompanying the round-cell type, and the appearance may be more or less confusing. The skiagraph cannot always be accurately interpreted by itself, but must be studied in connection with the clinical data.

In the semimalignant types of osteosarcoma the appearance is usually characterized by the evidence of new bone formation, together with more or less bony destruction. There is considerable variation to be noted in the appearances in different cases, and, although they are usually characteristic, some experience is required to interpret correctly the skiagraphs of these less common growths (Fig. 9).

FIG. 9



Osteosarcoma—semimalignant or giant-cell type—of calcis of female, aged forty-seven years. Note new bone formation in contrast with complete bone destruction shown in more malignant form (Fig. 10).

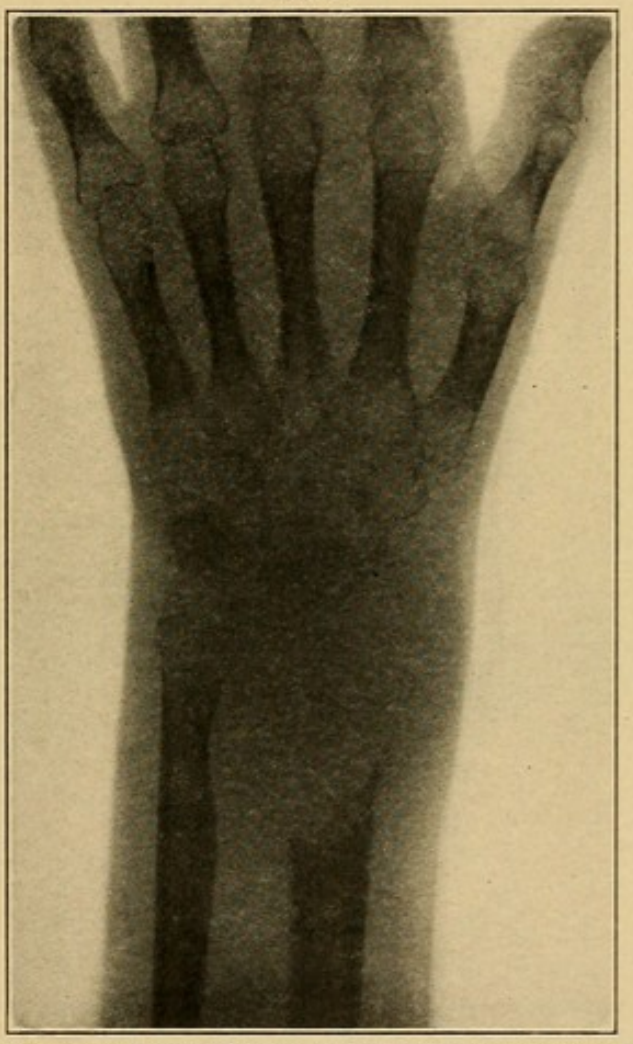
In the malignant round-cell *central* osteosarcomata the appearance is invariably characteristic, except in the early stages of the growth, when it may be confused with a bone cyst or a syphilitic osteitis. After the growth has reached an appreciable size, however, the appearance of this type cannot readily be mistaken (Fig. 10).

Bone Cysts.—The skiagraphic appearance of this condition closely resembles that of central sarcoma. Although there are some points of distinction, the diagnosis by the *x*-ray examination alone is difficult

and sometimes impossible. A knowledge of the clinical history of the case is very important in interpreting the skiagraph. Bone cysts are comparatively rare, however.

Osteoma.—The skiagraph readily establishes the nature of these tumors, together with their size, location, and anatomical relations, especially in connection with neighboring joints. There is a type of osteoma which bears some resemblance to sarcoma, and through lack of experience it may be mistaken for the latter (Fig. 11).

FIG. 10



Typical osteosarcoma of lower end of radius in adult female.

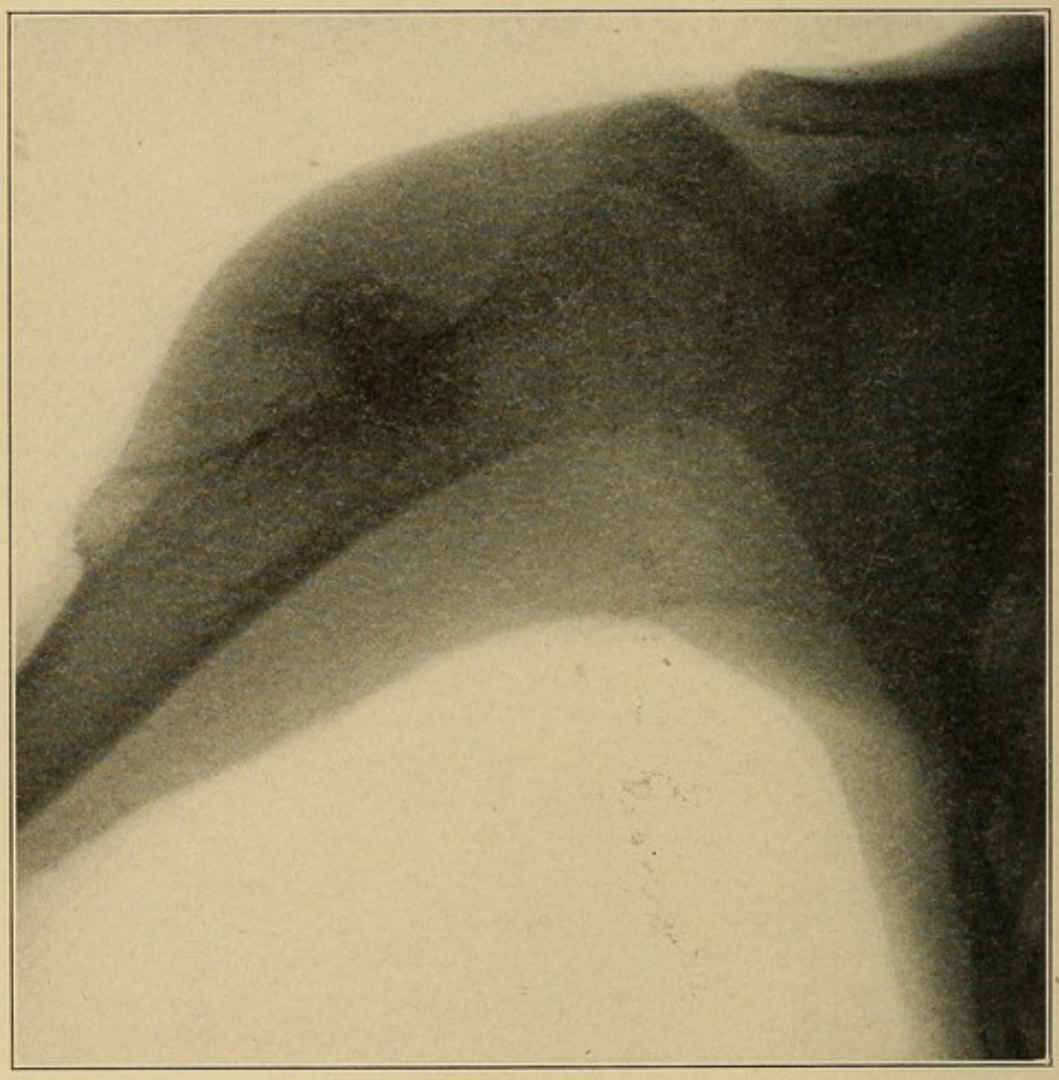
Enchondroma.—The shadow is faint and lacks any characteristic details, owing to the homogeneous structure of the growth and the slight difference in density between it and the surrounding soft structures. The *x*-ray diagnosis is usually more one by exclusion than a direct one.

Carcinoma.—In this condition the value of the skiagraph depends to a great extent upon whether the bone is involved by contiguity or by metastasis. In the former instance the examination will show, first, whether the bone is involved or not, and secondly, the extent of involvement. Metastatic carcinoma of bone has no special skiagraphic feature of its

own, and the diagnosis must usually be made with the assistance of the clinical data.

Injuries and Surgical Affections of the Joints.—**Dislocations.**—The diagnosis of the majority of dislocations, especially those of the larger joints, can be made without the assistance of the skiagraph, but that it is not always done is shown by the comparatively large number of old unrecognized unreduced dislocations seen by the *x*-ray specialist. The radiograph will show the displacement and will prove the completeness

FIG. 11



Osteoma of humerus in a female, aged thirteen years. Appearance not unlike that of sarcoma in some respects.

or incompleteness of reduction, but its main value lies in the detection of complicating fractures. All luxations should be so examined whether satisfactory reduction has been accomplished or not.

Such fractures are apt to extend into the joint, and they may be overlooked because of the greater prominence of the manifestations of the dislocation, or because they are obscured by swelling, or because they are of such types as are naturally difficult to diagnosticate clinically. Their detection is important and a routine *x*-ray examination of all cases of

dislocation, either before or after reduction, is the most reliable means of avoiding otherwise inexcusable mistakes which are likely to result in disability and discomfort to the patient and to reflect discredit upon the one who treats him.

In children dislocations are sometimes mistaken for epiphyseal separations, and vice versa, but the skiagraph will nearly always reveal the exact condition which exists, although extreme care in taking the picture and a certain amount of experience are often essential for correct interpretation of the plates.

The common dislocations of the *shoulder-joint* are rarely difficult to diagnosticate clinically, although old unreduced ones are frequently met with. It should be borne in mind, however, that they are often complicated by fractures, usually of the surgical neck of the humerus, rarely of the anatomical neck, or other less common fractures. In children this dislocation may be associated with separation of the upper epiphysis of the humerus. An *x*-ray examination of a shoulder is advisable after reduction, because in some instances reduction is found to be incomplete even when it has apparently been satisfactorily performed. The comparatively rare subspinous dislocation is rather difficult to demonstrate with absolute certainty in the skiagraph. These same remarks are applicable in connection with *acromioclavicular* dislocations, although the latter are usually less difficult to detect.

Fractures of either the clavicle or the acromion in close proximity to this joint are sometimes very difficult to distinguish from dislocations except by means of the skiagraph.

By far the greatest number of serious mistakes in diagnosis of dislocations are made in connection with those at the *elbow-joint*, either in failure to detect the presence of this injury or of one or more complicating fractures, or both. The skiagraph shows that dislocations at this joint are complicated by fractures in a large percentage of cases.

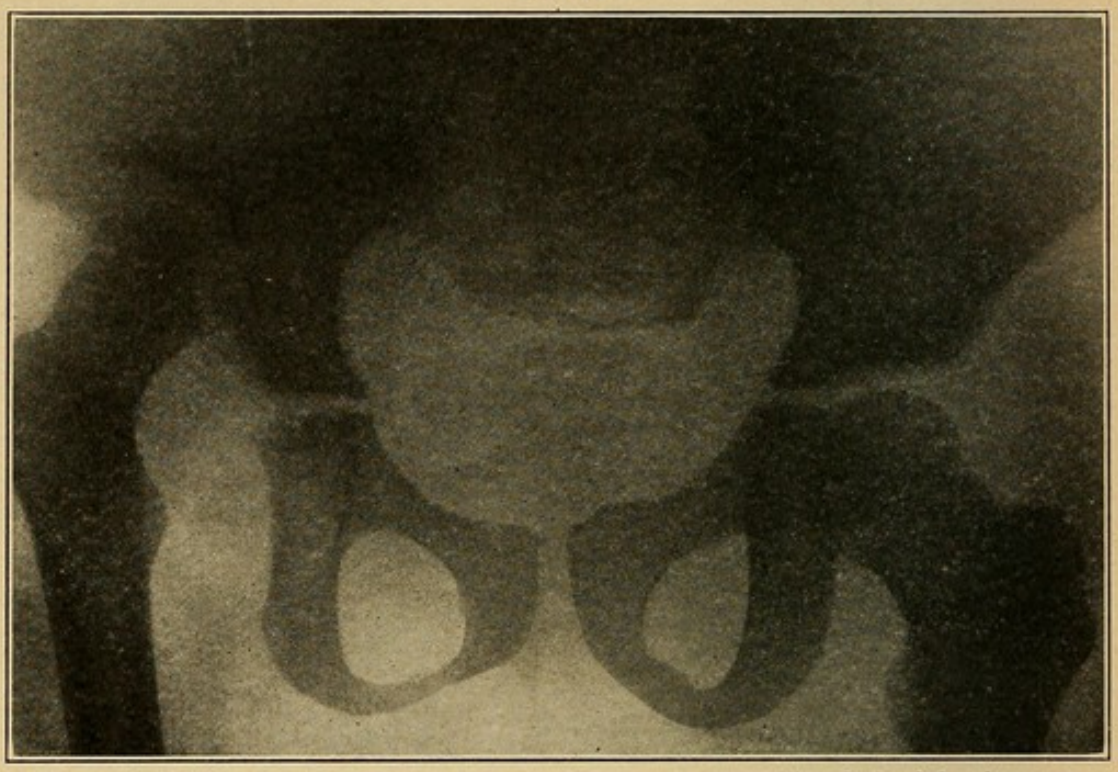
A careful skiagraphic study of injuries of the wrist shows that dislocations of the *carpal bones* are far more common than was formerly supposed. Luxations of one or more of these bones may occur independently, but they are usually associated with fractures of the bones of the forearm, which, by the greater prominence of their manifestations, are apt to divert attention from the possibility or even the evidence of the former injury. Some of these fracture-dislocations of the wrist are complicated. Blows on the wrist by automobile cranks have become a frequent cause of such injuries.

Carpal dislocations are difficult to diagnosticate clinically, and, even in the skiagraph, a dislocation of one or more of the bones may be overlooked unless pictures of the opposite wrist are made for comparison.

Traumatic dislocations of the hip do not usually require *x*-ray examination for their detection, but there is always the possibility of complicating fractures in these cases, especially of the rim of the acetabulum. In connection with *congenital hip dislocations*, the skiagraph is important as a means of diagnosis alone; it is also of great value in determining the extent of development of the acetabulum and the head and neck of the

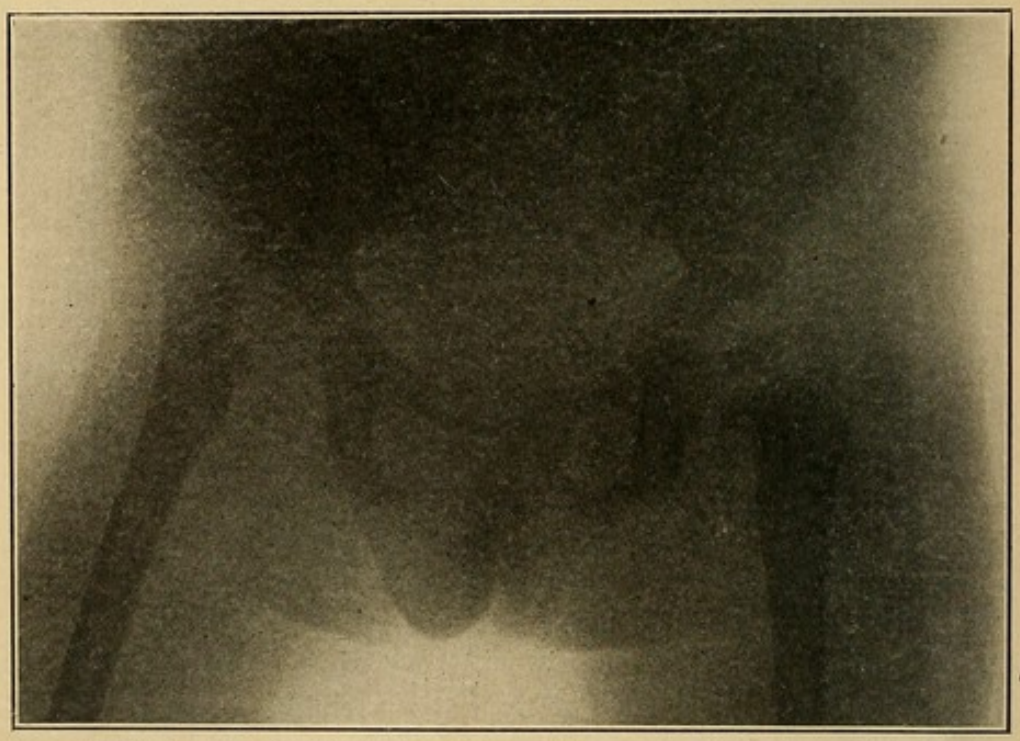
femur, and, in this way, of showing to a certain extent the possibilities of obtaining a successful result in treatment. It may also offer some suggestions as to the best method of treatment (Figs. 12 and 13).

FIG. 12



Congenital dislocation of left hip in a boy, aged seven years. Note lack of development of acetabulum and head, and formation of new socket.

FIG. 13



Congenital dislocation of left hip in a child, aged two years. Note lack of development of acetabulum.

The *x*-ray examination has now come to play an essential part in the treatment of these cases. It is the only accurate means of determining the measure of success in reduction and the relation of the head of the femur with the acetabulum after the application of the retentive dressings, especially as the latter are employed in connection with the after-treatment of the "bloodless" methods of reduction. The examinations can usually be made through the casts if the removal of the latter is not desirable.

Dislocations of the *tarsus* are not so frequent as are those of the wrist and carpus, but their detection by manual examination may be equally difficult, and the nature of the injury may not be readily or accurately determined without the assistance of the skiagraph. Subluxations in which a comparatively slight amount of displacement is permitted by the torn or stretched interosseous ligaments are of somewhat frequent occurrence, as is shown by the skiagraph, but their detection by other means is usually difficult or impossible.

Arthritis.—A discussion of the value of *x*-ray diagnosis in connection with the various forms of joint inflammation renders it necessary to follow some appropriate classification of the different types of arthritis, in the light of our more recent knowledge concerning certain distinguishing features to be observed in the radiographic appearance characteristic of each one. The classification here employed does not differ materially from the one which is now coming into use by many authorities, and is as follows:

1. Acute arthritis:
   - (*a*) Septic.
   - (*b*) Infectious, *acute suppurative* type.
   - (*c*) Acute articular rheumatism.
2. Chronic tuberculous arthritis.
3. Chronic non-tuberculous arthritis:
   - (*a*) Atrophic type.
   - (*b*) Hypertrophic type.
   - (*c*) Infectious type.
   - (*d*) Gouty arthritis.
4. Arthropathies.

1. *Acute Arthritis.* In either the septic, infectious, or rheumatic form the skiagram is of little or no diagnostic value in the early stage before the destructive process has advanced to any appreciable extent. The diagnosis by other means is, however, usually obvious. At a later stage, after erosion of the articular surfaces or more extensive destruction of bone has taken place, the skiagraph can be relied upon to indicate such changes, and also their extent and exact locality.

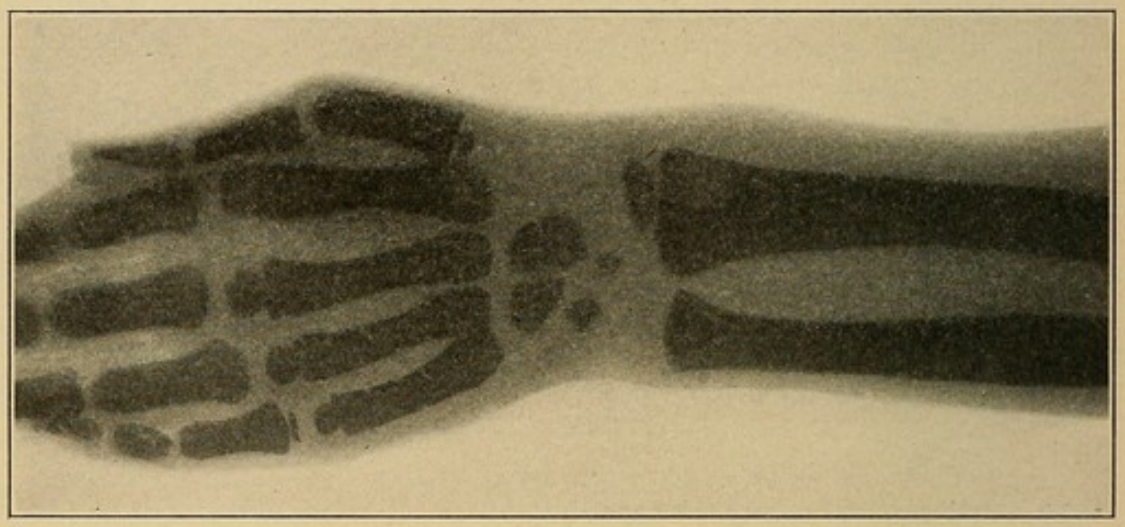
2. *Chronic Tuberculous Arthritis.* This being a slow and at the same time progressively destructive process makes it possible to detect the existence of the disease and to determine the locality of the focus at a relatively early stage.

All of the chronic forms of arthritis present more or less characteristic skiagraphic appearances, but the *x*-ray diagnosis is particularly important

in this form, because it is invariably reliable and will show the presence of the disease at an early period, often before the clinical diagnosis can be settled with certainty. A negative *x*-ray diagnosis should not be accepted as final in the incipient stages of the affection. As soon as the process has involved the bony structure to any appreciable extent, the resulting erosion of the articular surfaces in a case of primary arthritis is easily demonstrable. The primary focus of the disease lies often in an adjacent epiphysis or just beyond the epiphyseal line. The location of such a focus can be made with certainty only by the *x*-rays (Figs. 14 and 15).

In hip-joint disease the diagnosis can be made by means of the skiagraph at a comparatively early period. In advanced cases *x*-ray findings serve as useful guides in determining the form and extent of surgical intervention.

FIG. 14



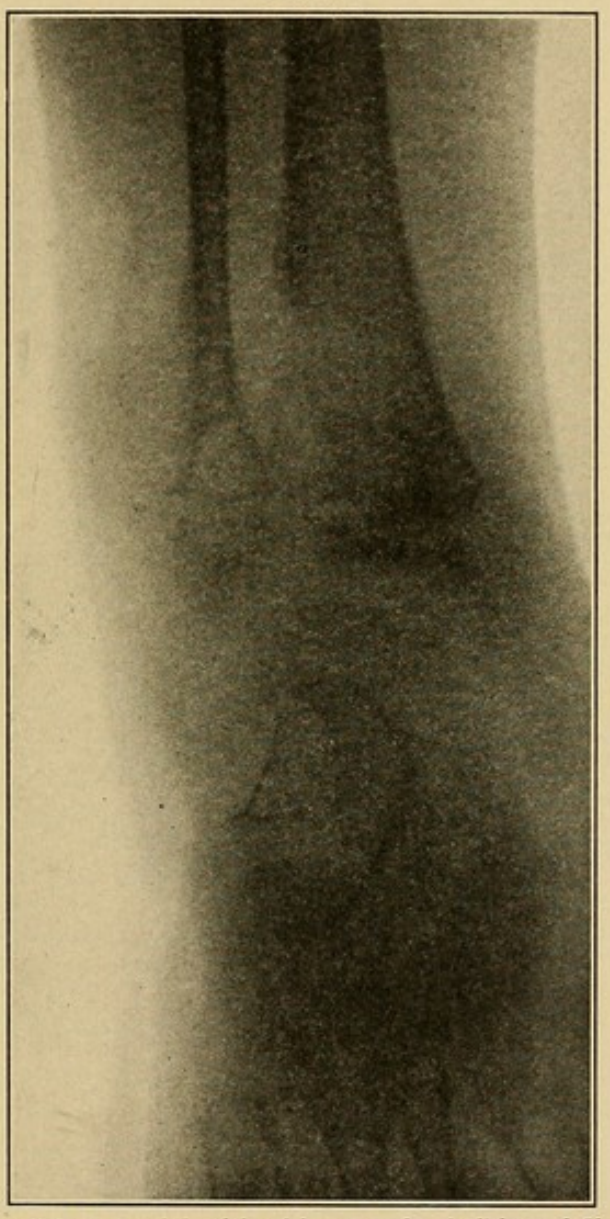
Tuberculous abscess of lower end of diaphysis of radius in a child, aged six years. Radiograph indicates exact location and extent of lesion.

3. *Chronic Non-tuberculous Arthritis.—Atrophic Type.*—This type is characterized by slow progress with subacute exacerbations, and, observed in ill-nourished adults of low vitality. It usually affects first the joints of the hands and wrists. The radiographic features of this type are: (*a*) Absorption and erosion of the articular cartilages, represented in the skiagraph by an abnormally close approximation of the articular surfaces of the bones; (*b*) erosion of the articular surfaces of the bones, readily demonstrable radiographically; and (*c*) rarefaction of the cancellous structure, which is in a measure a part of the atrophic process and partly an atrophy of disuse.

Hypertrophic Type.—This type is observed most frequently in later adult life, usually in active individuals who are apparently otherwise healthy and well nourished. The course of the disease is usually more gradual; exacerbations may be observed, but are usually slight or wanting. The joints of the hands and wrists are first affected, the term "Heberden's nodes" being applied to the swellings due to the hypertrophies, but the disease is manifest in the larger joints quite as frequently, particularly

the knees and hips. It is frequently monarticular clinically, especially in the case of the large joints, but skiagraphic evidence of the disease is very often found on the opposite and apparently healthy side. The radiographic features of this type are: (*a*) Absorption and erosion of the articular cartilages; (*b*) characteristic hypertrophy of the bones near the articular surfaces; and (*c*) more or less condensation of the cancellous

FIG. 15



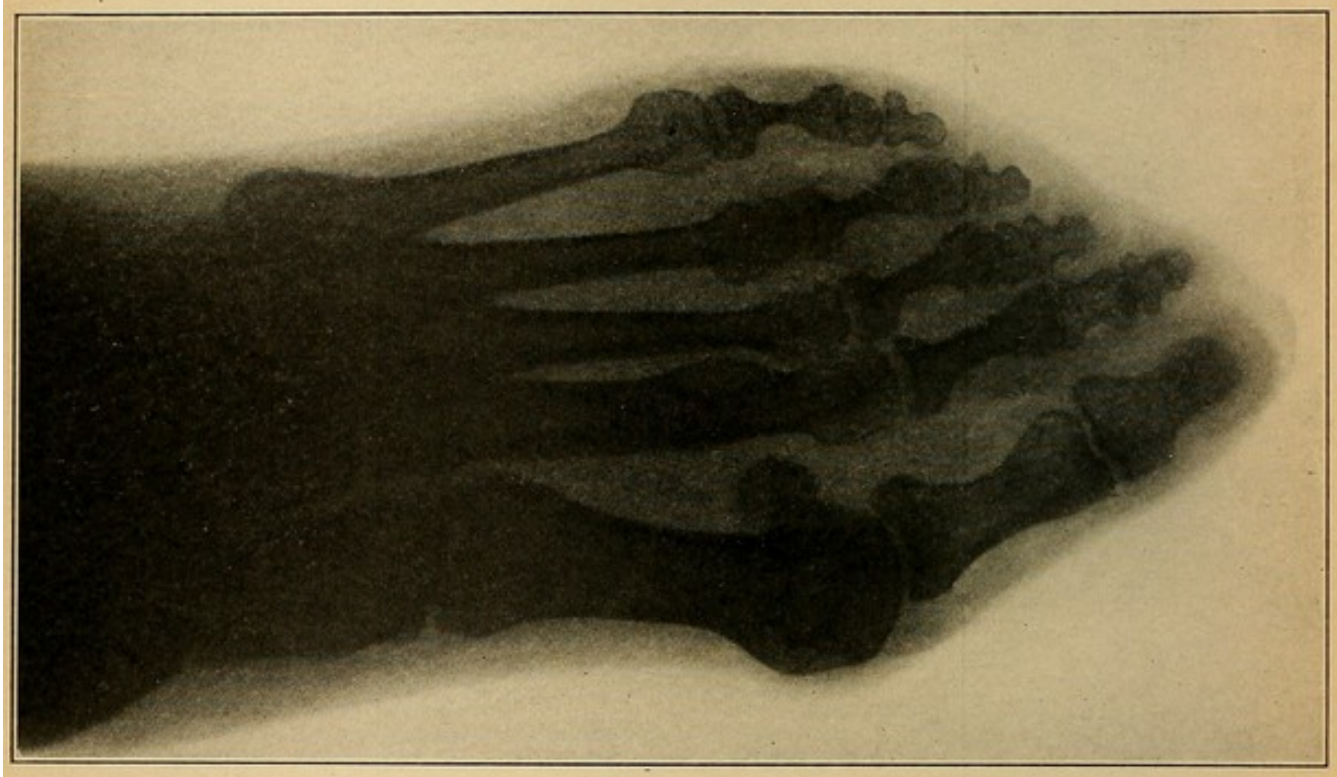
Tuberculous osteomyelitis and epiphysitis of lower ends of tibia and fibula of a child, aged four years. Radiograph indicates exact location and extent of process.

structure, although rarefaction is apt to predominate as a part of the coincident atrophy of disuse.

The typical picture is not always found in these cases, as the process of atrophy often accompanies that of hypertrophy. Evidences of absorption and erosion of *cartilage* are more apt to be observed than of hypertrophy, and erosion of the articular surfaces of the bones is often found associated with the excessive deposits outside.

Infectious Type.—Broadly speaking, this type includes all chronic non-tuberculous joint manifestations not conforming to either of the two preceding types, and not of gouty origin. From the etiological point of view, the term applies to all chronic joint manifestations associated as complications or sequelæ with gonorrhea, pneumonia, many of the acute infectious fevers, and such joint disturbances as are referable to various toxemias arising from altered metabolism and other sources. The joint condition into which acute articular rheumatism lapses often conforms to this type.

FIG. 16



Case of supposed metatarsalgia in adult female. Note exostosis on second metatarsal, causing pain by nerve pressure.

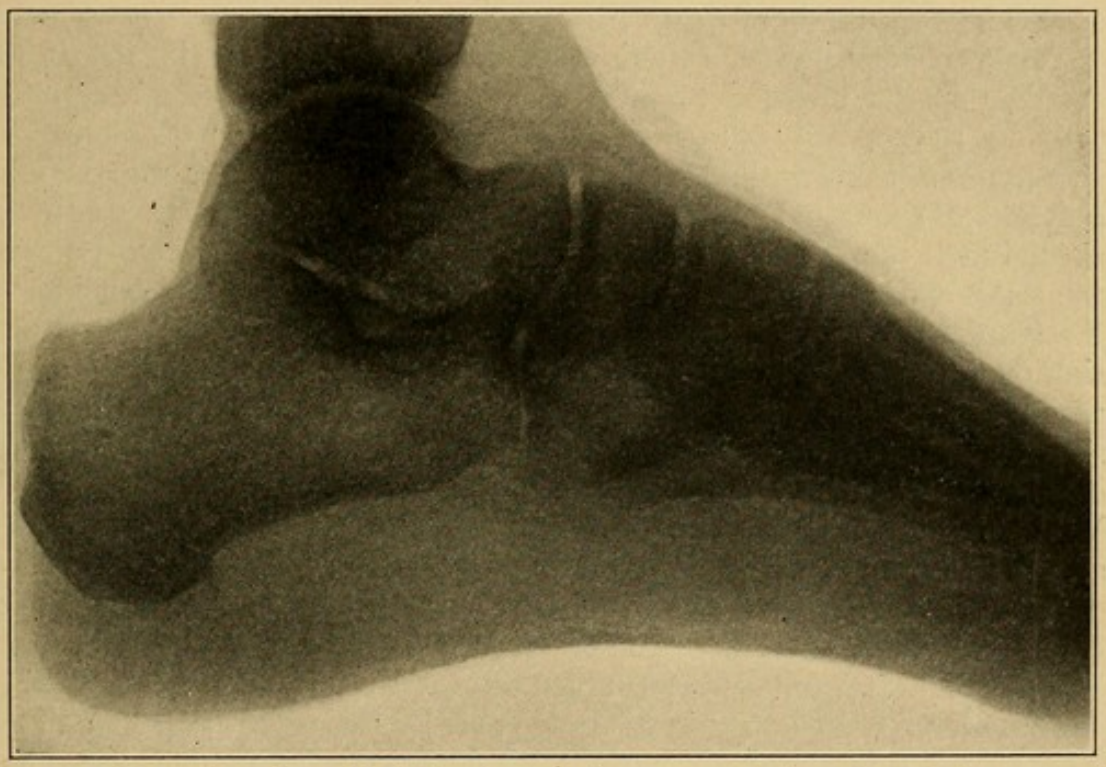
The process in some of these joint complications may be acute and go on rapidly to suppuration, but this is the exception. The great majority of these manifestations are essentially of a chronic nature, and the prominent clinical features are more or less pain, tenderness, and disability, associated with articular and periarticular swelling, and perhaps atrophy due to disuse.

The radiographic features of this type are: (*a*) The entire absence of hypertrophy of the ends of the bones and of atrophy of their articular surfaces; (*b*) often more or less absorption of the articular cartilages, shown in the skiagraph by the closer approximation of the bones, but not usually an erosion; (*c*) evidences very often of articular swelling due to effusion, and of periarticular swelling made evident by thickening of the capsule and other periarticular structures; and (*d*) a rarefaction of the cancellous structure, corresponding, in part at least, to a local atrophy of disuse.

It will be noted that the essential difference between this type and the two preceding ones is the absence of any distinct articular lesions.

Gouty Arthritis.—The characteristic joint manifestations of gout as revealed in the skiagraph make this form of arthritis a distinct type in itself. The special radiographic features are the early destruction of bone and the actual disappearance of the cancellous trabeculæ of the ends. The process may involve the shafts of the short long bones as well. The appearance often somewhat resembles that of central osteosarcoma. Evidence is also to be found, of course, of erosion of the articular surfaces. The tophi are to be included in the periarticular swellings, but they do not cast characteristic shadows.

FIG. 17



Spur on under surface of os calcis in female, aged sixty years. Radiograph made for suspected piece of needle, but shows spur to be the cause of pain.

4. *Arthropathies.*—These present skiagraphic findings in accordance with the nature and cause of the pathological process. There is nothing distinctive in the appearance of the joint manifestations of underlying nerve lesions.

Loose Bodies.—The presence of loose bodies in joints can be detected by means of the radiograph, provided their structure is of sufficient density to cast perceptible shadows.

The knee is the joint involved in the great majority of instances, and a detached or movable semilunar cartilage is the offending body in perhaps the majority of cases. The skiagraph is of value only in so far as it excludes other conditions.

The presence of small detached fragments of bone, calcified synovial

fringes with or without attachment by a pedicle, and sometimes even rice bodies, can be satisfactorily demonstrated.

Bunion.—The *x*-rays are at times useful in showing the presence of destructive inflammatory processes in the bones or the joint. They are also helpful in suggesting a form of surgical intervention when this is needful.

Orthopedic Conditions.—Orthopedic conditions, especially cervical rib, congenital dislocations of the hip, coxa vara, scoliosis, genu varum and valgum, and congenital malformations and deficiencies, present a wide field for *x*-ray diagnosis, and in many instances it is essential in determining the exact nature, seat, and extent of the condition.

INJURIES AND SURGICAL AFFECTIONS OF THE HEAD.

Foreign Bodies.—The examination for foreign bodies in the head requires special mention because of the serious disturbances they may provoke, the necessity of their removal in so many instances, the comparative frequency of gunshot injuries in this part of the body, and the importance of accurate localization by means of special apparatus requiring special methods. In the large majority of cases it is necessary to determine the exact location of bullets, whether lodged within or outside of the cranial cavity, first, in order to determine the advisability of extraction or whether the body is accessible or not; secondly, accurate localization simplifies the operation for removal by indicating the easiest and safest avenue of approach. Such special methods should always be employed if accuracy is desirable, as the crude method of localization by making two pictures in opposite directions is not sufficiently reliable, and in fact may be very misleading.

In the eye and orbit foreign bodies may be localized with unusual accuracy, and an examination is practically imperative in most instances. There are a few important sources of error to be avoided, but such examinations must be made with care and by competent persons. The detection of a foreign body in the orbit depends upon the density of the substance. Small fragments of superior qualities of glass, as from the lenses of spectacles, splinters of wood, and other less dense substances, may not cast shadows, and their presence, therefore, may not be detected. Hence, negative *x*-ray diagnosis in such instances is not always conclusive.

The Nose and Accessory Sinuses.—It is possible to secure excellent details of the accessory sinuses, especially by means of the stereoscopic method. Important data may be derived from the *x*-ray examination of the frontal sinuses—their size, shape, the extent of their development, the number of subdivisions or the septa dividing them, and whether they are symmetrical on both sides. In addition, the presence of pus and even any considerable degree of thickening of the lining mucous membrane can be determined with uniform accuracy. The radiograph is, therefore, a valuable means of diagnosis of disease of these cavities and is far superior to transillumination. The skiagraph is equally reliable and useful for the detection of disease and newgrowths of the antra.

Although it has always been possible to radiograph the frontal and ethmoidal sinuses and the antra laterally, it is only since anteroposterior and stereoscopic views have become practicable that we have been able to obtain uniformly reliable and useful data. The anterior ethmoid sinuses may be examined in the fore-and-aft direction, but the stereoscopic method shows them to much better advantage. The sphenoid and posterior ethmoid sinuses can be clearly shown stereoscopically, but they cannot be satisfactorily examined otherwise.

Disease (caries and necrosis) of the bony walls of all of these cavities can be detected with reasonable accuracy, as can also the presence and the extent of newgrowths.

Tumors.—Tumors involving the bones of the skull are mainly recognizable by the presence of either destruction or formation of bone. Osteomata may usually be detected by the application of proper methods of examination. Destructive tumors, such as sarcomata involving the cranial vault or base of the skull, may also be detected and studied under favorable conditions.

When tumors involve the lower jaw the skiagraphic evidence is positive and reliable.

In connection with brain tumors, recent advances, especially in the stereoscopic method, have made it possible to obtain valuable information in some instances, although the *x*-rays are not often dependable for diagnosis.

Dental Radiography.—Many of the abnormalities and pathological conditions in connection with the teeth and surrounding structures that were formerly exceedingly difficult or even impossible to determine with certainty are now clearly and accurately demonstrated by the skiagraph. Some of these conditions can be determined in no other way. Among them may be mentioned the presence of unerupted and impacted teeth, supernumerary unerupted teeth, absence of teeth not erupted, deformities and exostoses of roots causing symptoms or complicating extraction, abnormal relations of any of the upper set with the antra, presence of foreign bodies, such as broken pieces of instruments in the root canals or beyond the apices, fillings in the root canals, and calcification of the pulp or "pulp stones." The skiagraph is the only certain means of diagnosticating dentigerous cysts.

The *x*-ray examination is of considerable value in the diagnosis of diseases of the surrounding structures, such as alveolar abscess and necrosis and pericementitis, and is often useful in showing the relations of the roots in cases in which irregularities of the teeth exist and in which correction is indicated. It is also important in showing the relations of teeth to fractures, especially of the lower jaw.

Salivary Calculus.—The detection of calculi in the duct of the parotid gland is not difficult, but Wharton's duct is overshadowed by the lower jaw, and shadows of calculi in this duct are rather difficult to differentiate, although the *x*-ray diagnosis can be made.

INJURIES AND SURGICAL AFFECTIONS OF THE THORAX AND THORACIC VISCERA.

In the examination of the chest, the *x*-rays have a wider application in connection with the diagnosis of medical than of surgical conditions. This is largely because the number of injuries involving this part of the body is relatively small and the majority of disease conditions affecting the thoracic organs are distinctly medical in respect to their treatment.

The Ribs.—Fractures.—*X*-ray examinations are made less frequently for fractures of the ribs, perhaps, than for fractures of any other bones of the body except those of the skull. There is no particular reason why the skiagraph should not be more often employed in this connection, but the failure to use this method more extensively probably arises from the tendency to regard its practical diagnostic value as incommensurate with the difficulty, trouble, and expense involved in such examinations. In the majority of instances fractures occur in those portions of the ribs which are most inaccessible for the radiographer, namely, between the anterior and posterior axillary lines. Side views would frequently be necessary, but satisfactory lateral radiographs of the chest are usually difficult to obtain. Fractures frequently occur in the localities where the shadows of the ribs are more or less obscured by the liver and heart, and in stout subjects the examination of the ribs in these areas is by no means easy. When the diagnosis is practically certain clinically, an *x*-ray examination is not necessary, as a rule. When an *x*-ray examination is absolutely necessary, however, it can usually be successfully and satisfactorily made, even in the presence of the most serious obstacles. The first two or three and the last two ribs can be easily shown throughout their entire extent. It might be said that the *x*-ray examination is easiest in those localities in which the clinical examination is most difficult, and vice versa. The *x*-ray examination is especially valuable for the detection of incomplete and fissured fractures.

Vertical displacement is easily shown, but this is not the case when the fragments are driven in. Separations at the costochondral junctions cannot be demonstrated radiographically.

The interpretation of old united fractures should receive careful consideration, especially in medicolegal cases. Various prominences and irregularities in outline are to be found in many ribs, and are easily mistaken for old fractures surrounded by callus.

Osteoperiostitis.—The skiagraph is often of value in determining the presence of disease in the ribs, its exact location, and the extent to which the bone is involved. The same difficulties are to be encountered as in the examination for fractures. In caries, neither the presence of the condition nor the extent of bony destruction is likely to be shown unless the process has reached a comparatively advanced stage. A gummatous osteitis can usually be observed at a comparatively early stage unless the locality is inaccessible to the *x*-ray examination. When sinuses exist, they should be injected with bismuth or iodoform before the examination is made.

Tumors.—Tumors associated with appreciable loss of bony substance may usually be demonstrated if the region is accessible, and the examination in such instances may be of considerable value. Exostoses are easily shown. Sometimes a small exostosis, by pressure upon an intercostal nerve, may be the cause of intercostal neuralgia, and under such circumstances an *x*-ray examination might be the only way in which the cause of the trouble could be discovered.

Deformities.—Deformities of the ribs may also produce symptoms of nerve pressure, and the skiagraph is the most satisfactory means of revealing the cause. The particular deformities to be noted are those resulting from fractures, either in the form of permanent displacement or excessive callus; close approximation of the bones such as is seen in marked scoliosis; or those due to rickets.

The Sternum.—The sternum is one of the most difficult bones of the body to radiograph, and, until recently, very few satisfactory pictures of it have been made. The manubrium is the easiest portion to examine, but considerable ingenuity is required to obtain skiagraphs of even this small portion. The *x*-ray examination for *fractures* or dislocations at the junction of the manubrium and gladiolus is unsatisfactory, but fortunately the diagnosis is easily determined clinically.

Disease and *tumors* are likewise difficult to demonstrate for the same reasons, and an *x*-ray examination is of practically no value unless the extreme upper portion of the bone is involved.

The Dorsal Vertebræ.—As a rule, this is the most difficult portion of the spine to radiograph satisfactorily, mainly because clear details of the vertebræ are obscured by the superimposed shadows of the great vessels, heart, liver, and sternum. In thin subjects, clear details are easily obtained, but the stouter the individual the more unsatisfactory the skiagraph.

Fractures.—Fractures of the dorsal vertebræ can, of course, be easily demonstrated under favorable circumstances. The difficulties attending the *x*-ray examination of this portion of the spine in a case of recent fracture are to be added to those just mentioned. Lateral views when they are obtainable show the bodies to the best advantage, especially in dislocations, but the upper dorsal vertebræ can seldom be skiagraphed in this direction, and it is useless to attempt a lateral radiograph in stout subjects.

Caries.—Caries of the bodies of the dorsal vertebræ is difficult or impossible to demonstrate unless the destruction has advanced far enough for the disease to be clinically evident beyond question. Occasionally, in very thin subjects, Pott's disease has been recognized at a very early stage by the skiagraph. In young children the examination is always unsatisfactory because of the incomplete ossification of the vertebral bodies.

Tumors.—The *x*-ray examination for tumors of this portion of the spine is of little practical value. In rare instances, however, the skiagraph may give some valuable information.

To credit the radiograph with any practical diagnostic value in connection with tumors of the spinal cord is, of course, absurd.

Scoliosis.—Scoliosis is easily demonstrated, and the extent of the deformity, the degree of rotation of the vertebral bodies, and many of the secondary deformities, such as those of the ribs, can be readily shown. Details are not so essential in this condition, but, as a rule, they are unusually clear because the curve of the spine carries the vertebræ away from some of the structures which normally obscure them.

Arthritis.—Arthritic conditions involving the spine, such as the type associated with chronic osteo-arthritis, for example, cannot be demonstrated unless there is some marked structural change. Bony and cartilaginous absorption are to be noted in advanced stages of the atrophic types, and excessive bony deposits in the hypertrophic type.

Foreign Bodies.—The examination for foreign bodies in the thorax, other than those associated with gunshot injuries, requires special mention because of the localities in which they lodge and the avenues of their introduction, both of which are peculiar to this portion of the body.

Esophagus.—The majority of the cases examined for suspected bodies lodged in the esophagus are young children. Many of the articles which are swallowed and which are too large to pass through are first halted at the uppermost constriction where the pharynx and esophagus join. Here they may be easily palpable through the mouth, and, if so, can be removed without the assistance of localization by the radiograph. The level at which the radiographer usually finds bodies lodged is about that of the suprasternal notch. This point is slightly below the first constriction and slightly above the next lower one, where the left bronchus crosses the esophagus. The point of lodgement, however, depends somewhat upon the nature and size of the object swallowed. Straight pins and *small* open safety pins passing point downward may lodge anywhere, although the former invariably pass, and even the latter usually do. Long straight pins are much more apt to lodge than short ones if they pass point downward. Large open safety pins will usually lodge high up in children if they pass the first constriction.

In children, the majority of the objects found lodged at the point just mentioned are coins—more often pennies, but sometimes nickels. Dimes will usually pass, and larger coins will not enter the esophagus of children, although a half-dollar has been found lodged at this level in the esophagus of an adult. Other articles commonly swallowed by children, and likely to lodge, are buttons, jackstones, and rounded flat metal whistles. In rare instances, tooth plates have been swallowed by adults and have lodged in the esophagus.

An *x*-ray examination is practically imperative in all cases in which the lodgement of a foreign body in the esophagus is suspected. Primarily it is necessary in order to determine with absolute certainty whether a body has lodged or not. In addition, it will show the nature of the object and its exact location, so that the surgeon is at once able to decide upon the most appropriate method for extraction.

The examination for less dense objects, such as pieces of chicken bone or nut shells, is usually somewhat different from that in case of the much

denser ones, and is far more difficult. The radiographer should, therefore, have some previous knowledge of the nature of the object for which he is to examine. Fish bones are extremely difficult and usually impossible to demonstrate in the skiagraph, but they usually pass, and the sensation referable to their lodgement is generally due to the trauma produced by their passage.

The Air Passages.—Many objects which may gain entrance into and become lodged in either the larynx, trachea, or bronchi cannot be detected by means of the *x*-rays, because of their lack of sufficient density to cast shadows. Some objects, of comparatively slight density, if lodged in the larynx or upper portion of the trachea, may be more or less plainly shown in a lateral view of the neck when a radiograph made in the anteroposterior direction would give no indication of their presence.

Gunshot Injuries.—Primarily the essential object of the examination is to determine the presence of the missile; this the skiagraph does invariably. It will also show the exact location of the missile and thereby aid in determining its accessibility for removal. Methods of accurate localization by means of special instruments of precision may be employed advantageously in some instances, but, as a rule, fore-and-aft and lateral views will suffice.

Aneurysms.—Radiographs have frequently shown aneurysms when their presence could not be detected clinically, but in many such instances the pictures have been misinterpreted and the *x*-ray diagnosis has been incorrect. Moreover, the skiagraph has not infrequently failed to reveal the presence of an aneurysm that undoubtedly existed. But ordinarily the *x*-ray diagnosis is not especially difficult in the hands of a careful examiner with a reasonable amount of experience, although there are instances in which it is extremely difficult.

There is, perhaps, no other condition better adapted to examination by the fluoroscope. It is a most convenient method for both diagnosis and study of thoracic aneurysms, and reveals some features that cannot be shown readily by the skiagraph. Its superiority over the latter for diagnosis alone, however, is questionable, and any special advantages it may possess certainly do not justify the risks entailed in its routine use, since there is no way of employing the fluoroscope with absolute safety. Improvements in apparatus have made it possible to radiograph the chest of the average individual in a fraction of a second, and satisfactory stereoscopic radiographic examinations of the thorax are within the range of possibility. When this state of perfection has been realized, the accuracy of the *x*-ray diagnosis of aneurysms will be markedly increased, and the fluoroscope will practically cease to hold any special advantage beyond the observation of pulsation.

Aneurysms of the aortic arch are peculiarly adapted to examination by means of the *x*-rays because of the transparent structure of the surrounding lung tissue. The heart and aortic arch are readily observed unless other abnormal shadows obscure them. The outlines of the normal aorta are nearly or entirely overshadowed by the spine and sternum, but this is unimportant for the reason that any enlargement or

displacement of the vessel is always perceptible unless obscured by abnormal structures.

As to the interpretation of a radiograph taken for aneurysm, if there is no marked enlargement of the aortic shadow, aneurysm may be excluded. If, however, it is apparently abnormally enlarged, the next question to decide is as to whether this shadow arises from the aorta or is due to some other condition that may be present. This is often a difficult point to determine with certainty. If the abnormal shadow can be positively identified as that of the aorta, it is often necessary to determine next whether the condition is an aneurysm or a dilated aorta. This too is sometimes a difficult problem, and, as a rule, the correct solution requires judgment and experience.

Radiographically, aneurysms of this locality may be classed primarily as diffuse and those which are more or less localized, or sacculated.

Diffuse aneurysms involve the entire arch, or a greater part of it. When small, they may be mistaken for a condition known as *dilated aorta*.

Localized, or sacculated, aneurysms can be easily detected, as a rule, in any of the three portions of the arch. A small one involving the transverse portion and extending directly upward may escape detection, especially in stout subjects, because it is more or less obscured by the shadow of the spine. A dilated or hypertrophied left heart may be confusing in connection with a suspected aneurysm of the descending portion of the arch.

Aneurysms involving the descending portion of the thoracic aorta, or the part of the vessel below the arch, are much more difficult to demonstrate because of the overlying cardiac shadow. They are comparatively uncommon, however. They usually involve that portion of the vessel just above the point where it passes through the diaphragm.

Differential Diagnosis.—Radiographically, aneurysmal shadows are to be differentiated from those of the following conditions.

1. *Mediastinal Tumors.*—This diagnosis is not difficult, provided the shadow of the aorta can be determined in case of tumor or the enlarged shadow can be positively identified as that of the vessel in case of aneurysm. If the identity is questionable in case of a single large shadow of considerable density and of uniform outline, the diagnosis is difficult.

2. *Enlarged Mediastinal and Bronchial Lymph Glands.*—An experienced examiner is not apt to confuse the shadows of such structures with the appearance of aneurysm if the skiagraphic details are satisfactorily clear.

3. *Localized Empyema or Thickened Pleura.*—The skiagraphic appearance may occasionally bear some resemblance to that of aneurysm. Under such circumstances the clinical history of the case is essential in making a correct diagnosis.

Localized Thickened Pleura.—The same remarks are applicable in connection with this condition.

5. *Tortuosity or Displacement.*—Familiarity with the normal variations in placement, size, and contour are essential to the correct interpretation of abnormal appearances.

6. *Dilated Aorta.*—Under certain circumstances the distinction from aneurysm may be impossible because of the presence of other diffuse shadows having a density equal to or greater than that of the vessel.

Liquid effusions of any kind filling one or both pleural cavities or the pericardium render the radiographic diagnosis of aneurysm difficult or impossible. Our knowledge concerning the diagnostic value of the *x*-rays in regard to aortic aneurysm may be summarized as follows:

The appearance of normal shadows in the region of the thoracic aorta in a skiagraph in which the details are satisfactorily clear is the most reliable evidence against aneurysm. Its presence or absence can be demonstrated with accuracy in the large majority of instances. Most errors arise from inexperience, poor negatives, faulty technique, or failure of the clinician to coöperate with the radiographer in the interpretation of the skiagraph, especially in doubtful cases. An *x*-ray diagnosis may be impossible in rare instances. A skiagraphic diagnosis can often be made at a very early stage of the disease and sometimes even earlier than any definite clinical signs can be detected. When aneurysm is suspected, but the clinical diagnosis is uncertain, the *x*-ray examination is, in the majority of instances, the most valuable and accurate means for determining its presence or absence. Even when the clinical evidence seems apparently unquestionable, the skiagraph not only gives confirmatory evidence, but it will, in addition, accurately demonstrate the size and position of the aneurysm, and is always a safeguard against a possible error.

Innominate and subclavian aneurysms are as well adapted to *x*-ray examination as are those of the aorta, although their detection is usually more difficult. For this reason, and because of their comparative infrequency, they are likely to be overlooked when their presence is unsuspected. A skiagraphic examination before an operation upon an aneurysm of one of these vessels is of importance for determining its size, character, and extent, and the possibility of associated involvement of the aorta by an aneurysmal dilatation independent of or continuous with that of the smaller vessel.

The Lungs and Pleura.—The surgical affections of these structures, in which the *x*-ray examination is applicable for purposes of diagnosis, are abscess and gangrene of the lungs and pleural effusions and empyema.

Exposure of the chest to *x*-rays during the *acute stage of pneumonia* is not advisable unless it seems absolutely necessary from the point of view of immediate surgical intervention.

Abscess of the Lung.—The distinction between abscess and localized empyema is one that is often required, and one that is sometimes difficult to make clinically. The radiograph is a reliable means of differentiating between these two conditions.

With reasonable care and experience the skiagraphic appearances of abscess and *cavity* should not be confused. A knowledge of the clinical history of the case is always necessary as a safeguard against errors in the interpretation of the pictures.

Gangrene.—If this condition is suggested clinically the skiagraph may be a valuable aid in the diagnosis. It is unquestionably of value in the

localization of the affected area. Here especially a knowledge of the clinical data is essential.

Pleural Effusions and Empyema.—The presence of fluid in the pleural cavity, whether serum, blood, or pus, can be accurately and easily demonstrated by the skiagraph. The *x*-ray diagnosis is especially valuable in connection with localized effusions and empyemas. The skiagraph is likely to be inadequate or misleading unless careful attention is paid to certain important points, such as the position of the patient, the position of the plate and tube, etc. The skiagraphic appearance of an area of greatly thickened pleura may closely resemble that of a localized effusion or empyema, and vice versa, and this fact, therefore, should not be overlooked.

Subphrenic Abscess.—This condition may be appropriately mentioned here because of the question of differential diagnosis from certain intrathoracic conditions, especially empyema. Under certain circumstances, and with the exercise of care and ingenuity, a subphrenic abscess may be diagnosticated by means of the *x*-ray examination.

SURGICAL AFFECTIONS OF THE ABDOMEN AND PELVIS.

Considering the number and the variety of pathological conditions associated with the abdominal organs, the field for *x*-ray diagnosis is a comparatively limited one. Perhaps this method of examination is most helpful in the diagnosis of certain conditions of the urinary and the gastro-intestinal tract.

Urinary Tract.—Renal Calculus.—The radiographic examination is the most valuable and the most uniformly accurate method at our command. It must not, however, be regarded as infallible.

No skiagraphic examination for renal calculus can be entirely satisfactory unless the patient has received an adequate preliminary preparation. This implies that the stomach should contain little or no food, that the intestinal tract should be nearly empty, particularly in regard to *gas*, and that no pills or tablets should have been taken after a time which would allow any chance of one remaining in the intestinal tract when the examination is made. Salol in particular casts a distinct shadow.

Given a well-prepared patient, an efficient apparatus, and a skilful operator and interpreter, the most but not all of the sources of failure or error are eliminated.

The presence of excessive amounts of fat in the abdominal walls and omentum, thick abdominal muscles, tumors, a pregnant uterus, or ascites may obscure the shadow of a stone.

A skiagraph of the kidney area, to be considered reliable for diagnosis, should show the shadows of the psoas muscles at least, and, to be still more certain of accuracy, it should have sufficient detail to show the shadows of the kidneys in addition. An absolute diagnosis, whether it be positive or negative, should not be made from a single skiagraph or even one examination.

Shadows similar to those of calculi may be cast by calcified lymph glands, circumscribed collections of pus in the kidney, small enteroliths, and fecal or other concretions in the lumen of the appendix. The possibility of error from such sources is influenced to some extent by the skill and experience of the examiner, though it cannot be altogether eliminated.

In the skiagraphs of pelves of many normal individuals will be found shadows which have an appearance practically identical with that of ureteral calculi. The position of such shadows often distinguishes them from those of calculi. This is not always the case, and in some instances the only way of proving the exact identity of the shadows is to radiograph the patient with a catheter and stilette in the ureter, or to make a stereoscopic examination, but the former method is preferable.

Most of the extraureteral shadows are due to the presence of phleboliths in the pelvic veins or to small sesamoids in the tendons attached to the ischiatic spine. A less frequent source of error is the presence of calcified pelvic lymph glands. Should one of these be located about the line of the ureter, it is practically impossible to distinguish it radiographically from a ureteral calculus except by skiagraphing after catheterization. A calculus lodged in the portion of the ureter overlying the bony pelvis, an infrequent position, may be obscured by the shadow of the bone.

Nephroptosis.—The displaced kidney is more readily shown than the normally placed organ. The preliminary preparation is that indicated in the examination for calculus.

Tumors.—Under favorable conditions the skiagraph will in many instances render valuable assistance in the diagnosis of renal tumors, especially in regard to the identification of those in which the renal origin is uncertain.

Pyonephrosis.—In many instances the skiagraph will aid materially in the diagnosis of circumscribed abscess in the kidney substance. The shadow of such a lesion has sometimes been mistaken for stone.

Hydronephrosis.—The shadow of the enlarged kidney and sometimes a faint shadow of a dilated pelvis are the skiagraphic data obtainable in this condition under favorable circumstances.

Perinephric Abscess.—The skiagraph is only of negative value in diagnosis.

Vesical Calculus.—The *x*-ray diagnosis of vesical calculus is more difficult and more uncertain than that of renal calculus. This is mainly because of the position and anatomical relations of the bladder and the stone and the consistency of the majority of vesical calculi. Conservatively speaking, we may regard the skiagraphic examination as a very valuable and fairly accurate means of diagnosis in vesical calculus, but having a higher percentage of error than in connection with renal calculus. The preliminary preparation is that called for in renal examinations.

Prostatic Calculi.—The presence of calculi may be readily detected, but distinction from vesical calculi is more difficult.

Foreign Bodies.—The presence of foreign bodies in the bladder, introduced accidentally or partially by intent, is easily determined by the skiagraph.

Liver and Gall Bladder.—In thin or moderately thin subjects the general outline of the liver is easily obtained in the skiagraph. The radiograph is especially accurate in demonstrating the position of the organ, especially its lower right border. This is important in connection with the examination of cases of gastroptosis. The size of the liver can be estimated from the skiagraph, though the shadow is often misleading.

In thin subjects abscesses and cysts of the liver may sometimes be detected. Sinuses may be outlined by previous bismuth injections.

Biliary Calculus.—As yet, the *x*-ray examination in connection with biliary calculus has proved so unsatisfactory and so unreliable as to render it of no practical value in the diagnosis of this condition. In comparatively rare instances and under especially favorable conditions a positive diagnosis has been made, and confirmed later, but a negative *x*-ray diagnosis has so far been absolutely valueless. Notwithstanding the unsatisfactory results in the past, it is more than likely that the rapid strides now being made in the improvement of apparatus and methods will tend to make the *x*-ray diagnosis of gallstones sufficiently reliable in the near future to be dependable, but only under certain *favorable conditions*. It will be necessary, however, to limit the use of the skiagraphic examination strictly to those cases in which the latter term is applicable. "Favorable conditions" would imply comparatively thin subjects; the location of stones in the bile ducts, especially the common duct, and, if in the gall-bladder, the absence of distention with bile; and the absence of conditions which would tend to interfere with the important details essential to the success of such an examination. Careful and thorough preliminary preparation of the patient is of course imperative. The size of the stones would influence the likelihood of their detection, and the presence of lime salts would render it more certain.

The Pancreas.—The attempt to employ the skiagraph in connection with the examination of the pancreas has with very rare exceptions met with no success. The *x*-ray examination is, therefore, of no practical value in the diagnosis of pancreatic affections except possibly calculus.

The Spleen.—The spleen is easily skiagraphed, provided the patient is not too stout, but there is seldom any practical use for the *x*-ray examination of this organ beyond the determination of its position.

Abdominal Aneurysms.—Aneurysms of the abdominal aorta are difficult to demonstrate satisfactorily by means of the skiagraph except in thin subjects. It is possible that in some of the cases in which this portion of the vessel is the supposed seat of the lesion the aneurysm is really in the lower extremity of the descending thoracic aorta.

Foreign Bodies.—Foreign bodies in the abdomen and pelvis can usually be localized within reasonably accurate limits. Absolute localization is difficult because the movements of the abdominal walls and the constant variations in the dimensions of the abdomen are serious obstacles to the use of special localization apparatus.

Tumors.—Intra-abdominal tumors in the early stage of their growth cannot be detected by radiographic examination; later the shadows may show the extent and location of tumors and demonstrate the structures from which they spring or with which they are connected.

The Lumbar Spine.—This portion of the spine is easily and satisfactorily radiographed unless the subject is very stout. Often such comparatively slight injuries as fractures of the transverse processes can be recognized in no other way. Marked changes can be seen in cases of advanced spinal caries, but rarely any in the beginning. Sinuses may be followed after preliminary injection with bismuth or iodoform suspension. The changes of lateral curvature, typhoid spine, and spondylitis deformans are clearly shown. The radiographic examination of spina bifida is unsatisfactory in its results and is of little or no practical value.

THE GASTRO-INTESTINAL TRACT.

In the application of the *x*-rays in the diagnosis of abdominal and pelvic conditions, the examination of the stomach and large bowel may now be regarded as next in importance to that for renal calculus. These hollow viscera are rendered distinguishable only by the shadows of some opaque substance within them, usually the subnitrate of bismuth—introduced by mouth in the examination of the esophagus and stomach, and either by mouth or rectum in the case of the large intestine. All radiographs must be anatomically accurate, and must be so interpreted as to convey the correct impression of the existing conditions and relations which they are intended to represent.

Esophagus.—In the examination of this portion of the tract, accurate data can be obtained in regard to the presence, location, and extent of strictures, dilatations, and congenital and acquired diverticula. In some instances in which comparatively extensive growths are the causes of stenoses the skiagraph is capable of furnishing many important and reliable facts concerning the condition.

Stomach.—Perhaps the widest application of this method is in the examination of the stomach. The important data directly or indirectly obtainable are: (1) The exact outlines, position, and size of the stomach under varying conditions; (2) a definite knowledge of the factors directly or indirectly concerned in the production of ptosis and dilatation, such as the position of the pylorus, the actual existence or the likelihood of a duodenal kink, the length of the gastrohepatic ligament, the degree of tonicity or relaxation of the muscular coat, the existence of ptosis of the liver, the possibility of traction by a ptosed colon, and in some instances the presence of causes of pyloric obstruction other than kinks; (3) an approximate knowledge concerning the motility of the organ; (4) valuable suggestions in regard to the most appropriate method of treatment of the gastroptosis and dilatation; (5) definite knowledge of the actual mechanical and anatomical results derived from any methods of treatment employed.

The presence of "hour-glass" constrictions is readily determined.

The skiagraph is capable not only of demonstrating the above-mentioned facts with dependable accuracy, but also with more certainty and uniformity, as a rule, than any other methods at our command, and in many instances the information derived from the *x*-ray examination is practically unobtainable by any other means.

Until recently the *x*-rays promised little in the early diagnosis of carcinoma, but quite recent advances in stomach examination have made it possible to obtain fairly reliable data that will frequently verify or strengthen an uncertain clinical diagnosis at an early stage of the disease.

Small Intestine.—The examination of this portion of the tract has so far been unsatisfactory. Its successful application has been practically limited to the detection and location of various forms of obstruction, in which relation the skiagraphic information has occasionally proved most useful.

Colon.—Next in importance to the examination of the stomach by this method is the examination of the colon. It is undoubtedly the most reliable and accurate means we have of determining displacements of this portion of the gut. The presence and the location of obstructions are readily shown. In connection with obstruction due to newgrowths, it is often possible to determine whether the latter involves the walls of the colon or encroaches upon the lumen by pressure from without. In some instances the presence of adhesions between loops of displaced large bowel may be suggested. In cases of fecal fistula, it is possible, after injection of bismuth through the external opening, to determine by the skiagraph the portion of the bowel into which the fistula opens.

Sigmoid.—This portion of the bowel is also easily examined by this method. Its important application is in the diagnosis of ptosis, redundancy, and obstructions.

INJURIES AND SURGICAL AFFECTIONS OF THE SOFT PARTS.

The field of application for the *x*-ray examination in connection with injuries and other surgical affections of the soft parts is comparatively limited. The few instances in which it is applicable will be given brief mention.

Arteriosclerosis.—The presence of advanced sclerosis in any of the main vessels of the extremities and of their larger branches is easily determined by means of the skiagraph. Although its employment for this purpose is seldom necessary, it may occasionally be of some practical value.

Traumatic Aneurysms.—The skiagraph is sometimes useful in connection with this condition, especially in popliteal aneurysms.

Bursitis.—In certain localities the skiagraph serves a very useful purpose in the diagnosis of this condition, especially in connection with the deltoid bursa.

Myositis.—The skiagraph is especially useful as a means of differential diagnosis in this condition. Myositis ossificans is the particular type

in which it is directly applicable for the examination of the condition itself.

Rupture of Muscles.—The skiagraph is sometimes useful in the diagnosis of this injury.

Painful Stumps.—The *x*-ray examination of painful stumps is often the only satisfactory means of determining the cause of this sequel of amputations.

CHAPTER III.

INFLAMMATION.

Inflammation, the tissue reaction against injury, has for its end the removal of necrotic material, the neutralization of toxins, and the restoration of structural continuity.

Following trauma without infection, the local symptoms are slight and transitory, nor are there constitutional symptoms other than those incident to the shock of injury and the fever of reaction and absorption. By the third day these symptoms should have disappeared or be obviously subsiding.

Following infection, the local and constitutional symptoms become progressively more marked, and are well pronounced by the third to the fifth day, thereafter running a course dependent on freedom of drainage, virulence of infection, and tissue resistance.

The local symptoms of inflammation are heat, redness, swelling, pain, tenderness, and alteration of function.

Heat and redness can be detected only in inflammations of the surface or those lying near it. Swelling can be noted in parts which are normally palpable through the parietes. The surface edema of deep infection is a valuable localizing sign. Tenderness and pain, usually associated with protective muscular rigidity, are often the symptoms which indicate the seat of a deep-seated inflammation.

The constitutional symptom of inflammation is fever, usually accompanied by leukocytosis of the polymorphonuclear type.

High fever, rapid pulse, and a pronounced leukocytosis are indicative of an organism stimulated to powerful reaction against an active infection. Moderate fever, slight leukocytosis, and running pulse suggest an organism overwhelmed by the infection.

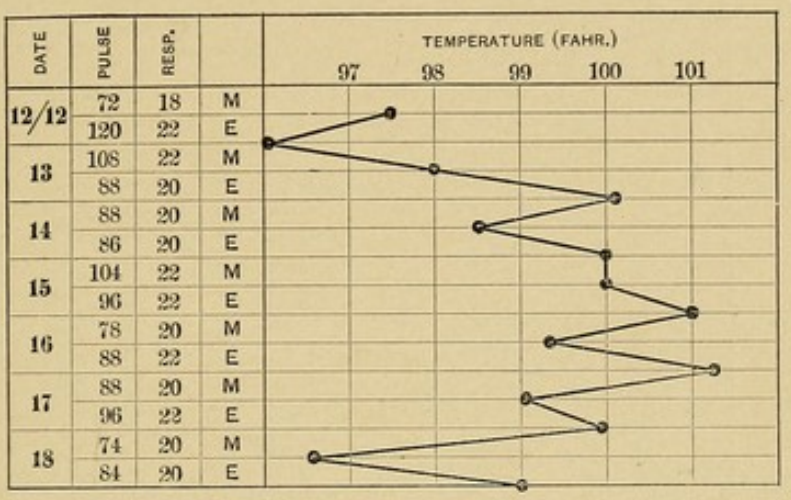
In accordance with the infecting agent, its virulence and the tissue resistance inflammation may be circumscribed or diffuse, acute or chronic. The same form of bacterial infection may cause a slight and transitory inflammation, suppuration, or gangrene. Acute suppuration is usually due to the ordinary pyogenic organisms. The formation of cold abscesses is particularly characteristic of the tuberculous and the post-typhoidal infections. It may, however, follow an attenuated or highly resisted infection by the ordinary pyogenic microörganisms.

Fever.—Fever associated with increase in pulse and respiratory rate, headache, loss of appetite, lessened peristalsis, deficient secretion and excretion, and general muscular pain, occurs at least in a slight degree after all severe traumata. It is an almost invariable symptom of the acute infections, unless they be of overwhelming and shocking intensity. It

is usual in chronic infections, and is frequently observed in rapidly growing neoplasms.

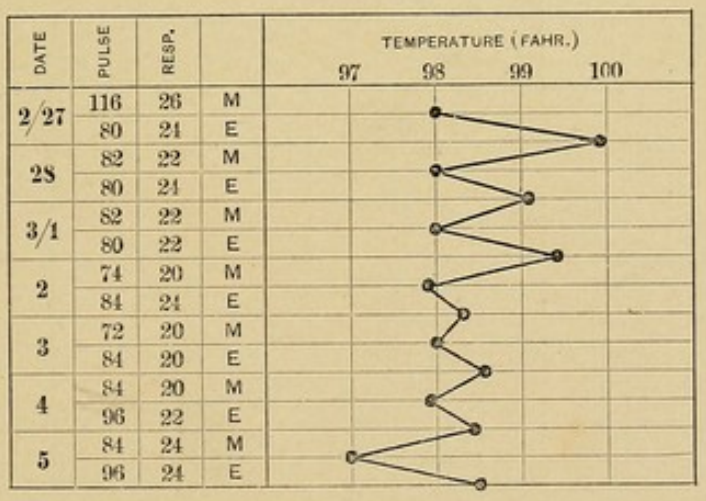
Traumatic Aseptic Fever.—In its lightest form it is observed after fractures or clean wounds. The temperature rises in the first twenty-four hours to between 99° and 101°. Neither the pulse nor the temperature is materially affected, nor are other symptoms of malaise pro-

FIG. 18



Carcinoma of stomach. Partial gastrectomy and gastro-enterostomy. The chart shows the effect of shock following the operation, the temperature dropping to 96° and the pulse rising to 120°.

FIG. 19



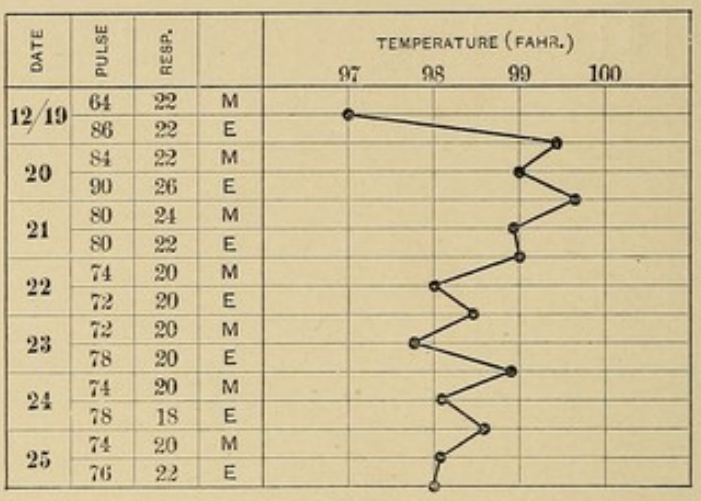
Appendectomy. Typical traumatic reactionary fever.

nounced. Within the next forty-eight hours the fever drops to about normal unless there be a large thrombus, in which case it may remain of the same grade for three or four days. There may be slight leukocytosis, and albumin and a few red cells may be found in the urine. When a wound, either operative or otherwise, has been attended by profound shock the temperature rise is correspondingly greater.

This form of fever, due to the absorption of devitalized tissues and

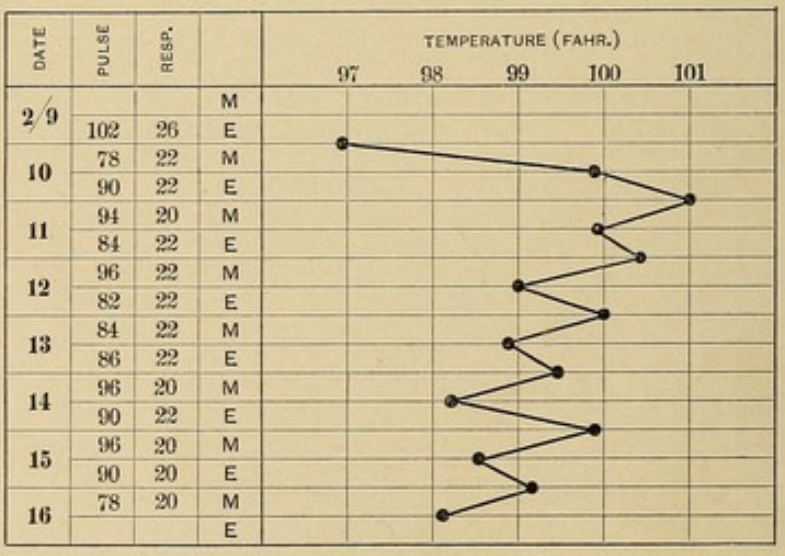
effused blood, at times partially to reaction from the shock, is characterized by its transitory nature, its tendency toward subsidence rather than increment after the first onset, and the absence of associated toxic symptoms. At the seat of traumatism there is swelling, with heat, tenderness, and redness, reaching its moderate maximum about the third day and thereafter rapidly subsiding.

FIG. 20



Cholelithiasis. Typical moderate traumatic reaction.

FIG. 21

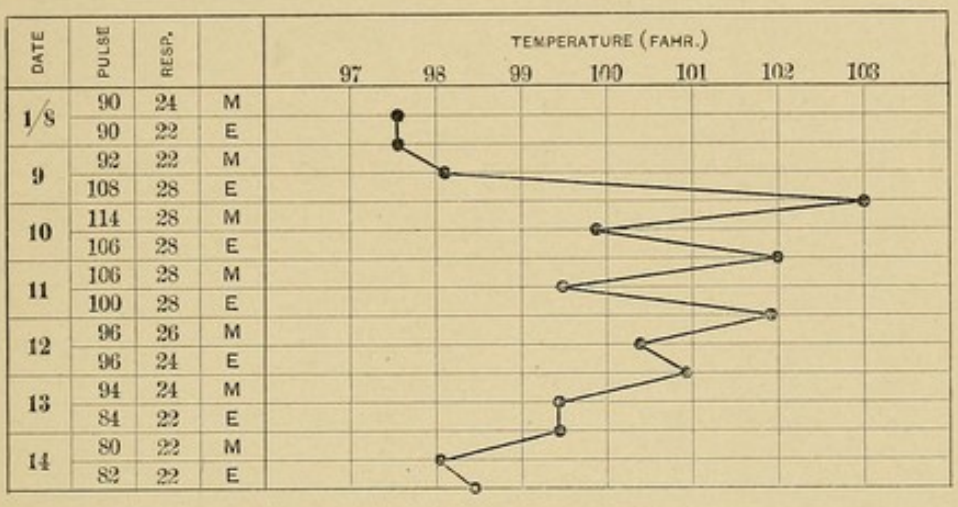


Incarcerated femoral hernia. Fever continued several days without any visible evidence of infection. There was, however, after the first day a gradual fall. There was no pulse hurry.

Septicemia.—Following an infected wound, there may develop within the first twenty-four hours the fever characteristic of reaction. Instead of subsiding on the second or third day, this fever becomes more pronounced, exhibiting a morning remission and an evening rise. It is associated with headache, general muscular pain, distaste for food,

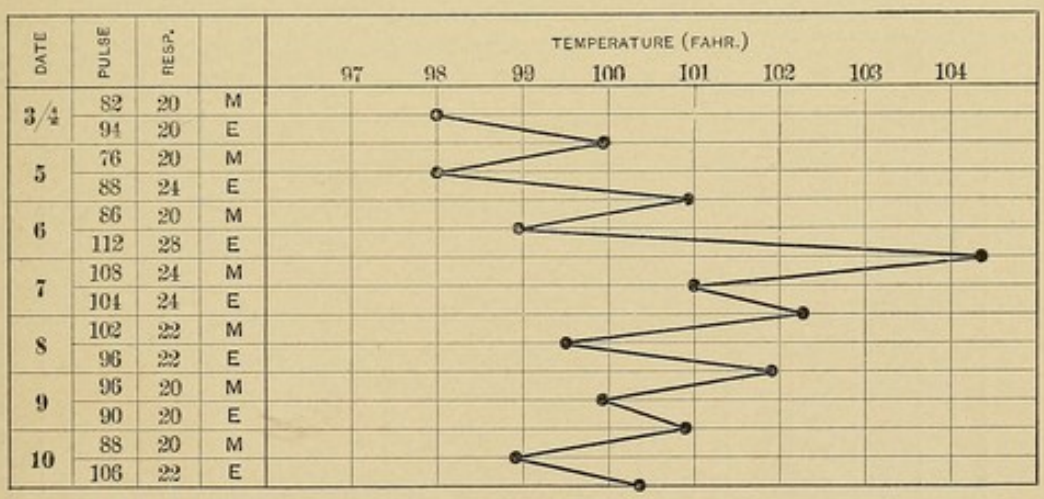
constipation, and high-colored, scanty urine and pronounced leukocytosis. If the wound has been properly drained, the vital resistance high, and the infecting organism one of ordinary virulence, this fever reaches its maximum on the third or the fifth day and then gradually subsides. Under other circumstances, pus under tension, virulent infection, or low resist-

Fig. 22



Retention cyst of breast, followed after excision by sloughing of a portion of the overlying skin. Sudden rise in temperature and gradual daily fall.

Fig. 23



Perforating gastric ulcer. Convalescence normal until fourteenth day; temperature then began to rise. The chart shows an unusual temperature jump due to a small parietal abscess. Pulse but slightly affected. Prompt subsidence of symptoms on drainage.

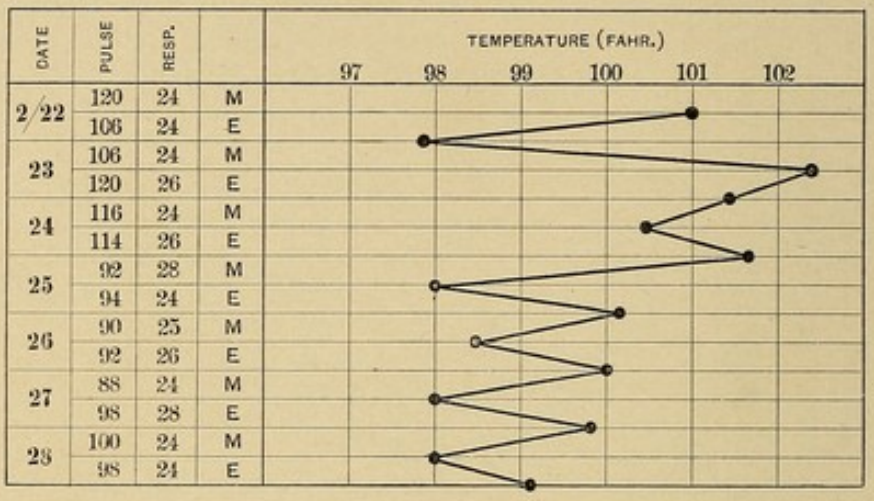
ance, this fever continues, ranging from 101° to 105°, with nocturnal, often irregular exacerbations, the latter not infrequently accompanied by a chill, and being suggestive but not diagnostic of the development of other suppurating foci through the medium of septic emboli.

If the systemic reaction against the infecting agent be well expressed, there will be a strong, regular pulse proportionate in rapidity to the

degree of fever and pronounced leukocytosis (polymorphonuclear). A pulse disproportionately rapid as compared with the temperature and slight leukocytosis are suggestive of reactive failure.

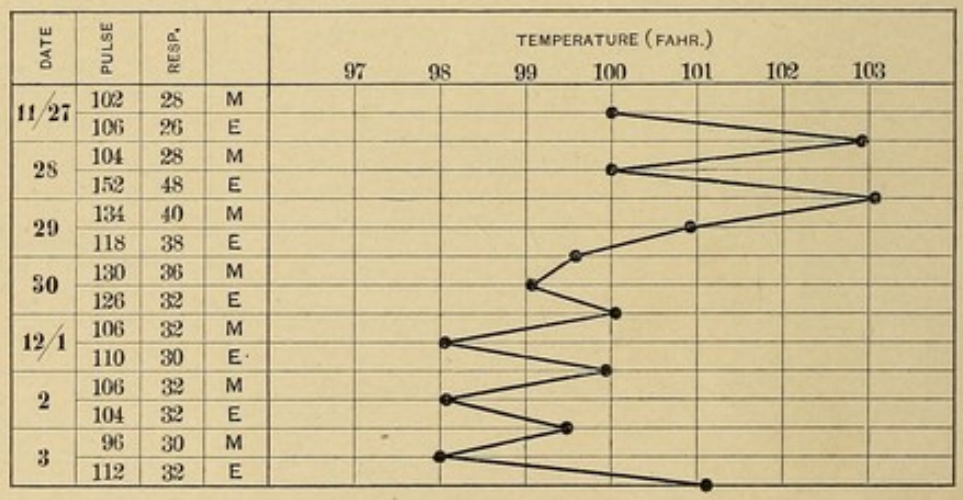
A long continuance of acute septicemia is impossible. There is rapid emaciation, profound muscular degeneration indicated by the increasingly

FIG. 24



Perforated appendix. Immediate postoperative drop in temperature; rise in reaction plus continued sepsis; gradual drop from drainage and elimination.

FIG. 25



Typhoid perforation. Immediate postoperative drop in temperature and rise in pulse rate.

rapid and feeble heart action, pronounced anemia, and scanty and perverted secretions and excretions. The dry, brown tongue, the feeble muttering, restless delirium, and the general condition of adynamia are characteristic.

The local symptoms of increasing infection in the wound are more severe pain and tenderness, and on inspection the well-developed phenomena of acute inflammation.

A mild form of septicemia may continue for months, characterized by evening rise of temperature, often night sweats and rigors, pulse hurry, and progressive emaciation. This is called hectic fever, the word hectic meaning habitual, and is seen typically in tuberculosis with mixed infection and inadequate drainage, as of the lungs. It is also characteristic of other chronic infections.

Pyemia.—If septic thrombi are carried into the general circulation, metastatic abscesses will form, the lungs, spleen, kidneys, and joints being seats of predilection; the liver, if the infecting focus lie in the area drained by the portal vein.

Paroxysms of chill, fever, and sweat are habitual in this condition and may recur several times in twenty-four hours; the temperature fluctuations are from 97° to 106°. The diagnosis is based on the local symptoms of infection in regions removed from the primary focus. Bronchopneumonia characterized by hurried, painful respiration cough, pleuritic pain, friction, percussion dulness, and the usual auscultatory sign is commonly the first manifestation.

The particular variety of microörganisms which causes septicemia or pyemia is determined by cultures made from the blood.

Fever of the acute or chronic septic type is common to both medical and surgical affections; before deciding that it is purely medical an adequate local cause should be searched for. If the fever be acute and violent, some surgical conditions which are at times overlooked should be considered. Among the more important of these are osteomyelitis, otitis media and its complications (especially in infants), infections of the accessory nasal cavities, and septic thrombosis of the kidney. Acute osteomyelitis and otitis media may have in children no early, readily elicited, localizing symptoms.

Acute ulcerative endocarditis is in itself an adequate cause for violent sepsis, though it is very commonly a complicating factor.

Even though a wound remains sterile, fever of such height may develop as to suggest the presence of a local infection. Two common causes of such fever are constipation and follicular tonsillitis.

Constipation fever is characterized by a rapid rise during the course of an apparently smooth convalescence, with an associated coated tongue and heavy breath; usually there is a slight headache, with a history of no bowel movement for two or three days. The pulse as compared with the temperature is disproportionately slow (often characteristic of intestinal toxemia), nor is there more pain referred to the wound than has previously been experienced. The diagnosis is based on the prompt subsidence of these symptoms when the bowels are moved.

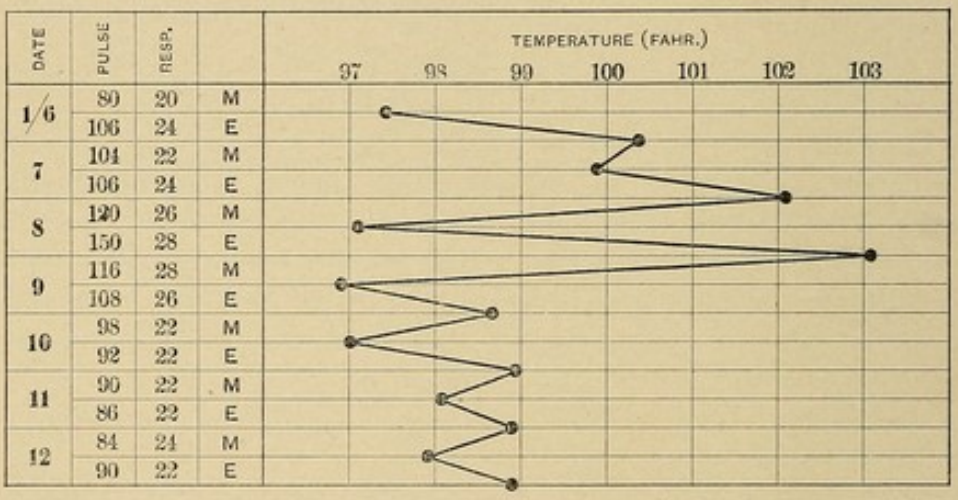
The fever of follicular tonsillitis is typical of acute infection, and would suggest a hyperactive bacterial growth in the wound were sore throat and the red, swollen, spotted tonsils not found.

The malarial paroxysm may exactly simulate that of pyemia; the complete and regular intermissions and the comparatively trifling effect on the general health are characteristic. The blood examination is diagnostic.

Complicating septic fevers there are a number of skin eruptions, herpetic, urticarial, scarlatiniform, or petechial, the latter of serious moment.

In the absence of an obvious focus of entrance there may develop a condition of chronic sepsis characterized, not so much by fever, though this may be present in an irregular hectic form, as by deterioration of general health, multiform skin lesions, affections of the joints usually regarded as evidences of chronic rheumatism, loss of weight, slight albuminuria, and gastro-intestinal disturbances incident to absence or perversion of secretion or sluggish peristalsis. Blood examination may show the presence and the nature of the infecting organisms. When this fails, in the absence of organic lesions it is to be assumed that the symptoms are incident to a toxic absorption.

FIG. 26



Vesical calculi. Perineal cystotomy. Immediate and violent sepsis. Characteristic rapid fall in temperature and pulse rate.

To this form of hidden infection the term cryptogenic has been applied. This is not applicable unless the nose and its accessory sinuses, the teeth, mouth, throat, especially the tonsils, urethra, prostate, and seminal vesicles, and the anus and rectum have been carefully examined for signs of chronic infection. The common sources of such infection or toxemia which are not subject to direct examination are the appendix, gall bladder, the stomach and duodenum, and the renal pelvis.

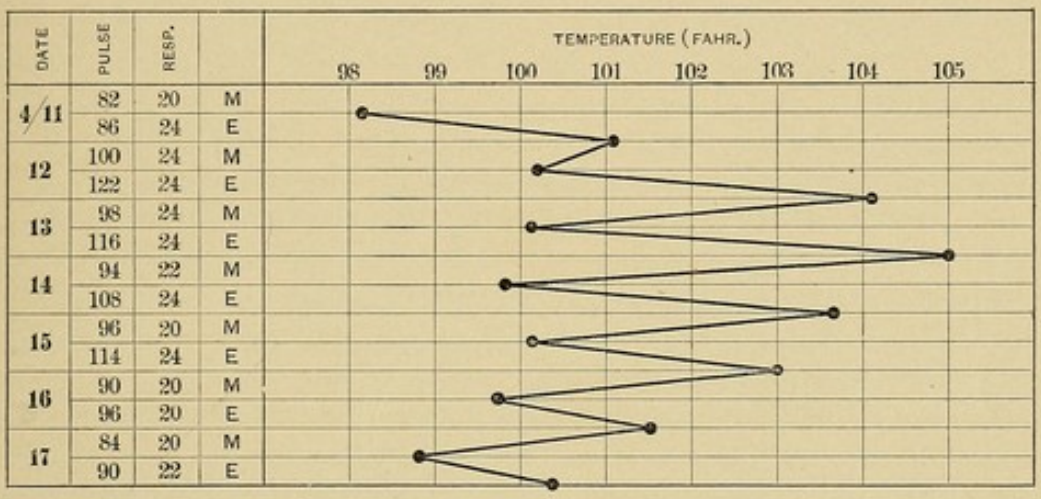
The fever symptomatic of a cholangitis, which frequently accompanies gallstones, is characterized by its irregular recurrences and its marked fluctuations, constituting, when depicted in graphic form, the so-called steeple chart.

The septicemia which accompanies urethral traumatism is characterized by its sudden onset and usually equally sudden subsidence. It is commonly expressed in the form of a single paroxysm which may occur in an hour from a trauma so slight as that incident to the gentle passage of a sound. There is chill, fever which may go as high as 106°, and

headache, often without corresponding rise in the pulse rate. It may subside completely in six to twenty-four hours, or may recur, assuming then the features of an acute septicemia. A rapid pulse is suggestive of a recurrence of such attacks.

Erysipelas (Streptococcus).—Erysipelas, exhibiting a predilection for the face, is often initiated by chill, fever, and vomiting, and the formation of a red patch, with distinct, slightly raised borders, which rapidly invades the surrounding skin, is usually attended with moderate vesication and glandular enlargement, and is accompanied by the constitutional symptoms of an active sepsis. The inflammation is most intense at the borders and has a tendency to fade in the centre.

FIG. 27



Urinary fistula and stricture. Internal urethrotomy; urinary sepsis developing eleven days after operation, following instrumentation but not immediately; duration longer than usual.

A deeper infection, *cellulitis,* is characterized by more profound sepsis, a dusky rather than red color of the skin, pitting on pressure, ultimately bogginess from tissue destruction and pus formation, and the symptoms of at first a violent, then, if the infection be progressive, an overwhelming sepsis. This is the form of infection common in deep lacerated and contused wounds.

Abscess, carbuncle, and erysipeloid are elsewhere described.

Tuberculous Infection.—Tuberculous infection, against which none of the tissues of the body are immune, in its surgical form exhibits a predilection for the lymphatic glands, the vertebral bodies, and the growing epiphyses of the long bones. It is characterized by a chronic inflammation attended by few symptoms beyond swelling incident to organization of exudate and destruction of tissue. There is ultimately abscess formation, characterized by the appearance of a fluctuating tumor without other local symptoms until, by pressure necrosis and skin infection, the abscess is about to burst.

The diagnosis of the tuberculous nature of the lesion is based upon its otherwise inexplicable occurrence, its chronic course, its age and loca-

tion, incidence, the results of the tuberculin test, and the examination of the discharge. Similar chronic inflammations may be caused by a great variety of infecting organisms, among them exceptionally the staphylococcus and streptococcus.

Actinomycosis.—Actinomycosis, an infection due to the Streptothrix actinomyces, usually develops in the lower jaw; the upper jaw, tongue, fauces, lungs, or any part of the alimentary tract, especially the cecum and the liver, may be the primary seat of infection.

The disease is characterized by dense nodulation, slow extension, a marked tendency to fistulization, and the discharge of pus containing granules in which the infecting organisms may be identified. It spreads by continuity of tissue, is slow in progress (months, years), and, in the case of the internal organs, is usually not suspected until the parietes are infiltrated and the sinuses or fistulas form.

The distinction from tuberculosis is based on the tendency of the latter infection to invade the lymph glands, the results of tuberculin and laboratory tests.

Anthrax.—Anthrax. observed in those who handle the hides, or the carcasses of animals which have been affected by the disease, develops on an exposed surface of the body as an acutely inflamed, painful pimple, which becomes densely indurated and is surrounded by a cluster of vesicles. These are regarded as characteristic. There is central sloughing and rapid extension of induration and edema. The symptoms are those of acute sepsis.

Diagnosis is made by examination of the blood, of the wound secretion, and finally by the excision of a small portion of the area of active infection and the examination of it for the anthrax bacillus. From carbuncle the distinction is suggested by the prompt skin necrosis and the rapid extension of the infection. The edematous form is characterized by a widespread swelling and multiple sloughs.

Tetanus.—Tetanus, incident to the toxic action of the bacillus tetani and particularly likely to follow punctured and lacerated wounds infected by earth, is characterized at first by stiffness of the jaw and neck of such slight degree that the patient may give it little attention. If the wound has involved the hand or foot, the corresponding extremity may first exhibit muscular stiffness. There follow fixation of the jaw, rigid extension of the head and tonic spasm, the latter accompanied by clonic exacerbations, distorting the body and causing asphyxia, which may be fatal in its completeness and prolongation. The rapid progression and violence of the symptoms is usually inversely proportionate to the period of incubation, those developing within a week of the wound usually ending fatally. A prolonged incubation, two weeks or more, is often followed by spasm less frequent and less violent, with almost complete muscular relaxation during the interval.

There is a form of tetanus occurring after infected head wounds characterized by unilateral facial palsy and spasm limited mainly to the muscles of the head and neck.

The diagnosis of tetanus is based upon the presence of an infected wound, the development of the characteristic symptoms, and often upon finding the specific bacillus in the wound.

Hydrophobia, or Rabies.—Hydrophobia incident to the bite of a rabid dog, wolf, or other animal and occurring after an incubation period which should average forty days is characterized first by depression, restlessness, and apprehension, and often by pain or hypersensitiveness in the region of the wound. Thereafter follow for some days stiff neck and difficult deglutition, with the development of spasm confined to the neck and jaw muscles, and brought on or aggravated by efforts at swallowing. Hallucinations, delirium, recurring throat spasm, and finally an ascending palsy are the characteristic features of the affection. It is distinguished from tetanus by the difference in etiology and by the general spasms of the latter condition, which especially involve the muscles of respiration. Moreover, tetanus in its virulent form has a short incubation period.

When a psychic hydrophobia attacks one not familiar with the true symptomatology of the infection, it is characterized by an incubation period too brief to be real and the sudden onset of symptoms corresponding in type with the popular impression of the disease rather than its terrible reality.

Glanders.—Glanders, an infection by the Bacillus mallei, observed in those who handle horses or other aquidæ, is characterized by a preliminary typhoidal state with discharge from the nose, the symptoms of bronchopneumonia of slight or moderate severity, and the development of multiple hard swellings in the skin, beneath it, or in the muscles, which soften and break down, discharging a bloody pus. The constitutional symptoms are those of an active and progressive sepsis. The diagnosis is based on finding the specific bacillus in the discharge of the lesions. It is suggested by the usual occupation of those suffering from this infection, but is usually not suspected until the skin nodules appear.

If the inoculation be through a skin abrasion or wound, this becomes converted into a destructive ulcer, usually of small size, with lymphatic involvement. The red skin nodules constituting the farcy buds appear later.

CHAPTER IV.

COMPLICATIONS AND SEQUELS OF TRAUMA.

Shock.—Shock, a condition of vasomotor paresis, mainly incident to trauma, often accentuated by the psychic state, is characterized by pallor, subnormal temperature, muscular relaxation, shallow, irregular breathing, often hurried in rhythm and interrupted by long deep breaths, low blood pressure, and a running pulse. The mentality is lethargic, the skin moist, the face expressionless, the pupils moderately dilated; nausea, vomiting, and incontinence of urine are often present. There is an erethistic form characterized by uncontrollable restlessness and delirium.

Shock is especially pronounced in burns, acute perforation of the stomach with rapid escape of contents, acute hemorrhagic pancreatitis, and injury to the central nervous system. In peripheral crushes it is usually proportionate to the amount of tissue involved. There is an extraordinary individual variation of susceptibility to this condition.

The shock of operation is usually proportionate to the duration of exposure. extent of traumatism, and particularly the quantity of blood lost.

The sudden death which occurs in consequence of testicular injury, incarcerated or strangulated hernia or efforts at its reduction, tapping of pleural exudates, or the passing of a stomach tube, is probably due to cardiac inhibition.

Hemorrhage.—Hemorrhage is characterized by rapid, feeble pulse, irregular, shallow respirations, with recurring deep sighing inspiratory effort, pallor, sweating skin, blanched lips, air hunger, thirst, often uncontrollable restlessness, failing vision, tinnitus, unconsciousness, and convulsions. The symptoms are those of shock; the two conditions are often associated. The diagnosis is dependent upon the history; in case of internal bleeding, by the progressive severity of symptoms in the absence of adequate cause, and the demonstration of a fluid effusion into the peritoneal or the pleural sac or into the gastro-intestinal canal, as shown by vomited blood or that passed per rectum.

Postoperative Vomiting.—Postoperative vomiting may be absent, slight and transitory, or persistently recurring, usually exhibiting a definite relation in its severity to the skill of the etherizer. When the patient has been properly prepared the vomitus is of glairy mucus, not infrequently containing streaks of blood from the throat, and smelling strongly of ether. Later there is a bile admixture. In the course of the first twelve hours this vomiting practically should cease. When it is prolonged for more than twenty-four hours, and particularly when it is

frequently recurring it is symptomatic of either deficient hepatic metabolism (acidosis) or renal elimination, or, if an abdominal operation has been performed, it suggests acute gastric dilatation or mechanical or dynamic ileus.

Defective liver metabolism is evidenced by the presence of acetone and diacetic acid in the urine. In its more pronounced form coma develops. In this relation it is worthy of note that a latent diabetes may be made active by operative procedure and may cause fatal coma even though the wound run a clean course.

The vomiting of ileus or acute gastric dilatation is accompanied by the characteristic symptoms of these conditions. It is usually regurgitant in type, and is profuse, offensive, and brown in color.

Pressure palsies are first observed when the patient recovers from ether. The brachial plexus or some of its branches are commonly involved, usually due in the former case to prolonged Trendelenburg position, with the forearm hanging above the head (pressure of the clavicle), in the latter to resting the arm on the edge of the table (ulnar, musculospiral).

Postoperative Complications of Celiotomy.—Some complications are peculiar to abdominal operations, others follow them more frequently than they do operations on other portions of the body.

In the first twenty-four hours after celiotomy there is always local, at times general atony, characterized by feeble peristalsis, general tympany, and pain and tenderness incident to the peritoneal reaction against traumatism; the pulse is not markedly affected. This condition is usually transitory, audible peristalsis, colicky pain, and the passage of flatus, denoting the return of intestinal tonus on the second or third day.

Exceptionally immediately after operation, and as the result of rough manipulation, prolonged exposure, and inadequate preparation, the gastro-intestinal atony is associated with a distention so great as to constitute dynamic ileus (p. 481). Ether vomiting is succeeded by that characteristic of ileus, the pulse becomes rapid and feeble, and the breathing hampered by upward pressure against the diaphragm. Neither the severe pain, great tenderness, nor muscular rigidity of diffuse peritonitis are present.

Dynamic ileus, developing on the second or third day after operation, is usually incident to diffuse peritoneal infection.

Acute gastric dilatation, a local form of dynamic ileus, coming on immediately after operation or days later can be recognized as such only in the early stages when the tympany is mainly epigastric and peristalsis not yet abolished, unless the great relief obtained by gastric lavage can be considered characteristic.

Postoperative diffuse peritonitis is characterized by a steady increase in postoperative pain, a progressive rise in the pulse rate, a temperature higher than that characteristic of normal wound reaction and the tenderness and muscular rigidity of peritonitis associated with absent peristalsis, tympany, regurgitant vomiting, and absolute constipation (p. 482). Postoperative mechanical obstruction and strangulation exhibit the

symptoms of these conditions as they occur in the absence of operation (p. 482).

Postoperative phlebitis, probably an expression of mild infection, develops in the second week after abdominal section, and involves most frequently the left femoral and the long saphenous vein. Pain, fever, and leukocytosis are accompanied or followed by the detection of a tender indurated cord occupying the position of the vein. Thrombosis and phlebitis of intra-abdominal veins can be recognized only by exclusion.

Pneumonia is comparatively rare when the anesthesia is intrusted to skilful hands and the after treatment of patients is conducted in rooms and wards in which pneumonia cases are not treated, except in its embolic form, and is characterized by moderate fever and pulse hurry, rapid breathing, localized signs of consolidation, and at times slightly blood-stained expectoration. When lobar or lobular, it conforms to type. Pneumonia, bronchitis, and pleurisy are observed more frequently after abdominal than after other operations even when local anesthesia is used.

Parotitis, characterized by local swelling, tenderness, and pain, is more frequent after abdominal operations, particularly those involving the pelvic organs, than after peripheral ones. It may be chronically inflammatory in type or acutely suppurative (p. 302).

Hematemesis is an expression of profound blood dyscrasia, rare as a postoperative complication, but less so after operation in the upper abdominal segment than after intervention in other regions. It follows the usual postanesthesia vomiting immediately, after a short interval, or not for days; it is regurgitant in type, black and acid, not very profuse, and is attended by the constitutional symptoms and the facies of prostrating toxemia. It may be associated with blood in the stools and subcutaneous bleedings.

Sudden Death Occurring after Operation.—Aside from death due to shock, hemorrhage, sepsis, colossal pulmonary thrombosis, fat embolus (p. 97), myocarditis, acute dilatation of the heart, uremia, acute fatty degeneration, and a few other well-recognized conditions with fairly characteristic symptomatology, there remain to be explained certain fatalities which occur suddenly in the midst of an apparently smooth convalescence and with premonitory symptoms entirely wanting. Death may be incident to a sudden change in posture or muscular effort, and may be preceded by only a few seconds of agony. In such cases colossal pulmonary embolus or the final overwhelming of a dilated heart are regarded as adequate causes, as they are, though pulmonary embolus is not immediate in its effect and a myocarditis with dilatation and impending breakdown should have given warning symptoms. At autopsy neither of these conditions, nor coronary embolus, nor adequate heart lesion, nor bulbar thrombus has been found.

Death may occur during sleep without change in posture or other sign aside from respiratory arrest. In the case of one patient convalescent from sunstroke and sleeping quietly, with normal pulse and tempera-

ture, the death pallor was seen to sweep over his face, the respiration and the heart stopping apparently at the same moment. In this case a small clot was found in the wall of the fourth ventricle.

In some cases such an apparently causeless death seems to be associated with the condition termed status lymphaticus, characterized by enlargement of all the lymphatics and the thymus gland and a general flaccidity of tissue, though the fatality in this condition is more likely to occur during the administration of an anesthetic, particularly if this be chloroform.

Iodoform Poisoning.—Iodoform poisoning in its acute form, characterized by a fatty degeneration of the heart, liver, and kidneys, and at times edema of the brain, is characterized by irregular, rapid, feeble pulse, nausea and vomiting, or at least absolute distaste for food, headache, sleeplessness and psychical depression, or even active delirium. In severe cases coma may develop. This sometimes may follow shortly after the first dressing or injection, or may be delayed some weeks, developing only after repeated applications of the drug. Where this has been used judiciously the appearance of toxic symptoms must be attributed to an idiosyncrasy.

The diagnosis should be based on the apparently causeless circulatory failure, associated with cerebral symptoms, and upon the fact of absorption as attested by the presence of iodine in the urine. The diagnosis is usually confirmed by the beneficial effect of withdrawing the drug as a dressing, though the systemic improvement may be slow. Chronic poisoning may be manifested by wasting, complete distaste for food and symptoms of acute poisoning expressed in a mild form, the characteristic feature, however, being persistently rapid pulse.

Mercurial Poisoning.—Mercurial poisoning is characterized by salivation, vomiting, bloody diarrhea, and blood and albumin in the urine. The examination of the urine will show the presence of mercury.

CHAPTER V.

TUMORS.

Tumor, by which is meant a functionless independently growing tissue hyperplasia, may be generally classed under the headings benign and malignant.

The benign tumors, at times multiple in their beginning, are usually of slow growth, are characterized by the presence of an investing capsule, the absence of lymphatic involvement, failure to recur after complete removal and are innocent of hurtful effect, except that of mechanical pressure incident to their position.

Malignant tumors, rarely multiple in their beginning, are usually of rapid growth, are characterized by the absence of distinct capsules, a tendency to infiltrate the surrounding tissues, to involve the anatomically associated lymph glands, to recur after complete removal, and to become disseminated through the system by either the lymphatic or the blood channels. They are ultimately lethal.

Rapid growth of an obviously benign cyst or tumor, if not adequately accounted for by trauma or inflammation, should be regarded as suggestive of malignant transformation.

The general symptoms of tumor independent of its benign or malignant nature are those of pressure and the formation of a mass. In the early stages of growth neither skilled palpation nor long experience can always determine whether this mass is benign or malignant. When the diagnosis is certain because of infiltrations, glandular involvement, and metastases, the time for intervention has passed. It would, therefore, seem logical to diagnosticate all tumors which are not obviously benign, which are small and progressively increasing in size, and have recently developed, by wide removal and microscopic examination.

Tumors which have existed for years without marked change in size, without metastasis, or influence on general health, are obviously benign. Superficial lipomata and angiomata, multiple osteomata and osteochondromata of the growing period, papillomata and certain of the fibromata, adenomata, dermoids, and many of the cysts present features so typical that they can be recognized at once as benign. Any of these tumors may undergo malignant degeneration, first evidenced by rapid growth. The diagnosis under such circumstances, if inflammatory and traumatic causes be excluded, should be made by wide excision.

If the infections can be excluded, particularly the syphilitic and the tuberculous, all persistent and apparently causeless ulcerations of the skin or of the accessible mucous membranes occurring in an otherwise fairly healthy person should be diagnosticated in the early period of their devel-

opment by wide excision and microscopic examination. From this general rule leg ulcers and those which are prevented from healing by lack of cleanliness and recurring irritation should be excluded.

This same rule in regard to diagnosis by early excision holds true in regard to tumors of the muscle and tendons and to those of the bone. In the latter case the early symptoms are expressed in the form of pain. If this be persistent, well localized, increasing in severity and without apparent cause, and, if the *x*-rays show a circumscribed area of rarefaction or absorption, the diagnosis should be made by exploratory operation.

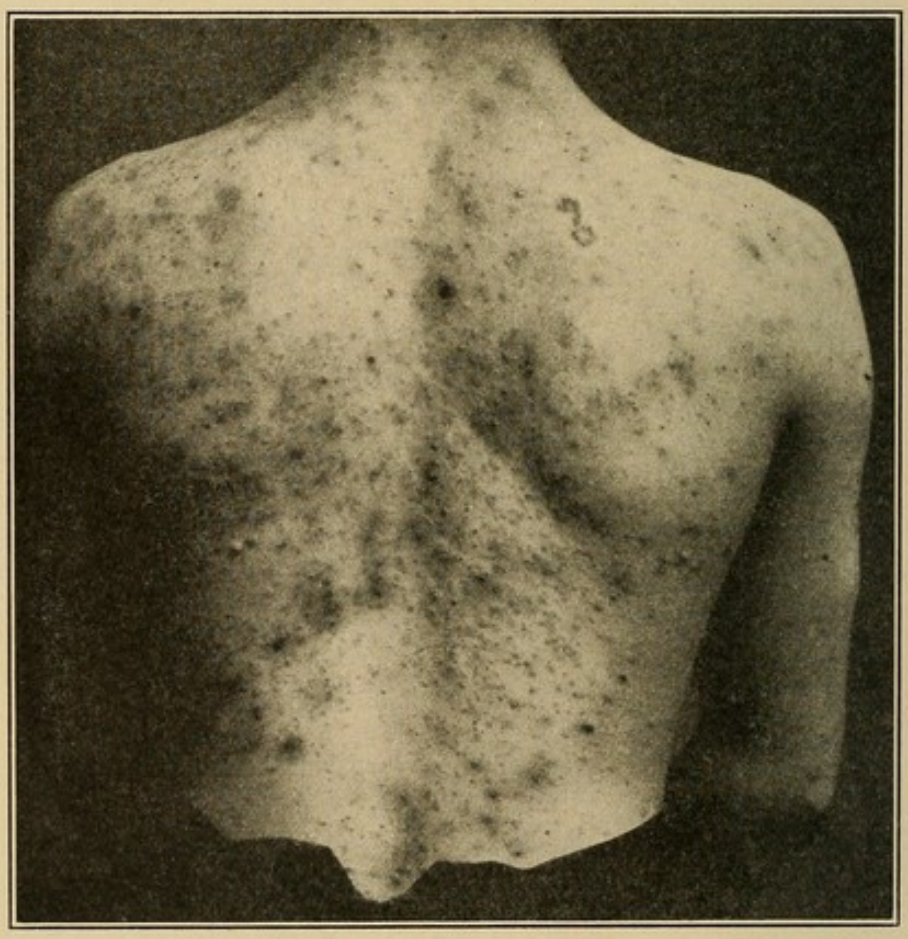
Tumors of the intra-abdominal organs have usually reached such size before they can be detected by palpation or can be suspected from obstructive or pressure symptoms that, if malignant, the favorable time for intervention has passed.

CHAPTER VI.

THE SKIN.

BULKLEY, in an analysis of 20,000 cases of skin diseases, notes that the commonest affection is eczema, about 30 per cent. Next in order of frequency comes acne, 16 per cent. Next, syphilis, 12 per cent. It follows that nearly two-thirds of all patients who present themselves with skin lesions are affected with one of these three diseases. Psoriasis, the eruptions due to phytoparasites (tinea), zoöparasites (pediculus, acarus, etc.), and urticaria come next in order of frequency.

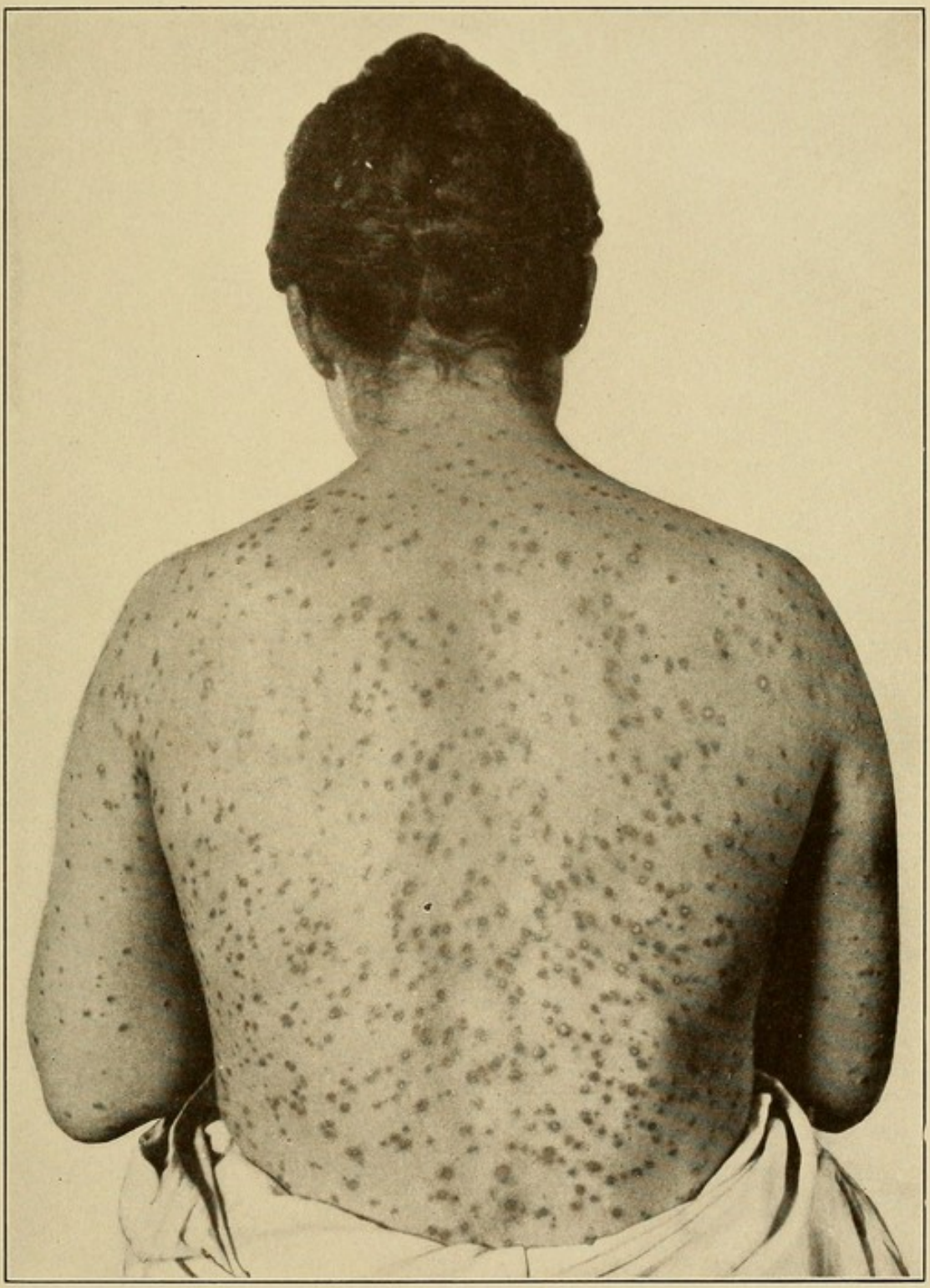
FIG. 28



Acne vulgaris. (Hartzell.)

Eczema.—Eczema is the term applied to a chronic skin inflammation of unknown etiology which is characterized by infiltration, usually exudation, exhibits a tendency to persist or recur, and is attended by itching and burning. It may appear in the erythematous, papular,

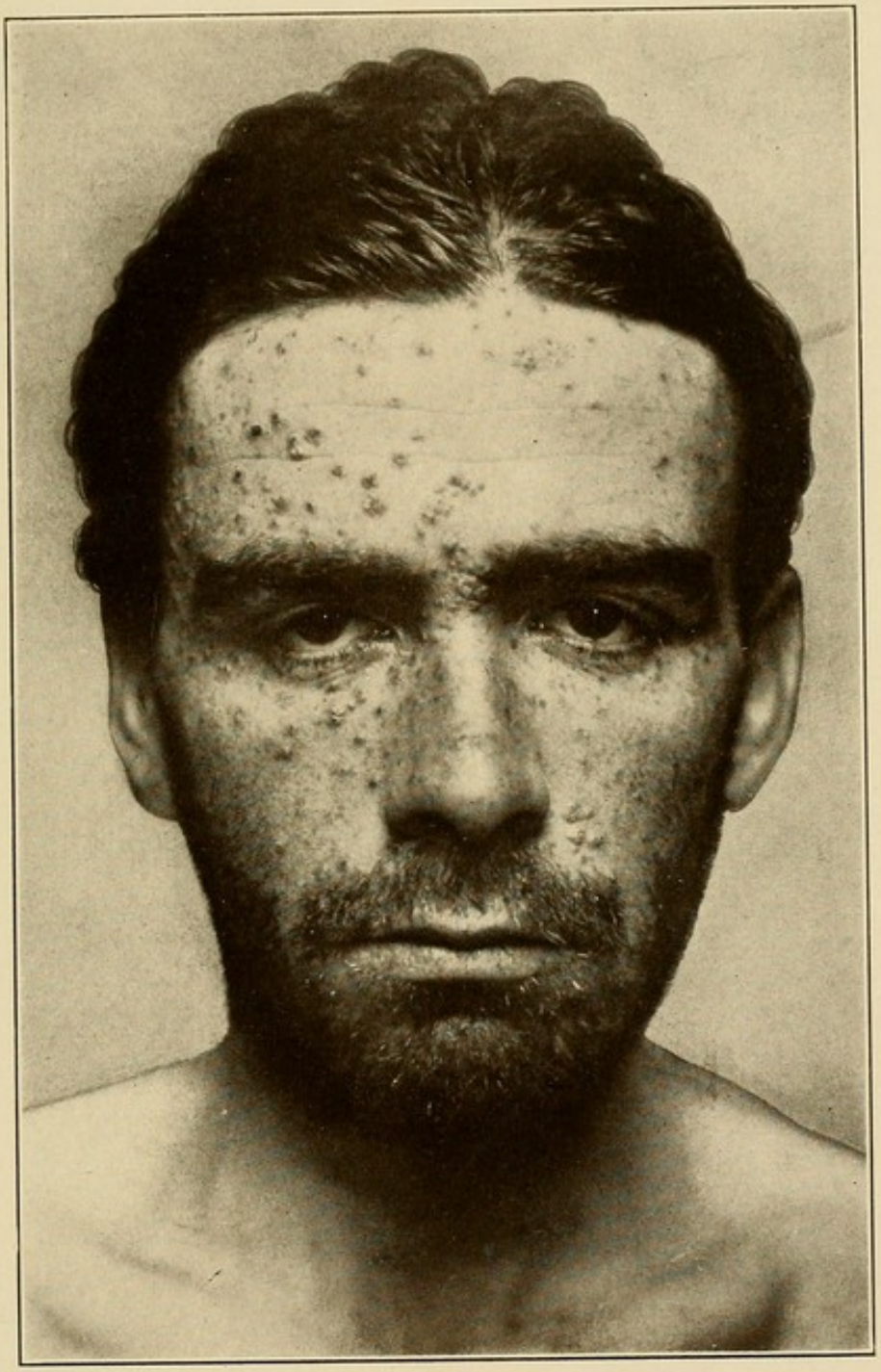
PLATE IV



Papular and Papulopustular Syphilides.

Early secondary (months). No subjective symptoms. Patient feeling well.

PLATE V



Early (Months) Secondary Syphilides.

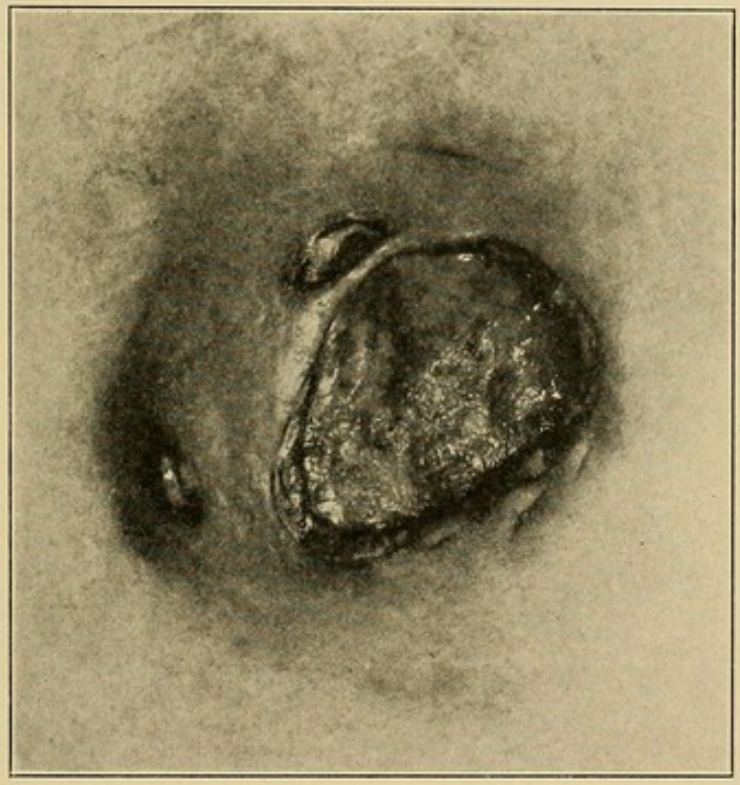
Eruption universal. Lesions macular, papular, and papulopustular. Coppery red, neither painful nor itching. Patient feeling well.

vesicular, or pustular form. It exhibits remissions, intermissions, relapses, and exacerbations without apparent cause, is not ulcerative or destructive in its tendency, and often is closely related to gastro-intestinal disturbances and error in diet.

Acne.—Acne (pimples), a chronic inflammation of the sebaceous glands and the periglandular tissue, occurring during adolescence and affecting by preference the face, back, and chest, is characterized by the appearance of usually multiple red papules, nodules, or pustules. There are few subjective symptoms. The individual papules may often show the black centres characteristic of comedones, and the latter are usually abundantly distributed over the surfaces involved.

The black point of the comedo represents the dried secretion of a sebaceous gland.

FIG. 29



Gumma of back. Duration, months. No subjective symptoms.

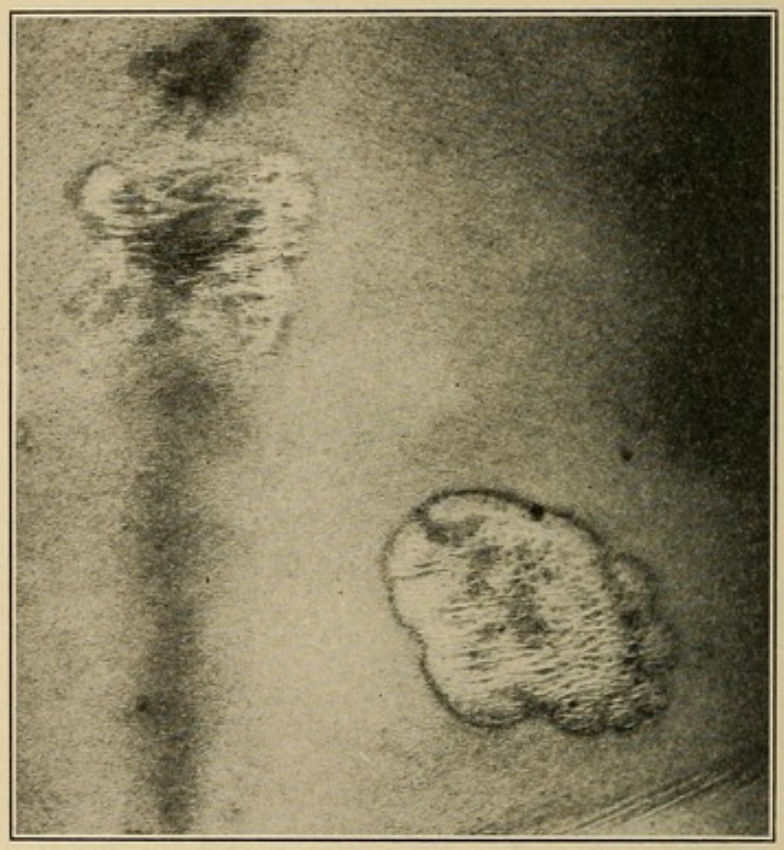
Syphilitic Skin Lesions.—The manifestations of the secondary stage of syphilis are widespread, superficial, non-destructive, polymorphous, rounded in shape, slightly desquamative, raw-ham colored, without subjective symptoms, and exhibit either the history of a primary lesion or the scar and often the glandular involvement of its one-time presence. An examination of the serum obtained by attrition and cupping of these lesions will show the presence of the spirochete. Destructive lesions occurring early are characteristic of a virulent infection.

Tertiary lesions, single, grouped, or symmetrically disposed, appear as painless, infiltrating, rounded, coppery red lesions which exhibit a

tendency to ulcerate and which leave permanent pigmentation and scars. When the individual lesions become confluent the resultant ulcer exhibits circinate borders often with central healing and scar formation. If glandular involvement occurs, this is incident to mixed infection. The diagnosis strongly suggested by the indolent, painless, rounded lesions is corroborated by the history and by the clinical test for syphilis.

Psoriasis.—Psoriasis is characterized by the development of rounded, distinctly defined, slightly elevated, red, non-ulcerating papules, often symmetrically distributed on the two sides of the body and exhibiting a preference for the extensor surfaces of the elbows and knees. These

FIG. 30



Typical cicatrix of tertiary skin lesions. Soft, irregularly pigment non-adherent scar, with rounded outlines of the original grouped lesions.

papules exhibit no tendency toward ulceration, but are often covered by an imbricated crust of silvery white epithelial scales. The individual lesions vary from the size of pinheads to that of a half-dollar, and by coalescence may form irregular patches. The condition is an extremely chronic one. The exfoliation is a characteristic feature. The distinction from syphilis must at times be based on the history and the results of specific treatment.

Of the phytoparasitic eruptions, tinea favosa, tinea trichophytina, tinea versicolor, and erythrasma are the forms commonly encountered.

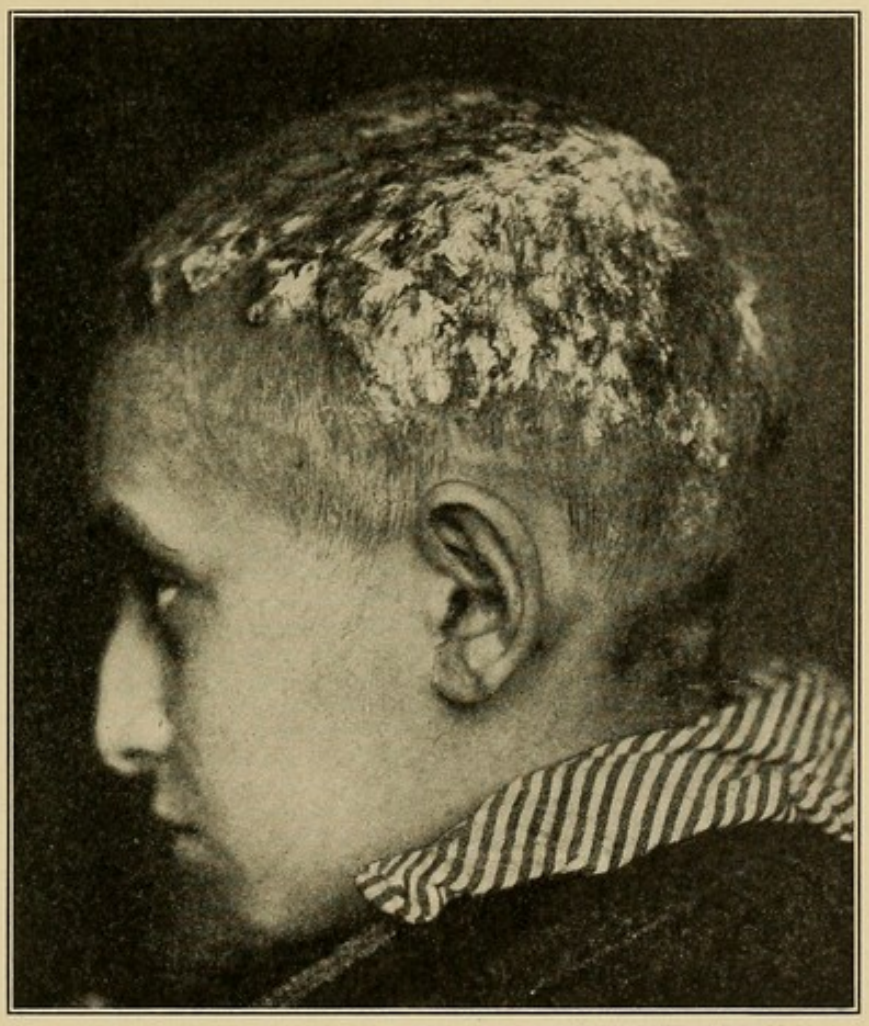
Tinea Favosa.—Tinea favosa, a contagious affection commonest in infancy and childhood, is characterized by the formation of thick, yellowish, brittle crusts of mouse-like odor, occurring in rounded or irregular

patches upon the scalp. The hair of the involved region is brittle, stubbed, broken, and exfoliated. The crusts, when not disturbed, exhibit a characteristic cupping.

Diagnosis is based on the finding of the Achorion schönleinii.

Tinea Circinata (Ringworm).—Tinea circinata, as it occurs upon the body, forms usually typical red annular lesions, which begin as small papules. At times concentric rings are observed and sometimes vesiculation. Even if the circle be broken the outline is generally crescentic. The diagnosis is based on the finding of the Trichophyton tonsurans.

FIG. 31



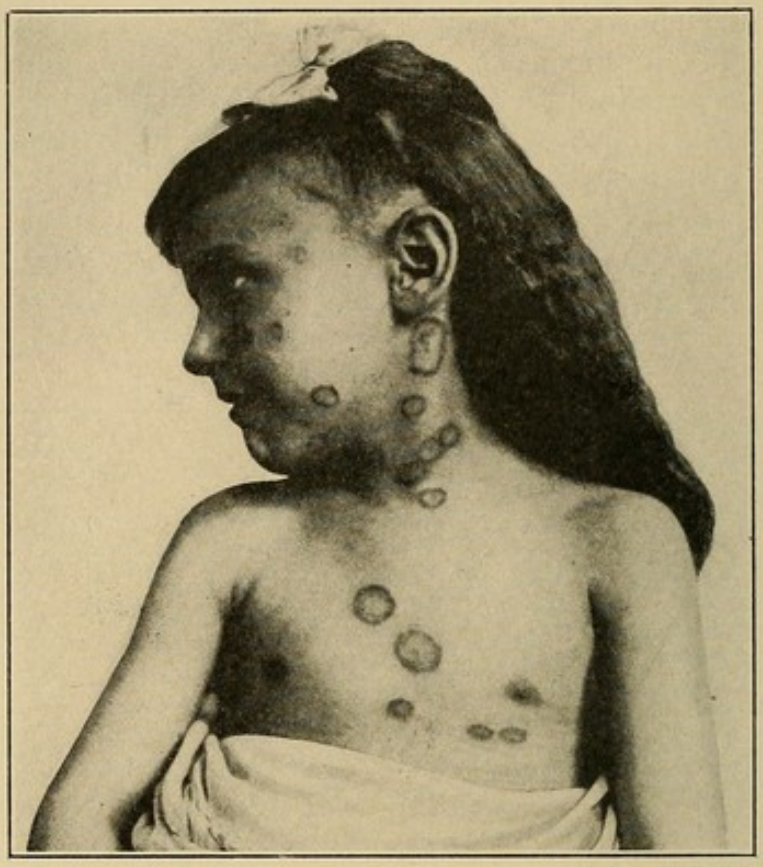
Tinea favosa (scalp).

Tinea Tonsurans.—Tinea tonsurans, the expression of scalp invasion by the same parasite, appears in the form of rounded scaling skin patches, in which the hair is stubbed, broken, and exfoliating. The diagnosis is made by finding the parasite.

Exceptionally tinea tonsurans may cause a distinct boggy scalp tumor made up of multiple small abscesses exuding a gummy secretion.

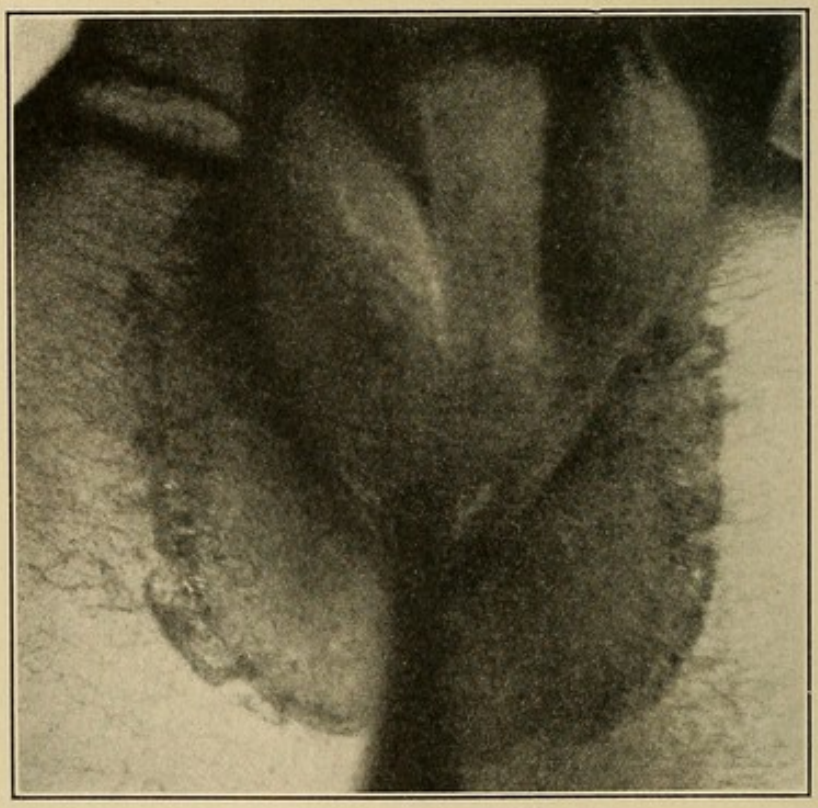
Tinea Sycosis.—Parasitic sycosis, due to the same infecting agent but appearing upon the bearded face, is characterized at first by small erythematous or edematous rings and brittle broken hairs and stubs.

FIG. 32



Tinea circinata. Fungus demonstrated. (Hartzell.)

FIG. 33



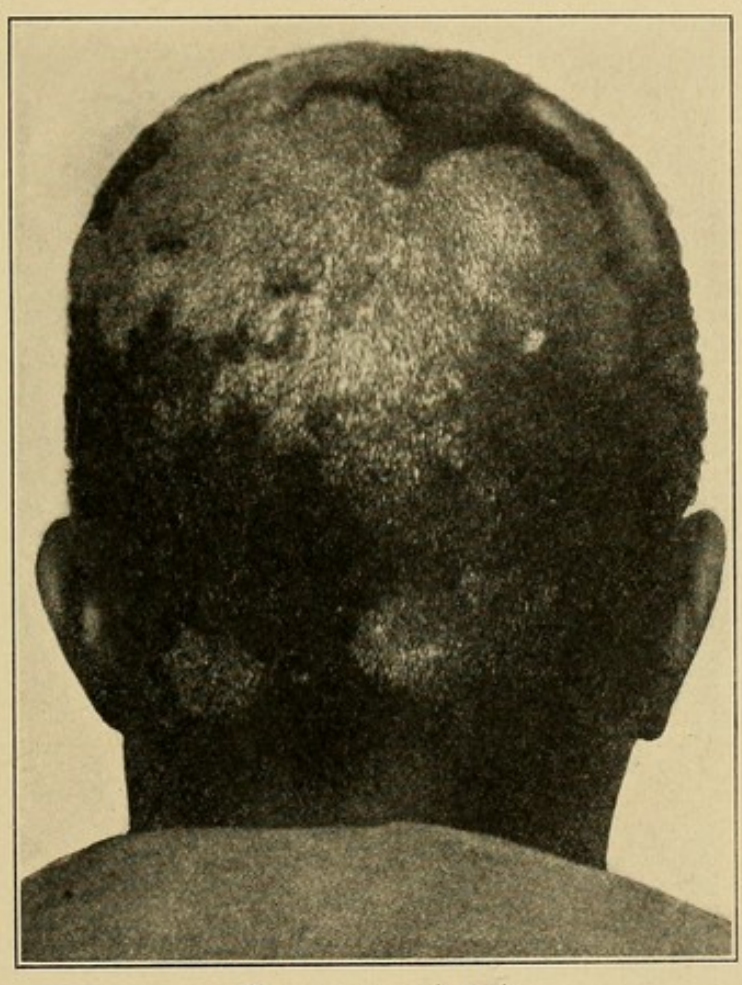
Tinea cruris. (Hartzell.)

Later, by a diffused skin inflammation, exhibiting papules and pustules and discharging a sticky purulent exudate which crusts.

The distinction from non-parasitic sycosis is made by finding the Trichophyton tonsurans.

Tinea Versicolor.—Tinea versicolor appears in the form of extensive patches of pigmented, slightly scaling skin, usually on the anterior surface of the chest, sometimes involving the greater portion of the surface,

Fig. 34



Tinea tonsurans (negro).

which is protected by the clothing. Pigmentation is the only feature which attracts attention. The diagnosis is made by finding the Microsporon furfur.

Erythrasma.—Erythrasma is the term applied to a hyperemic discoloration appearing in the form of red or brownish patches on surfaces subject to prolonged skin contact and slight friction, such as the gluteal fold, about the axilla, beneath the breast, and on the inner upper surface of the thigh. The diagnosis is based on finding the Microsporon minutissimum.

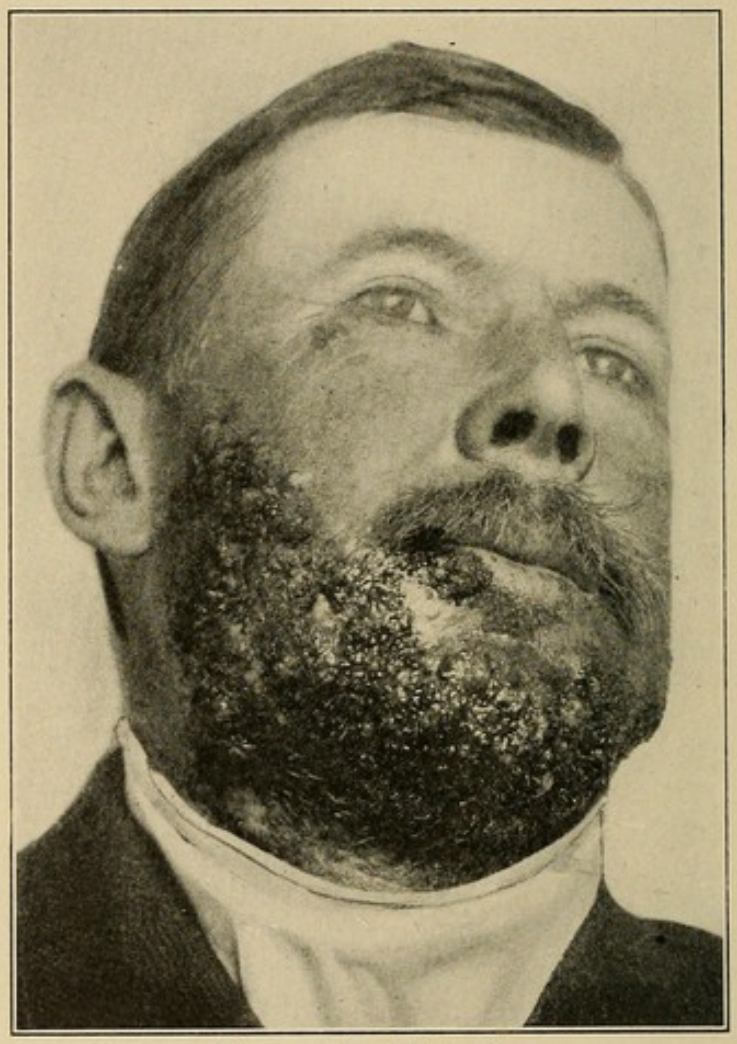
Pediculi.—Pediculi may cause lesions varying from a slight erythematous patch, with a punctate centre, to multiple superficial pustulization with the formation of thick crusts.

The diagnosis of the presence of the head louse is made by finding the nits glued to the hair in the area of preference, *i. e.*, the occipital region.

Body lice are always indicated by the excoriations of universal scratching, usually associated with minute red points indicating recent puncture.

Pubic lice lead to violent itching in the pubic region, and the lesions of scratching, which are to be seen on inspection, together with the nits attached to the hairs.

Fig. 35



Tinea sycosis. (Hartzell.)

Scabies, or Itch.—Itch appears as a papulopustular eruption, most pronounced in the interdigital folds, the axilla, and on the wrists, thighs, and abdomen. It is attended by intense itching, particularly at night, and often out of proportion to the extent of the lesion. Diagnosis is assured on finding in an unscratched region a characteristic tunnel and made absolute by extracting the Sarcoptes scabiei therefrom with a fine needle.

Urticaria.—Urticaria, often accompanied by fever, is characterized by the sudden or rapid development of small or large burning or itching wheals, which may disappear as rapidly as they come.

Closely associated with this condition is angioneurotic edema, in which circumscribed soft swellings are produced either in the form of nodes on the surface or edematous infiltration of regions such as the lip, the eye-

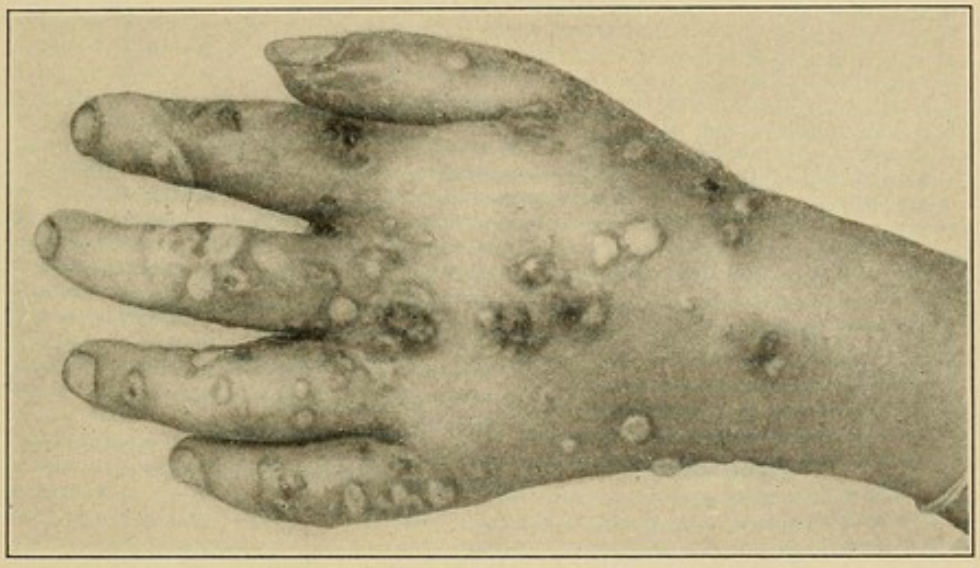
lid, the glottis, or internal organs. Such an edema may be attended by a rapidly developing and dangerous asphyxia. Its internal manifestations are sometimes evidenced by typical symptoms of acute intestinal obstruction (p. 481). It is not infrequently associated with purpuric eruption and with the joint manifestations commonly regarded as rheumatic.

The affections of the sweat glands characterized by excess, deficiency, or perversion of secretion are sufficiently obvious.

Miliaria, or prickly heat, usually associated with hyperactivity of the sweat glands, is characterized by the development of a multitude of minute vesicles upon a reddened, stinging, burning skin.

Cysts of the coil duct occasionally appear upon the surface, usually of the face and nose, in the form of non-inflammatory, tense, round, translucent vesicles.

FIG. 36



Itch. (Hartzell.)

Disorders of the sebaceous glands are usually expressed in the form of seborrhea, acne, or comedone.

Seborrhea.—Seborrhea, exhibiting a preference for the scalp, face, and genital regions, may appear either as an oily exudate or more commonly as a greasy scaling which sheds freely. The distinction from tinea, when it appears in patches with slight inflammatory symptoms, is made by the microscope.

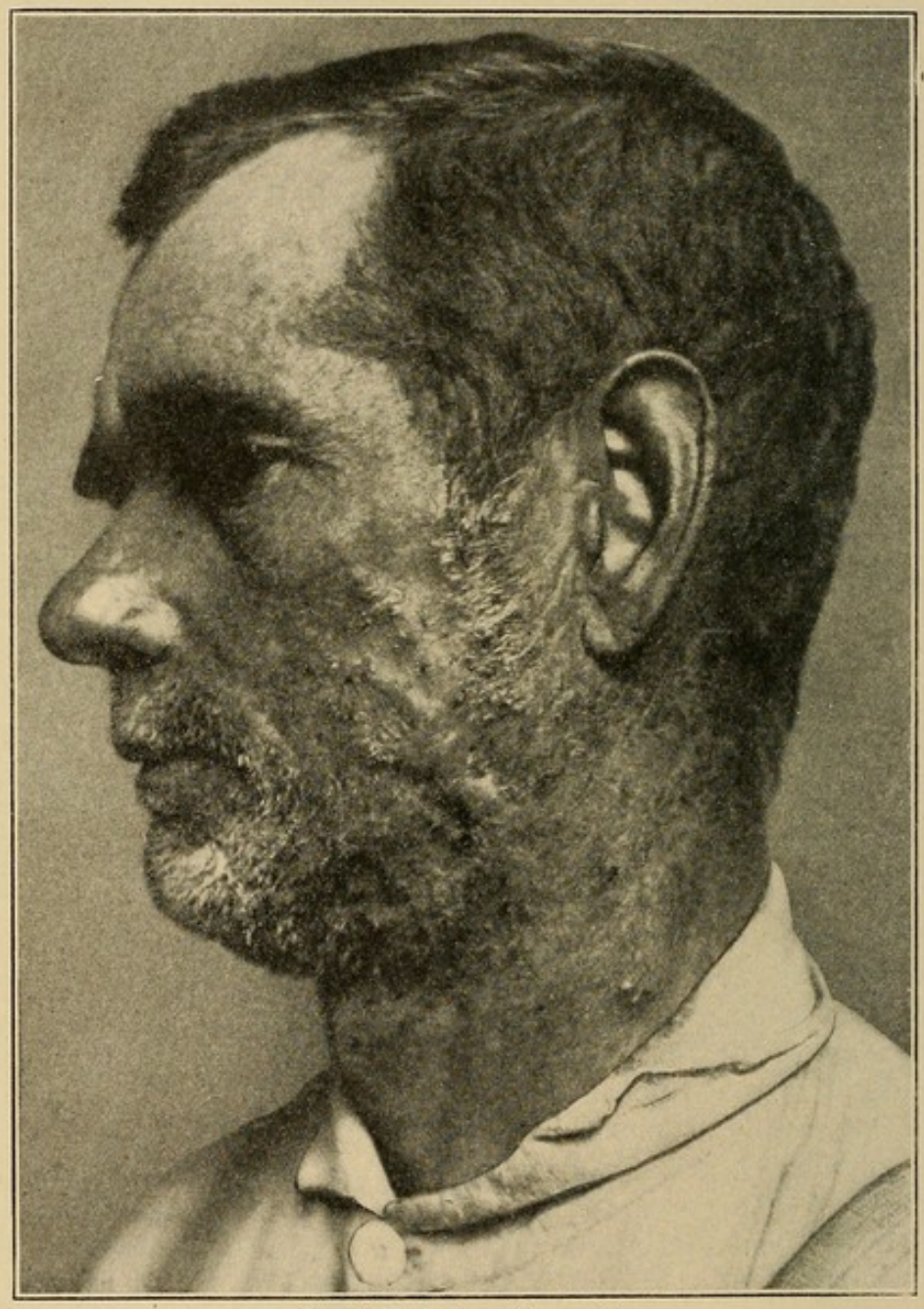
Milium, common in infants and presenting the appearance of minute white skin-embedded seeds (p. 260) and wens (p. 240), are described elsewhere.

Erythematous skin lesions are common manifestations of toxemia and infection. They develop rapidly as irregularly shaped red patches, often of large size. The eruption may closely resemble that of scarlet fever, but is unattended by the pronounced throat symptoms, and desquamation begins in a few days.

Herpes (p. 259), erysipelas (p. 75), erysipeloid (p. 360), furuncle (pp. 245, 360), carbuncle (p. 245), and anthrax (p. 76) are described elsewhere.

Sycosis.—Sycosis due to the ordinary staphylococcic infection appears on the hairy part of the face in the form of papular, papulopustular, and nodular lesions, which by coalescence produce disfiguring patches. The distinction from tinea sycosis (barbers' itch) is made by microscopic examination.

FIG. 37



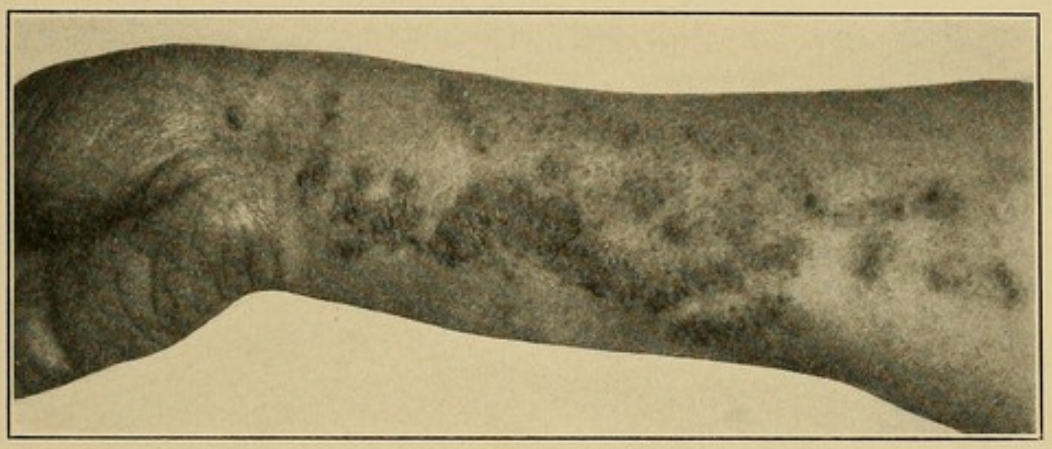
Sycosis vulgaris. (Hartzell.)

Impetigo.—Impetigo, at times an epidemic and apparently contagious pus infection, appears on the face of young people in the form of a vesicular eruption followed very shortly by rupture of the vesicles and the formation of thin, flat, brown crusts. The lesions are disseminated rather than grouped. There are few subjective symptoms, and the affection is self-limited.

Pityriasis Rosea.—Pityriasis rosea is of importance to the practitioner because it bears a close resemblance to lesions of secondary syphilis. The lesions are maculopapular, rounded or annular in shape, and exhibit a tendency to fine scaling. The distinction from syphilis is based on the history, on the results of treatment, and carefully conducted examination of the serum obtained by attrition and cupping of a lesion for the spirochete.

Lichen.—Lichen is a chronic affection exhibiting a predilection for the flexor surfaces of the forearms and appearing in the form of small, flat, clearly defined angular papules, exhibiting a polished red surface. These papules coalesce, forming angular patches. There is usually slight desquamation and much itching.

FIG. 38



Lichen planus. Several years' duration. (Hartzell.)

Purpura.—Hemorrhage of the skin of non-traumatic origin is usually an expression of pronounced toxemia. Its first appearance suggests an erythema, but the color cannot be made to fade by pressure. Shortly the characteristic discoloration of effused blood becomes manifest. Small spots are termed petechiæ; larger ones are termed ecchymoses. Exceptionally the blood effusion may be so pronounced as to form bullæ. Lesions are usually most pronounced in the lower extremities.

When the purpuric eruption occurs in the course of fever, or is associated with arthritic pains and swelling, the term rheumatic purpura is applied to it. It is not infrequently associated with urticarial lesions, gastro-intestinal crises, or bleeding from the kidneys.

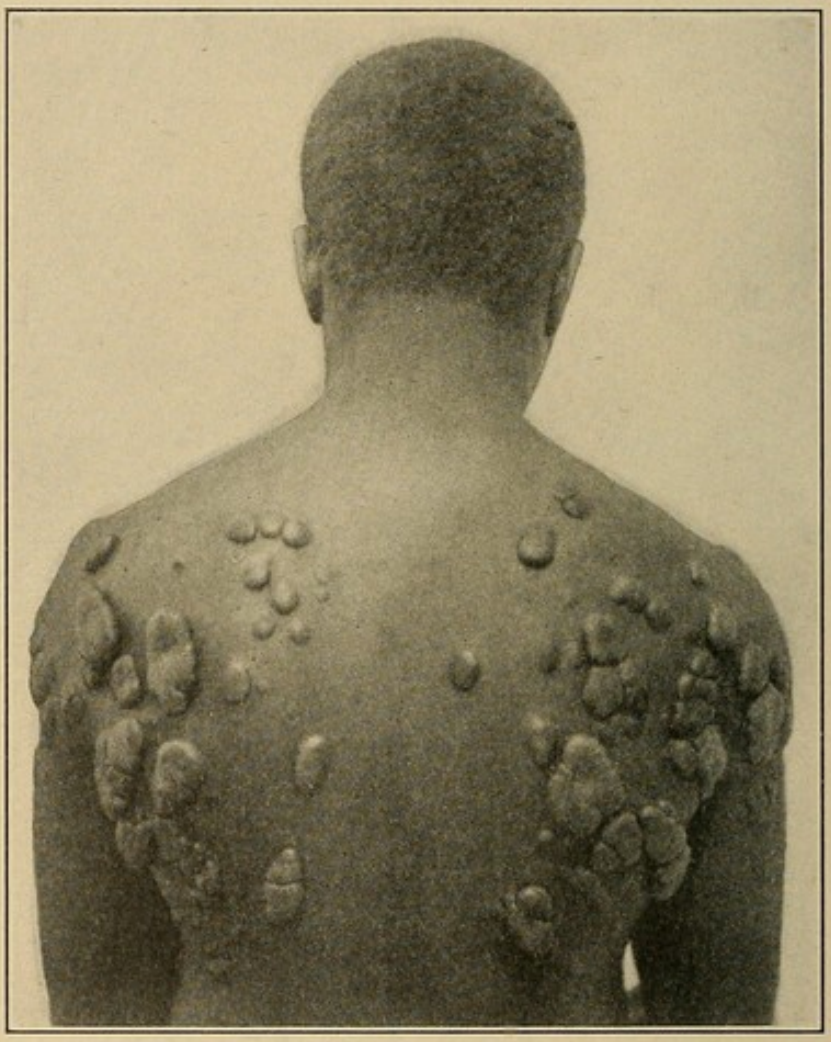
Of the hypertrophies, *lentigo*, or *freckles*, *chloasma*, or patches of discoloration termed *liver spots*, *keratosis*, or horny thickening, *molluscum contagiosum*, *corns*, and *warts* will be mentioned in discussing the regions of predilection.

Keloid.—Keloid, usually of traumatic origin, is characterized by an irregular white or pink nodulation with claw-like extensions into the surrounding skin, usually painless, sometimes itching intensely, and often distinctly vascular. The seat of predilection is the skin over the sternum.

Of the slowly ulcerating and destructive skin affections, those due to tuberculosis and syphilis are of major moment.

Lupus Vulgaris.—The primary tuberculous skin affection usually begins in early youth by the formation of red, raised, soft, jelly-like nodules which by confluence and peripheral growth form destructive

FIG. 39



Fibroma molluscum. Smaller lesions are sessile and overlying skin unaltered. Larger lesions pedunculated and lobulated. Skin is thinned and adherent. Neoplasms consistency of soft wax. (Duhring's service: Carnett.)

lesions. The common seat is the face. The progress is extremely slow. There is cicatrization of one part while the ulcer is extending both superficially and in depth in another.

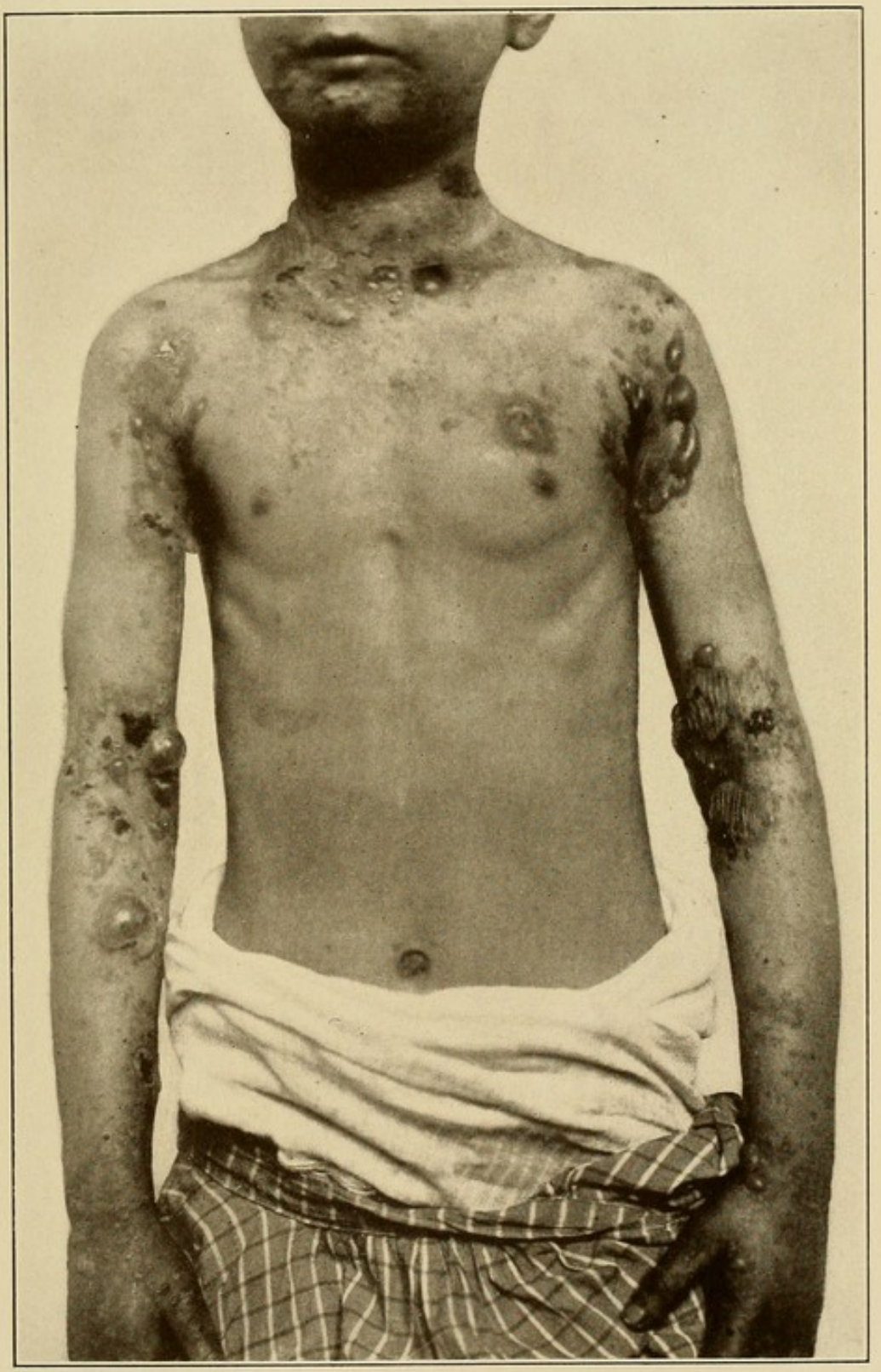
The diagnosis is based upon the presence of the reddish jelly-like lupoma and the results of microscopic examination.

Lupus Erythematosis.—This appears as a persistent erythema, often associated with seborrhea and branny desquamation. Neither nodules nor crusts develop and the lesion is very commonly symmetrical, forming patches on either cheek, with a ridge across the nose connecting them. This affection develops at a later period of life than lupus.

PLATE VI

Senile Keratosis Epithelioma. (Hartzell.)

PLATE VII



Pemphigus. (Hartzell.)

Sarcoma.—Sarcoma of the skin may be solitary or multiple. In its pigmented form it often originates in an irritated nevus. Some forms of the multiple infiltrating sarcomata exhibit a tendency toward self-limitation. In case of a single growth the diagnosis should be made by excision and examination.

Sarcoma of the skin may appear shortly after birth in the form of flat, hard, or soft nodules, exhibiting rapid growth.

In later life the affection may develop in the form of a hard tumor, which cannot be distinguished from fibroma and which may remain dormant for years.

Exceptionally the tumor is formed with such rapidity and with such hyperemic symptoms as to suggest a subacute abscess.

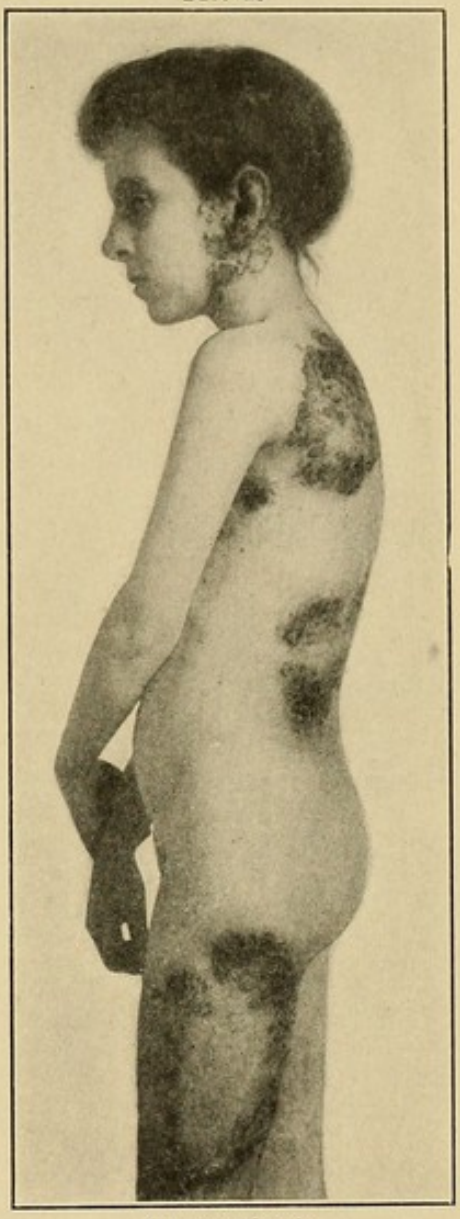
Epithelioma.—Epithelioma begins as a persisting inflamed patch of keratosis pigmentation or papillary outgrowth, often as a slight trauma which refuses to heal.

The rodent ulcer type is usually placed on the face above the level of the nostrils; the fungating type affects particularly the lower lip of males.

Syphilis as a causative factor must be excluded. The rapid growth and prompt adenopathy of chancre, the multiplicity and polymorphism of secondary lesions are characteristic. Tertiary lesions are usually grouped rather than single, nor are their regions of predilection usually those of epithelioma. They begin as infiltrations rather than ulcerations.

The diagnosis should be made by wide excision of persistent small ulcerations occurring in those past middle age.

FIG. 40



Lupus vulgaris.
Duration, years. (Hartzell.)

CHAPTER VII.

THE BLOODVESSELS.

As the result of trauma a bloodvessel may be contused or partially or completely ruptured. The contusion, in case the inner coats have been ruptured or distinctly injured, is followed by thrombosis, characterized by loss of distal pulse if arterial, peripheral congestion and edema if venous, and local tenderness and swelling. If the thrombus becomes acutely infected, abscess will develop, and may be followed by secondary hemorrhage or septic embolism. Partial rupture may be followed by aneurysm.

Wound or rupture involving all the coats of a bloodvessel is followed immediately by blood extravasation, characterized by the rapid formation of a fluctuating tumor which may pulsate if a large artery be involved. If the bleeding be into the pleura or peritoneum, the symptoms are those of progressive hemorrhage with the evidence of free fluid in the thoracic or the abdominal cavity. Bleeding into the brain is characterized by pressure symptoms.

Arteritis.—The effects of inflammation of the arterial walls are lessened elasticity and power of vasomotor response, diminution in caliber, the formation of thrombi, and such weakening as to favor the development of aneurysm. Trauma and the infections, particularly the staphylococcic, streptococcic, syphilitic, typhoid, and rheumatic, are the usual causes.

The local symptoms are expressed in the form of hardened arteries, diminished nutrition, hence lessened vitality and impaired or altered function, the symptoms of thrombosis and embolism, and aneurysm.

Phlebitis.—Phlebitis, due to a trauma or infection, often of unknown origin, is expressed in the form of venous thrombosis, usually non-suppurative and characterized by fever and leukocytosis and the development of a painful, tender, cord-like swelling along the course of the vein, with dusky and edematous swelling of the overlying skin in the case of a superficial vein, or pronounced edema of the parts from which the vein carries the blood in the case of a deep one.

The left femoral vein is the favorite seat of thrombosis. Typhoid fever (third week), abdominal operations (convalescent period), pneumonia (postfebrile stage), and childbirth are predisposing causes. Superficial varicosities and lymphedema are sequelæ.

Thrombosis and Embolism.—Thrombosis inevitably follows wounds, nor is it unusual after clean operations for small emboli to be carried to the lungs. These, if not infected, occasion few symptoms aside from slight cough and moderate and transitory pleuritic pain, usually on the right side, attended by the detection of friction sound on auscultation.

An embolus so placed as to produce an infarct of some size causes more pronounced symptoms, together with a bloody expectoration. Such infarcts are common after operation on incarcerated and strangulated hernias.

When an embolus lodges in the pulmonary artery or one of its major branches, symptoms develop at once, characterized by sudden and urgent dyspnea, tumultuous heart action, pale face, and usually dilated pupils. This attack may terminate fatally in a few minutes, or partial recovery may take place, followed by a new crisis. The diagnosis is based on the history of a recent severe traumatism, operative or otherwise or on the presence of a venous thrombosis.

The symptoms of fat embolus are similar, but often less violent in onset. There is shock, violent dyspnea, cyanosis, cough, often blood-stained sputum, sometimes cerebral excitement characterized by delirium, or torpor or coma. There is a general elevation of temperature, a rapid small pulse, irregularity of the heart action.

If the patient lives long enough for the test to be made, fat will be found in the urine. Fat embolism commonly follows injury to bone, particularly that largely involving the cancellous structure.

Thrombosis of the internal jugular vein, usually secondary to middle ear infection and sinus thrombosis, is characterized by a tender induration along the course of the vessel and pain increased on motion.

Thrombosis of the hemorrhoidal veins is characterized by pain, swelling, and sphincterismus. The severe pain of sudden onset, called an attack of piles, is due to rupture of a vein and blood extravasation.

Thrombosis affecting the deeper veins, characterized by pain, fever, and leukocytosis, can scarcely be diagnosticated unless there be an accompanying suggestive superficial thrombosis. Such complication occurring in the abdomen following operation, or in the course of typhoid fever or pneumonia, may simulate an acute peritonitis.

Thrombosis of the superior mesenteric vein is less common than an embolic blocking of the same artery which it may accompany, is characterized by similar symptoms.

Septic thrombosis incident to acute progressive infection is characterized by the symptoms of thrombosis with those of abscess added thereto. It is an occasional cause of deep abscesses in the lower extremity. It is the usual cause of abscesses developing in regions remote from the seat of original infection and having no direct lymphatic connection therewith. Infection thus carried finds lodgement first in the lungs or, if it be derived from the collecting branches of the portal circulation, in the liver.

Chill, fever, and sweat, irregularly recurring, and profound systemic depression are the constitutional expressions of such transferred infections with the symptoms of pylephlebitis, bronchopneumonia, or, if the thrombus be carried beyond the lung capillaries and lodged elsewhere, local abscesses.

The kidney is a favorite seat of lodgement for thrombi, resulting, if these be acutely infectious, in the formation of multiple abscesses at the seats of infarct and complete destruction of the organ.

The acute osteomyelitis of adolescents may be similarly conveyed from a surface infection in itself of minor moment.

Embolism of the mesenteric artery, secondary to endocarditis, or occurring in the course of infection, or without obvious predisposing cause, and at times associated with a thrombus of the mesenteric vein usually causes blood stasis and gangrene in the area of distribution (small intestines). The symptoms are sudden and are those of acute peritonitis (p. 478). A history of previous embolic attacks, or the presence of valvular heart lesions or a thrombosis elsewhere would be suggestive.

Thrombosis or embolism of the peripheral arteries is characterized by the rapid or sudden failure of the peripheral circulation. There is severe pain, absence of pulse, and the part becomes cold, livid, painless, and, if collateral circulation is not established, gangrenous. Endocarditis with dislodgement of vegetations is the common cause of the larger peripheral emboli. The arterial block occurring in the course of infections may be embolic or thrombotic.

Aneurysm.—Aneurysm, a blood sac which communicates with an artery, is due to a preëxisting vascular lesion. Exceptionally it is traumatic, usually it is a consequence of arteritis. The affection is usual in middle-aged athletic Anglo-Saxons who have had syphilis and are alcoholic. The aorta, the popliteal, the femoral, the iliac, the subclavian, and the axillary artery are the ones commonly involved. Broca's formula reads to the effect that as one grows older supradiaphragmatic aneurysms become commoner and those beneath the diaphragm rarer.

In shape the aneurysm may be fusiform, saccular, or distinctly loculated, and may be single or multiple. In its progression the aneurysm erodes both soft and hard tissues lying in the path of its enlargement, including the bones and joints; cartilage exhibits a greater resistance.

The characteristic symptoms of aneurysm are the presence of a tumor in the region of an artery and fixed to it, which exhibits an expansile pulsation, thrill, and systolic bruit, which are abolished by proximal pressure. In the vessel distal to the dilatation a retardation and softening of the pulse is noted, with weakening of impulse and absence of dicrotic wave. Pressure symptoms characterized by pain, venous congestion, and at times paralysis are marked. There is usually a steady, often intermittent, rapid growth.

In spite of the complete symptomatology of aneurysm, the clinical distinction between this condition and other affections is not always made.

When the sac becomes greatly thickened by deposit of laminated clots the characteristic aneurysmal symptoms may be slight or wanting. When the tissues around the aneurysmal sac become inflamed, either from rupture with slow leak or from infection, the resemblance to abscess is close.

The distinction between aortic aneurysm and mediastinal tumor of other form is often made correctly only at postmortem. Nor are the *x*-rays satisfactory in these difficult cases.

On general principles the possibility of aneurysm should be carefully

considered whenever a tumor is placed near or upon a large blood-vessel. The history of the case, particularly a careful examination, and finally aspiration, will usually establish the diagnosis.

Arteriovenous aneurysm, a persistent abnormal communication between artery and vein, usually traumatic in origin, is an affection characterized by a soft, compressible, pulsating swelling exhibiting thrill and bruit and made up in large part of varicose veins. Pressure symptoms are usually not so well marked as those characteristic of arterial aneurysm, though cramps, neuralgia, and anesthesia are common in arteriovenous aneurysm of the extremities. There is often an increase of growth in the affected part, sometimes a condition resembling elephantiasis; at times trophic changes and ulceration. The condition may be entirely lacking in subjective symptoms.

Angioma.—A swelling made up of arterial varicosities is called cirsoid aneurysm; when the veins also are involved it is called aneurysm by anastomosis. These tumors (rare), exceptionally traumatic, form irregular, pulsating swellings beneath the skin, through which the tortuous vessels are readily seen. There is distinct thrill and bruit. The scalp is a favorite seat.

Nevus, or birthmark, is the common form of angioma, appearing red or blue in accordance with the preponderance of arteriole or venule dilatation. It is congenital and often associated with lipomatous deposits. It may be markedly pigmented and may present extraordinary variation in surface configuration and color. Telangiectasis is a term applied to a dilatation of the skin capillaries acquired usually in adult life. The lesions are usually multiple, and may be widely diffused over the body, but are commonest on the face. Single tortuous vessels may appear; usually they are grouped. They develop in regions exhibiting the lesions of chronic acne or the infiltration of rapidly growing tumor.

Cavernous angioma, exhibiting the structure of erectile tissue, forms soft, lobulated swellings, which exhibit marked variation in size incident to changes in venous pressure. Such a tumor may be mistaken for a cephalocele. The color and compressibility of the cavernous angiomata are the characteristic features. They may involve the greater part of an extremity, exhibiting in one part cystic formation, in another thick fibrolipomatosis. The difference in size and tension incident to the position of the leg is characteristic.

Gangrene.—Gangrene is essentially dependent on failure of the blood supply to the part. This may be due to traumatism which immediately and completely cuts off the circulation; to inflammation which occludes the lumen of the vessels by thrombus, aided in some cases by the direct pressure of the inflammatory exudate; to arteriosclerotic occlusion of the arterial lumen; to venous thrombosis producing stasis by back pressure; or to vasomotor spasm incident to disturbed innervation. In accordance with its cause gangrene is recognized as:

1. Traumatic gangrene, due to crushing and destructive violence, prolonged devitalizing pressure or constriction, the action of heat, cold, or chemicals. It may be dry or moist, in accordance with the amount

of tissue involved and the completeness with which saprophytic and pyogenic bacteria are excluded.

Acute spreading gangrene, particularly incident to lacerated contused wounds, may be due to the intensive action of the ordinary pyogenic organisms associated with the putrefactive and gas-forming germs, or to special infection by the bacillus of malignant or edema, the Bacillus aërogenes capsulatus. It is characterized by rapid extension of cellulitis beyond the area obviously involved, with the formation of gas in the tissues and the constitutional symptoms of profound sepsis. The nature of the infecting organism is determined by bacteriological examination.

2. Embolic gangrene. If peripheral and involving large vessels the block is often at the bifurcation of the artery. The popliteal, femoral, and brachial are seats of predilection. The gangrene may appear in the dry form, affecting the fingers or toes, and may be followed by the moist form incident to secondary infection, involving the foot and leg.

Thrombotic gangrene, if incident to trauma, would be suggested by the history and evidences of injury. If infective, the distinction from embolic gangrene would be difficult.

3. Senile gangrene, predisposed to by arteriosclerosis, occasionally observed in the young, usually precipitated by an attendant trauma or slight infection of the part involved, or thrombosis at the seat of greatest arterial lesion, usually attacks the feet in the form of mummification.

4. Diabetic gangrene is of the acute infective type, and is favored by tissues of poor resisting power and an associated arteritis and neuritis. It is characterized by the rapid sloughing and extension of a trifling infection, often by little or no pain. Except when associated with pronounced arteriosclerosis and directly dependent on this it appears in the moist form.

5. Angioneurotic gangrene exhibits a predilection for young women, affecting particularly the fingers and toes, but occurring at times in symmetrical patches on the surface of the body. It is characterized by a preliminary causeless, extremely painful pallor, numbness and coldness, followed by slow necrosis.

The symptoms of gangrene are those of local death, *i. e.*, loss of pulse, heat, sensation and motion; livid, finally black, discoloration, with mummification or putrefaction, always associated with vital depression, expressed in the form of acute or chronic sepsis. Whether the gangrene be of slow or sudden onset the initial symptoms are severe pain, lividity, loss of heat, loss of pulse, loss of sensation. The diagnosis is usually obvious.

Following severe contusion there may be discoloration and vesication which resemble gangrene. Preservation of pulse, of heat, of sensation, and a vitalized skin surface beneath the vesications establish the nature of the condition.

CHAPTER VIII.

THE LYMPH VESSELS AND GLANDS.

Rupture of the Thoracic Duct.—If this occur without peritoneal involvement, it results in an extravasation of chyle which burrows downward, becomes sooner or later infected, and opens as a huge postperitoneal abscess in the groin, closely simulating in position and symptomatology psoas abscess. Associated with this condition there will necessarily be a rapid emaciation. Diagnosis in these cases has usually been made by the continued flow of chyle after evacuation of what was supposed to be a psoas abscess.

The usual seat of wounding of the thoracic duct is at the root of the neck during extensive operations, such as removal of tumors from this region. The injury has been recognized at the time of operation by a continuous flow of chyle after the bleeding has ceased. Usually it is not suspected until an abundant flow of chyle fills a closely sutured undrained wound or flows from the drainage openings.

Progressive wasting rarely follows, the circulation of the chyle being provided for by collateral channels.

Lymphangitis.—Lymphangitis incident to infection may be acute or chronic. In its manifest form it is usually secondary to a virulent infection; it exceptionally develops after contusion or strain. It is usually associated with enlargement of at least the group of lymphatic glands into which the involved vessels empty.

A general reticular lymphangitis involving the small divisions of the peripheral lymphatics is not an unusual sequel of infected wounds. Because of its resemblance to the eruption of scarlet fever it has been named surgical scarlatina. This eruption is local with an infecting focus for its centre, or, if otherwise placed, it appears in patches and not as a diffuse eruption, nor are the associated lymphatic glands generally enlarged.

In its ordinary acute form, lymphangitis is characterized by rosy red, slightly edematous streaks corresponding with the position of the lymphatic vessels, accompanied shortly by enlargement of the associated glands. This acute form of infection may become suppurative, in which case nodular swellings, which shortly soften and discharge pus, are formed along the course of the vessels. Such suppuration is not unusual in an acute lymphangitis accompanying chancroid and the wounds contracted in postmortem examinations. The resultant abscesses are characterized by an abundant thin, purulent discharge, which exceptionally may be persistent and which may be increased by dependent position or by milking the parts.

In place of circumscribed abscess there is more likely to be developed general purulent infiltration of the surrounding cellular tissues. Suppuration of the deeper lymphatic vessels is characterized by the symptoms of acute cellulitis.

The distinction between lymphangitis and phlebitis may be difficult. Velpeau stated that "phlebitis can be palpated, but not seen; lymphangitis can be seen, but not felt"—a dictum which, though not accurate in its expression of fact, is suggestive as to the differentiation.

Chronic lymphangitis may be an expression of either local or systemic infection. In its syphilitic form it is characterized by painless induration of the vessel or vessels leading from a chancre to the associated group of lymphatic glands. Its usual position is on the dorsum of the penis, where it can be picked up from the skin and rolled between the thumb and finger as a hard cord. Palpable fine cords corresponding to the direction of the lymphatics are found in both the secondary and the tertiary manifestations of syphilis.

Tuberculous lymphangitis has been observed most frequently as a sequel to the anatomical ulcer observed on the hands of dissectors. It has developed even when the focus of skin inoculation could not be demonstrated. The affection is characterized by induration extending along the course of the lymphatic vessels, slow (months) in development, persistent, and exhibiting a series of nodules which gradually soften and break down, forming multiple ulcers, superficial or deep in accordance with the position of the lymphatic vessel involved. There is usually enlargement and softening of the associated lymphatic glands. Since other chronic infections may produce these lesions, diagnosis must be based on the finding of the tubercle bacillus or on the results of animal inoculation and the tuberculin test.

Malignant lymphangitis, characterized by painless, often nodular enlargements, is always associated with involvement of the lymphatic glands. It is usually obscured by the major malady. It can often be detected during operation.

Lymphangiectasis.—Lymphangiectasis, or dilatation of the lymphatic vessels, may be congenital or acquired.

The congenital form is usually manifested in infancy; it may not form an obvious swelling until later in life.

Macrocheilia and *macroglossia* and *lymphangioma* of the neck and axilla are the usual expressions of congenital cystic dilatation of the lymphatic vessels. These conditions are commonly associated with hemangioma.

Acquired lymphangiectasis due to obstruction, either extrinsic or in the vessel itself, and in the latter case usually incident to postinflammatory contraction, is commonest in the groin and genital regions, forming here at times a diffuse, soft, slowly growing tumor, which never reaches great size, which is lobulated, is distinctly varicose, and is to an extent movable upon the deeper parts and partly reducible. The convolutions of the dilated vessels can often be seen on inspection and palpation, suggesting the sensation which is conveyed by a bundle of worms.

The latter distinguishes this condition from lipoma, while translucency is highly characteristic when the vessels are so superficially placed that this sign can be elicited. Associated dilatation of the vein lower down is usually characteristic of venous varicosity in this position.

Obstruction of the large lymphatic ducts, if the collateral circulation be insufficient, will cause not only lymphangiectasis, but also lymphedema; or this condition may develop in the absence of obvious dilatation of the lymphatic vessels.

Lymphedema.—Lymphedema is characterized by a brawny infiltration which in its ultimate development produces the condition known as elephantiasis. The overlying skin is thickened, often papillomatous, and subject to dermatitis. The subcutaneous tissues are those mainly involved. Ultimately the muscles atrophy.

This condition may develop in any part of the body, but is commonly encountered in the leg and the scrotum. The obstruction causing it may be due to repeated inflammations, producing ultimate narrowing and obliteration of the vessels, to infiltration of the receiving glands (carcinoma and tuberculosis), or their removal, or to lodgement of the filaria.

The diagnosis of the latter condition depends upon the associated hematuria and chyluria and the finding of the parasite in the blood.

In its slighter development lymphedema is often associated with chronic leg ulcer. The difficulty in healing leg ulcers which are unassociated with other visceral disease or obvious venous dilatation is probably incident to retarded lymph circulation, due to a chronic lymphangitis, this condition not being sufficiently developed to cause obvious lymphedema.

Lymphadenitis.—The lymph nodes may be either acutely or chronically inflamed.

Acute inflammation is usually due to the ordinary pus microbes and is characterized by the formation of one or more rounded tender swellings, over which the skin is movable, developing in the glandular group which drains an infected focus, and usually associated with mild symptoms of septic absorption. If the affection be virulent and destructive, the nodule or nodules are quickly obscured by periglandular edema and abscess formation. Inflammation in the superficial glands offers no diagnostic difficulties.

When the deeper glands are involved in acute suppurative inflammation, the local and constitutional symptoms are simply those of deep phlegmon the glandular origin of which can be determined only by the position of maximum tenderness and swelling, the pain radiations, the interference with function, and the finding of a surface infection, which drains by the lymphatic vessels to the region involved. Such abscesses may burrow wide of their original seat. Deep local tenderness and infiltration and superficial edema are the localizing symptoms which guide the diagnostic and curative incision.

Chronic lymphadenitis, an occasional sequel of acute inflammation, usually the result of a continued and frequently repeated mild infection,

not infrequently tuberculous, sometimes syphilitic, is characterized by the enlargement and induration of a single gland or of an entire group, unattended by pain or local inflammatory symptoms, subject to recurring subacute attacks with rapid variations in size, terminating either in resolution or suppuration.

Chronic Non-tuberculous Inflammatory Hyperplasia.—This is commonly encountered in the cervical and inguinal regions, less frequently in the axilla. In the cervical region it is usually secondary to infections of the nose, mouth, throat, or ear. In children, particularly when it involves the posterior group of glands, it is often due to head lice.

The affection, if the cause is not removed, is slowly progressive and results in softening of individual glands and the discharge of an apparently sterile pus without inflammatory symptoms more marked than those needful for skin perforation. This softening takes place before the glands have reached the size of a pigeon's egg, and usually involves but a single gland.

These cases of non-tuberculous chronic hyperplasia are rarely seen by the surgeon, since the enlargement is moderate and not progressive and the tendency is toward cure. Most of the cases referred to him are progressive and tuberculous.

The lymphatic enlargement of beginning Hodgkin's disease is rapidly progressive, the tumor shortly reaching a size beyond that encountered in inflammatory cases while still preserving its normal consistency.

Chronic adenitis in the inguinal region, usually secondary to urethral inflammation, occasionally maintained by a fissure or other anal lesion, or by repeated slight trauma of the feet, or following excessive coitus without genital lesion or assignable cause, is distinguished from syphilitic bubo by the absence of the primary sore of the latter disease and its different evolutions; from tuberculous adenitis by discovery of a non-tuberculous source of infection or by the failure of the glands to undergo the typical tuberculous evolution.

Syphilitic Adenitis.—Syphilitic adenitis is a customary early manifestation of syphilitic infection, involving, first, the glands anatomically connected with the seat of primary lesion, later to some extent all the lymphatic glands of the body. The syphilitic buboes, symptomatic of chancre, are characterized by their multiplicity and painlessness, the individual glands rarely attaining a size greater than the last joint of the thumb and remaining freely movable and non-adherent to each other beneath the skin. The glands in the upper postcervical regions and those placed in front of the internal condyle of the humerus are the ones whose enlargement is considered particularly characteristic of the developing secondary lesions. Suppurative adenitis is occasionally observed as the result of mixed infection.

A general glandular involvement with moderate fever and the muscle pains of toxemia occurs as the result of infections other than syphilis. This is seen in la grippe epidemics. The distinction from syphilis is based on the absence of a primary lesion.

Tertiary syphilis is exceptionally characterized by multiple, indurated,

painless glandular swellings, particularly in the neck, axilla, the elbow, and the groin.

Gumma (extremely rare) occasionally develops in the glands of the groin and neck. The progress is slow (months); softening and ulceration occur before the glands reach the size of a hen's egg.

The diagnosis in the infiltration period cannot be made from malignant growth, except by a consideration of the history and the finding of more characteristic lesions or their scars.

There is a phagedenic form of ulceration secondary to syphilitic lymphadenitis observed in the groin. The skin lesion, incident to perforation of the abscess, slowly (months) extends, inducing widespread destruction of both the superficial and the deep tissues.

Tuberculous Adenitis.—Tuberculous adenitis, commonest in ill-nourished girls of the second decade but observed at any age, strongly predisposed to by heredity and affecting by preference chronically inflamed glands, has for its seats of predilection the neck, the groin, and the axilla. In the neck the submaxillary and the deep cervical nodes commonly are first involved. Tuberculosis of the axillary and inguinal nodes is less frequent.

In its early stages tuberculous adenitis cannot be distinguished from inflammatory hyperplasia of other origin. There is a painless induration and enlargement of one or all of the gland group which may persist for months or years without change other than gradual growth and progressive involvement of glands lying nearer the trunk. As a rule, a gland group, sometimes the entire chain, exhibits the symptoms of a chronic periadenitis, *i. e.*, the surrounding tissues become infiltrated and form part of the tumor mass, and individual glands soften and discharge through the skin, leaving ragged, undermined openings, from which there is a continuous running of thin, curdy pus.

The diagnosis is suggested by the age incidence, the chronicity, the absence of pain or marked tenderness, the tendency to extend toward the trunk glands, and the persistence after the cure of an infecting focus which might account for chronic inflammatory hyperplasia. The diagnosis should be strengthened by tuberculin injection, and, if needful, should be confirmed or disproved by removal of the gland before the period of suppuration.

Exceptionally tuberculous adenitis presents almost the identical features of Hodgkin's disease.

Hodgkin's Disease.—Hodgkin's disease, occurring usually in men, is characterized by the slow or rapid growth of lymphatic glands, at first distinct from each other, finally merging to form huge masses. There is usually an associated intermittent fever. The blood shows no changes excepting diminished hemoglobin and eosinophilia.

This affection usually begins as a soft, painless enlargement of one or two of the cervical glands, or of the axillary or inguinal group. At this stage the preservation of normal elasticity and consistency, the absence of an exciting cause, and particularly rapid growth, without exhibiting any tendency toward periadenitis might suggest a diagnosis. Similar growths

in other regions shortly make the nature of the affection plain. Removal for microscopic examination shows usually the structure of the normal gland or one exhibiting a slight degree of inflammatory hyperplasia.

Lymphatic Leukemia.—Lymphatic leukemia is characterized by similar enlargements associated with tumefaction of the spleen, the liver and thymus, and bone-marrow changes. The diagnosis is based on blood examination, which shows marked leukocytosis, the lymphocytes being relatively and absolutely enormously increased in number. The myelogenous form of anemia is characterized by leukocytosis with many myelocytes.

Lymphosarcoma.—Lymphosarcoma as a primary affection usually involves a group of glands, presenting precisely the picture characteristic of Hodgkin's disease with the exception of the blood changes. The growth is rapid, and quickly invades the surrounding tissues. The diagnosis should be made by the prompt removal of the soft, rapidly growing, apparently causeless gland or group of glands.

CHAPTER IX.

THE MUSCLES, TENDONS, AND BURSÆ.

THE MUSCLES.

Traumatisms.—Contusion.—Contusion of the muscle is characterized by a condition of partial palsy, deep pain, local tenderness to palpation and on movement, swelling, and late (days) ecchymosis.

If there has been extensive blood effusion, which always implies muscular rupture, there will be formed rapidly a fluctuating tumor, which later becomes indurated and may ultimately exhibit bony hardness.

Unless the nerves be involved, atrophy and contracture are not likely to occur.

Rupture.—Rupture of muscles is caused by violent contraction or the direct application of force when they are in a condition of contraction. Predisposing factors are muscular degeneration such as follows prolonged fevers and overuse. It is common in athletes out of training.

In the order of frequency the rectus abdominis, the adductors of the thigh, the pectoralis major, the deltoid, the midportion of the quadriceps extensor, the muscles of the back, the muscles of the calf, and the flexor muscles of the legs and arms are the ones involved.

The rupture may be fibrillary, partial, or complete.

Fibrillary rupture is characterized by sudden severe pain, disability, and usually tenderness on deep pressure. It is the usual cause of affections called sprained back, sprained neck, sprained shoulder. The pain on motion and tenderness may last for weeks in the absence of immobilization.

Complete ruptures usually located at or near the musculotendinous juncture, and characterized by a feeling of something having given way, are accompanied by sudden pain, usually extremely severe; immediate disability, not only of the affected muscle, but of the whole muscle group; tenderness; gap in continuity at the seat of break, with a hard lobular swelling at either end of the breach, the proximal one most pronounced and increased in size and hardness by efforts at contracture; often the rapid formation of a large blood tumor; and late ecchymosis.

A central partial rupture exhibits the symptoms of the complete rupture, the pain being even more severe. In place of a gap in continuity, there is formed a rounded or oval tumor which becomes denser and more pronounced and moves upward during contraction and can be partially reduced when the muscle is relaxed. This at first may be obscured by tenderness and blood effusion.

Partial rupture may recover in a few weeks. Sometimes it becomes the seat of osteoma. Very exceptionally atrophy results, due to rupture of the nerve. One or both fragments may undergo this change.

Hernia.—Hernia of the muscle (extremely rare) is a gradual development, due to a yielding of the fibrous sheath. There is formed a small oval tumor without subjective symptoms. It is soft and prominent when the muscle is relaxed. When the muscle is forcibly contracted it becomes hard with the rest of the muscle, not more so, and either partially or completely reduced. There is but slight interference with function.

Most cases reported have been those of muscular rupture. From rupture it may be distinguished by its slow and painless development and its different behavior on forced contraction; from tumor, by the fact that the latter does not change in density or volume incident to contraction either voluntary or forced.

Myositis.—Myositis may be traumatic, toxic, or infectious; acute or chronic. It is exceptionally suppurative.

Infection may be due to extension of inflammation from the surrounding parts, or may occur as a local expression of systemic poisoning, in the course of acute infections or after them. Myositis is characterized by extreme pain greatly aggravated by motion, tenderness, swelling, induration and contracture producing a fixed position.

Traumatic Myositis.—Traumatic myositis, representing the reaction from contusion, sprain, or overuse, is typically instanced by the affection of the extensors of the leg called by football men "Charley horse," to a less degree by the stiffness and soreness of any group of muscles subject to unaccustomed, violent, or prolonged use. It predisposes to muscular rupture.

Toxic and Infectious Myositis.—Toxic and infectious myositis, usually rheumatic, is common in the muscles of the shoulder, back (lumbago), and neck (sternomastoid, trapezius, extensors). It is always a symptom of systemic poisoning, often of focal origin (appendix, tonsils, teeth, sinuses of the head).

Exceptionally there is multiple involvement, the skin overlying the affected muscle being reddened and edematous, the muscle below swollen, tender, hard (sometimes soft), and painful on movement.

Suppurative Myositis.—Suppurative myositis may be expressed in the form of localized abscess or diffuse phlegmon.

A localized abscess reaches the surface slowly. The seat of suppuration is characterized by an almost bony hardness, followed by softening, taking place in days or weeks.

Early diagnosis is based on the deep seat of the inflammation, its acute onset, its limitation to the muscle affected, fixed position due to contracture, and the constitutional symptoms of retained pus.

Diffuse Phlegmonous Myositis.—Diffuse phlegmonous myositis occurs in those of depressed vitality subject to prolonged fatigue. It is at times a sequel to trauma. It begins with characteristic violent septic symptoms and severe pains, often supposed to be rheumatoid. Nicaise calls attention to the frequency of head symptoms, particularly pain and active

delirium and violent agitation. Constitutional symptoms may entirely overshadow the local lesion. Tenderness and pain in the muscle, with contracture, are accompanied by an edematous thickening not so clearly outlined as in the case of non-suppurative myositis. The course is extremely acute, much like that of osteomyelitis.

Chronic Myositis.—Chronic myositis may follow an acute attack. In the absence of other demonstrable cause it is called rheumatic. It is characterized by induration and slow contracture.

Ossifying Myositis.—Ossifying myositis may occur about the seat of an old fracture, may be an extension from osteoarthritis, or may be due to muscular trauma, particularly that which is moderate in severity and frequently repeated. Partial muscular rupture is particularly a predisposing factor.

Its commonest manifestation, so-called "rider's osteoma," is placed near the pubic insertion of the adductors. There may be multiple foci of ossification in the muscle. These tumors have also been observed in the deltoid and brachialis anticus, and occasion little distress aside from mechanical interference with function.

Progressive ossifying myositis is usually observed in the male; sometimes the newly born; as a rule, before the fifteenth year. There is a preliminary swelling. The dorsal muscles of the spinal column, particularly those in the cervical region, are first involved. The affection is irregularly progressive, characterized by disseminated areas of swelling in the muscle, by tenderness and often skin edema, and fixed position. The swellings become hard and finally bony.

Diagnosis is based on the generalization of the affection.

Tuberculosis of the Muscles.—Tuberculosis of the muscles is usually secondary to neighboring bone or surface affection. In its primary form (rare) it may appear as a nodule (tuberculoma) or cold abscess or general infiltration.

Tuberculoma cannot be distinguished in its early stages from gumma or neoplasm. If gumma can be excluded with reasonable certainty the diagnosis should be made by excision.

Cold abscess of the muscle, exceptionally due to softened primary muscle tuberculoma, usually to an extension of tuberculous infiltration from bones or joints, is characterized by tumor and fluctuation preceded by the symptoms of chronic myositis (contracture). Acute inflammatory symptoms are absent until the skin is about to break.

General infiltration occurs secondary to bone and joint tuberculosis and is followed by softening and abscess formation.

Syphilis of Muscles.—Myosalgia, or acute muscular pain, is a common affection of early syphilis; indeed, it is one of diagnostic value, especially as it occurs about the shoulders and back of the neck. In the case of the sternomastoid muscle it may produce torticollis.

The muscles are tender, both on movement and palpation. The affection has been called syphilitic rheumatism.

Syphilitic myositis attended by contracture, particularly common in the biceps, also observed in the sternomastoid, the trapezius, the biceps

femoris, and other muscles, occurs in the first year of the disease as an expression of the secondary period. It is characterized, first, by muscular stiffness, swelling, and hardness, followed, in the case of the biceps, by fixed flexion of the forearm. Even in the absence of syphilitic history or other signs of the disease such a contracture not incident to trauma or nerve lesion can be regarded as characteristic.

Tertiary syphilitic myositis is characterized by swelling and induration which may be diffuse or circumscribed. The diffuse form exhibits the symptoms of the secondary involvement, except that the onset is more insidious, the course slower, the swelling greater, the contraction more marked. Pain and tenderness may be severe or absent. The muscular structure entirely degenerates and is replaced by fibrous tissue. The sternomastoid, the rectal sphincter, the biceps, pectoralis major, the deltoid, the common extensors of the fingers, the trapezius, and the calf muscles are those of predilection. The early diagnosis is of major importance, since treatment is futile after muscular degeneration has become complete.

Gumma of the muscle may begin with subacute inflammatory phenomena or entirely in the absence of these, forming at first an ill-defined, slow-growing (weeks) infiltration, later a rounded or elongated tumor in the muscle substance, usually near the region where the latter merges into the tendon. Such tumors occasionally involve at the same time the same muscle on the two sides of the body. They may undergo absorption and sclerosis. They usually soften and break down, forming typical gummatous ulcers.

Neoplasms.—Neoplasms of the muscles are usually benign.

Angioma and *lymphangioma*, usually congenital, are suggested by their softness, obscure outlines, and alterations in sizes, incident to dependent and elevated positions of the parts in which they are placed; often they are associated with cutaneous and subcutaneous tumors of a similar nature.

Lipoma, encapsulated and of slow growth, may be inferred from its lobulation and softness.

Enchondroma is characterized by its density.

Sarcoma begins precisely as do the benign tumors, gumma and tuberculous infiltration. It is distinguished from the latter clinically only in its late development, growing to a much larger size. The diagnosis by any form of examination is absolutely impossible at the time it is serviceable. It should be made, if gumma be excluded, by the prompt excision of any apparently causeless, rapidly (weeks) growing tumor placed in the muscle.

Echinococcus Cyst.—Echinococcus cyst, commonest in women, is characterized by the slow growth (years) of a hard rounded muscle tumor which rarely reaches large size. Occasionally this tumor gives the so-called hydatid fremitus.

Diagnosis is impossible without exploration, since the hydatid cyst may exactly simulate gumma, tuberculoma, hematoma, indeed, any of the muscle tumors.

Muscular Contracture.—This term, implying persistent shortening as contrasted with contraction, which indicates the intermittent physiological process, may be reflex, postural, myositic, of central nerve origin.

Reflex contracture is an early and nearly constant symptom of arthritis and peritonitis, involving the muscles whose action is most protective.

Myositis in any of its forms, if persistent, is followed by contracture due to the formation of fibrous tissue.

Postural contractures are such as are observed after long splinting or fixed position; or as occur sequent to failure to provide against the effects of gravity and unopposed force after peripheral palsies.

Ischemic contracture palsy due to pressure which cuts off blood supply is particularly noted in the forearm after tight bandaging; in all the extremities after the Esmarch tube. It may follow wounds or ligature of larger vessels. The degeneration affects muscular fibers, the nerves themselves remaining intact. It is characterized by contracture, loss of power, and atrophy.

The severe forms are incurable.

Atrophy.—Atrophy of muscles is due to non-use, long-continued contracture, as from inflammation and fixation of joints, persistent extension and peripheral nerve lesions. Atrophy of joint inflammation is in part reflex. It is particularly marked in the deltoid and in the extensors of the thigh.

Paralysis.—Paralysis of muscles is due to injury or disease of central or peripheral nervous system or to muscular degeneration.

Postanesthetic Paralysis.—Postanesthetic paralysis may be central, hysterical, reflex, or peripheral. It is usually peripheral, and follows prolonged Trendelenburg position with the arms hanging over the head. Thus is pinched the brachial plexus against the transverse vertebral processes, between clavicle and first rib; or possibly against the head of the humerus.

The upper cords are most injured, as expressed by paralysis of the deltoid, biceps, brachialis anticus, and long and short supinators. All of the muscles of the arm may be involved.

The arm resting against the edge of a table may compress the musculospiral nerve, causing wrist-drop, or the peroneal muscles may be paralyzed by pressure on the external popliteal.

The diagnosis is based on the finding of a paralysis not present before operation and by the rapid and progressive development of the reactions of degeneration in severe cases.

Crutch palsy is usually expressed in the muscles supplied by the musculospiral nerve; those innervated by the median or ulnar may be involved.

Obstetric or birth palsy following difficult labor usually involves the brachial plexus. It may affect the mother by pressure of the head upon the sciatic or obturator nerve, causing pain, contracture, and palsy.

In the child it is commonly manifested by facial palsy from forceps pressure; or brachial plexus palsy usually of the superior root type, *i. e.*, deltoid, biceps, brachialis anticus, infraspinatus, and supinator longus.

Reflex palsies, characterized by exaggerated reflex, moderate, but persistent atrophy, and diminution in electrical excitability, but not the reactions of degeneration, are such as are observed following joint trauma.

THE TENDONS.

Trauma of the Tendons.—Wounds.—Wounds of the tendons, usually obvious on inspection, are characterized by complete loss of that motion on which their integrity is dependent. When the tendon is completely divided, often, but not always, there can be felt a loss of continuity, and the divided ends can be palpated, the proximal one moving with contraction of its muscle and often retracted from the wound.

Rupture.—Rupture of the tendons is characterized by sudden pain, the loss of motion which was dependent upon the integrity of the tendon, and usually an appreciable gap in continuity, filled in by blood which can be pushed aside, thus allowing the two extremities of the tendon to be felt. The distinction from muscular rupture is made by the position of the break; from tearing away of the tendinous insertion of the bone; sometimes, but rarely, by bony crepitus or palpation of the bony fragment.

Luxation.—Luxation of tendons in the absence of complicating fracture is rare. It usually affects the tendon of the peroneus longus. What has often been called luxation of the long head of the biceps is usually a subacromial bursitis.

Tendon luxation is accompanied by pain, the sensation of something having given way, by impaired function, and local tenderness. The displaced tendon can be felt and reduced.

Inflammation of the Tendon.—Peritendinous Cellulitis.—Peritendinous cellulitis may be traumatic or infective, and involves the cellular tissue immediately surrounding tendons not provided with an investing synovial sheath. It is common after overuse, and in the foot often follows the wearing of ill-fitting shoes, forming a tender, puffy, edematous swelling on either side of the tendo Achillis, which gradually fades into the surrounding healthy tissues.

The diagnosis of this condition is based on the position of the swelling. If the inflammation becomes suppurative, tendon sloughing is likely to result.

It is distinguished from inflammation of the bursa by the fact that the outlines of the latter are rounded and distinct.

Syphilis of the tendons may appear as infiltrations or small gummatous nodules.

Fibroma and fibrosarcoma are rare tumors of tendons.

A fibrous nodulation, probably traumatic, of the flexor of a finger causes a peculiar locking in flexion and extension, followed by a sudden giving way, called trigger finger.

Tenosynovitis.—The inflammations of the synovial sheaths of tendons correspond in etiology, and to some extent in symptoms, with inflammations of other synovial sacs.

The inflammation may be traumatic, toxic or infectious, acute or chronic, serous, plastic or suppurative.

Acute tenosynovitis is usually due to overuse or sprain. In its mildest form it represents simply a hyperemia and a slight hypersecretion, and is termed crepitant tenosynovitis from the fine crackling sensation given when the tendon slips in its synovial sheath as the result of muscular contraction.

Tenderness, pain on motion, and crepitation, elicited by grasping the part and directing the patient to make movements which require contraction of the muscle of the involved tendon, are the characteristic symptoms. The swelling is slight. There may be a rosy edema of the overlying skin. The tendons commonly involved are those of the forearm, wrist, hand, and ankle.

If the trauma be severe, there is distinct effusion not only within the tendon sheath, but in the surrounding tissue, forming a cylindrical swelling in the course of the tendon, which is tender to pressure and on motion. This effusion may undergo organization fixing the tendon.

Plastic and serous tenosynovitis are occasionally expressions of constitutional toxemia or infections such as rheumatism, la grippe, typhoid, pneumonia, and the exanthemata. They are usually due to gonorrhea. The effusion is fibrinous rather than serous, and moderate in quantity. Exceptionally it is abundant and undergoes organization, limiting motion. This is particularly likely to be the case when the inflammation of the tendon is associated with a gonorrheal arthritis.

Suppurative synovitis is usually due to direct infection through a wound or to extension from surrounding soft parts. It is common in the tendons of the finger and hand secondary to panaris or palmar abscess, and is characterized by a tender, edematous swelling extending along the tendinous sheaths, with the local and systemic symptoms of acute extending suppuration.

Suppurative tenosynovitis is often followed by extensive sloughing of tendon, or, if this is avoided, by firm adhesion of the tendon to its sheath or to the surrounding soft parts.

Chronic tenosynovitis may be traumatic, toxic or infectious. It is usually tuberculous.

Chronic tenosynovitis due to repeated slight trauma, or to overuse, appears as a serous effusion, forming a soft, fluctuating, painless tumor in the course of the tendon sheath. This is rare.

Tuberculous tenosynovitis appears in the serous or fungous form.

In the serous form the synovial sheath is greatly thickened, distended by a thin fluid, and contains few or many white bodies varying greatly in size, looking like grains of half-boiled rice. The enclosed tendon may be quite intact or may be fibrillated and torn across.

This may be the sole demonstrable manifestation of tuberculosis. It often follows slight trauma, and is usually found in the common sheath of the flexors of the fingers. Occasionally it involves the sheath of the extensors of the hand or of the foot.

It is characterized by slow growth, with periods of acceleration incident

to trauma, and in the hand by the formation of a characteristic tumor, non-sensitive, fluctuating, which projects in the palm and the wrist and is divided into two portions by the annular ligament. There is usually a crepitation which is distinct, and has been compared to the rubbing of a chain. When the solid bodies are few or absent this friction sound cannot be elicited.

The muscles of the tendons involved are contractured and ultimately atrophy. The fingers are moderately flexed and cannot be extended. When the sheath of the extensor tendons of the hand is involved a globular swelling forms on the back of the wrist.

The affection is slowly progressive (years). Untreated it ultimately ulcerates and becomes converted into the fungous form.

Fungous synovitis is usually secondary to tuberculous involvement of bones or joints. In its primitive form it may develop as an expression of general tuberculosis or as an isolated lesion. The synovial lining and often the tendons themselves are invaded by a mass of lowly vitalized gelatinous granulation tissue.

It occurs, as a rule, in the young, and is most frequent in women. The predisposing factors are slight trauma or repeated irritation, as from excessive use of certain tendons. It occurs particularly in the sheaths of the common flexors of the fingers or those of the thumb. It is also observed about the ankle.

The fungosity begins in the cul-de-sac at either end of the tendinous investment, and finally involves the whole sheath.

The onset is gradual, being attended by slight soft swelling and limitation of motion. The further progress is evidenced by a slow (months, years) increase in swelling, occupying the position of the tendon sheath. In the palm the swelling is bilobed by the annular ligament. In the early stages the swelling can be slightly displaced laterally and also moves with the tendon, showing close connection between the two. The tendons at first become fixed, limiting motion; later they soften and break. This does not alter the fixed position of the parts, since the distal stump of the tendon remains adherent to its sheaths. Ultimately (years) softening occurs with tuberculous ulceration. Neighboring joints may be involved.

This affection may be distinguished from syphilis by its wider diffusion, its slower course, and in the case of syphilitic lesion associated specific lesions and the therapeutic test; from lipoma, by the slower course of the tumor, absence of tendon fixation and muscular atrophy, and free mobility of the part; from sarcoma, by the rapid growth of the latter, and by operation; from tuberculous arthritis, the late stage of which it generally complicates, by the location of the swelling and the *x*-ray. After sinus formation the depth and direction of these and the presence or absence of dead bone on probing will suggest the diagnosis of the seat of the affection.

Syphilitic tenosynovitis may take the serous or gummatous form, the former during the secondary period. It affects by predilection the extensors of the hand and foot. It is insidious in onset, exceptionally inflammatory, may be symmetrical, and causes but trifling disability.

Gummatous tenosynovitis (rare) forms an induration which grows to an ill-defined, hard, rounded tumor in the course of weeks or months, usually softening before reaching the size of the end of the thumb and discharging through a central ulceration.

Tumors of the Tendon Sheaths.—Tumors of the synovial sheath are the lipoma, fibroma, and sarcoma.

Lipoma.—Lipoma has been observed in the extensors of the hand and in the sheath of the flexors beneath the palm. The soft tumor simulates tuberculous tenosynovitis; it does not, however, fix the fingers in flexion with muscular atrophy. The diagnosis must be made by incision.

Fibroma.—Fibroma (rare), usually observed in the tendon sheaths of the fingers, forms small hard tumors of slow growth. In their first development these tumors should be distinguished from sarcoma by excision and by microscopic examination.

Fibrosarcoma.—Fibrosarcoma is usually observed in the flexor tendon sheaths of the fingers and hand. It remains small and quiescent for years and then begins a rapid growth. Until this period of growth it exhibits the symptoms of fibroma, nor can the diagnosis be made except by excision and microscopic examination.

THE BURSÆ.

The bursæ are connective-tissue sacs with an endothelial lining. They are antifriction devices which secrete a synovial fluid. In the positions where they are customarily encountered they are not developed until their presence is required by muscular activity, hence children are wanting in many of them. They may develop in regions where they are not customarily found as the result of pressure and friction, and are then termed accidental, or adventitious.

Bursitis.—Bursitis may be traumatic, secondary to inflammation of surrounding parts, or a local expression of systemic poisoning, as from the acute and chronic infectious diseases (gonorrhea, rheumatism, exanthemata, etc.).

Acute Bursitis.—Acute bursitis is characterized by pain increased by motion, tenderness, often crepitation at first, later fluctuation in the region of the bursæ. If the exudate is fibrinous or serous, there will be no other symptoms. If the affection is suppurative (secondary to infecting wound or peribursal suppuration), the local and general symptoms of acute suppurative infection will be present; at first localized to the bursa and its immediate environment, later characterized by a diffuse phlegmonous infiltration of the soft parts, or even of the joint, causing acute suppurative arthritis. The distinct localization, clear outlines, and rapid progression of the inflammatory tumor are in the early stages diagnostic. Even when suppuration takes place the general inflammatory edema will be found to focus in the region of the bursa. It is only when the inflammation has been allowed to run on to diffuse phlegmon that the complications obscure the original lesion.

Chronic Bursitis.—Chronic bursitis is characterized by the gradual formation of a tumor, usually fluctuating, exceptionally translucent, and, when placed beneath a tendon, becoming tense or flaccid in accordance with the position of the joint. It is usually of medium size, not larger than an average orange, though it may become huge. It is sharply outlined and corresponds in position with that of a normal bursa or in history and mechanics of development with that of an adventitious one. Often crepitation and at times the rice-like bodies with which these bursæ are frequently filled can be felt.

The fibrous hemorrhagic hygromata so exactly simulate tumor that the diagnosis can be made only by operation, though it may be suspected from the anatomical position of the growth, often subject to transitory attacks of acute inflammation.

Acute infection of a chronically inflamed bursa, often following trauma, usually leaves a fistula which refuses to close. The nature of this fistulous tract is determined by probing and exploratory operation. The *x*-rays also are useful, since they will demonstrate the absence of a bone lesion.

The sac wall may be greatly thickened or even cartilaginous in places and closely adherent to the surrounding parts, or even surrounded by a dense fatty deposit. The inner surface may be clean, may exhibit vegetating outgrowths, or in gouty patients calcareous concretions. From organization of repeated small hemorrhages of the sac the wall may become so thick as to suggest solid tumor, the fluid contents of which are entirely obscured by the rigid sac. Or the contents may be solid or semi-solid, appearing in the form of partially organized fibrin or granular debris.

The bursæ commonly involved in chronic inflammation are the olecranal, supra-acromial, subacromial or subdeltoidean, subiliac, trochanteric, prepatellar, subpatellar, pretibial, semimembranosus, popliteal, and that of the tendo Achillis.

Tuberculous Bursitis.—Tuberculous bursitis usually secondary to infection of the neighboring joints, sometimes primary, is especially observed in the bursæ about the knee, shoulder, elbow, and hip-joint. It is characterized by tuberculous infiltration of the bursal wall, a serous effusion, ultimately caseous degeneration and the formation of a cold abscess. In its comparatively early manifestation the affection may assume either the serous or the fungating form.

Tuberculous bursitis is characterized by tumor in the position occupied by a constant or an adventitious bursa. This tumor offers the characteristics of other forms of bursal effusion. A single suggestive feature is its causelessness. The diagnosis may be made by excision and microscopic examination, or aspiration of the bursal contents and injection into susceptible animals. The ultimate history of a tuberculous hygroma is fistulization.

Syphilitic Bursitis.—Secondary syphilis may cause a serous effusion in the bursæ, with inflammatory symptoms either slight or wanting.

Gummata are fairly common, particularly in the prepatellar and the

pretibial bursæ and that of the olecranon. Traumatism is a predisposing factor. The affection is sometimes symmetrical.

Both the serous effusion and gummata are characterized by the absence of subjective symptoms and promptly yield to specific treatment. The gummatous affections usually soften and ulcerate, forming the characteristic punched-out ulcer. The distinction from tuberculosis in the late ulcerating cases must be based upon the history and the associated lesions.

Tumors of the Bursa.—*Sarcoma* is the commonest bursal tumor.

Myxoma, enchondroma, and *fibrochondroma,* all tumors of slow growth, have been observed. The neighboring joints are not involved and the tumor is usually movable over the bone. The diagnosis should be suggested by the existence of a rapidly growing bursal tumor and must be confirmed by prompt excision.

CHAPTER X.

THE BONES AND JOINTS.

THE BONES.

Traumatism.—The bones may be bruised or broken.

Contusion.—Contusion is characterized by pain, usually severe, deeper placed and more persistent than that of bruising the soft parts, by exquisite tenderness on deep pressure, and, if the bruised bone is superficially placed, by palpable swelling, not movable over the underlying bone. There may shortly follow this injury a soft subperiosteal hematoma.

The osteitis resulting from the contusion usually is circumscribed and undergoes prompt and complete resolution. It may be persistent and be followed by distortion (coxa vara) or by bony overgrowth. Suppurative or tuberculous osteitis is an occasional sequel.

Fracture.—Commonest in males except at the extremes of life, may result from either direct or indirect force or muscular action.

Direct force breaks the bone at the seat of application; indirect force, in the case of the long bones, usually toward their extremities.

The fracture may be simple, the line or lines of bone-break not communicating with a skin wound, or compound, there being in this case such communication. The break may be incomplete (green-stick fracture, fissured fracture) or complete.

A multiple fracture is one in which a bone is broken into more than two fragments. A comminuted fracture is multiple, with the lines of cleavage intercommunicating.

The direction of the break is usually oblique; it may be transverse (direct violence) or spiral. The latter frequently in the bones of the leg and in the femur and humerus.

The deformity of the fracture may be angular, transverse, rotary, or longitudinal. Often it is a combination of these, the displacement being produced by the vulnerating force, muscular contraction, and the weight of the part.

An impacted fracture implies the driving of one fragment into another so firmly that preternatural mobility cannot be elicited.

Fracture from muscular contraction is usually in the form of a tearing off of a shell of bone at the point of tendon insertion. This is a common complication of luxation. The ribs, the clavicle, the humerus, any of the long bones may be broken through their long axis by muscular action alone.

Birth fractures are comparatively common following instrumental

or manual delivery, or even in the absence of these. The bones of the skull are those which suffer most. The clavicle, femur, and humerus are also frequently involved.

Spontaneous fracture, by which is meant the break of a bone from trifling force, should always suggest either a local or a systemic predisposing condition.

Among the predisposing conditions are osteomyelitis, suppurative, tuberculous, or syphilitic; infiltrating or eroding tumors; rickets; osteomalacia; senility; pregnancy; locomotor ataxia; psychoses; paralysis, and disuse atrophy. The diagnosis is often not made until visible deformity calls attention to the lesion, since those spontaneous fractures have few subjective symptoms and often occur in patients whose major malady inhibits function. There is at times an enormous outgrowth of callus attending union which is usually slow and often never takes place.

Aside from the causes predisposing to fracture already given there is a bone fragility of unknown origin unassociated with other lesions, sometimes congenital, often persisting through life and characterized by many fractures which heal kindly. This is called fragilitas ossium.

The diagnosis of fracture is based on the presence of one or all of its cardinal symptoms: (1) Abnormal mobility; (2) deformity; (3) crepitus.

The abnormal mobility is detected by direct palpation at the seat of break supplemented in the case of the long bones by extension, and, where this is applicable, attempts at angulation. It is absent in greenstick and fissured fractures, and in those which are impacted.

Deformity, often obvious on inspection and palpation, is usually corroborated by mensuration and the *x*-rays. It is absent in fissured fractures. It may be present only when produced by manipulation in subperiosteal and epiphyseal fractures and in breaks of bone naturally splinted by either another bone or muscle, as in the case of the fibula, ribs, or scapula.

Crepitus is detected by rubbing the broken ends of the bone together. This is accomplished by direct manipulation or by pulling, angling, and rotatory movements of the distal fragment, the proximal one being fixed. Crepitus can be distinctly felt as a grating, and can be heard by the naked ear or by means of a stethoscope. It is absent in incomplete and impacted fractures and in those the broken surfaces of which cannot be brought into apposition either because of wide separation or interposition of soft parts.

In addition to these cardinal fracture symptoms there are those of all severe trauma, *i. e.*, pain, disability, swelling, and discoloration, the latter coming on late (days).

Pain and tenderness are felt at the seat of fracture, and both are persistent even in the absence of deformity. Disability is usually pronounced.

Swelling and late discoloration not due to direct trauma are extremely suggestive symptoms.

Sugar, indican, and fat are commonly found in the urine after fracture and are of some slight diagnostic value.

The fever reaction, rarely over 100°, for one to three days, is that common to trauma.

The examination for fracture cannot be considered complete until the presence or absence of lesions of important nerves and bloodvessels lying near the seat of injury has been determined.

Within twenty-four hours there very commonly develop about the seat of fracture, particularly when the tibia, humerus, or both bones of the forearm are broken, large vesicles filled with blood-stained serum. These blisters, often attributed to irritating dressing, are quite independent of the latter.

Fractures which lie partly or wholly within the joints in addition to the symptoms common to all fractures, are characterized by a rapid distention of the articular cavity, due to free bleeding and later serous effusion. Because of the rapid swelling and marked tenderness attending these joint fractures, the examination is rarely satisfactorily diagnostic unless it be made by the *x*-rays or, in the absence of these, by the aid of an anesthetic.

Delayed union may be due to local or systemic cause. It is characterized by preternatural mobility persisting at the seat of fracture after the period (four weeks) when consolidation should have taken place. It is usually associated with tenderness on motion, marked disability, and hard swelling due to hyperabundant callus. Exceptionally callus formation is totally wanting. The local conditions usually at fault are imperfect apposition, inadequate mobilization, the interposition of soft parts; exceptionally, inflammatory lesions or malignant infiltration.

Ununited Fracture.—This condition represents a persistence of delayed union beyond the period when there is a reasonable expectation of union without surgical intervention (twelve weeks). Its causes and symptoms are those of delayed union.

Diagnosis is based on the detection of preternatural mobility; this is usually, but not always, associated with pain greatly aggravated by attempts at function. Unnatural mobility is at times difficult to elicit. The *x*-rays may be needed for diagnosis.

Vicious union due to improper apposition or inadequate retention is usually manifest on inspection. At times it is dependent on callus formation which by its bulk interferes mechanically with movement, exerts a crippling pressure on muscles, tendons, nerves, and bloodvessels, or binds the bones which normally move upon each other, as, for instance, the radius and ulna, thus preventing pronation and supination.

Inflammation of Bones.—Inflammation may be traumatic or infective, acute or chronic.

Acute Traumatic Osteoperiostitis.—This is the expression of reaction against a bone bruise, characterized by localized tenderness to deep pressure and the formation of a subperiosteal swelling, which may undergo organization into bone.

Osteomyelitis always follows a more extensive injury, such as fracture, and is the process essential to repair. When the neck of the femur is involved, the softening incident to a persistent inflammation may predispose to marked deformity.

Acute Infective Inflammation of the Bones.—This may appear in the form of an osteoperiostitis or osteomyelitis. The usual pus organisms, particularly the staphylococcus, are the causative agents. Other organisms are occasionally at fault.

Acute Suppurative Osteoperiostitis.—Acute suppurative osteoperiostitis, in its frankly suppurating form, is either traumatic or due to extension of inflammation from neighboring soft parts. The local and general symptoms are those of pus under tension, the pain being severe.

Acute Syphilitic Osteoperiostitis.—Acute syphilitic osteoperiostitis at times precedes the skin eruption; usually it develops at about the same time. It is characterized by extremely painful, hypersensitive, slightly elastic swellings, involving by preference the bones of the cranium, the tibia, the ribs and the sternum. The overlying skin may be reddened and edematous. The diagnosis is based on associated syphilitic symptoms.

Typhoid Osteoperiostitis.—Typhoid osteoperiostitis exceptionally develops in an acute form, appearing as a tender, painful bone swelling, usually on the sternum, ribs, or tibia, preceded by severe bone pain and attended by moderate fever. This form of typhoid osteoperiostitis is prone to develop during the convalescing period. It may undergo resolution. Usually it breaks down, exposing an area of superficial necrosis.

When it attacks the vertebræ, persistent crippling pain and disability are the cardinal symptoms.

Gonorrheal Osteoperiostitis.—Gonorrheal osteoperiostitis in its acute form exhibits a predilection for the calcaneum, causing pain and tenderness on the plantar surface of the heel.

Acute Infective Osteomyelitis.—Acute infective osteomyelitis affects mainly the long bones of growing boys, particularly those of depressed vitality who have been subject to slight trauma or severe chilling, and who have an infecting focus such as a boil or an inflamed tonsil. The Staphylococcus aureus is the common infecting germ; in virulent cases the streptococcus may be found. The pneumococcus, the colon and the typhoid bacillus are also at times causative factors.

Acute osteomyelitis, though it begins at or near the epiphyseal line, usually extends in the direction of the diaphysis. The femur and tibia are the bones of election. The radius, the fibula, the pelvis, the ulna, the inferior maxillary bone follow in order. The affection is often multiple. Acute osteomyelitis usually terminates in necrosis, which may be localized or may involve the entire shaft of a long bone. Exceptionally it infects the neighboring joint, being then complicated by suppurative arthritis. It not infrequently becomes quiescent or chronic, with a life-lasting tendency to recurrence. Exceptionally it undergoes complete resolution.

Growing pains probably represent an ephemeral form of osteomyelitis, especially when they are characterized by slight tenderness near one or more joints, recurring and starting pain and prompt subsidence under rest.

Destruction or separation of a growing epiphysis may result in deformity or developmental failure.

As the result of softening and during the period of convalescence spontaneous fracture is at times observed, particularly in the tibia, fibula, and humerus.

As observed in infants and young children, acute osteomyelitis attributable to infection carried from the stump of the umbilical cord or from other suppurating skin or mucous membrane lesion, may develop as an acute arthritis, the epiphyseal focus of infection promptly breaking into the neighboring joint.

The diagnosis of acute osteomyelitis is based on the sudden or rapid development of the constitutional symptoms of virulent sepsis, associated with severe local pain, great tenderness, best elicited by prolonged deep pressure, or bone percussion, disability so complete that in infants paralysis is often suspected and shortly (two days) edema of the overlying soft parts. Skin redness and fluctuation become obvious in the course of days or weeks if death from septicemia does not occur before this.

The systemic infection of osteomyelitis may so closely resemble that of typhoid that the conditions may be confused when the seat of bone infection is not accessible to direct examination, as in the case of acute inflammation of the vertebræ, of the mastoid process of the temporal bone, or of the upper extremity of the femur. The leukocytosis of osteomyelitis is characteristic, and, if searched for, localizing symptoms generally can be found.

The bone pains of the eruptive fevers and of meningitis are shortly followed by other characteristic symptoms; moreover, they involve many bones. Rheumatism involves joints primarily and is attended by rapid swelling and tenderness, elicited by direct joint pressure, while in osteomyelitis there is usually a point of maximum tenderness in the juxta-epiphyseal line, and the swelling of the soft parts does not become obvious for two or three days.

Chronic Inflammation of the Bone.—Chronic osteomyelitis is characterized clinically by thickening, sometimes lengthening, of the bone. It is usually associated with pain. It may be traumatic or infective. In its development it may be formative, causing pronounced overgrowth of bone, or destructive, as expressed by caries, necrosis, and sinus formation. These processes are commonly combined. The infective form is usually tuberculous or syphilitic. Occasionally it is an expression of either feeble or well-resisted pyogenic infection.

Chronic Traumatic Osteomyelitis.—This is either a sequel of severe trauma inadequately treated or is incident to repeated slight trauma. It is characterized by pain, aggravated by use, tenderness, and bone enlargement, or distortion due to overgrowth or softening. This form of osteomyelitis is instanced by the bony deformities about the ankle and wrists following unrecognized fissured fractures, and by the bending of the femoral neck, entitled coxa vara.

The diagnosis of chronic traumatic osteomyelitis must be based upon

the history of the case, the relief of symptoms incident to rest, the findings of the *x*-rays, and, if the case has been observed late (years), the absence of all tendency toward abscess formation, steady or rapid growth, or progressive deformity. In its earliest stages it may readily be confounded with tuberculous osteomyelitis.

Chronic Infective Osteomyelitis.—Chronic infective osteomyelitis in its superficial form, the so-called osteoperiostitis, is usually an expression of syphilis, gonorrhea, typhoid, or rheumatism.

In its deep form osteomyelitis is usually tuberculous, sometimes syphilitic, exceptionally an expression of the irritating effects of other infecting organisms, particularly those of the pus group and the typhoid bacillus.

The osteoperiostitis of syphilis, an expression of the late secondary or early tertiary period of the disease, appears in the form of hard bosses, involving by preference the tibia, ulna, and the frontal and parietal bones, usually moderately painful, sometimes excessively so, slightly tender and slowly progressive (weeks). These bosses may soften and discharge through a sinus, which later becomes an ulcer of considerable size, exposing carious bone, or may undergo organization, leaving prominent bony bosses which form permanent records of a constitutional infection, and are quite unaffected by treatment. The diagnosis is based on the history of syphilis, associated lesions of the disease, and, in the infiltrating stage, the prompt resolution as the result of efficient treatment.

Chronic Rheumatic Osteoperiostitis (rare).—This is a term applied to a form of bone infection in which the organism cannot be found. It is characterized by local pain and progressive swelling which may either soften slowly (weeks), discharging a serous, sterile fluid, or may undergo resolution, leaving thickened bone.

Gonorrheal osteoperiostitis exhibits a predilection for the calcaneum. It is usually formative in nature, causing a bony outgrowth, which makes walking or pressure painful. Similar outgrowths are observed in the absence of gonococcal infection and are possibly traumatic or rheumatic. The diagnosis is made by the *x*-rays.

Tuberculous Osteomyelitis.—Tuberculous osteomyelitis is the commonest form of chronic bone inflammation. It is characterized by its insidious onset, predilection for the epiphyses of the young, slow progression, and ultimate destructive tendency.

Slight trauma is the most important predisposing factor.

Pain is usually the first symptom of tuberculous osteitis, varying greatly in intensity, worse at night, aggravated by use, and associated with some tenderness. It is at times entirely lacking, involvement of the neighboring articulation being the first sign.

Swelling gradually develops, forming in the case of the long bones of the hands and feet the spindle-shaped tumor called spina ventosa.

On the sternum, ribs, and radius the infection may remain superficial, forming painless tumors which gradually soften and discharge a cheesy pus through a sinus which leads to carious bone.

The bones in their order of involvement are (Nélaton) vertebræ, tibia, femur, humerus, phalanges, metatarsals and metacarpals, sternum, ribs, iliac bones, tarsals and carpals, petrous portion of the temporal bone.

In the case of bones deeply placed the symptoms are usually those of arthritis or cold abscess which may open near the seat of bone disease or burrow wide of this, as, for instance, the psoas abscess of Pott's disease, forming fluctuating tumors without appreciable symptoms of local inflammation. Later they ulcerate and discharge a characteristic cheesy pus, often with small fragments of bone. Probing or the *x*-rays lead to the detection of dead bone. Sometimes the tuberculous process becomes encysted and quiescent.

Since in its early stage tuberculous osteomyelitis is characterized only by moderate pain, associated with local tenderness if the part be accessible, or, if the focus of infection be near a joint, with synovial effusion, the diagnosis is not possible unless destruction of bone substance has been sufficient to give a distinct *x*-ray picture.

The causelessness and persistence of such pain and tenderness are, however, suggestive.

The swelling, which shortly becomes palpable in the case of bones superficially placed, such as the ribs, sternum, tarsal bones, and phalanges, lacks the characteristics of acute infection, and, if syphilis can be excluded, should be diagnosticated by incision and microscopic examination, as a distinction from malignant growth is at this stage not possible.

Since the joint symptoms of tuberculous osteomyelitis may be the first to attract attention to the affection, the diagnosis of the underlying lesion is based upon the probability of its existence, as nearly every tuberculous arthritis is secondary, and on the findings of the *x*-rays.

Syphilitic Osteomyelitis.—Syphilitic osteomyelitis, usually a tertiary manifestation of the disease, may be either circumscribed or diffuse. In its infiltrating stage it is a common cause of spontaneous fracture. It causes pronounced hyperplasia of the bone, and, if untreated, usually terminates in necrosis and sinus formation. The seats of election are the tibia, humerus, nasal septum, palate, cranial bones, and the inner third of the clavicle.

When it attacks the bones of the nose, mouth, and face, it usually begins as a painless bone swelling, which because of its position is often unnoticed. The destruction of bone is extremely rapid (days or weeks), but is unattended by widespread acute inflammation of the soft parts or pronounced constitutional symptoms. Painless perforations of the palate and the nasal septum are in themselves almost diagnostic of syphilis. Gummata of the cranium at times cause intolerable anguish; usually they are painless.

Syphilitic osteomyelitis of the metacarpals and phalanges is characterized usually by the almost painless development of a fusiform bone swelling which in the course of weeks softens and tends to discharge. The diagnosis between this condition and tuberculous osteomyelitis cannot be made from the local appearance of the lesions. The syphilitic

lesion is more likely to be symmetrical, involving the two hands. Both are observed in infants and children; either may occur in the adult. Tuberculous involvement is, however, somewhat more frequent at a later age.

Syphilitic osteomyelitis involving the long bones is attended by the pain, tenderness, and, if the inflammation be near the joint, the serous effusion, fixation, and muscular atrophy which are regarded as characteristic of tuberculous osteomyelitis.

If the syphilis manifest itself in the form of a circumscribed gumma, the symptoms may be identical with those of a beginning sarcoma.

The diagnosis must be made by careful consideration of the history, the results of a thorough trial of specific treatment, and, in some cases, the findings of the *x*-rays.

The bone manifestations of hereditary syphilis are characterized shortly after birth by a thickening of the epiphyseal osteochondral plates so marked that in accessible joints distinct tumor may be felt. In two or three months the process of softening may reach such a stage as to cause juxta-epiphyseal fracture, usually characterized by a pseudo-paralysis, since there may be no displacement because of the thickened periosteum, nor bone crepitus. A child of six months presents precisely the appearance of one suffering from rickets.

Periosteal outgrowths, sunken nose, high vaulted palate, and sabre-shape nodular tibias represent typical results of the hereditary form of the disease.

Chronic osteomyelitis which is neither syphilitic nor tuberculous is commonly a sequel to an acute attack, and is due to the ordinary pus organisms, exceptionally to other forms of microbian infection. The bone is always thickened, sometimes enormously so, about the area of suppuration or necrosis, the pus often being found sterile to bacterial investigation. There may be a large sequestrum unattended by suppuration. The affection is characterized by pain located in the bone, aggravated by use and subject to periods of exacerbations; swelling of bony hardness, which may be found only in the epiphyseal region, shading off gradually into the diaphysis, or which may involve the entire shaft, tenderness often elicited only by deep and prolonged pressure or by percussion, and by somewhat characteristic *x*-ray showings.

The favorite seats of circumscribed abscess are at either extremity of the tibia, particularly the upper, and the lower extremity of the femur. When the condition is associated with a serous effusion into the nearest joint the distinction from tuberculous osteomyelitis may be quite impossible without exploratory and curative operation.

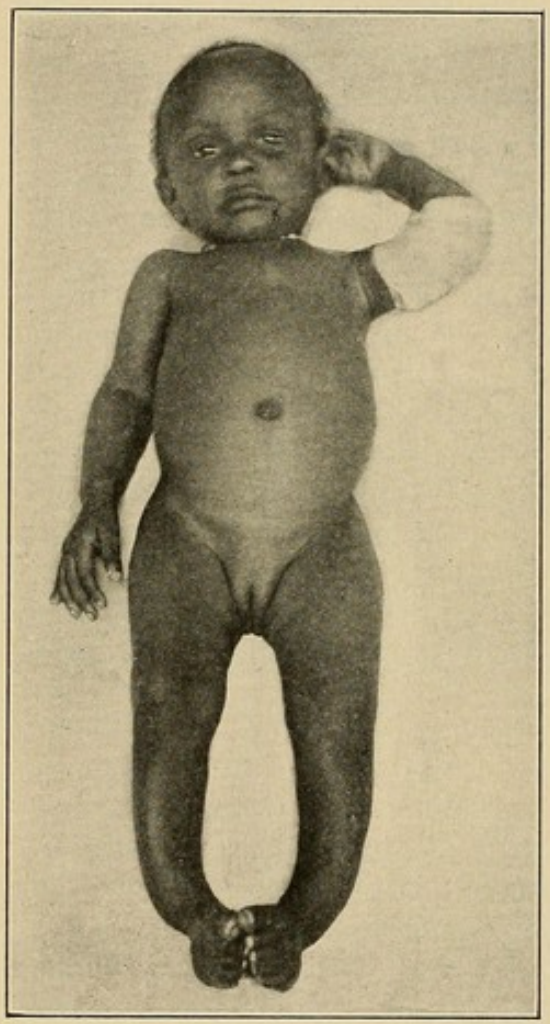
Malignant growth in its early stage affords precisely the clinical picture of a localized chronic osteomyelitis, excepting that the onset and progression of the newgrowths are more rapid. When tumor has developed, neoplasm always gives a more distinct outline from the surrounding bone than is afforded by the overgrowth of tissue incident to a chronic osteomyelitis.

The diagnosis, suggested by a previous acute attack of osteomyelitis,

should be made by the *x*-rays and by early incision, providing gumma can be excluded.

Rickets.—This is an affection of infancy, but sometimes of late development, supposed to be due to malnutrition, common in those of syphilitic parentage. Its acute form (rare) is characterized by painful swelling of the ends of the long bones, usually diagnosticated and treated as rheumatism.

FIG. 41



Rickets. Large head; protuberant abdomen; bowing of tibiæ. (Carnett.)

The customary mode of onset is by gradual impairment of health, juxta-epiphyseal bone swellings, and mechanical deformities incident to softening.

A rickety child exhibits a bossed forehead, open fontanelles, delayed dentition of deformed and rapidly rotting teeth, high palatal vault, alveolar flaring in the upper jaw, the reverse of this in the lower, beaded ribs (rachitic rosary), chicken breast, pot-belly, spinal curvature, usually anteroposterior, and enlarged epiphyses.

The distinction from hereditary syphilis by the symptoms alone is impossible.

Osteomalacia.—Osteomalacia, an affection of adults, exceptionally observed in children and in the aged, sometimes epidemic, most frequently affects gravid women who have borne many children in quick succession, and is characterized by tenderness, softness, and flexibility of the bones and rapid loss of height, associated with impaired general health, cutaneous hyperesthesia, and exaggerated reflexes. Spontaneous fracture is common and exhibits little tendency toward healing. From gravity and the pull of muscles, deformities are rapidly developed, particularly curvature of the spine. Exceptionally, multiple cysts are found in the bone, forming symmetrical tumors.

The diagnosis in the early stage may be suggested by distinct and widespread bone tenderness and pain. Later, when the bones become flexible, deformities are produced, and spontaneous fractures occur, at least the name of the malady is readily suggested.

When it attacks the aged, osteomalacia is particularly characterized by bone pain and tenderness involving especially the ribs and spine, associated with muscular contracture, inducing anteroposterior curva-

ture. There is almost complete helplessness. This is particularly the case when the condition, as is common, is associated with spontaneous fracture.

Osteitis Deformans.—Osteitis deformans, or Paget's disease, an affection of the elderly, usually associated with arteriosclerosis, and indicative of a predilection toward malignant growth of the bone, is characterized by deformities which are due to combined processes of absorption and overgrowth. The bones of the leg are the first to be obviously affected, though an early symptom attracting attention may be the need for getting a hat of larger size. As a rule, pain located in the bone, at times of exhausting severity, initiates the affection, followed in the case of the legs by weakness, stiffness, and bowing and thickening of the diaphyses of the long bones, is usually symmetrical. The progress of the disease is slow (years). It may remain in the part first affected or may become generalized. The diagnosis is based on the dissemination of the lesions and their slow progression.

From syphilitic osteomyelitis the affection is distinguished by its much slower course, its wide diffusion, the absence of a tendency to necrosis and sinus formation, and failure to respond to specific treatment, though the latter will be equally futile even in cases of syphilis when the formative changes incident to irritation have reached their complete development.

Achondroplasia is a congenital affection akin to rickets in its bone manifestations.

The few children who survive are symmetrically headed, long-bodied, pot-bellied dwarfs, with short extremities and big epiphyses.

Osteogenesis Imperfecta.—Osteogenesis imperfecta is a congenital affection characterized by multiple fracture incident to imperfect bone formation. Children who survive are of low stature and are short-legged. The diagnosis is based on the occurrence of multiple fractures from inadequate cause.

Acromegaly.—Acromegaly is a chronic painless affection due to disease of the pituitary body, insidious in onset, slow in progress, and characterized by gigantic growth of the hands, feet, face, and head. The soft parts participate in the overgrowth of bone, though the nails remain of normal size. The gross face, projecting eyebrows, big tongue, large nose, bulging occipital protuberance, enlarged mastoid processes, thick lips, and coarse features are characteristic. There is an associated testicular atrophy in men; in women, enlarged clitoris and vagina and hypertrophied larynx, giving them a bass voice. The thymus gland is enlarged.

Perhaps the most diagnostic feature of the affection is the slow and apparently causeless increase in the size of the hands and feet.

Tumors of the Bone.—Osteoma.—Osteoma, a benign tumor of slow growth and extreme hardness, is usually fixed to the underlying bone. Either local or diffuse hyperostosis is a common expression of chronic inflammation. During the period of epiphyseal growth and consolidation, usually before puberty, exostoses, often spur-shape, but exhibiting great diversity of conformation, and capped with cartilage, develop, origin-

ating near the epiphyseal line and growing toward the diaphysis. These cease growing when the epiphyses have reached full development. Their seats of predilection and greatest development are the bones of the forearms and legs, though they may occur toward the extremities of any of the long bones. They are characterized by causelessness, multiplicity, slow growth ceasing with maturity and absence of symptoms aside from those incident to their bulk.

The affection is often hereditary.

The diagnosis of all forms of osteomata is based on the slowness of growth, the absence of symptoms other than those incident to mechanical interference and pressure, the *x*-rays and excision and microscopic examination. Exceptionally after injury about the knee there is a comparatively rapid development of a tender, painful osteoma. This can be distinguished from beginning sarcoma only by excision and microscopic examination.

Exostoses of the sinuses of the cranial bones conform to type in that they develop slowly, usually in young adults, and manifest their presence only by pressure symptoms, usually beginning with a sinusitis, later followed by tumor developing in the case of the frontal sinus in the direction of the orbit. The *x*-rays give a characteristic picture.

Chondroma.—Chondroma, often an hereditary affection, has for its seat of predilection the bones of the hands and feet. The tumor may be single or multiple, and frequently gives a traumatic history.

Chondromata are characterized by the slow (years) growth of a painless, usually lobulated, hard, elastic tumor, which, if subperiosteal, may be covered by a thin shell of bone. Pressure ulcers may occur in the soft parts when the tumor has attained great size.

The centrally placed enchondromata may give rise to severe pain and spontaneous fracture. Moreover, in their transitional (usually malignant) forms these tumors may become soft and grow rapidly.

The distinction from sarcoma in the early stage of the growth should be made by excision. Later, the slow extension of the chondroma, distinct encapsulation, and sometimes enormous size are sufficiently characteristic of the nature of the tumor.

In its pelvic development chondroma commonly springs from near the sacroiliac synchondrosis, exceptionally from the pubic region. Growth is rapid and characterized by density, fixation, and pressure symptoms, particularly in the direction of the sciatic and obturator nerves. The distinction from malignant growth can be made only by excision.

Lipoma.—Lipoma of the bone (rare) may be congenital, inflammatory, or neoplastic. The congenital lipoma may be placed at or near the epiphyses, particularly that of the upper portion of the femur. It may be pedicled or sessile and not infrequently causes bone erosion. This form of lipoma may grow rapidly. It is characterized by the softness typical of lipomata. It is prone to recur, and apparently produces a cachexia almost as profound as that of malignant growth.

Diagnosis can be made only by operation.

Lipomata growing from the bones of the head and spine are usually the remains of cured meningocele.

The bone lipoma of the adult is characterized by the softness, lobulation, slow growth, and absence of subjective symptoms characteristic of this form of tumor.

Sarcoma.—Sarcoma is the commonest bone tumor. It is usually single, developing in youth and early manhood. It is observed in infancy, and may be prenatal. It is usually most malignant in young subjects. The favorite seats are the jaw, femur, tibia, radius, and humerus. The epiphyseal extremities of the long bones, particularly those about the knee, are the seats of predilection.

The diagnosis of sarcoma is based on pain, tumor, and the *x*-ray findings (pp. 41 and 43). Pain is fixed, persistent, often referred to the neighboring joint, and is generally treated as rheumatic. These symptoms may precede the development of tumor by weeks or months. The tumor may be globular or fusiform, hard or soft, and in the case of central sarcomata, often gives an egg-shell crackling which in itself is not diagnostic of malignancy. In highly vascular cases there is both pulsation and bruit. In rapidly growing cases there is a distinct rise in temperature, both local and general. Fracture is common in central sarcomata, and may be the first pronounced symptom to call attention to disease of the bone. In periosteal sarcomata, tumor may be observed early. It does not encircle the bone, has fairly abrupt margins, and is more regular in outline and rapid in development than either osteoma or chondroma.

Sarcoma of the bone is usually central, and, if of the giant-cell type (common), is relatively benign; exceptionally it gives metastases and recurs after thorough operations. Central spindle-cell sarcoma (rare) is also of relative benignancy. The central round-cell sarcoma is highly malignant, as are the periosteal sarcomata.

The diagnosis of sarcoma may be suggested by the *x*-rays, but can be made certainly only by excision and microscopic examination, the latter facilitated by a freezing microtome, made at the time of operation, since the form of intervention depends upon the type of growth. The macroscopic appearance of some of these tumors is sufficiently characteristic of relative benignancy to enable a probably wise decision to be made between local excision and amputation wide of the disease. The giant-cell sarcoma is usually completely enclosed in a capsule of bone, on breaking through which there is exposed a vascular pulp which bleeds furiously. The limitation of the more malignant growths is less distinct.

Myeloma.—Myeloma exhibits an early predilection for bones of the thorax, including the vertebræ. It is characterized by the multiplicity of its lesions and albumosuria. Distinction from sarcoma may be made clinically on this basis.

Endothelioma.—Endothelioma presents the characteristics of central sarcoma. Nor can a distinction be made excepting by microscopic examination. The affection is one of middle age, and is likely to be multiple.

Carcinoma.—Carcinoma of the bones is always secondary, usually to cancer of the breast, prostate, or thyroid. These metastases may occur, particularly in the case of the prostate or the thyroid, before the primal focus has reached sufficient dimensions to excite clinical symptoms.

Diagnosis is based on pain and swelling; there is often spontaneous fracture. Thyroid metastasis is commonly observed in the sternum, bones of the skull, the humerus, and the vertebræ. The prostatic metastasis is commonly manifest in the vertebræ.

The bone manifestations of hypernephroma are those of malignant disease. The distinction must be made with the microscope.

Bone Cysts.—Bone cysts (rare) develop in the shafts of long bones during youth near the epiphyseal line, particularly in the tibia, femur, and humerus. They are characterized by a tendency to spontaneous fracture, often by pain of moderate severity, and by the gradual formation of a fusiform tumor made up of a single fibrocartilaginous sac containing bloody fluid, surrounded by a thin cortex and normal periosteum.

The diagnosis is based upon slow growth (months, years), the *x*-rays, and by incision.

Multiple bone cysts are frequently found in the bones of osteomalacia, while cystic degeneration is common in sarcomata and enchondromata.

Dentigerous Cysts.—Dentigerous cysts, originating in the jaws, form slowly growing bone swellings extending in the direction of the outer surface of the jaw, occurring in young adults who on examination show the absence of a tooth. They cannot be distinguished clinically from dermoid cysts nor, excepting by operation, from sarcoma.

Echinococcus Cysts.—Echinococcus cysts are rare, and can be diagnosticated only by operation.

Fibromata.—Fibromata of bone, with the exception of certain forms of epulis and nasopharyngeal growths, are rare. The latter condition is observed mainly in young men under twenty-five years of age. The slow growth and dense consistency of fibromata are thoroughly characteristic, but diagnosis must be made by excision and microscopic examination, since the distinction cannot otherwise be made from fibrosarcoma.

Fat Embolism.—Fat embolism is an occasional complication of bone lesions such as are accompanied by extensive crushing of the medulla, as in fracture of the lower end of the femur. It may follow operation upon bone. It is characterized by acute edema of the lungs, coming on suddenly some days after bone injury. Signalized by dyspnea, often accompanied by coughing up of blood-stained serum indicative of infarct, and by a rapid, labored heart action, right-sided dilatation and vertigo, apathy, or even loss of consciousness (Forgue). The diagnosis is based upon the sudden onset of all such symptoms following bone trauma and the finding of fat in the urine which appears on its surface as a cloudy deposit made up of fat globules, which may be demonstrated by staining with osmic acid.

THE JOINTS.

Traumatism.—Contusion.—Contusion may be from direct or indirect violence. In the latter case the major lesion is a bruising of the articular surfaces often associated with fracture; in the former case the soft parts exhibit the major evidences of traumatism.

The symptoms of joint contusion are: tenderness on pressure and motion, severe pain, disability, and rapid swelling which, if the joint be accessible to palpation, can be felt to be mainly intra-articular.

Rapid (minutes or hours) swelling, severe, persistent pain, absolute disability, excessive tenderness, are presumptive evidences of fracture.

Rapid and extensive effusion into a joint as the result of slight contusion or sprain is suggestive of hemophilia. This suggestion becomes almost a certainty if there is but slight pain and disability, the major symptom being swelling due to rapid capsular distention, associated with a history of prolonged bleeding from slight wounds.

The diagnosis of joint contusion is made by the *x*-rays and by prompt recovery as the result of rest.

Chronic arthritis following contusion is an expression of recurring trauma from hypertrophied synovial fringe, loose body, fracture, etc., or of the localization of a toxin or infection at a point of lessened resistance (gout, rheumatism, tuberculosis).

Sprain.—This implies sudden overstretching of periarticular soft parts, often associated with a tearing away of bony attachments and bruising of the joint surfaces. The wrist and ankle are the usual seats. It is characterized by disability, severe pain, swelling, tenderness most marked at the seat of tear, and late discoloration.

Exaggeration of local symptoms, and especially their persistence, is presumptive evidence of complicating fracture or the localizing in an area of lessened resistance of systemic toxemia or infection.

Since the diagnosis in severe cases calls for the elimination of fissured fracture, this usually requires the help of the *x*-rays.

Wounds of Joints.—The diagnosis is usually obvious or may be suggested by escape of synovial fluid.

Punctured wounds, as from a dirty needle, may cause a serous or serofibrinous effusion, characterized by distention of the capsule, tenderness and limitation of motion, or the most virulent type of purulent arthritis.

When infection has taken place, this may remain latent until the second or third day when symptoms of acute suppurative inflammation, both local and constitutional, develop rapidly. In hyperacute cases inflammatory symptoms develop within twenty-four hours. This is particularly the case when there is a large effusion into the joint.

Dislocation.—Dislocation, rare in the young and the old, may be traumatic or pathological. The latter as a consequence of disease; usually an abundant intra-articular effusion, extensive bone destruction, or both.

The diagnostic features of traumatic dislocations are: marked deformity, usually appreciable on inspection and palpation; elastic fixation;

alteration of the axis of the bone luxated in relation to that of the bone with which it should articulate, and either lengthening or shortening. In addition the symptoms common to all traumata are present, *i. e.*, pain, swelling, tenderness, disability, great discoloration.

On palpation the articular extremities of the bone can usually be felt not in their proper relation one with the other. This in the case of deep joints or great tenderness and swelling may not always be easily demonstrated.

Distinction from contusion, sprain, and fracture is made by the *x*-rays and examination under ether. Elastic rigidity is contrasted with the preternatural mobility of fracture, the rounded joint ends with the jagged ones of fracture, the deformity is of the joint itself and not simply near it, and the deformity, reduced with difficulty and often with a sudden jar or slip, does not recur immediately on removal of the traction or support.

Complicating fracture in or near the joint often requires the *x*-rays for its diagnosis. Injuries of neighboring nerves and vessels should be detected at the time of first examination.

From epiphyseal separation, dislocation is distinguished by the fact that the epiphyseal separation is an affection of youth, there is no elastic fixation, but rather preternatural mobility, the deformity is easily reduced, and as readily recurs on removing traction or support.

Pathological luxation may be concealed by the swelling and deformity incident to the causative lesion (caries, necrosis, hydrops or rheumatoid arthritis).

The power of voluntary, usually incomplete, luxation is sometimes seen developed to an extraordinary degree, and is due to the unusual laxity of the ligaments. This maneuver is commonly dependent upon long practice.

Congenital luxation, commonest in the hip, is the result of imperfect fetal development, and is often combined with other deformities. It is most frequent in females, is usually unilateral, and is obvious by comparison of the trochanters of the two sides. When bilateral the diagnosis may necessitate the use of the *x*-rays.

Arthritis.—Arthritis may be traumatic (a single severe or slight repeated injury); secondary to inflammation of neighboring structures, particularly the epiphysis; a local expression of systemic infection or toxemia (rheumatism, pyemia, typhoid, gonorrhea, la grippe, gout, pneumonia, tonsillitis, any focus of suppuration); neuropathic (tabes, syringomyelia, peripheral nerve inflammation or injury); or incident to the nutritional changes of arteriosclerosis (senile arthritis deformans).

In its clinical manifestations it may be acute or chronic. The exudate may be serous, fibrinous, or purulent.

The type of acute serous arthritis, often called synovitis, because the synovia exhibits the principal lesions, is characterized by more or less abundant effusion, often slightly turbid because of the mixture with endothelium and fibrin. The synovia is markedly congested and often infiltrated with leukocytes and even with extravasated blood. There is

heat, tenderness, swelling, and fluctuation, with fixation of the joint in the position allowing of greatest distention (usually slight flexion), great pain on motion, rigidity of muscles, and usually some atrophy. This type of arthritis follows traumatism, either from external violence, in which case the effusion usually contains blood, or from pinching of the articular surfaces incident to loose bodies in the joint. It is also the commonest expression of systemic infection, particularly of that form called rheumatic fever. Typhoid, la grippe, pneumonia, gonorrhea, even pyemia, may in their joint expression be characterized by serous effusion. Even an acute juxta-articular suppurative osteomyelitis, unless the pus breaks directly into the joint cavity, may be attended simply by a serous arthritis.

The fibrinous exudate is characterized by the same symptoms; the distention of the joint capsule is less marked, there is no fluctuation even in accessible joints, but the periarticular swelling is greater. Pain is more intense, fixation and muscular atrophy develop rapidly, and the affection runs a much more chronic course, frequently resulting in permanent fixation.

Traumatism when associated with intra-articular bone lesions may be characterized by a fibrinous exudate. This form is a frequent expression of la grippe and gonorrhea, an occasional one of other forms of infection.

Purulent arthritis commonly follows a serous effusion, or may be purulent from the first. The pain is intense, the muscular fixation absolute. The periarticular heat, redness, and swelling are more marked and rapidly progressive, constitutional symptoms are profoundly septic, and the joint structure is rapidly destroyed.

This form of arthritis is usually incident to an infected wound or is secondary to suppuration of structures near the joint (osteomyelitis, tenosynovitis).

In mild cases, and this is particularly true of the acute suppurative synovitis of small children and of the suppurative arthritis secondary to pyemia, the infection remains confined to the joint, and, if this be promptly drained, joint function may be restored.

It is an occasional local expression of pyemia and exceptionally one of pneumonia or gonorrhea. It is possible in any form of infectious arthritis.

The diagnosis is based upon hyperacute local inflammatory symptoms, with rapid and progressive involvement of the soft parts and the constitutional symptoms of profound sepsis associated with polymorphonuclear leukocytosis.

Acute Traumatic Arthritis.—Acute traumatic arthritis, incident to contusion, wrench, or the pinch of a locked loose body, attended by a serous or sanguinoserous effusion, is characterized by fixation, pain on joint palpation and movement, and, where the capsule is palpably near the surface, fluctuating swelling. In the absence of bone lesion, repeated trauma, or gouty or rheumatic diathesis the recovery is prompt and complete.

Wounding of the joint may lead to acute suppurative arthritis characterized by the local and constitutional symptoms of retained pus.

Acute Rheumatic Arthritis.—Acute rheumatic arthritis is a local expression of a constitutional toxemia or infection which begins with chill and fever, not remittent, accompanied or shortly followed by pain, tenderness, swelling, fixation, and in severe cases, heat and redness of one or more of the larger joints.

The arthritis is usually multiple and shifts from joint to joint, though it may be monarticular. Acid sweats are regarded as characteristic, and endocarditis is such a frequent complication that its development is of diagnostic value.

In children the onset is less abrupt, the joint symptoms not so well marked, and the inflammation may exhibit little tendency to flit from joint to joint. It is at times associated with tonsillitis.

The monarticular type of rheumatic arthritis can be distinguished from acute suppurative arthritis by the more profound sepsis of the latter condition and the rapid progression of local symptoms.

Acute Gouty Arthritis.—Acute gouty arthritis is characterized by the suddenness of an acute attack, particularly of the metatarso-phalangeal joint of the great toe, accompanied by rapid swelling, heat, and redness of the skin. The attacks are transitory but recurrent, affect the small joints by preference, are unattended by pronounced constitutional symptoms, and are often accompanied by palpable urate nodules about joints other than the ones acutely inflamed.

The finding of glycocoll in the urine with diminution in the amount of uric acid is said to be characteristic (Hirschstein).

Acute Gonorrheal Arthritis.—Acute gonorrheal arthritis, either monarticular or polyarticular, affects the knee by preference. The ankle, the shoulder, the wrist, the hip, and the joints of the fingers and toes come next in order of frequency. It is a complication of posterior urethritis, and occurs usually after the third week of disease.

The effusion is serous or fibrinous. In the former case the swelling is confined to the joint; it may be persistent or recurrent; when accessible, is distinctly fluctuating; pain and disability are moderate.

The fibrinous exudate is attended by severe pain, prompt fixation, pronounced peri-articular swelling attended by heat and redness, and rapid muscular atrophy.

The diagnosis of gonococcal arthritis is made by finding a focus of infection. This is usually in the glands and follicles of the posterior urethra, the ampulla of the vas or the seminal vesicles.

Exceptionally suppuration due to mixed infection occurs accompanied by the local or constitutional symptoms of this condition.

The polymorphonuclear leukocytosis and, in case of aspiration, the examination of the joint contents indicate the condition. The rapid progression of the local inflammatory symptoms in suppurative cases is characteristic.

From gonorrheal arthritis the rheumatic form is distinguished by its more acute fever, acid sweats, and polyarticular expression in larger

joints. Gonorrheal arthritis may exhibit the same features. The differential diagnosis is then dependent on the presence of a focus of gonococcal infection (urethra, conjunctiva).

Acute Arthritis Deformans.—Acute arthritis deformans, observed in the badly nourished, particularly in overworked and inadequately clad young women, is characterized by fever (exceptionally none), pulse hurry, and simultaneous development of acute inflammatory symptoms in a number of joints, both large and small, but particularly those of the fingers and toes. In one form of the affection, usually observed in children (Still's disease), there is enlargement of glands into which the inflamed joints drain and tumefaction of the spleen. This form of arthritis does not undergo resolution, but persists in a chronic form, often with acute exacerbations, ultimately (months or years) causing stiffening, deformity, and distortion.

The diagnosis from acute rheumatic arthritis can be made only by the persistence of the inflammation.

Typhoid Arthritis.—Typhoid arthritis in its polyarticular form may closely simulate acute rheumatic arthritis. It usually develops during the acute or subsiding stage of the fever; or not until a late period of convalescence.

In its monarticular form it commonly involves the hip, resulting in a chronic serous effusion which may be so great as to cause luxation. The symptoms of arthritis are not well marked, and, if the affection occurs during the period of profound systemic depression, neither pain, tenderness, limitation of motion, nor disability may be noted. The swelling is obscured by the deep position of the joint.

The diagnosis is based on the presence of an arthritis following typhoid fever and not accounted for on other grounds.

Typhoid arthritis may be of the suppurative type incident to mixed infection.

Scarlet fever arthritis so closely simulates the rheumatic form of the affection that in the absence of sore throat, of rash and characteristic rapid pulse, diagnosis cannot be made.

Influenza arthritis closely corresponds to that complicating gonorrhea in both symptomatology and development. Its diagnosis is dependent upon its association with influenza.

Pneumococcic arthritis develops in from two to fifteen days from the onset of acute pneumonia (Cave). Exceptionally it precedes the lung involvement or may even occur independent of this inflammation. It usually suppurates and is attended by a large mortality, due probably to the major disease.

In the absence of lung involvement the diagnosis must be made by microscopic and bacterial examination of the joint contents. This is not infallible.

Acute Tuberculous Arthritis.—Tuberculous arthritis occasionally develops in the acute form. The diagnosis can be made only by microscopic examination and inoculation of the joint contents into susceptible animals. Estimation of the opsonic index (less than 0.8 or more than

1.2) may be useful. A preceding tuberculous periarthritis or tuberculous lesions elsewhere are suggestive.

Acute hemophilic arthritis is characterized by pronounced acute joint effusion without adequate cause, attended by at most slightly marked inflammatory symptoms and followed by late ecchymosis. It occurs in young subjects who in most cases give a history of free bleeding from trivial wounds, and more than one joint is commonly affected, though not synchronously.

The affection is recurrent and ultimately results in pronounced disability and extensive deformity. The diagnosis is suggested by the characteristics given, but is usually made on aspiration of the joint.

Acute purulent arthritis of infants, from the first to the fourth year, is common in the hip, shoulder, and elbow, and is a joint expression of neighboring osteomyelitis.

The joint effusion may be serous; this can be determined by aspiration. It is usually purulent, and is indicated by an increase in the local and constitutional symptoms, fixation of the joint, and rapidly progressing edematous swelling of the soft parts surrounding it. Unlike purulent arthritis at a later age, after drainage the functional prognosis is good.

Chronic Arthritis.—Chronic arthritis incident to repeated slight traumatism, sequent to an acute attack, due to a persistent or recurring infection or toxemia, consequent to nerve lesion, or secondary to arteriosclerosis, is characterized by muscle atrophy, partial or complete fixation (exceptionally preternatural mobility), and deformity. The changes may be atrophic or hypertrophic so far as the bone and cartilage are concerned, but in either case the joint capsule is greatly thickened.

Chronic traumatic arthritis, when it follows the acute form of this affection, is usually incident to an injury to ligament, bone, or cartilage resulting in a healing which puts the joint at a mechanical disadvantage when it is used. Such an arthritis is often expressed in the form of a serous effusion (hydrops) which may be persistent or subject to apparent cure and frequent relapses. In the latter case, particularly if the relapses are attended by subacute or acute inflammatory symptoms, loose body (joint mouse), displaced cartilage (knee, jaw), or thickened synovial fringe should be suspected. Slightly traumatized joints are susceptible attacks of gout, rheumatism, tuberculosis, and the various infections which have joint manifestations.

Chronic arthritis deformans of either the atrophic (rheumatoid arthritis) or hypertrophic (osteoarthritis) type may follow an acute attack resembling inflammatory rheumatism, or may develop insidiously from the first. Swelling, stiffness, and deformity are slowly (years), often irregularly, progressive, or the disease may be arrested.

The affection may be polyarticular or monarticular.

The former variety involves the joints of the fingers and toes, and exhibits a tendency toward centripetal joint extension. Observed in children it is often of the fibrinous and ankylosing type, with an acute onset.

The monarticular form, an affection of the elderly, has a predilection

for large joints, particularly the knee and hip. In this type the bone and cartilage proliferations are usually pronounced. Joint grating, synovial effusion, and loose bodies are common accompaniments.

The diagnosis of arthritis deformans is based upon the persistence of joint symptoms and the gradual development of permanent lesions either following an acute arthritis or developing gradually. In the latter case there is recurring joint stiffness, at first intermittent, and usually most marked after periods of disuse, as in the morning, followed by gradual deformity, limitation of motion, and muscular atrophy. Not infrequently distortion results from muscular contracture, cicatricial contraction of periarticular structure, or alterations in the conformation of the ends of the bone.

Bony nodulations of the interphalangeal joints, particularly the distal ones (Heberden's nodes), are regarded as especially characteristic. They may remain the only evidences of joint involvement, causing little inconvenience and unattended by obvious inflammation or deformity of the joints near which they are placed or of any other articulations. Similar bony outgrowths are observed about the phalangeal joints after trauma. The nodular deposits of gout, if deeply placed, cannot be distinguished by palpation from these nodes.

Since the etiology of the affection, variously termed arthritis deformans, chronic rheumatoid arthritis, osteoarthritis, nodular rheumatism, etc., is entirely unknown, the differential diagnosis, according to types and names, seems unnecessary. There is reason to suppose, as is the case with acute joint affections, that these chronic lesions are secondary to infection or toxemia, nor should the diagnosis be regarded as complete until the sources of possible infection or of auto-intoxication are eliminated.

By the aid of the *x*-rays the type of joint involvement, *i. e.*, atrophic or hypertrophic, may be determined, also the differential diagnosis of those forms of obscure etiology from those which are known to be infectious, particularly from tuberculous arthritis.

Chronic gouty arthritis, usually a sequel of recurring acute attacks, corresponds to the general type of arthritis deformans in that the joints of the toes and fingers, later those more centrally placed, are involved in a deforming and crippling arthritis. Gout is, however, characterized by periarticular deposits of uric acid (tophi), which may also be found in the ear, and patients thus afflicted usually have Bright's disease and arteriosclerosis.

The diagnosis from other forms of osteoarthritis is based upon the presence of the tophi.

Chronic tuberculous arthritis is usually an affection of young males and frequently follows slight trauma. Its characteristic symptoms are fixation of the joint, or at least limitation of its motion, and muscular atrophy with pain which is often referred.

The time when this affection should be diagnosticated is when there is little or no effusion into the joint, no blurring of its outlines, no constitutional symptoms, and at the most a limitation in motion and conscious or unconscious saving of the part, some tenderness, and muscular atrophy.

A chronic monarticular arthritis of a child is usually tuberculous. The joints of election are those of the spine, hip, knee, ankle, and elbow.

Since the tuberculous affection is usually primary in the epiphysis, involving the joint later, the *x*-rays will often detect a lesion before the joint is infected. In appropriate cases the tuberculin test and the opsonic index will be found serviceable.

Arthritis deformans in its monarticular form is an affection of the elderly, the slow (years) progression of which is characteristic; still more so the absorption and hyperplasia of the bones and cartilages as shown by the *x*-rays.

The symptoms of chronic traumatic arthritis are so like those of early tuberculous arthritis that prompt diagnosis must be made by the *x*-rays or aspiration of fluid and injection into susceptible animals.

Syphilitic arthritis is usually secondary to gummatous osteomyelitis. In its development it corresponds closely to a local tuberculosis. Nor in adults does it conform to the type of tertiary lesions, which are usually painless.

In children hereditarily syphilitic, an almost painless chronic inflammation of the knee, elbow, hip, or shoulder, characterized by a non-sensitive swelling and accompanied by marked disability is a common expression of the constitutional disease.

A preceding history of syphilis, other signs of the disease, and, before the destructive and cicatricial stage, the curative effect of appropriate treatment are of diagnostic value.

Neuropathic arthritis is usually secondary to tabes or syringomyelia. It may follow trauma or complicate neuritis.

Tabetic arthropathy commonly affects the knee, the hip, and the ankle; exceptionally it involves the joints of the upper extremity. There is an atrophic and a hypertrophic form. Diagnosis is based upon the absence of pain and the inadequacy of cause for an abundant exudate or a greatly deformed joint which may be preternaturally mobile or dislocated. From hemophilic arthritis the affection is distinguished by the associated symptoms of tabes.

Syringomyelic arthropathy occurs in the upper extremities of men of advanced years. The progress is slower than in tabes, the deformity is pronounced, even monstrous, osteophytes being common, and dislocation is frequent. Analgesia is a prominent symptom.

Free Bodies in the Joint.—These may be fibrinous, fibrolipomatous, cartilaginous, or bony.

Fibrinous concretions, the result of previous inflammation, are often multiple and individually attain considerable size. Exceptionally free bodies are found in healthy joints. Usually in those which have been subject to chronic inflammation. The knee and elbow are common seats.

The affection is characterized by synovial effusion, thickened capsule, and the detection of the movable body by palpation. Mechanical locking of the articulation causes recurring attacks of sudden, often excruciating, pain brought on by certain movements of the joint, accompanied by fixation, which is temporary, and is followed by synovial effusion.

The diagnosis can usually be confirmed by the *x*-rays. The patient often makes it himself.

Joint Neurosis.—Under this title, termed also hysterical joint, are classed affections which, though mimicking those of an inflammatory nature, are found on attentive and repeated examination to depart from type. The knee, hip, and shoulder are the seats of election. The major complaint is usually pain associated with tenderness and at times surface heat and redness. Slight trauma is a common predisposing factor. In the more severe forms there may be fixation, atrophy, and contracture, associated with vasomotor disturbances.

Diagnosis is based upon the negative evidence of the *x*-rays, the absence of inflammatory symptoms, the disappearance of contractures under an anesthetic, variability of symptoms, and the association of other hysterical phenomena.

Lipoma is occasionally observed in the joint, usually attended by a moderate degree of synovial effusion and acting as a loose body. The diagnosis is usually made by excision.

CHAPTER XI.

DISEASES OF THE NERVOUS SYSTEM.

By T. H. WEISENBURG, M.D.

In this chapter will be discussed those neurological affections which are either amenable to surgical treatment or in which such procedure is considered justifiable. The general principles upon which neurological diagnoses are based, and only so much of the histology, anatomy, physiology, and pathology of the nervous system as is needful for diagnostic purpose are given

PHYSIOLOGICAL ANATOMY.

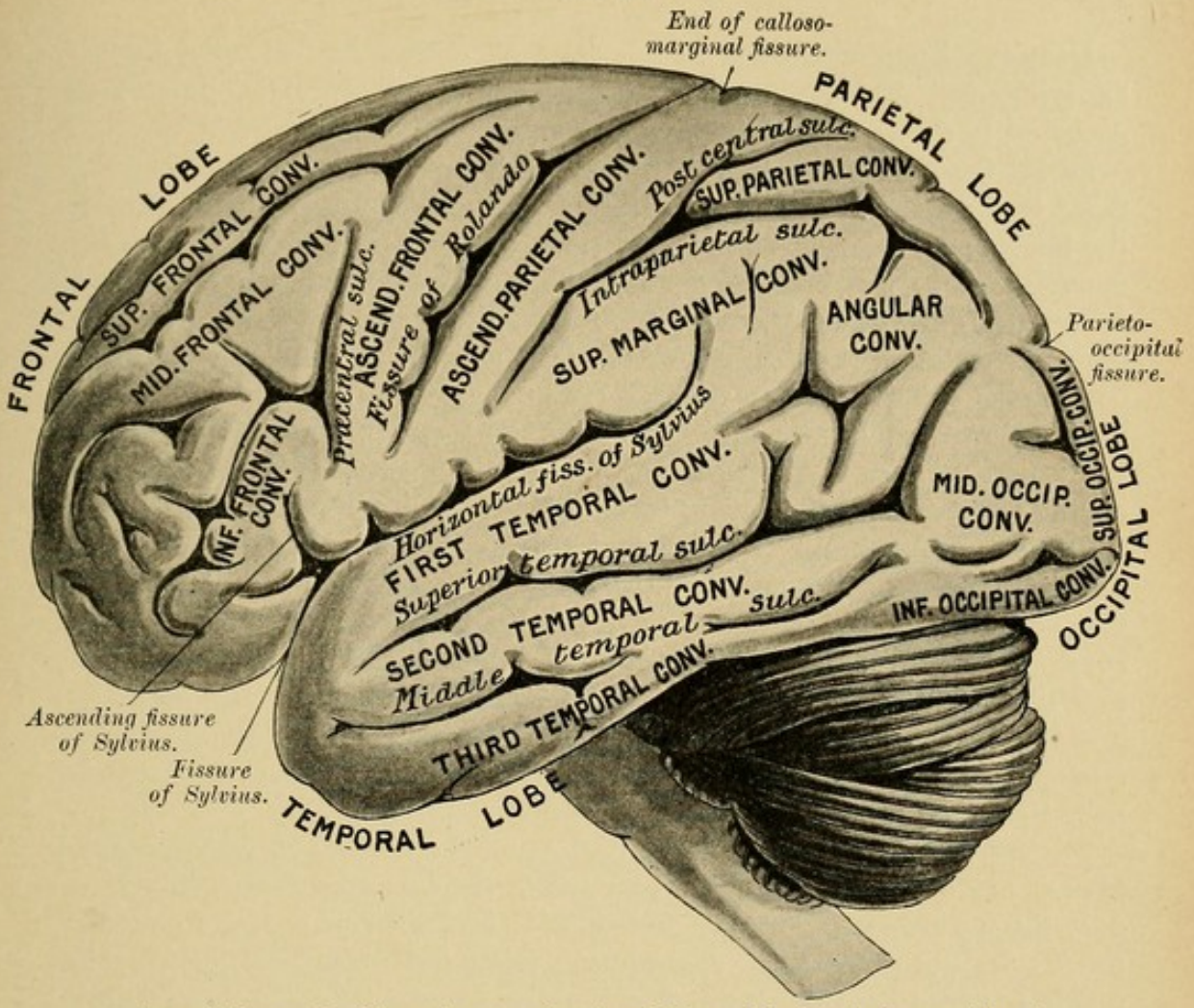
The nervous system consists principally of the brain and spinal cord and their meninges, of a peripheral system of nerves which brings the former in constant communication with every part of the body, and of the sympathetic system of nerves and plexuses which serve the same purpose for the internal organs.

The brain itself consists of two lateral hemispheres and their envelopes, an after part which is called the cerebellum, and a basal portion which connects it with the spinal cord. Closely surrounding and adhering to the surface of the brain is the pia mater, this dipping into the various fissures. The other parts of the meninges, that is, the arachnoid and the dura, adhere so closely that they cannot be differentiated (Fig. 42).

The substance of the brain itself consists of a cortex averaging about one-quarter inch in thickness, in which are situated a series of layers of nerve cells. From these nerve cells arise numerous fibers which go to other parts of the brain and into the spinal cord. That part of the nervous system which consists of nerve cells is always grayish in appearance, and that which is composed of nerve fibers is of white color. Besides the accumulation of nerve cells which is found in the periphery of the brain tissue, that is, the cortex, there are other collections of nerve cells, or ganglia, which are situated within the hemispheres. These ganglia are called the corpora striata, and consist of the caudate nucleus, the lenticular nucleus, and the optic thalamus.

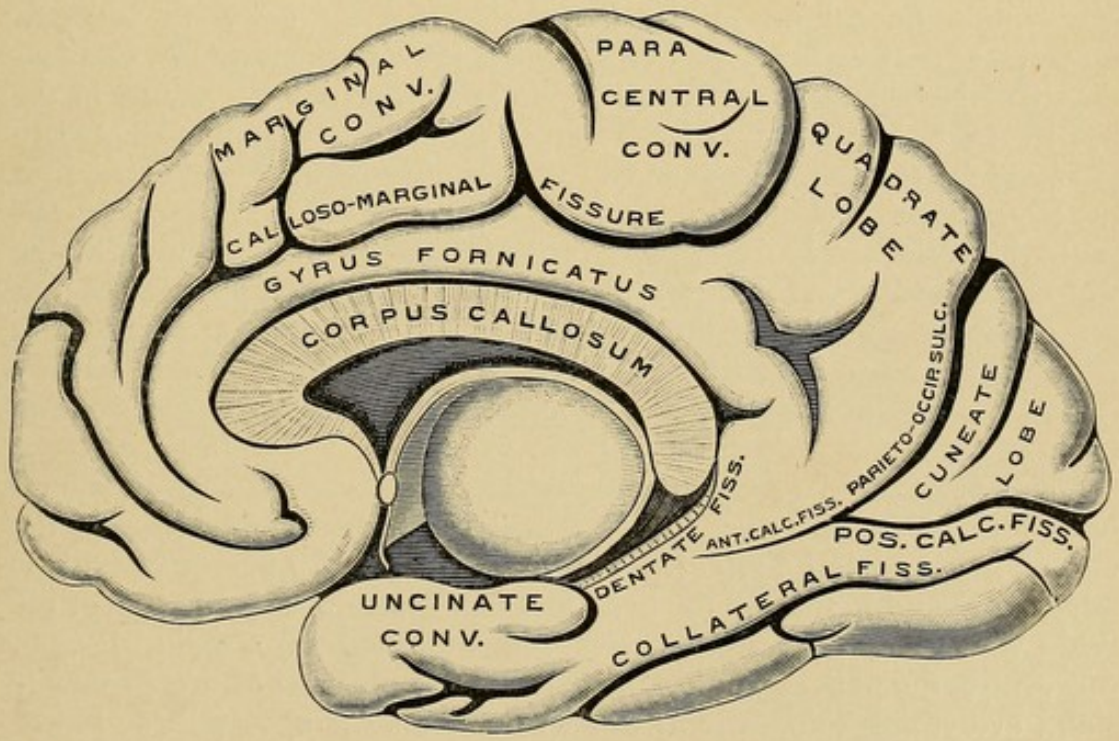
The convolutions and fissures which make up the surface of the brain underneath which the cortex lies have a definite and systematic arrangement, this being apparently in accordance with the importance of the functions concerned. Thus, embryologically one of the first fissures to be marked is the Sylvian fissure, around this being the important motor and sensory centres, and the nerve fibers which are in relation with these functions are the first to develop or obtain their myelin sheaths (Fig. 43).

FIG. 42



Convolutions and sulci on the exteral surface of the cerebral hemisphere. (Gray.)

FIG. 43



Convolutions and sulci on the internal surface of the cerebral hemispheres. (Gray.)

Cortical Localization.—As a result of embryological, histological, experimental, and pathological studies, different functions have been assigned to different parts of the cortex.

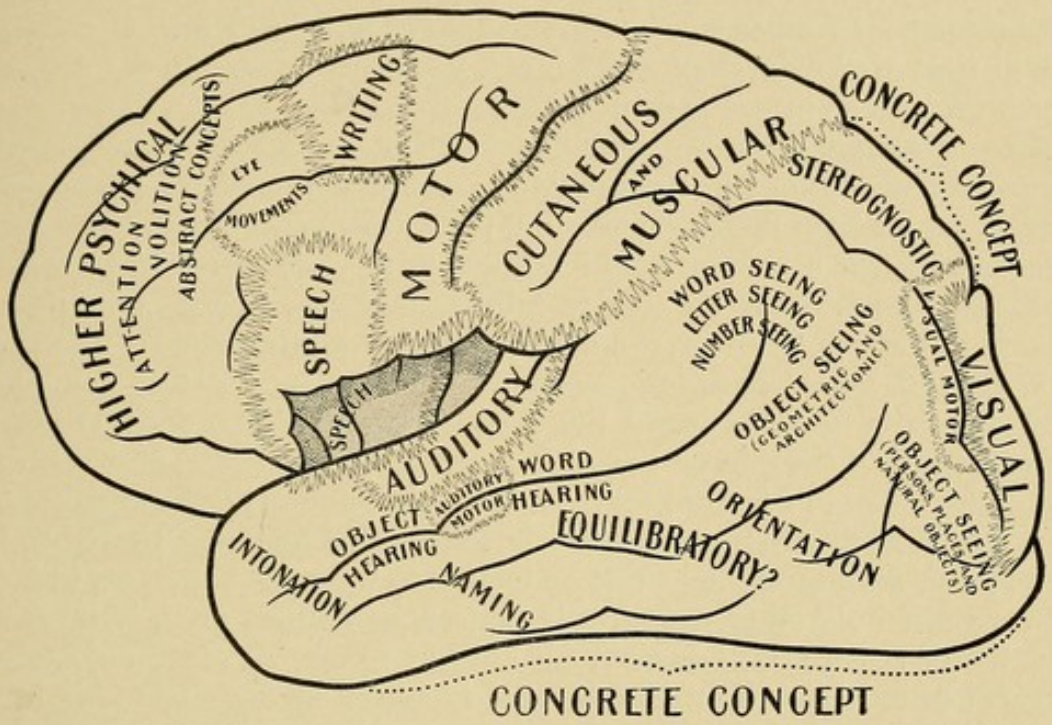
Motor Centres.—The motor functions have been placed directly in front of the central, or Rolandic, fissure in the precentral convolution on the lateral surface of the brain and in the anterior part of the paracentral convolution in the median portion. Every movement has its cortical representation, the head centre being in the lowest part of the precentral convolution, then the centres for the face, arm, trunk, abdomen, and leg coming in order, that for the leg being highest. Thus a man stands upside down in his motor cortex. Should there be any lesion such as would irritate any of these centres, for instance a tumor in the arm area on the right side of the brain, there would result convulsive movements of the left upper limb. Should this lesion destroy this centre, paralysis of the limb would result. It must be remembered that while the centres concerned in the innervation of structures necessary for a movement are somewhat distinct, there cannot be and there is not a definite division, and that the nerve cells related to different functions are in apposition and intermingle. Thus it is that irritation of the arm area by an electric current or by a tumor, while it will cause a convulsion of an upper limb, might also cause movements of the lower limb.

Sensory Centres.—Directly back of the motor centres, behind the central fissure, are located the sensory functions. In this area are included not only the postcentral, but also the superior and inferior parietal convolutions. In the postcentral convolution itself are placed the centres for touch, pain, and temperature, that is, those sensations which are primary and which develop first. Their localization is similar and in apposition to that of the motor functions; that is, those which are concerned in the innervation of the head are below, and of the leg above. In the parietal convolution have been placed the centres for the so-called acquired sensations; that is, the senses of pressure, movement, position, localization, and stereognosis, or the ability to recognize objects placed in the hand. In the inferior parietal convolution the above sensations are localized for the upper limb and in the superior parietal convolution for the lower limb. Should there be any irritative lesion, for instance, in the centre for sensation in the upper limb on the right side of the brain, there will be numbness and pain localized in the left upper limb, these sensations being analogous to the convulsive movements which result from irritative phenomena of the motor centres. Destruction of any sensory centre will also in a similar way produce loss of sensation or anesthesia (Fig. 44).

Motor Aphasia.—In the posterior portion of the third, or inferior, frontal convolution is Broca's convolution, that is, the gyrus which surrounds the end of the ascending limb of the fissure of Sylvius. This convolution is adjacent to and in front of the head and face centre, and is the part of the brain which controls motor speech. Should there be a disturbance of this centre, the patient would know what he wanted to say, would understand everything said to him, but would not be able to talk or repeat

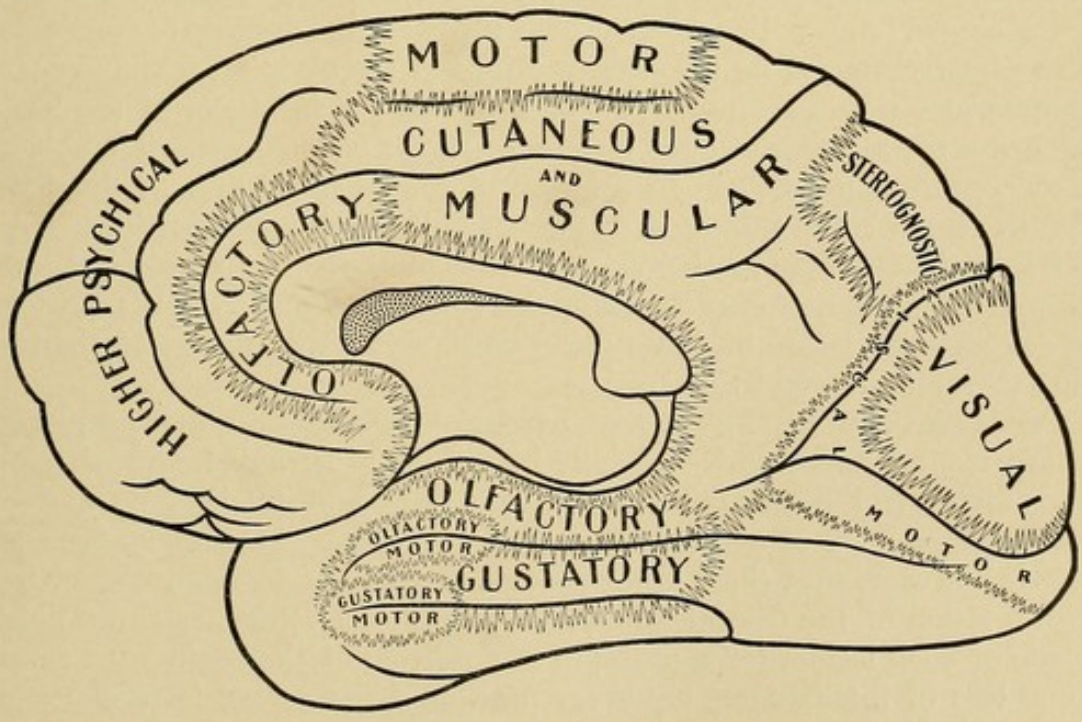
words: not because of any paralysis of the muscles which are concerned in speech, but because of destruction of the coördinating centre which controls these muscles. This is motor aphasia.

Fig. 44



Side view of human brain, showing localization of functions. (Charles K. Mills.)

Fig. 45



View of the mesial surface of the human brain, showing localization of functions. (Charles K. Mills.)

As most of us are right-handed, the speech centre is localized mostly in the left cortex. In left-handed persons, however, the speech centre is on the right side of the brain. Another important point must be remembered, that is, what act controls the right- or left-handedness of the individual. Given a person who is equally skilful with either hand, but who writes with the right hand, such a person will be preponderantly left-brained. In other words, the function of writing, which is perhaps the highest of the developmental functions, controls largely the side on which the speech centre is principally localized (Fig. 45).

Sensory Aphasia.—In the middle portion of the left first and second temporal convolutions in right-handed persons is the centre for sensory speech. A lesion of this part will cause loss of memory for words and their meaning. Such a person would be unable to understand what is said to him, and he would be able to talk, because his motor apparatus is intact. His words, however, would be unintelligible and devoid of meaning.

Word and Letter Blindness.—Around the end of the first temporal convolution is what is called the angular gyrus. This convolution is directly back of the inferior parietal, or sensory, convolution and between it and the visual or occipital centres. In right-handed persons this centre controls the ability to recognize words, letters, and figures. In a destruction of this area the patient will be unable to write his name, or, in fact, to write anything or to read words, letters, or figures, or to write from dictation. He would, however, be able to recognize other objects, as pictures or music, or he would be able to sketch or draw or recall from memory any object in which words, letters, or figures are not concerned. This is called word, letter, or figure blindness.

Visual Centres.—The centres for vision are localized in the occipital convolutions, especially around the part surrounding the calcarine fissure or the cuneal lobe. The parts around the calcarine fissure are concerned with direct vision, while the other portions of the occipital cortex control peripheral vision. Should there be a lesion, for instance, of the right calcarine fissure, there would be loss of direct vision in the left half of each central visual field. In a lesion of the occipital lobe of the right side there will result blindness of the left half of each visual field, that is, left lateral homonymous hemianopsia, because the right occipital lobe supplies the right half of each retina, this controlling the left field of vision. In an irritative lesion of these parts there will result flashes of light in the corresponding fields.

Psychical Centres.—The higher psychical functions have been placed in the frontal lobes, and especially in the left. In any lesion of these lobes there will result failure of memory, loss of intelligence and of reasoning, change of disposition and of character. It must be remembered, however, that there is no definite mental phenomenon associated with a lesion of the frontal lobes, and failure of intelligence is not diagnostic of such lesion, for a lesion in any portion of the brain must cause some loss of intelligence, for every portion of the cortex is in constant communication with every other, and a destruction of one part must cause a disturbance of the integral whole.

Subcortical Centres.—Generally speaking, the symptoms of a tumor or a lesion localized underneath the cortex will depend entirely upon what fibers are cut off. As any lesion will interfere with the fibers related to more than one function, the symptoms will never be clean cut. For instance, a tumor localized underneath the precentral convolution will not only give motor symptoms, but will also give some involvement of sensation.

While it is acknowledged that in the cortex are localized the centres for every motion, sensation, and special act, it must be remembered that this is so only so far as simple acts like lifting a finger or moving a limb are concerned. Where, for instance, it is necessary to perform a complex act, such as talking, laughing, crying, eating, or swallowing, there must be some one place or centre which coördinates the different functions which such an act must comprise. The speech centres, probably because of their importance, are largely localized in the cortex, but they also have representation in the subcortex. As to where the centres for laughing, crying, eating, and swallowing are we are not certain, but we believe that they must be localized in some of the ganglia in the subcortex, among these the optic thalamus and the lenticular and the caudate nucleus probably playing the most important role.

Internal Capsule.—The internal capsule is the name given to the pathway of fibers which come from the cortex. It contains an anterior limb, a knee, and a posterior limb. The anterior limb transmits the fibers coming from the frontal to the opposing cerebellar lobe, the so-called frontocerebellar fibers. The knee of the internal capsule transmits those fibers which come from the lowest portion of the precentral convolution, *i. e.*, the head and face centres, these being the fibers which go to the nuclei of the cranial nerves situated in the crus, pons, and medulla, *i. e.*, from the third to the twelfth nerves inclusive (Fig. 46).

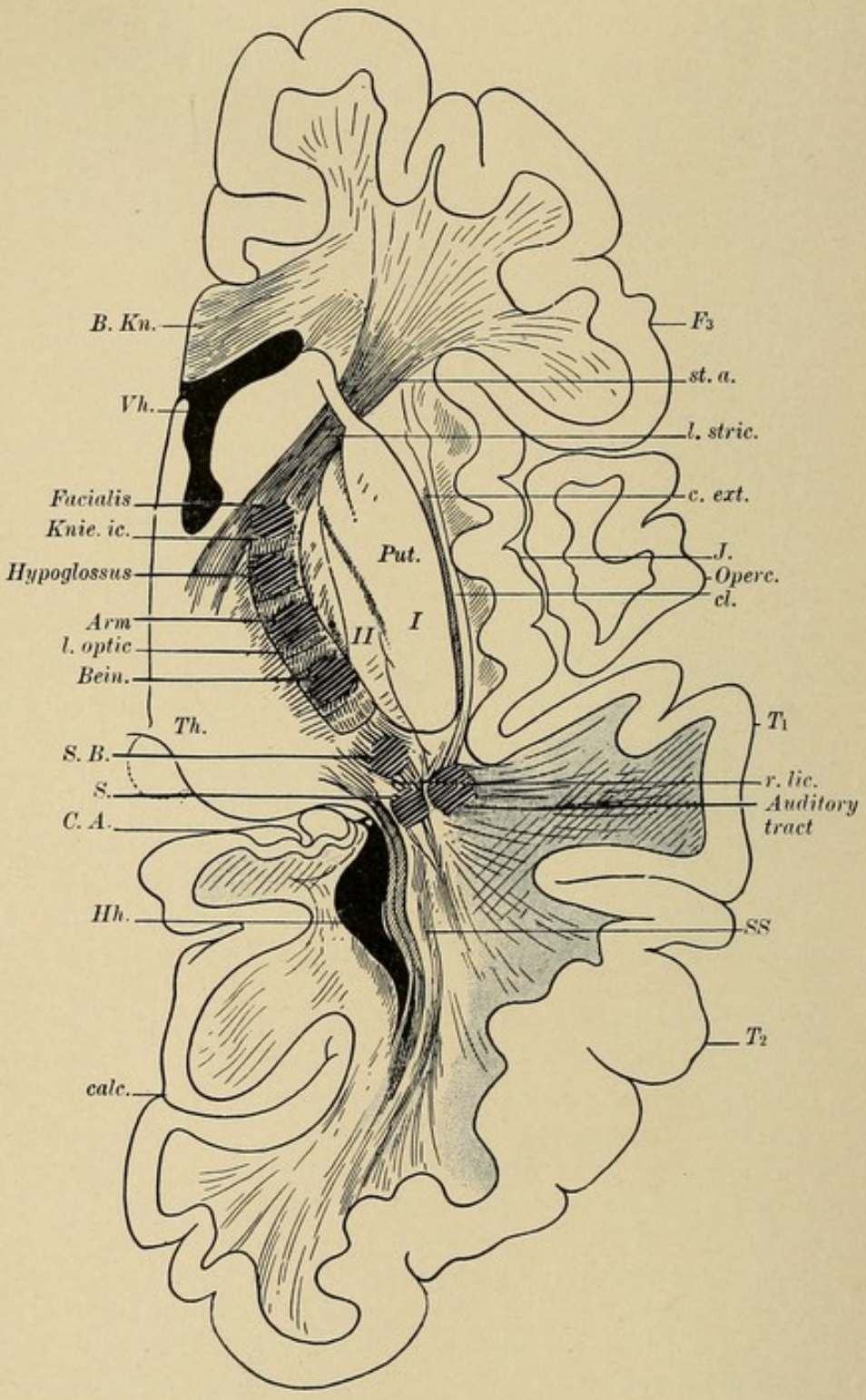
The posterior limb of the internal capsule transmits in its anterior portion the motor fibers, in its middle the sensory, and in its posterior portion the fibers which come from the occipital or visual lobes. Should there be a lesion of the posterior limb of the internal capsule, as, for instance, a hemorrhage, there would result hemiplegia, hemianesthesia, and hemianopsia on the other side. This is the only place in the brain where one lesion will always give these three symptoms.

The Crus, or Cerebral Peduncles.—The cerebral peduncles are practically the continuations of the posterior limbs of the internal capsule and transmit the fibers for motion and sensation, thus connecting the brain proper with the brain stem.

The nucleus of every cranial nerve from the third to the twelfth inclusive receives its innervation from the opposite cortical centre. The first and second cranial nerves do not enter into this, as they are really parts of the brain.

The nucleus of the third, or the oculomotor, nerve is situated in the posterior portion of the crus, and its fibers have their exit at the foot of the cerebral peduncles. A unilateral lesion, therefore, of the cerebral

FIG. 46



Horizontal section through the right hemisphere. *B. Kn*, knee of corpus callosum; *Vh*, anterior horn of lateral ventricle; F_3, inferior part of third frontal convolution; *l. stric*, lenticulo-striate division of internal capsule; *Knie. ic.*, knee of internal capsule; *l. optic*, lenticulo-optic division of internal capsule; *Th*, optic thalamus; *J*, island of Reil; *cl*, claustrum; *Operc*, operculum; T_1, first temporal convolution; *r. lic*, retrolenticular region of internal capsule; *C. A.*, hippocampus major; *calc*, calcarine fissure; *Hh*, posterior horn of lateral ventricle; *SS*, optic radiation of Gratiolet; T_2, second temporal convolution; *Facialis*, position in capsule of motor tract to the face; *Hypoglossus*, position of tract to the tongue; *Arm*, position of tract to the arm; *Bein*, position of tract to the leg; *S. B.*, sensory fibres; *S*, visual tract; *A*, auditory tract. (M. Allen Starr, after von Monakow.)

peduncle would always give oculomotor palsy on the same side with the addition of a paralysis of the lower part of the face, arm, and leg on the other side of the body.

The Pons.—In the pons are located the nuclei for the fifth, sixth, seventh, and part of that of the eighth cranial nerve, the exits of these nerves corresponding in order. In a unilateral lesion of the upper part of the pons there will be paralysis of the fifth nerve on the same side with hemiplegia of the opposite side. In a lesion limited to the lower portion of the pons, there will result facial palsy on the same side and paralysis of the arm and leg only on the other side. In discussing the symptoms of lesions in the crus and pons, it has been assumed that these are confined to the anterior portions of these structures. Should the lesion, however, be more extensive, there would necessarily have to be involvement of the sensory fibres which are localized directly back of the motor, and there would result in addition sensory symptoms on the other side.

Paralysis of Associated Ocular Movement.—Should, however, the lesions involve the median portions of the crus and pons, there would be paralysis of associated ocular movement. This is rather difficult to understand, unless it is remembered that it is impossible to move one eye without the other, and therefore every movement of the eyeballs must be an associated movement. When we look to the right we use not only the external rectus muscle on the right side, but we also use the left internal rectus, *i. e.*, we are receiving innervation from the nuclei of the sixth and third cranial nerves. To make this possible there must be a connection between these nuclei, and this is accomplished by means of the posterior longitudinal bundle which is located in the posterior and median portion of the crus and pons.

In looking downward we use not only the muscles which are innervated by the third, but also those which are innervated by both fourth cranial nerves. In looking upward we use only the muscles which receive innervation from both oculomotor nuclei. We see then that there must be a similar connection between the oculomotor nuclei and between these and the nuclei of the fourth nerves.

Should there be a lesion, for instance, in the lower part of the right side of the pons, cutting off the posterior longitudinal bundle, there will be inability to look to the right, and a similar lesion on the left side will cause inability to look to the left. A lesion cutting off both bundles will cause inability to look to the right or left, but the ability to look upward and downward will be retained.

In a lesion of the upper portion of the pons which cuts off the connection between the third and fourth nuclei there will be paralysis of associated movement downward. A lesion still higher up will cause failure of upward movement.

Partial or Total Lesions of the Medulla Oblongata.—Partial or total lesions of the medulla oblongata will not be considered, because hemorrhages nearly always prove immediately fatal. Neither will lesions of the quadrigeminal and other structures, because of our lack of definite knowledge.

The Cerebellum.—The cerebellum consists of a middle portion, or the vermis, and two lateral lobes. It is connected with the rest of the brain by three processes called the cerebellar peduncles, the superior or first connecting it with the brain proper, the middle with the pons, and the inferior with the medulla and spinal cord. In the middle lobe are situated the dentate nucleus, the nucleus fastigii, and the nucleus emboliformis and globosus. In addition certain nuclei situated in the medulla oblongata are in direct communication with the cerebellum, and should be regarded really as part of it. These include Deiter's nucleus, the nucleus vestibularis, and the nucleus magnocellularis substantia reticularis, these being called altogether the paracerebellar nuclei.

The functions of the cerebellum are not definitely known. Experimental and clinical evidence seems to show that lesions in any portion will produce symptoms of incoördination of a definite character. It has recently been demonstrated by Sir Victor Horsley that the cortex of the cerebellum is inexcitable, but that irritation of the intrinsic cerebellar nuclei will produce conjugate deviation of the eyes and head to the same side, besides flexion of the homolateral elbow, and that deeper excitation of the paracerebellar region will produce extension of the contralateral elbow, hyperextension of the neck and trunk, with powerful extension of the lower limbs.

It is probable that the cerebellum is concerned with the coördination of every voluntary movement, whether this be of the limbs, eyes, or of those muscles which are concerned in articulation, eating, or swallowing. It is characteristic of this incoördination that it is apparent only in voluntary movements and that it does not increase when the object is attained or when the eyes are shut and that it is not dependent upon any disturbance of peripheral sensation.

It has also recently been held that lesions of the cerebellum will produce weakness or paresis of the muscles of the trunk and limbs, but this is not a true weakness in the sense that it is dependent upon the motor fibers. Besides, there may be present in the muscles a lack of tone, so that the limbs would be moved like a flail. If the lesion is in the middle lobe, or the vermis, the symptoms of incoördination are most marked and will involve both parts of the body, while unilateral lesions will, of course, produce preponderant unilateral ataxia and atonia.

Whatever symptoms are produced by lesions of the cerebellum or by those lesions which invade the cerebellum by pressure are dependent upon this disturbance of coördination. This is apparent in every movement, whether it be in the gait, station, in the movement of a limb or limbs, or of the eyes, or of those muscles which are concerned in eating, talking, and swallowing. Other localizing symptoms will be discussed under the head of cerebellar tumors.

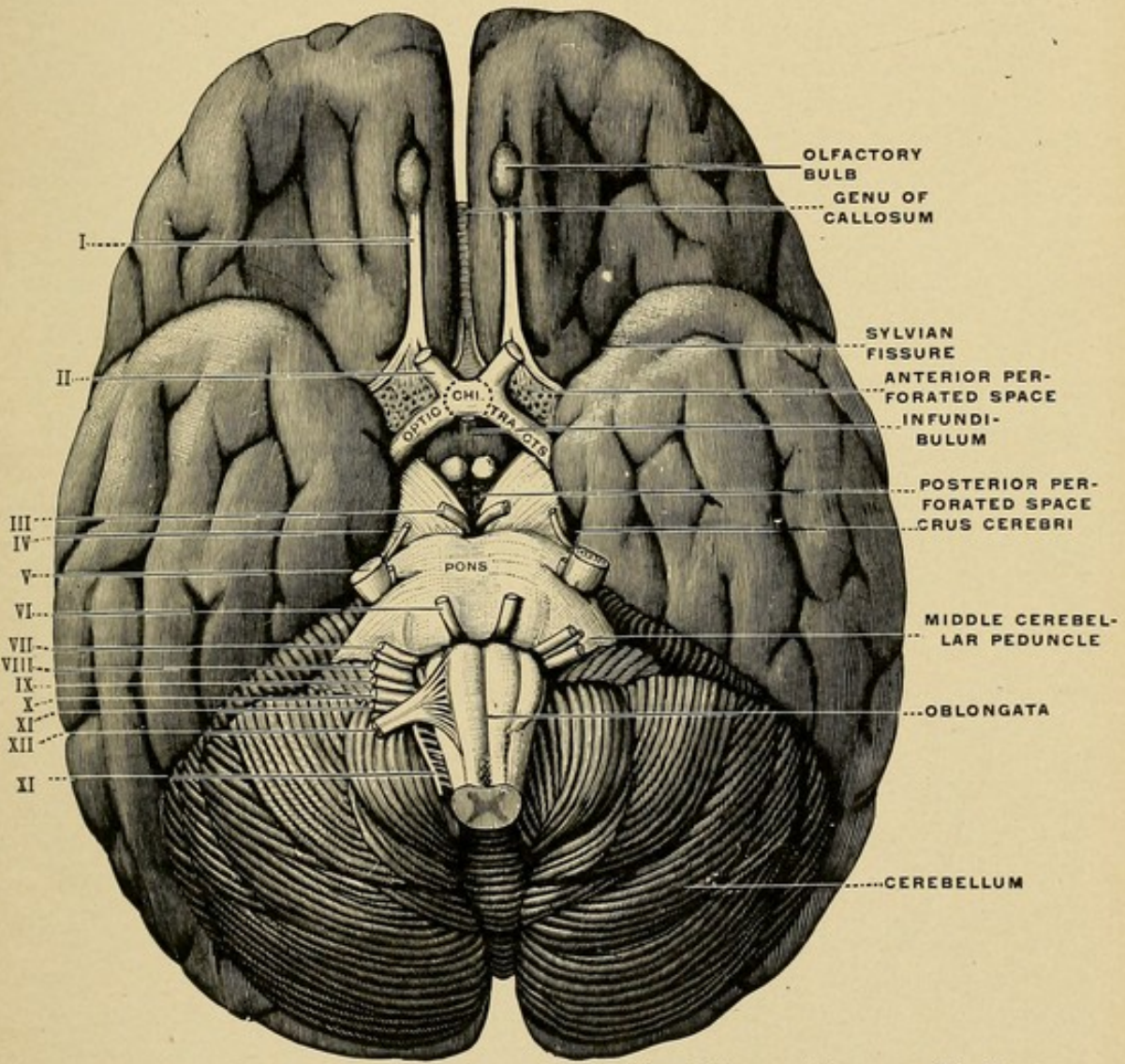
The Cranial Nerves (Fig. 47).—There are twelve pairs of cranial nerves. These are known either by special names or numerically. The first and second, or the olfactory and the optic, nerve should really be considered as parts of the brain proper and not as distinct cranial nerves.

The centre for the *olfactory* nerve is not definitely known, but its func-

tion is concerned with smell, the loss of which is very frequent in fracture of the base of the skull.

The *optic*, or *second, nerve* is the nerve of vision. From the orbits, in their course backward, the optic nerves enter into and form the optic chiasm and then the optic tract, and from here the visual fibers go to the primary optic centres, these constituting the anterior corpora quadrigemina, the external geniculate body, and the pulvinar, or posterior, portion of the optic thalamus. Thence the fibers pass through the extreme posterior portion of the posterior limb of the internal capsule to the occipital lobe.

FIG. 47

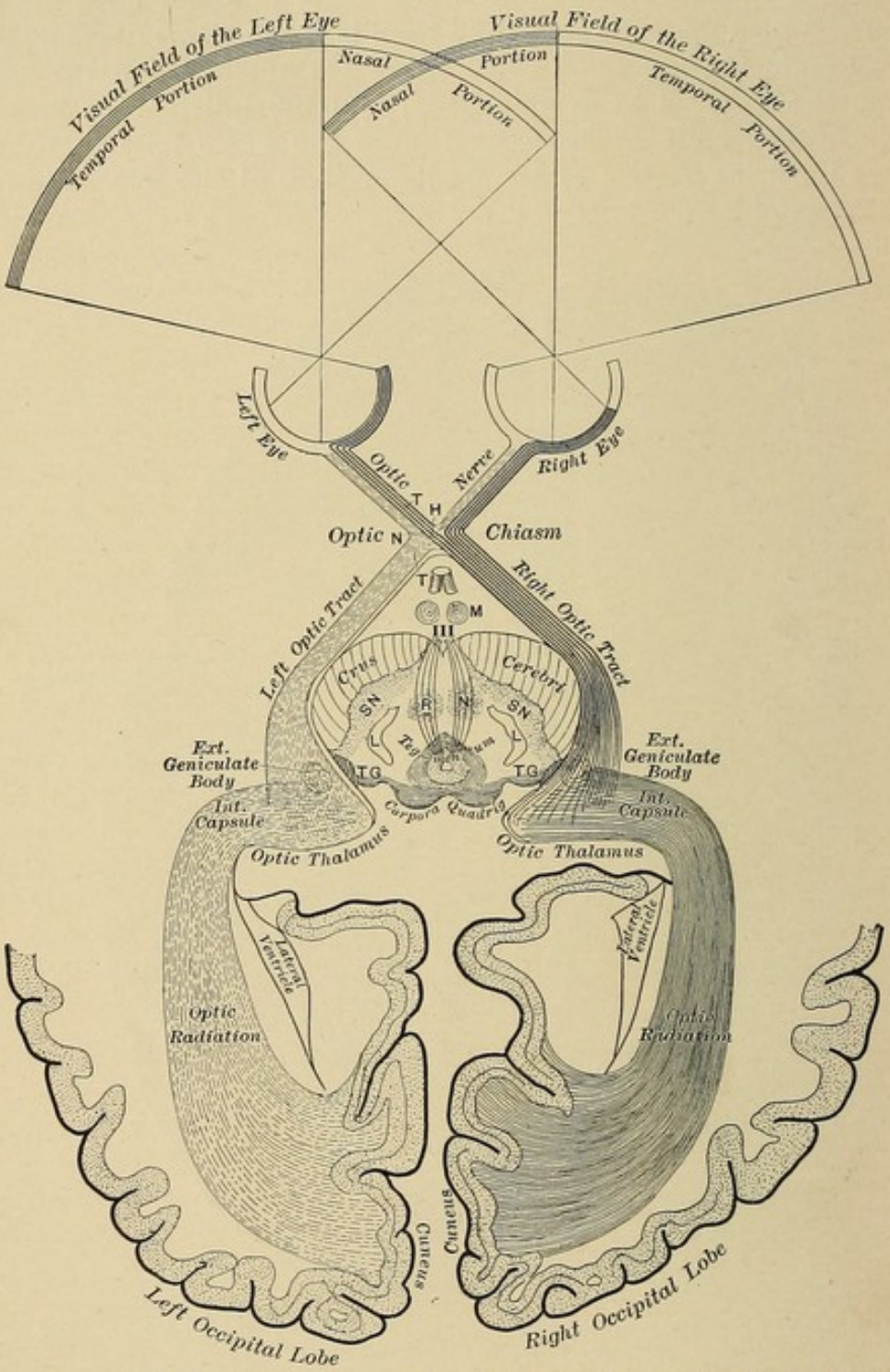


Under surface of the brain, showing the superficial origins of the cranial nerves. The Roman numerals indicate the nerves. (Testut.)

It must be remembered that the visual fibers coming, for instance, from the right occipital lobe innervate the right half of each retina and thereby supply vision to the left half of each visual field. A lesion interrupting the fibers coming from the right visual centres or the occipital lobe, for instance either in the extreme posterior portion of the posterior limb of the internal capsule or in the so-called primary optic

centres or in the optic tract, must give loss of half vision in both visual fields on the other side, or left lateral homonymous hemianopsia. From

FIG. 48



The visual tract. The result of a lesion anywhere between the optic chiasm and the cuneus is to produce homonymous hemianopsia. *H*, lesion at chiasm causing bilateral temporal hemianopsia; *N*, lesion at chiasm causing unilateral nasal hemianopsia; *T*, lesion at chiasm causing unilateral temporal hemianopsia; *SN*, substantia nigra of crus; *L*, lemniscus in crus; *RN*, red nucleus; *III*, third nerves.

each optic tract a part of the visual fibers innervate the temporal part of the retina on the same side and the nasal of the other. The decussation

of the nasal fibers takes place in the centre of the optic chiasm. A lesion, therefore, of the middle of the optic chiasm will give loss of innervation to the nasal part of each retina or bitemporal hemianopsia.

A lesion interrupting the fibers on the outer side of the optic chiasm, as for instance the right, will cause loss of innervation to the right temporal retina, and therefore loss of the nasal field of vision of the right eye. A bilateral lesion must give bilateral loss of vision of the nasal fields, or binasal hemianopsia (Fig. 48).

A lesion destroying the whole optic chiasm, as, for instance, a tumor of the hypophysis, will cause loss of vision in both eyes. Destruction of either optic nerve will necessarily give blindness in the corresponding eye.

Choked Disk, or Optic Neuritis.—Whenever there occurs increase of intracranial pressure, whether because of a brain tumor, trauma, or internal hydrocephalus, pressure will be exerted upon the optic chiasm and optic nerves. This is because pressure in any portion of the brain will result in a heightened tension in the lateral and the third ventricle, the latter pressing directly upon the optic chiasm and optic nerves.

In every choked disk there must be some inflammation of the optic nerve, or optic neuritis, but in optic neuritis choked disk does not necessarily occur, for the latter is distinctly a pressure symptom. When the optic nerve is pressed upon there will be first a stasis of the vessels, this resulting in a swelling of the veins which is so severe at times as to produce hemorrhages. There will also be retardation of the arterial flow causing a diminution in the size of the arteries. Because of this stasis there will result an edema, which will produce a swelling of the optic nerve fibers or of the optic nerve head. If the pressure is continued the nerve fibers will become diseased, resulting in impairment of vision. This is choked disk. If the pressure is continued for a long time there will necessarily result atrophy of the optic nerve fibers.

Pupils.—The ciliary muscles react to two forms of stimulus: (1) light, and (2) movement of the eyeballs. No matter what the stimulation, the contraction or dilatation of the pupil is performed by the same ciliary muscle, but the innervation differs. The ordinary light stimulation is transmitted by means of the optic nerve to the oculomotor nucleus, and from here the impulse to the ciliary muscle is carried by the oculomotor nerve. This is the light reflex arc, and, if there is any disturbance anywhere in the arc, there will be impairment or loss of the reaction of the pupil to light. The fibers which are concerned with the reaction of the pupil to movement, as, for instance, in convergence and divergence and in upward, downward, and outward movements, have probably a similar arc, with the addition that they are in connection with the nuclei of the muscles necessary to perform the given ocular movement.

There is no subject of which we have a less definite knowledge than this, and it is a safe rule when considering symptoms of brain lesion to pay no attention whatever to the condition of the pupils.

The *oculomotor*, or *third, nerve* supplies the orbicularis palpebrarum and all the muscles of the eyeball with the exception of the superior oblique and the external rectus. A total paralysis of this nerve will

cause ptosis of the upper lid, outward deviation of the eye, and enlarged pupil, with inability to move the eye in any but the outward direction. It is possible to have a partial involvement of the oculomotor nerve. A total or partial oculomotor palsy is nearly always indicative of basal syphilis.

Paralysis of the *trochlear*, or *fourth, nerve* is an extremely rare condition and hardly ever occurs alone, but is generally found in association with palsies of the other ocular muscles. This nerve supplies the superior oblique muscle which rotates the eye downward and outward. Basal syphilis is nearly always the cause of the paralysis.

The *trigeminus*, or *fifth, nerve* has both a sensory and a motor function, but is mostly sensory. The motor part supplies the muscles of mastication. The sensory division supplies sensation for the face, eye, nose, jaws, teeth, palate, and pharynx, and also the anterior two-thirds of the tongue.

In paralysis of the motor fifth there will be inability to chew on the side of the paralysis, the contraction of the masseter muscle will be weak, and the jaw will deviate toward the affected side. In an irritating lesion of the sensory part of the fifth nerve there will be pain either in its whole distribution or in a subdivision of the nerve, *i. e.*, the supra-orbital, infra-orbital or mental. If the nerve is cut, or if the lesion is destructive, there will be anesthesia in the related parts.

The *abducens*, or *sixth, nerve* supplies the external rectus muscle, which pulls the eye outward. Temporary or permanent paralysis is a very frequent and early symptom in basal syphilis and in brain tumors.

The *facial*, or *seventh, nerve* supplies the muscles of the face, including the buccinator. Paralysis causes inability to elevate the brow, shut the eye, or elevate the corner of the mouth on the involved side, with the addition of lacrymation in the involved eye. Palsy occurs in basal syphilis, but not so commonly as in the sixth nerve.

The *auditory*, or *eighth, nerve* has two divisions, the cochlear, which is the nerve of hearing, and the vestibular, which is concerned with coördination. Basal syphilis or tumors are the most frequent cause of unilateral deafness.

Ménière's disease is the name given to a symptom-complex which generally occurs in the latter end of life, and, as a rule, begins with unilateral noises in the ear, accompanied by some dizziness. These first come on at intervals; gradually the tinnitus increases, the noises sometimes resembling the shrieking of a whistle, becomes bilateral and is accompanied by excessive vertigo, which, as a rule, terminates in nausea and vomiting. There is progressive loss of hearing. The tinnitus, vertigo, and deafness become constant, sometimes preventing the patient from assuming an erect posture. Rarely, when the deafness becomes complete, the vertigo and tinnitus cease. It is supposed that this symptom-complex is due to a disease of the terminal filaments of the vestibular nerve in the labyrinth, and there may also be disease of the semicircular canals.

The *glossopharyngeal*, or *ninth, nerve* supplies sensation for the posterior third of the tongue and the pharynx, and also motion for some of the palatal and pharyngeal muscles.

The *pneumogastric*, or *tenth, nerve* supplies the heart, lungs, abdominal viscera, and the pharyngeal and laryngeal muscles.

The *spinal accessory*, or *eleventh, nerve* besides innervating the trapezius muscle helps to innervate the same structures that the tenth nerve does. Isolated paralysis of any of the above three nerves is most unusual.

The *hypoglossal*, or *twelfth, nerve* supplies motion to the tongue. In cases of paralysis the tongue will be protruded to the corresponding side and, when in the mouth, will deviate to the opposite side. Isolated lesions are very uncommon.

DISEASES OF THE BRAIN AND ITS MENINGES.

Certain general symptoms may be present in any disease of the brain or its meninges, the degree and number of these depending upon the nature, extent, and location of the lesion. They are headache, nausea, vomiting, vertigo or dizziness, disturbances in motility, such as tremors, convulsions, general or focal in type, partial or total paralysis, disorders of sensation and disturbances of vision or of the other special senses, and lastly alterations in mentality.

Headache.—Headache as a result of any cerebral lesion is nearly always due either to an irritation of the dura or an increase of intracranial pressure which causes tension of the dura. The meninges are innervated by the sensory portion of the fifth nerve, hence, diseases of this must cause pain. At times the headache is localized to the place of direct irritation, but, as a rule, it is general. The pain is usually severe and constant and is difficult to relieve by medication, and vomiting does not lessen its intensity.

Nausea and Vomiting.—The *nausea* and *vomiting* which are present in diseases of the brain are generally indicative of intracranial pressure, for they are not present unless such be the case. They are probably due to an irritation of the ninth and tenth nerves. The nausea may appear in the morning or at any time and may be accompanied by vomiting, but the latter, as a rule, does not relieve the nausea or the accompanying headache. The vomiting is generally projectile in character and comes on without warning. These symptoms are generally indicative of brain tumor. A greater amount of nausea and vomiting is present in cerebellar lesions because pressure is more direct upon the ninth and tenth nerves.

Vertigo, or Dizziness.—Vertigo, or dizziness, is also considered a pressure symptom in diseases of the brain. The dizziness may be objective or subjective, *i. e.*, the patient may either see objects move before him or he may have a sensation that he moves himself. In cerebral tumors this symptom is not very common, but in cerebellar lesions vertigo appears early and is marked and persistent. It is probably due to pressure which is exerted on the vestibular division of the eighth nerve.

Disturbances in motility do not occur unless there is an involvement either of the cortical motor centres or of the fibers coming from them.

Because of the readiness with which motor symptoms are detected, they are more quickly appreciated than other symptoms. They may consist of tremors, forced movements, convulsions, either general or focal, and partial or total paralysis.

Tremors.—These may be coarse or fine. Coarse tremors do not result from surgical brain lesions, and are usually indicative of paralysis agitans, multiple sclerosis, or of some functional disturbance. Under fine tremors we may consider fibrillary twitchings. These are always indicative of a slow and progressive degeneration of nuclear cells.

Forced Movements.—Under this will be discussed athetosis or athetoid movements. These may be present in the face or in all of the limbs, or in any one of the limbs or face, and are always indicative of a lesion of the motor columns either at infancy or birth. The athetoid movement is slow, twisting, and constant.

Convulsions.—These are characterized by spasmodic movements of a part of a limb, a whole limb, one-half of the body, or of the whole body, and may be accompanied by loss or impairment of consciousness. If the convulsive movement is limited to a part of a limb, or a limb, or one-half of the body, and if it begins always in the same muscles, it is called a *focal*, or *Jacksonian*, *convulsion*, and is nearly always indicative of an irritative lesion in the motor cortex. In Jacksonian convulsions, or epilepsy, the spasms come on quickly and may last from a few seconds to several minutes, are generally clonic in type, and, as a rule, are not accompanied by unconsciousness.

It is of the utmost importance to see where a Jacksonian convulsion begins, what muscles or movements it involves, and their succession. Supposing, for instance, twitchings began in the fingers of the right hand, and from here the movement extended into the muscles of the forearm, arm, and shoulder, and then into the muscles of the face. This would be indicative of a lesion in the left motor cortex, probably extending from the hand to the face centre, *i. e.*, from the middle to the lower portion of the precentral convolution. Should, however, the convulsion involve the leg instead of the face, it would indicate that the lesion extends from the middle of the precentral convolution upward or to the leg centre. These facts are of the utmost importance when surgical procedures are considered, for upon their correct observation will rest the selection of the seat of operation.

Epilepsy.—General convulsions are nearly always indicative of epilepsy. This disease is probably due to maldevelopment of the brain, and the spasms in the large majority of cases first appear in infancy. Only rarely do they appear after the twentieth year. One of the frequent causes is injury to the head very early in life, and less frequently does it follow injury to the head in adults. The cardinal symptom of epilepsy is loss of consciousness.

There are three types of attacks: First, *major epilepsy*, or *grand mal;* second, *minor epilepsy*, or *petit mal;* and third, *psychic epilepsy.*

In *major epilepsy*, or *grand mal*, there may or may not be an aura. This may be either a feeling of numbness which ascends from the fingers

to the shoulder, or starts from the stomach and goes to the neck. An aura may consist in disturbances of any of the special senses, or the patient may have a feeling that something is going to happen. This aura may last a second, a few seconds, or a minute or longer, and is followed, as a rule, by a cry, the so-called epileptic cry, and the patient falls to the ground unconscious. The body then becomes rigid, the head may bend backward, the hands are clinched, the face is blue or livid, the eyes may roll in any direction, and the teeth are clinched. Generally the patient bites his tongue and froths at the mouth. This tonic condition may last from a few seconds to several minutes, and is succeeded by clonic or intermittent movements which may last also from a second to several minutes. Relaxation then follows, and the patient may rally from the attack immediately or may not do so for several hours or longer. The patient generally feels weak and exhausted afterward. Because of the contraction of the abdominal muscles on the bladder walls there is usually some dribbling of urine.

The above description is that of a typical attack of major epilepsy. There are, of course, variations of this, some attacks being more severe than others. As a rule, these convulsions occur intermittently, sometimes daily or oftener, or every week or month; but if a number of attacks come on one after another the condition is known as *status epilepticus*.

By *minor epilepsy*, or *petit mal*, is meant a condition in which the patient has only very small movements, which may consist of the twitching of an eyelid or movement of an eye, or movements of the jaw or tongue or of any of the limbs; but the important point is that there is always momentary loss of consciousness.

By *psychic epilepsy* is meant a condition in which there is loss of consciousness, but in which no movements occur. There are of course variations of this, and there may be conditions in which the patient is in a semistuporous or somnambulistic condition, and performs automatic movements or does reasonable things, after which there is no recollection of what has happend. As a rule, however, these attacks last only a few seconds. In association with this there are always attacks of grand mal or petit mal.

Partial or Total Paralysis.—It must be borne in mind that in the motor cortex are represented the centres for movement, and, if these are destroyed, paralysis of movement will occur, the extent and completeness depending upon the centres destroyed. Paralysis of one limb, the result of a cortical lesion, is very unusual, and, if present, is always due to a small tumor or more probably an injury. If the whole motor cortex is destroyed, hemiplegia will result.

Reflexes.—Every reflex has its physiological arc, this consisting of a sensory impression, a centre, and a motor response. The simplest example is the knee, or patellar, jerk, in which, after tapping the patellar tendon, the impulse is carried by the sensory nerves and posterior roots to the cells of the anterior horn in the second, third, and fourth lumbar segments, and from here the motor response is transmitted by the anterior roots and the peripheral motor nerves. If there is a lesion in any portion of

this arc, there will be loss of the reflex, no matter what the condition above in the spinal cord and brain. The first principle then in the attainment of any reflex is to have its arc intact and in normal condition. Should, however, there be a lesion in any portion of the upper motor neuron or system anywhere in its course, and the relation of tone is disturbed, there will result exaggeration of the reflexes because of loss of cerebral, or what has often been called inhibitory, influence. That every reflex has a cerebral influence is proved by the fact that if there is a complete transverse lesion, for instance in one segment of the cervical cord, all the reflexes below are lost even though the arcs are intact.

Reflexes are of two kinds: First, deep, or tendon, and second, superficial, or skin. The usual tendon reflexes elicited are:

(*a*) In the upper limb: The biceps and triceps.

The biceps reflex is obtained by having the patient flex the forearm on the arm at a right angle. The thumb of one hand of the examiner is then placed on the biceps tendon. Striking the thumb with the percussion hammer will produce flexion of the forearm upon the arm. The centre of the reflex is in the fifth cervical segment.

Triceps Reflex.—With the arm in the same position, if the triceps tendon is struck near its insertion at the elbow, extension of the forearm on the arm will result. The spinal centre is in the sixth and seventh cervical segments.

(*b*) In the lower limb:

The knee, or *patellar, jerk* is best obtained by crossing one leg over the other and striking its patellar tendon near its insertion. A forward movement of the leg will result. The spinal centre is in the second, third, and fourth lumbar. When the reflex is diminished it may sometimes be brought out by reinforcement. This is done by having the patient lock his hands and then pull them apart at a signal, the examiner striking the tendon at the time of the greatest effort.

The Achilles jerk is best obtained by having the patient kneel on a chair and then tapping the Achilles tendon near its insertion into the heel. A flexion of the foot on the leg will result. The spinal centre is in the first sacral.

Ankle and Patellar Clonus.—A clonus is obtained only when there is an exaggerated tonicity, and always indicates a lesion of the motor, or pyramidal, tracts. *Ankle clonus* is obtained by first flexing the leg upon the thigh. With one hand held over the calf of the leg, the other holding the foot, a sudden flexion of the foot on the leg is made, this resulting in to-and-fro movements at the ankle which are regular in rhythm. *Patellar clonus:* With the leg extended on the thigh the patella is grasped between the thumb and the forefinger and suddenly brought forward. Rhythmical up-and-down movement constitutes patellar clonus.

Biceps and *triceps clonus* is sometimes obtained similarly to that of the ordinary reflexes.

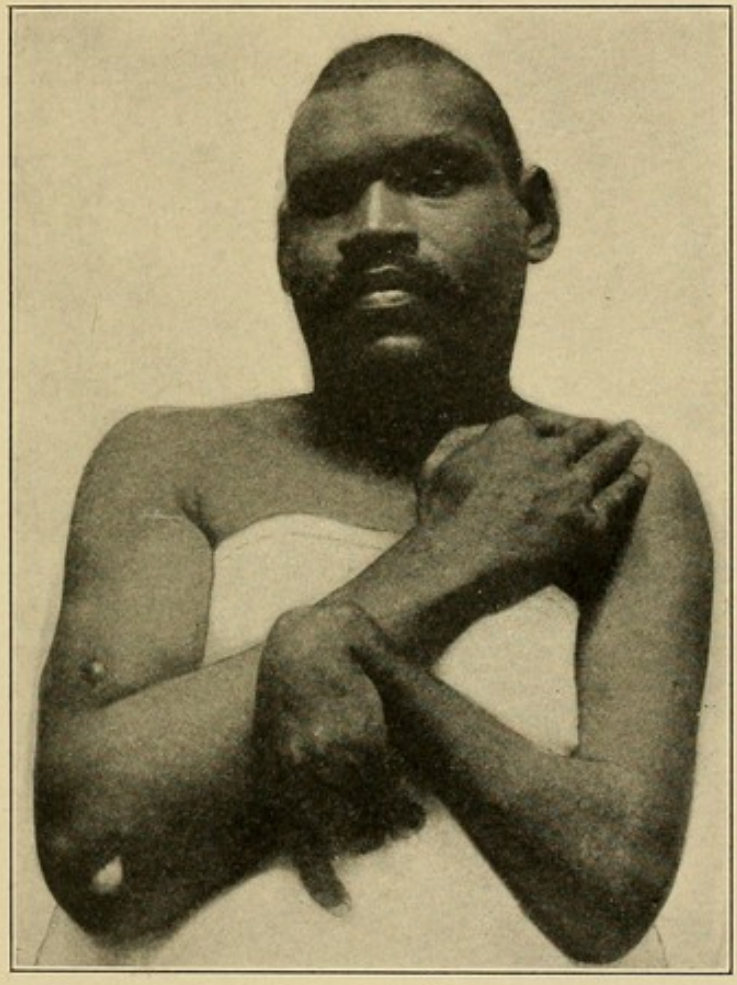
Rarely ankle clonus and sometimes patellar clonus can be obtained in hysteria, but the movements are not regular and the rhythm is influenced by the will.

Skin, or Superficial, Reflexes.—*The abdominal,* or *umbilical, reflex* is obtained by stroking upon one side of the abdomen, the umbilicus approaching to the side of the irritation. The spinal centre is in the ninth, tenth, and eleventh thoracic segments.

The cremasteric reflex is obtained by irritating the inner portion of the upper thigh, this resulting in upward movement of the scrotum on that side. The spinal centre is in the first lumbar segment.

The plantar reflex is obtained by irritating the plantar surface of the foot, flexion of the toes resulting. The spinal centre is in the second sacral.

FIG. 49



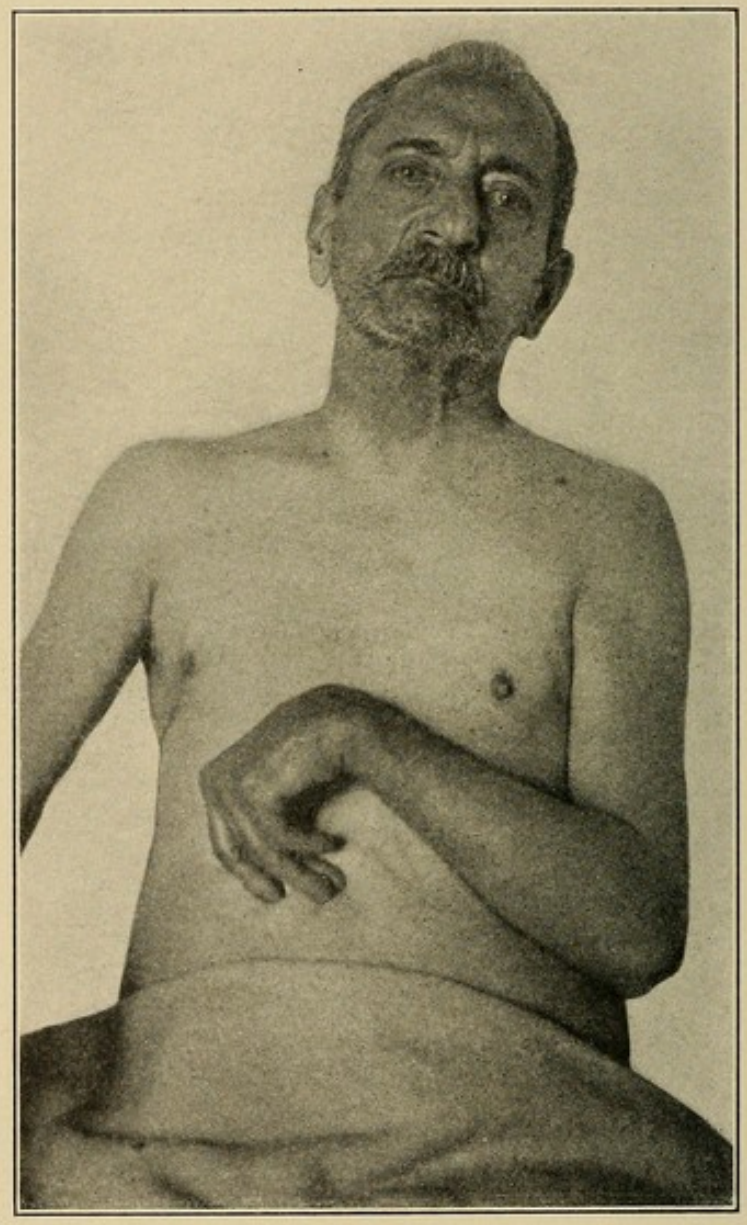
Contractures following hemiplegia. Birth palsy. Patient has epilepsy. Contractured elbow, wrist, and digits. Atrophic (poorly developed) musculature. Left leg similarly but less markedly affected.

Babinski's reflex is obtained by irritating the plantar surface of the foot, extension of the toes resulting Irritation is best produced with a match, which should first be carried on the outer part of the foot and then across. The important part of this reflex is the slow extension of the large toe; the movements of the small toes may be disregarded. It is also advisable to first grasp the foot at the ankle so as to obviate any voluntary movement. This reflex is never obtained in a functional condition, and is always indicative of a lesion of those motor fibers which are in relation

with the lower limb. A lesion of the motor fibers in relation with the upper limb will not produce this reflex.

Hemiplegia.—By hemiplegia is meant paralysis of an arm, leg, and the lower part of the face on the same side. Such a patient will be able to wrinkle the brow and close the eyelids, but will not be able to elevate the corner of the mouth on the paralyzed side. In every hemiplegia

FIG. 50



Left hemiplegia, showing drooping of the left side of the face and flexor contractures in the left upper limb, differing from the extensor contractures of spinal-cord disease.

there is always some return of power, and it is a rule that there is a greater return in those muscles which are concerned with the most common movements. In the upper limbs, the flexors being stronger, there is a greater return of power in these muscles, this resulting in a flexor contracture (Fig. 50). In the lower limbs, the extensors being the stronger, the contractures are always in extension. Besides the loss of power,

with its subsequent partial return, there is accompanying stiffness, or spasticity, with increase of all of the tendon reflexes, ankle clonus, and the Babinski reflex.

Whenever there occurs a lesion of the motor system, whether this be in the cortical centres or in the motor tracts anywhere in their course, either in the brain or spinal cord, there will always be, beside the weakness consequent upon such a lesion, a spastic condition, or spasticity, increase in the tendon reflexes, and the Babinski reflex.

Hemiplegia may come on as result of lesions at birth, in the infantile period, or that period in which the child cannot walk, in the time of mature development, or that period between the time when the child is fully able to walk to early adult life, about the twenty-first year, and from this time on. These subdivisions have been made because the clinical type of the paralysis will differ according to the time of life it comes on.

Hemiplegia Resulting from Injuries at Birth.—This occurs only when, as a result of difficult instrumental labor, there is an injury to the motor cortex either of one or both sides. Pathologically meningeal hemorrhages are most frequently found. If the injury is one-sided, a hemiplegia will result and the child from its earliest life will be unable to use the limbs of one side. The characteristic of this palsy is that the paralyzed limbs will never fully develop and will always be smaller than those on the healthy side, and there will be present athetoid movements. If the meningeal hemorrhage is removed early, it is possible to obtain considerable return of power.

Should there be *bilateral meningeal hemorrhage* there will result a paralysis on both sides of the body, or a so-called *infantile diplegia.* In such case there will be bilateral spasticity, increased reflexes, and the Babinski reflex. Besides, the limb will never become fully developed and there will be present athetoid movements of the upper and lower limbs and in the muscles of the face, head, and neck. In most instances also there will be inability to talk.

Paralysis Coming on during the First Two Years of Life, or in the Infantile Period.—To understand this it is necessary to consider the development of the motor system. The child, when it is born, cannot walk because of the lack of development of the motor fibers. This can be readily seen when a cross-section is made of the spinal cord of a newly born child, for the myelin sheaths will not stain. On the contrary, if the spinal cord of a chicken, which walks immediately after birth, be stained, it will be found that the myelin sheaths are fully developed. That is why the chicken can walk and the child cannot. Ordinarily it takes from one to two years for the myelin sheaths to obtain full development, and, when this is reached, the child will be able to walk. It can be readily seen from this why it is an error to force or urge children to walk before they are able to do so themselves, and it also is an evidence of the cause of the deformities of such children. Should, therefore, there occur a destruction of the motor centres because of an injury, there will result a hemiplegia, and, as is the case in paralysis which occurs as a result of meningeal lesions, there will be besides spasticity, increased

reflexes, the Babinski reflex, lack of development of the limbs; but this will not be so great as in lesions at birth. It can also readily be seen why a lesion occurring in early infancy will cause a greater lack of development. Athetoid movements, as a rule, do not occur, and if the lesion should be bilateral it is probable that there will not be much impairment of speech. The usual causes of paralysis at this age are either injuries or, what is most common, areas of inflammation, or encephalitis, resulting from or complicating such infectious diseases as scarlet fever, measles, and diphtheria.

Paralyses which Occur between the Second Year, or the Infantile Period, and Full Maturity.—A child grows and does not reach full development until about the twenty-first year, sometimes later. The hemiplegia which occurs in this period will differ from the paralysis occurring later only in the fact that there will be a lack of development of the limb, this being greater in the early periods of life. The causes are generally injury to the head, early syphilis of the nervous system, embolism, or a uremic condition.

The hemiplegias which occur after the twentieth year do not differ as to type, but they do as regards their etiology. It is a safe rule to assume that when hemiplegia occurs in early adult life, before the forty-fifth year, the cause is syphilis. The other causes may be embolism, uremic conditions, brain tumors, or injury to the head. If the cause is syphilis, there may or may not be present other indications or early history of such disease.

Hemiplegias coming on after the fortieth year are usually the result of apoplexy. The other causes are also operable.

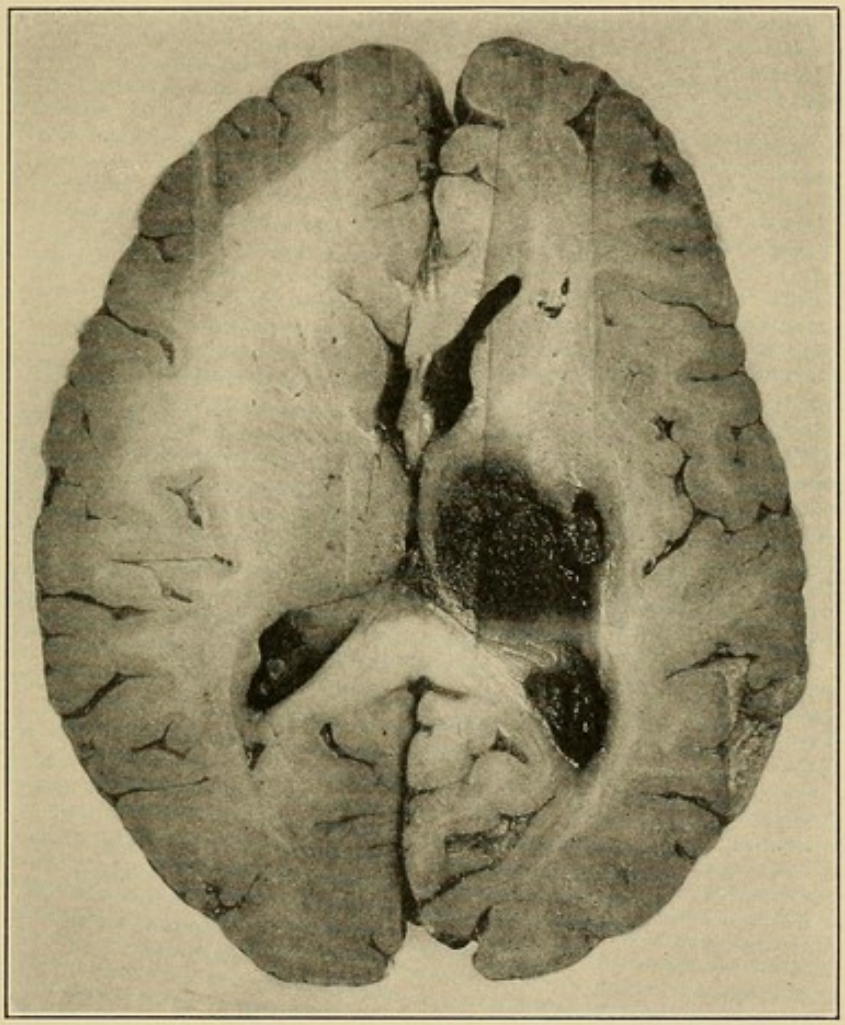
Apoplexy.—By *apoplexy* is meant the bursting of a bloodvessel, the usual seat of hemorrhage being in the lenticulostriate artery. A hemorrhage in this portion will usually injure the posterior limb of the internal capsule, thereby giving hemiplegia on the opposite side; and if the sensory and visual fibers are also involved, hemianesthesia and hemianopsia (Fig. 51). Hemorrhages in the other portions of the brain and brain stem will give various symptoms according to their localization. (See chapter on Cerebral Localization.)

When apoplexy occurs, there is usually an accompanying shock, the patient being rendered unconscious. It is somewhat difficult to tell which side is paralyzed, because in the period directly after the attack there is so much shock that there is complete loss of tone in all of the limbs, and it will be impossible to recognize by the resistance which is paralyzed. Later on, of course, tonicity will become apparent in the sound side. It will be found, however, that on the side of the paralysis there will be drooping of the lower part of the mouth, dribbling of saliva, and stertorous respiration. The paralytic will bring to aid all of the accessory muscles of respiration and in expiration the cheek on the paralyzed side will be puffed out, and because of this there will be dribbling of saliva from the paralyzed to the healthy side. This is an important sign. Again, if the patient is stuck with a pin, there will be reflex movement on the sound side, but not on the paralyzed side.

As a rule, the patient will regain consciousness within a few hours, and from then on there will be a progressive return of power, as indicated previously. If, however, the patient does not regain consciousness within twelve hours, the prognosis is almost invariably fatal.

When hemiplegia is due to *embolism*, there is always an accompanying heart disease and the signs of a valvular lesion. The onset is generally abrupt, and unconsciousness is nearly always present. It may come on at any age, but generally in the young.

FIG. 51



Hemorrhage into posterior limb of internal capsule and optic thalamus causing hemiplegia, hemianesthesia, and hemianopsia on the opposite side.

Hemiplegia due to *thrombosis* nearly always has a slow onset and occurs after the fortieth year. There is hardly ever unconsciousness.

When hemiplegia is the result of *syphilis*, the onset is usually abrupt and, as a rule, there is unconsciousness. It generally occurs in persons before the fortieth year.

In the course of a *uremic condition* it is possible to have paralysis of one side of the body. It is characteristic, however, of this disease that the paralysis is never complete, that it does not last, and that it is always accompanied by convulsions, which may be either Jacksonian

or general in type. There are also present the accompanying symptoms of uremia, such as unconsciousness, urinous odor, dropsical condition of the limbs, and albumin and casts in the urine.

The paralyses which come on in the course of *an injury to the head* are usually accompanied by the surgical symptoms of the injury. This subject will be discussed separately, as will also paralyses resulting from *brain tumor*. In the latter condition the hemiplegia comes on very gradually, and there are always the accompanying symptoms of an irritative lesion of the brain.

Disturbances in Sensation.—Disturbances in sensation occurring in the course of brain disease are always indicative either of a lesion in the sensory cortical centres or in their related fibers. The various forms of sensation are: touch, pain, temperature sensation, this including heat and cold, bone sensation, and the senses of localization, of movement, of position, of pressure, the last four composing what is known as muscle sense. The ability to recognize objects placed in the hand is known as stereognosis, while the inability to recognize objects is called astereognosis. Their cortical localization has been discussed.

Disturbances in touch occur as a result of lesions in the cortical sensory centres or in the postcentral and parietal convolutions. It is characteristic of the anesthesias the result of such lesions that they are never complete and may be segmental in their distribution, as, for instance, a patient may be able to recognize touch over the radial side of the hand and not over the ulnar. A complete disturbance of sensation is nearly always indicative of a lesion in the fibers away from the cortex, generally in the posterior portion of the posterior limb of the internal capsule. Such a lesion will produce complete hemianesthesia, not only for touch, but also for pain and temperature.

Disturbances of pain or of *heat* and *cold sensation* do not occur individually as the result of cortical lesions, for, as a rule, when they are present they are always associated with disturbances of touch. Disturbance of touch sensation is the only form then which can occur alone as the result of cortical lesions. Sometimes, however, if there is an irritative lesion of the sensory cortical centres, there may be attacks of numbness or of pain in the corresponding or associated limbs on the other side of the body. These spasms of pain can be compared to the Jacksonian convulsions which are the result of irritation of the motor centres.

Alterations in the senses of localization, of movement, of position, and of pressure do not occur individually, and if there is disturbance in one there are disturbances in all. Should such be the case, the patient will be unable to recognize where he is being touched (sense of localization), whether a limb or a part of a limb has been moved (sense of movement), the position in which the limb has been placed (sense of position), and whether any pressure is exerted when objects are placed in his hand (sense of pressure). All these make up muscle sense. If these alterations are present, the patient cannot recognize any object placed in his hand, that is, he has astereognosis. Combined with this there must be incoördination of the limbs or limb, depending upon the site of the lesion. Disturbances,

then, of these functions are always indicative of a lesion in the parietal lobules, in the superior if the lower limbs are involved, and the inferior if the upper. Disturbance in touch nearly always accompanies the above symptoms unless the lesion is limited to the parietal convolutions and to the cortex, a rather rare occurrence.

The incoördination which is present as a result of cerebral lesions differs from that which is due to cerebellar or posterior column spinal disease in the fact that it is always unilateral and limited to the limbs, depending upon whether the superior or inferior or both parietal lobules are involved; whereas, in cerebellar ataxia there is incoördination in all the motor functions, and in spinal-cord lesions the ataxia is bilateral and limited to the limbs.

Disturbances in Vision.—Disturbances in vision as a result of cerebral lesions may consist either of a diminution or loss of vision and of such alterations as are the result of paralysis of one or more of the ocular muscles. Under the head of cortical localization have been discussed the visual centres and the results of lesions either in this part or in the primary visual centres, optic tracts, chiasm, and nerves. Under the head of cranial nerves the ocular palsies have also been considered.

Disturbances in the Special Senses.—Disturbances in the special senses, such as hearing, smell, and taste, occasionally occur as a result of destruction of their cortical centres, but this is an extremely rare occurrence. They are mostly due to the involvement of their respective cranial nerves.

Alterations in Mentality.—Alteration in mentality may result either from lack of development, such as occurs in idiocy and imbecility; it may come on for no apparent reason, as is the case in different forms of insanity; or it may be the result of definite lesions, such as brain tumors, abscesses, and injuries to the head.

In *idiocy* and *imbecility* there is lack of development of the whole cerebrospinal system. The brains of such individuals are usually smaller, there is not the usual conformation, and the convolutions and fissures are not well developed. The prognosis is never good, and the only hope is that offered by education.

The different forms of *insanity* will not be considered here. It will only be necessary to say that in the course of some insanities patients develop delusions that they have certain diseases for which operations may be considered. Such operations are absolutely unjustifiable, and will have no beneficial effect upon the delusions and will only multiply them.

Lesions in any portion of the brain will necessarily influence mentality, this depending upon the location and extent of the lesion. Injuries to the brain will also cause disturbances in mentality, this depending upon the extent of the injury.

The question often arises whether it is possible to have *insanity resulting from injury to the brain.* Opinions differ regarding this, but it is probable that this is not possible.

Brain Tumors.—Under this head will be considered tumors, abscesses, areas of softening, or whatever else may give the symptoms of a neoplasm in the brain. The most common form of tumor is the sarcoma, next in

order being glioma, endothelioma, fibroma, fibrosarcoma, carcinoma, tuberculoma, syphiloma, adenoma, etc.

Sarcoma.—This form of brain tumor is probably more common than glioma. The growth may be small, flat, or nodular, or may be of large size. It is primary and usually solitary. Sarcoma always grows from the meninges, periosteum, or cranial bones, or from the pial covering of the bloodvessels. It never grows from the brain substance, and therefore, unlike the glioma, it always compresses the brain tissue and may be distinct from it, although not infrequently it infiltrates the latter. Even when growing within the brain a distinct margin may be sometimes found, due to the softened area surrounding it. It is usually harder in consistency than the glioma, slower in growth, and very vascular.

The tumor may soften or caseate, and myxomatous, hemorrhagic, and cystic changes are not uncommon. Cystic changes are especially common in the cerebellum, not only in sarcomata but also in gliomata. If the fibrous tissue is very marked we have a fibrosarcoma.

Sarcoma may manifest itself as a diffuse multiple sarcomatosis. This may involve, first, the nervous substance and the meninges, and secondly, the membranes only, when it may appear in the form of small tumors or as a diffuse infiltration. When the brain or its meninges are implicated in sarcomatosis, in about two-thirds of the cases a tumor of the cerebellum is found. Tumors may also be found in the fourth and lateral ventricles, Gasserian ganglia, and pituitary body, in fact almost anywhere.

It is important to remember that when sarcomatosis is present the soft tumor masses grow in the pia about the cranial nerves and spinal roots and may produce little or no compression or destruction of the nervous tissue. It is because of this that few clinical symptoms may appear, although there may be extensive alterations in the nervous tissue. A correct diagnosis of sarcomatosis of the brain and the pial covering is often impossible.

Isolated sarcomata are, next to fibromata, among the most favorable forms of tumor for surgical removal. Of course, the question of multiple sarcomatosis must always be carefully considered when deciding upon operation. With regard to surgical procedure, the hard, non-infiltrating sarcomata are the most favorable. Experience shows, however, that a sarcoma which appears to be infiltrating when the brain tumor masses are first exposed is often separable from the brain substance.

Endothelioma.—This is a form of sarcoma which grows either from the endothelial lining of the dura or from the perivascular spaces. It differs only from sarcoma in that the cells are arranged in clumps or columns and that it is more vascular. It never infiltrates the brain tissue, but compresses it and is a very favorable growth for removal. When it is present there may be an accompanying overgrowth of the cranial bones covering it.

Osteosarcoma.—Occasionally a sarcoma will grow from the cranial bones, or it may involve the cranial bones secondarily. In such cases the tumor is called an osteosarcoma.

Glioma.—This form of tumor is almost always primary and single, although metastasis may rarely occur. The tumor may be as small as a cherry or as large as a hen's egg. It always grows from the brain substance itself and is of slow growth. It is not sharply defined, but infiltrates the brain substance, and is difficult to distinguish from normal brain tissue, although sometimes there is an increased consistence and there may be a slight swelling. The border zone of the tumor may present an increased number of bloodvessels, and there may be islets of new tissue.

Gliomata may be hard or soft, depending upon the excess of cells or fibrils, and have a yellowish white or reddish appearance. Cystic formation is very common and it is possible that the whole mass may disappear, leaving nothing but a cyst wall, and it is necessary to examine microscopically the capsule to determine the gliomatous origin. Cysts form in the neighborhood of these tumors, and a surgeon may tap one of these cyst formations, believing it to be the only lesion present. It is always a wise procedure to remove a part of the cystic wall for microscopic examination. The fluid inside of these cysts may be whitish or bloody in character. Fatty, hemorrhagic, and myxomatous changes occur in gliomatous tumors.

Microscopically it is difficult to distinguish a glioma from sarcoma unless a differential stain has been employed. There is some doubt as to the simultaneous occurrence of glioma and sarcoma, the so-called gliosarcoma, as the former is of ectodermal and the latter of mesodermal origin. A gliosarcoma should be diagnosticated only when a sarcomatous, perivascular, cellular mass is found within the glioma. It can be readily understood from the slow growth and from its infiltrating character why clinical symptoms of brain tumor do not always appear or not until late in the disease. Surgically, it is difficult or even impossible to remove completely such a tumor.

Glioma, sarcoma, and cysts of various kinds are more frequent in the adult, and tuberculous growths are more common in persons below the age of twenty years.

Tuberculoma.—Tuberculous growths occurring in childhood are more frequently located in the cerebellum than in any other portion of the brain. In the adult they are found with equal frequency in this region, and in the pons and cerebral cortex. They are nearly always multiple and secondary to a tuberculous process elsewhere in the body. A tendency to symmetrical arrangement is also sometimes observed. Their size varies from that of a small nodule to that of a large fist. Macroscopically it is hard to distinguish a tuberculoma from a syphiloma. Both have poor blood supply and a tendency to caseate; the tuberculous growth tends to pus formation. Again, both have a tendency to grow from the meninges, although the tuberculous growths are found in the substance of the brain and may have granulation areas and miliary tubercles about their border.

The growth of a tubercle may be either rapid or slow. Tuberculous tumors may give no clinical symptoms. This has been explained by the

slowness of the growth, the brain tissue gradually accommodating itself to increased pressure. It is possible, however, to demonstrate by certain silver stains the persistence of the axis cylinders in these growths, thus explaining the persistence of function. Surgically, it is not advisable to operate upon tuberculous tumors, as they are multiple and cannot all be removed. A tuberculous growth may be part of a general tuberculous meningitis or there may exist tuberculous meningitis alone. If the symptoms of meningitis arise, it is always a wise procedure to look for a tuberculous process in the lungs as an aid to diagnosis.

Syphilitic Growths.—Gummata are rarely found postmortem, although they are usually thought to be the most common form of brain tumor (Fig. 52). The usual results of syphilis in the nervous system are endarteritis, round-cell infiltration, and meningitis. The endarteritis is usually general, and, because of the weakening of the bloodvessel walls, early hemorrhages may result.

FIG. 52

Gumma of the motor cortex and meninges, showing extensive round-cell infiltration throughout the whole section. Area (*a*) shows a gap in the tissue made at postmortem because of adhesion of brain and meninges to cranial bones. Clinically there were Jacksonian convulsions limited to the upper limb, followed later by paralysis.

Syphilitic meningitis usually involves the basal membranes, but may also involve those of the cortex. In the latter instance the meninges may be a half-inch in thickness and thereby compress the brain and give focal symptoms of tumor. Occasionally the syphilitic process involves the brain substance itself, causing a diffuse cellular infiltration, or the bones may be involved, causing a carious condition of a part or many of the cranial bones.

When basal meningitis occurs it may involve the whole extent, or, what is more often the case, only the meninges near the chiasm, thus involving the second, third, fourth, and sixth cranial nerves.

At times, instead of meningitis there may be diffuse areas of softening throughout the brain, these areas being yellowish red in color, soft in consistency, and well defined from the surrounding brain tissue.

Syphilitic growths are usually rapid in development, but it must be remembered that the various pathological conditions which lead on to the growths have long been present.

Fibromata.—These tumors are rare, but they are relatively more frequent in the cerebellum than in the cerebrum, and especially in the cerebellopontile angle.

A fibroma invading the cerebellopontile angle, or the angle between the pons and the cerebellum, may be only part of a general neurofibromatosis. This, however, is rare, and usually a tumor in this area is the only expression of this process. The growth is slow and generally unilateral, although in rare instances it may be present on both sides. Experience has shown that it is more common on the left side in the ratio of three to two.

The fibroma may be as small as a cherry or the size of a large egg. The growth is firm, hard, nodular, and has a distinct capsule surrounding it. When located in the cerebellopontile angle it is generally loosely attached to the brain by an atrophic nerve trunk and a few blood-vessels or a meningeal process. These attachments may be easily ruptured. These tumors are in organic relations, especially with the acoustic nerve, and more rarely with the trigeminus and facial nerves. They nearly always grow from the endoneurium and rarely from the perineurium or epineurium. Consequently it is possible to find medullated nerve fibers either in the periphery of the tumor or in its centre. As a rule, if many cranial nerves are involved, there is a general neurofibromatosis.

The fibroma may undergo a cystic, fatty, or myxomatous degeneration. Very often in the advanced stages it may assume a sarcomatous tendency. Histologically there is present connective-tissue structure, with entire absence of nerve elements except sometimes a few medullated nerve fibers either in the periphery or its central part. These are remnants of the nerve on which the fibroma grows, and should not be mistaken for a part of the newgrowth.

Sometimes in association with fibroma of the cerebellopontile angle there may be cortical changes consisting in hyperplasia and hypertrophy of the glia cells of the cortex, or there may be present an endothelioma or psammoma of the dura mater. At times the fibromatous process may involve the whole intracranial portion of the acoustic or other nerves.

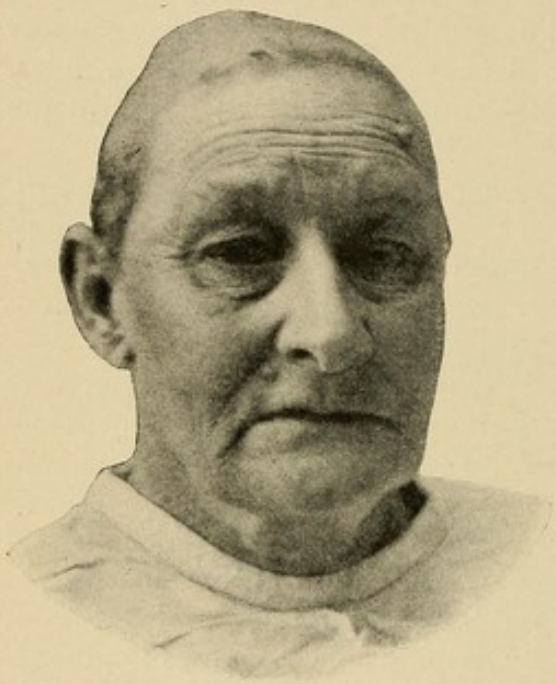
These tumors compress greatly the lateral lobes of the cerebellum, the pons, and the medulla oblongata. At times even the temporal lobe may be compressed. Because of the slow growth and nature of the tumor clinical symptoms may not appear at all or only late in the disease. Tumors of the cerebellopontile angle are among the most favorable for surgical removal.

Carcinoma.—Carcinoma of the brain is always secondary to growths elsewhere in the body, generally in the stomach, lungs, or breast. The tumor may grow in the substance of the brain, but mostly it grows from the dura or the cranial bones. It may be as small as a millet seed or may be of large size, and may occur anywhere in the brain substance. At times there may be an infiltration of cancer cells in the

pia, covering the whole brain substance. This, however, is a rare occurrence. The possibility of toxic changes must be considered, as it is not improbable that through intoxication caused by carcinoma elsewhere in the body, symptoms of tumor may be present.

Such other tumors as *osteoma* (Fig. 53), *adenoma*, *cholesteatoma*, *lipoma*, and *psammoma* very rarely occur in the brain, and, as they do not differ from similar growths elsewhere, will not be considered.

FIG. 53



Osteoma of right frontoparietal bones, causing pressure upon the brain with left hemiplegia.

Cysts.—Cystic degeneration of gliomata and sarcomata is very common and has already been discussed. Other tumors, as fibroma and carcinoma, are prone to undergo cystic change, but more rarely. It is possible for the whole tumor to disappear and only the cyst remain, so that microscopic examination will be necessary to detect the small tumor mass in the walls of the cyst.

Congenital cysts may occur in the fourth and lateral ventricles or in the substance of the brain. This, however, is a rare occurrence.

The most common cystic changes found in the brain are due to parasitic growth, the *cysticercus cellulosæ* and the *echinococcus*. These, however, are so rare in this country that they will not be considered.

Cysts due to traumatism may occur, but their genesis is by no means clear. It is probable, however, that they are the result of a hemorrhage which has occurred at birth or soon after. As the brain tissue at this time of life is not fully developed, cystic changes or porencephalus may result.

Cystic tumors occasionally grow from the choroid plexus in any of the ventricles. These may not give any symptoms, but, if sufficiently large, will compress the ventricular walls and the surrounding brain tissue.

The Influence of Brain Tumors upon the Surrounding Structures.—At operation when the dura is removed there is nearly always increased tension and the parts may bulge. The surface of the brain is flat and the fissures may be abolished, and the pia covering the neoplasm is generally poor in blood supply. The tissues near the growth may be softened. Pressure symptoms nearly always result, this depending upon the nature of the tumor, the extent of its growth, and its location. The greatest pressure is nearly always exerted upon the nearby structures, but often a tumor of the cortex may exert pressure upon the cranial nerves at the base of the brain.

The cerebrospinal fluid may be increased in brain tumor, but this is especially so when the growth is in the posterior cranial fossa, because pressure here is exerted directly upon the communication between the lateral and fourth ventricles or upon the veins of Galen, which convey the blood from the choroid plexus to the sinus rectus. Because of this, increased tension results in the lateral and third ventricles, the latter causing direct pressure upon the optic nerves.

Internal Hydrocephalus.—This condition is most often caused by brain tumor, but in children it is either congenital or the result of some early pathological condition. The cerebrospinal fluid is probably secreted by the choroid plexus, and, if there is any interference with the normal outflow of the fluid, or, if there is an overproduction, there will necessarily result a dilatation of the ventricles, or internal hydrocephalus. The causes may be congenital, such as closure of the foramen of Magendie or of the aqueduct of Sylvius or an aberrant secretion of the choroid plexus. When this disease appears later in life the closure of one of these foramina may result from a basilar meningitis, which is usually of a tuberculous nature. Whatever the cause, the gradual increase of fluid in the ventricles will increase the size of the cranial cavity and cause pressure upon the brain substance, with consequent atrophy and loss of function.

If the causes are congenital the child may be born with a very large head, but in most instances it does not become apparent until after birth, when it will be noticed that the development of the child both physically and mentally is delayed. The head gradually becomes large, especially in the frontal and middle portions, the fontanelles bulge and do not close, and the head sometimes assumes an enormous circumference. The face does not show any deformity, with the exception that the eyes may bulge. Coincident with this it will be noticed that the limbs do not become developed and soon show an increasing weakness, with rigidity and exaggerated reflexes and the Babinski phenomenon with contractures. The mentality is poor, although sometimes there may be considerable development. Associated with internal hydrocephalus there may be a rachitic condition of the chest.

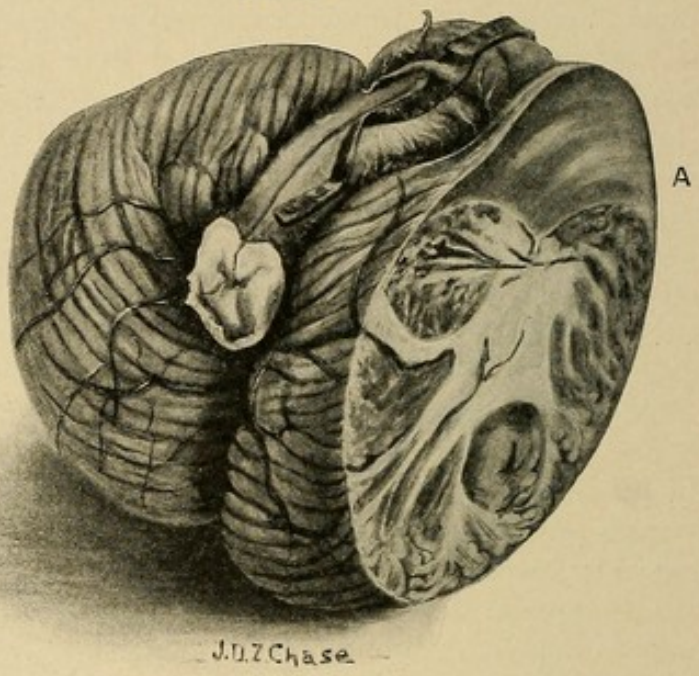
There is a form of hydrocephalus known as *external hydrocephalus*, by which is meant an accumulation of fluid in the cortical meninges. This occurs nearly always in association with chronic meningitis and will be discussed under that head.

Abscess of the Brain.—The localizing symptoms of an abscess of the brain are similar to those of any other lesion or growth. Because of the fact that most abscesses occur as a complication of middle ear disease or extension of such inflammation, most pus cavities or abscesses are to be found either in the temporal area, cerebellopontile angle, or in the cerebellum; or, what often happens, besides a lesion either in the temporal or cerebellar areas there may also be a meningitis with its accompanying symptoms.

Specifically it cannot be said that there are any general symptoms which indicate an abscess in the brain (p. 236). There may be, as is

usually the case in any growth, headache, nausea, vomiting, vertigo, and sometimes choked disk, these depending upon the extent of the lesion and the pressure exerted in the cranial cavity. There may or may not be changes in the temperature, such as result from pus elsewhere, and a slow pulse. The other symptoms will depend upon the location of the lesion, whether temporal or cerebellar.

FIG. 54



Abscess in pia in left cerebellopontile angle, causing cerebellar incoördination and paralysis of the sixth, seventh, and eighth nerves on the same side. Drawing shows wall of abscess.

The Diagnosis of Tumors of the Cerebrum.—In the preceding pages the individual symptoms of tumors have been considered and analyzed, and continuous reference will be made to their contents. The collective symptoms as they occur in brain tumors will now be discussed.

The general symptoms of brain tumor are headache, nausea, vomiting, vertigo or dizziness, and choked disk. As a rule, all these symptoms are present in a tumor of fairly large dimensions, but a growth may exist without the presence of any of these. Such a growth, however, must be small and of such character as not to cause pressure. The symptoms which are present in the great majority of cases are headache and choked disk.

The *headache* may be localized to the site of the lesion, but, as a rule, it is general. *Choked disk* occurs in about 90 per cent. of cases, and may be greater on the side of the tumor. The swelling of the optic nerves is always greater in cerebellar lesions and comes on earlier than in cerebral lesions.

Nausea, vomiting, and *vertigo* are especially prone to be present when the growth is large and great intracranial pressure exists. These symptoms are also more liable to be present in tumors which press upon the medulla, as is the case in occipital lesions and in tumors of the cerebellum.

When considering the symptoms of brain tumors, the side on which such a growth occurs must be taken into consideration. Tumors which are located on the left side of the brain can be more readily detected because our knowledge of localization is better on this side. This, of course, is in a right-handed individual. The contrary would be true of a left-handed person.

It is, of course, impossible to tell, when the symptoms of a brain tumor are present, exactly what the nature of the growth may be. If there are present elsewhere in the body certain conditions, such as carcinoma, tuberculosis, or abscess of the lung, or, if there is a history or other evidence of syphilis, the presumption is justifiable that similar conditions exist in the brain, providing the symptoms come on in regular order. A growth in the cerebral cortex is more liable to be sarcoma or glioma, while in the brain-stem glioma and tuberculoma are more common.

It is also important from a surgical point of view to differentiate between a *cortical* and a *subcortical growth*. A *tumor which is cortical* may in time involve the subcortex and a subcortical tumor may in time involve the cortex. Generally speaking, a cortical lesion will always give irritative phenomena. If in the motor cortex, there will result Jacksonian convulsions on the opposite side, to be followed later by paralysis. If in the sensory cortex, there will first be numbness and pains of the Jacksonian type, this to be followed later by anesthesia. If the location is in the occipital lobes, there will first be irritative visual phenomena, such as scintillating scotomata in the visual fields related to these areas, and later loss of vision. Generally speaking, then, in a cortical growth there will be irritative phenomena, to be followed by paralytic symptoms.

In a *subcortical growth* the symptoms will depend entirely upon what fibers are cut off, as, in the subcortex, a tumor, no matter how small, will always involve fibers concerned with more than one function. The symptoms of a lesion in this area will always be greater in number than in a cortical lesion, for in the latter instance a tumor may involve only a very limited portion of the cortex, thus giving only a few symptoms. Again in a subcortical lesion irritative symptoms are not liable to occur, and the earliest symptoms are those of loss of function (Figs. 55 and 56).

It is well known that tumors have a predilection for certain areas. These are the frontal, central or motor, parietal, occipital, and temporal. The symptoms which occur in growths of these parts will be taken up in order.

Tumors of the Frontal Lobe.—Tumors in this area are not very common. The growths more often are of the sarcomatous variety and in most instances grow from the frontal bones or from the orbital plate. When the neoplasm is limited to the frontal lobe itself, there are, as a rule, very few localizing symptoms. In the frontal lobes have been placed the centres for higher psychic functions, this being especially so in the left, but it cannot be said that any special mental symptoms occur from destruction of these areas. The usual mental symptoms are gradual change in disposition, and impairment of intellect, especially the memory and the power of reasoning. As can readily be seen, these symptoms may occur

FIG. 55

Subcortical gliomatous tumor (*A*), causing disturbance of motion and sensation on the opposite side. The symptoms were slow in onset, and, because of the nature of the growth, there were few general manifestations. A decompressive operation was performed by Dr. Martin.

FIG. 56

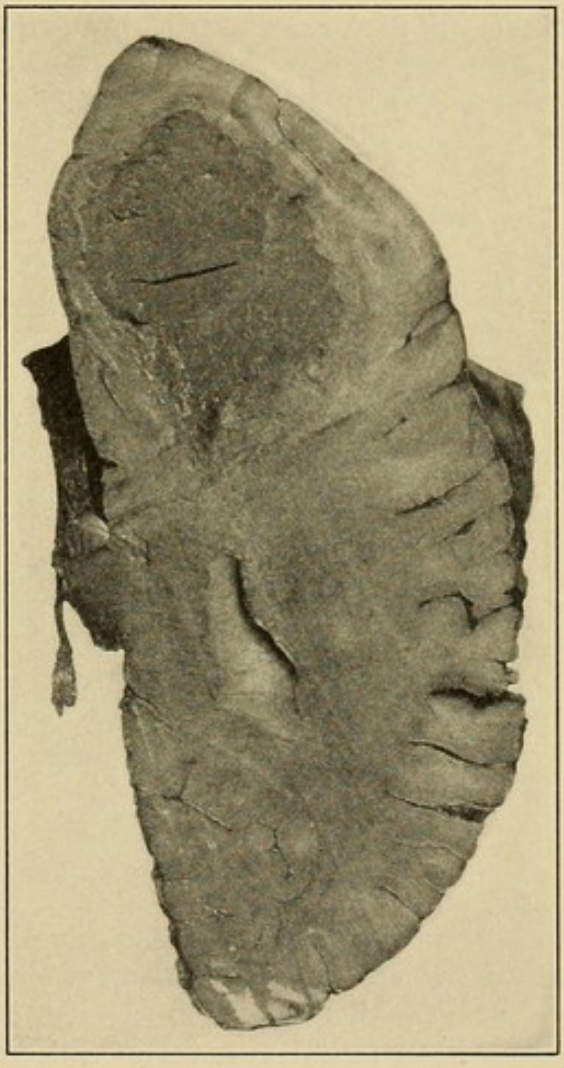
Horizontal sections of cerebral hemisphere, showing extent of gliomatous tumor infiltration. There was paralysis of the opposite side of the body, motor aphasia, headache, dizziness, and mild choked disk.

from tumors in any portion of the brain. Headache may or may not be present and is prone to be localized to the orbit and frontal bones. Nausea, vomiting, and dizziness are not very common, and choked disk is a rather rare occurrence except in those instances in which the tumor is mostly localized to the orbital part of the frontal lobes and direct pressure is exerted upon the optic nerve, in which case the choked disk is unilateral. In the latter instance the olfactory nerve is also pressed upon, causing loss of the sense of smell on that side. If the tumor is of large size and involves the precentral convolution, motor symptoms will be present (Fig. 57).

In the posterior portion of the second frontal convolution have been placed the centres for the movement of the head and eyes, and, if a lesion irritates these centres, conjugate deviation of the head and eyes or of both to the opposite side will result. If the lesion, however, destroys these parts, the head and the eye will be directed to the side of the lesion. This is because of the unrestrained action of the muscles which are innervated by the opposite cortical centres. If the lesion involves the inferior posterior portion of the third frontal, or Broca's, convolution, motor aphasia will be present.

The frontal lobes are in direct connection with the opposite cerebellar lobe by the so-called fronto-cerebellar fibers. In a growth of the frontal lobe, in which the tumor is largely subcortical, cerebellar symptoms may result, and it is difficult to differentiate the symptoms from those of cerebellar lesion. This, however, is a very rare occurrence.

FIG. 57



Tumor of frontal lobe, causing disturbances of mentality with loss of memory and reasoning, also some headache and optic neuritis.

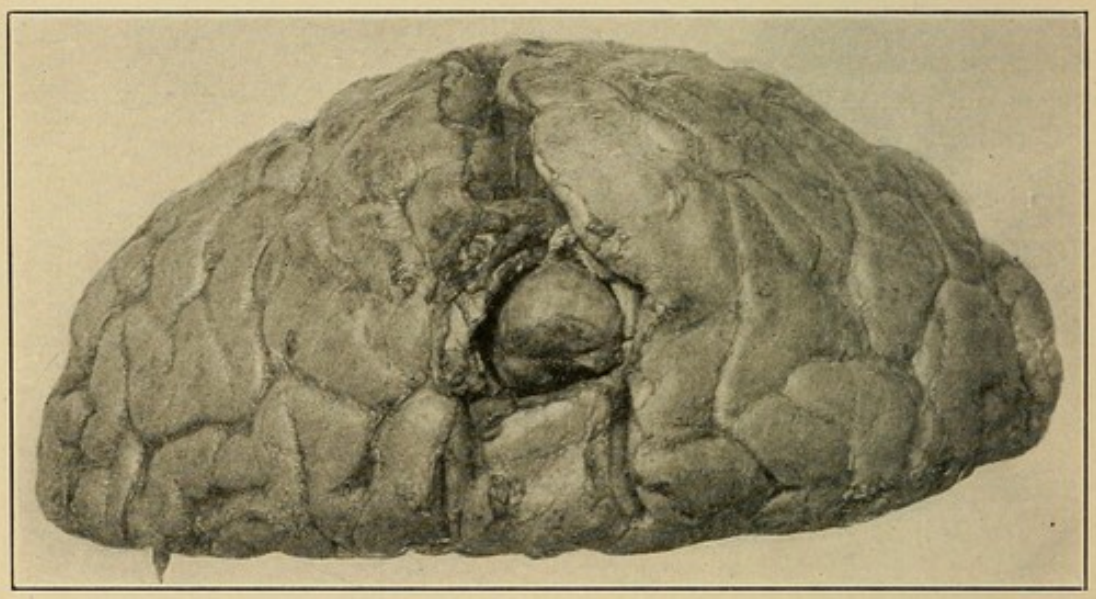
Another symptom which is sometimes supposed to be present is an abnormal tendency for poor jokes, or the "Witzelsucht" of the Germans. This, however, is of questionable value.

The symptoms, then, of a tumor in the frontal lobe are headache, localized mostly to the frontal bones, occasional nausea, vomiting or vertigo, and occasional optic neuritis, which is mostly unilateral and confined to the side of the lesion. The special symptoms are loss of memory and change in disposition.

If the tumor is of large size and presses upon the adjoining motor areas, the above symptoms are accentuated, and there may be in addition motor symptoms which may be either of an irritative or a paralytic character and which are confined to the limbs of the opposite side, conjugate deviation of the head or eyes, or of both, and motor aphasia.

Tumors of the Motor Area.—Growths in this location are more common than in any other portion of the cerebrum and are mostly sarcomata or gliomata. The symptoms will depend upon the location and extent of the lesion. If a growth is limited, for instance, to the centre for movement of the upper limb, the symptoms will be referred to this part. If the lesion is of large extent, the symptoms, of course, will be referred to the related parts. Jacksonian or focal convulsions nearly always result from a cortical lesion. A tumor, for instance, involving the centre for

FIG. 58



Tumor involving arm centre in precentral convolution. The symptoms were those of Jacksonian convulsions in one arm followed by paralysis, accompanied by headache, nausea, vomiting, stupor, and choked disk.

the upper limb will give Jacksonian convulsions beginning in this limb. If the growth extends downward, the movement will extend from the upper limb to the muscles of the head and face. If the growth extends from the middle to the upper portion of the precentral lobe, the convulsions will extend from the arm to the lower limb. It must be remembered that a convulsion that is first Jacksonian may become general in character, and that in an epileptic convulsion there may sometimes be Jacksonian manifestations. If the tumor destroys the motor areas, paralysis in the related parts will result.

Lesions in the motor area are only rarely confined to the precentral convolution and mostly also involve the postcentral convolutions or the sensory centres, in which case sensory symptoms will be present in addition to the motor. If the lesion is irritative, there will be pains of a Jacksonian type in the limbs of the opposite side; or, if the lesion is destruc-

tive, disturbances of sensation or anesthesia in the related limbs on the opposite side will result.

If the tumor involves the frontal lobes, and especially the head and eye centres, conjugate deviation will result to the opposite side if the lesion is irritative, and to the same side if the lesion is destructive. If the tumor is on the left side of the brain in a right-handed individual, motor aphasia will also be present (Fig. 58).

As a rule, tumors in the motor area give symptoms of great pressure, and headache, nausea, vomiting, and choked disk are present in most instances. Some of these symptoms may, of course, be absent, but, as a rule, headache and choked disk are present.

The symptoms then of a tumor confined to the motor area are headache, nausea, vomiting, choked disk, and Jacksonian convulsions on the opposite side, to be followed later by paralysis depending upon the extent of the lesion.

FIG. 59

Recurring sarcoma of motor sensory area. Tumor first removed by Dr. Martin. Symptoms were those of hemiplegia, incomplete hemianesthesia, and sensory aphasia.

If the tumor invades the postcentral convolution, there are in addition sensory symptoms, such as pains and disturbances in sensation for touch and pain. If the growth invades the frontal lobes, there may be at first conjugate deviation of the head and eyes to the opposite side and later to the same side. A lesion in the left side of the brain in a right-handed individual will also always give motor aphasia. The contrary is true in left-handed persons.

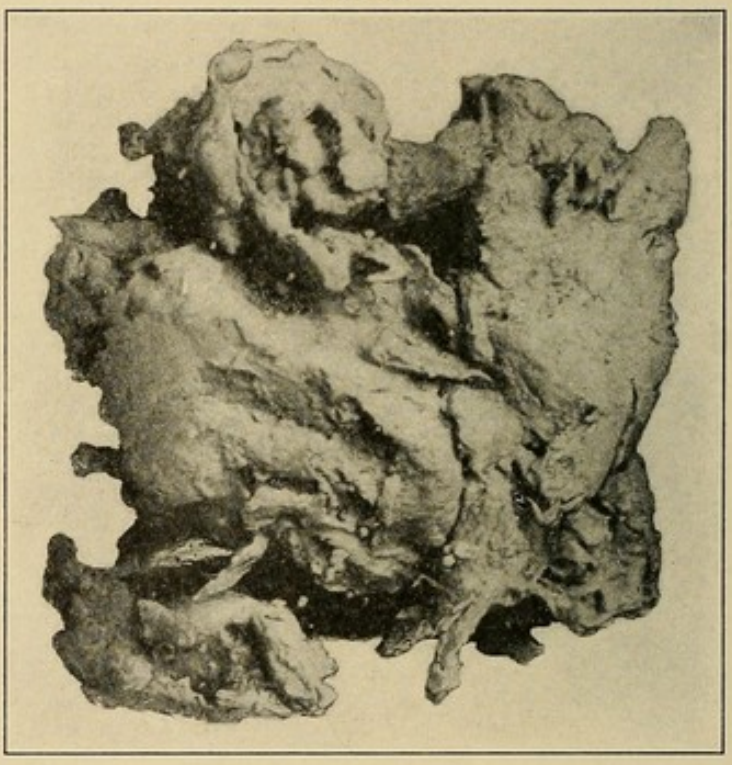
Tumors of the Sensory Area.—This includes the postcentral and superior and inferior parietal convolutions. Growths involving only this part are very rare, for in most instances the adjoining motor centres are also

diseased. As has already been stated, most tumors of the motor area involve the postcentral convolution (Figs. 59 and 60).

Isolated tumors involving either the superior or the inferior parietal convolution may rarely occur. In such case a lesion of the superior parietal convolution will give disturbance in the sense of localization, of position, of movement, of pressure and ataxia of the lower limb, with inability to recognize objects placed against the sole of the foot.

A lesion involving the inferior parietal convolution will give the above symptoms in the upper limb instead of the lower. In addition, in both there may be headache, nausea, vomiting, and choked disk.

FIG. 60



Sarcomatous growth removed postmortem.

In most instances we have the adjoining postcentral convolution involved, and there is in addition to the symptoms already enumerated disturbance in touch and pain. Very often in irritative lesions of the sensory areas there may be numbness and paroxysms of pain in the related limbs similar in character to the Jacksonian spasms, the result of motor irritation.

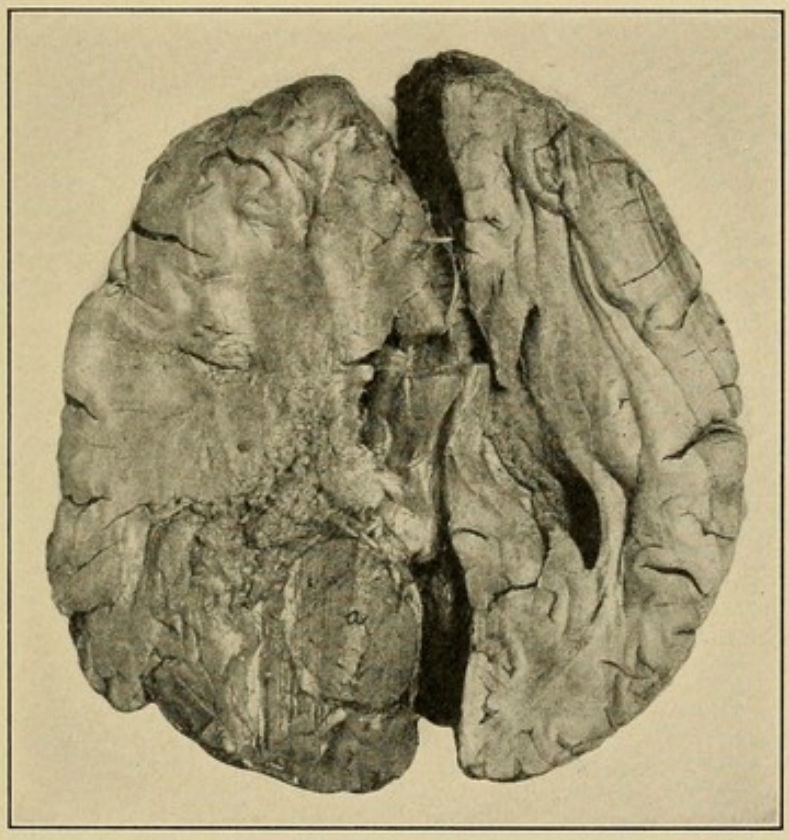
If the growth involves the adjoining occipital convolution, disturbance in vision will result. If the lesion is left-sided in a right-handed person and the angular gyrus is involved, there is in addition word and letter blindness, this causing inability to read or write voluntarily or from dictation.

Tumors of the Occipital or Visual Area.—Growths in this area are not very common. They, as a rule, cause early pressure symptoms, and disturbances of vision are among the first manifestations. These may be flashes of light or scintillating scotomata in the related visual fields, to be

followed later by disturbance of vision, either for light or for colors, and lastly loss of half vision, or hemianopsia. If the lesion is right-sided, there will be left lateral homonymous hemianopsia, and vice versa. Occipital headache is always marked, as are also nausea, vomiting, and vertigo, and choked disk will come on early. This is because direct pressure is exerted upon the cerebellum. There may be in addition the symptoms of cerebellar incoördination (Fig. 61).

If the growth involves the adjoining parietal or angular gyres, their related symptoms will occur.

FIG. 61



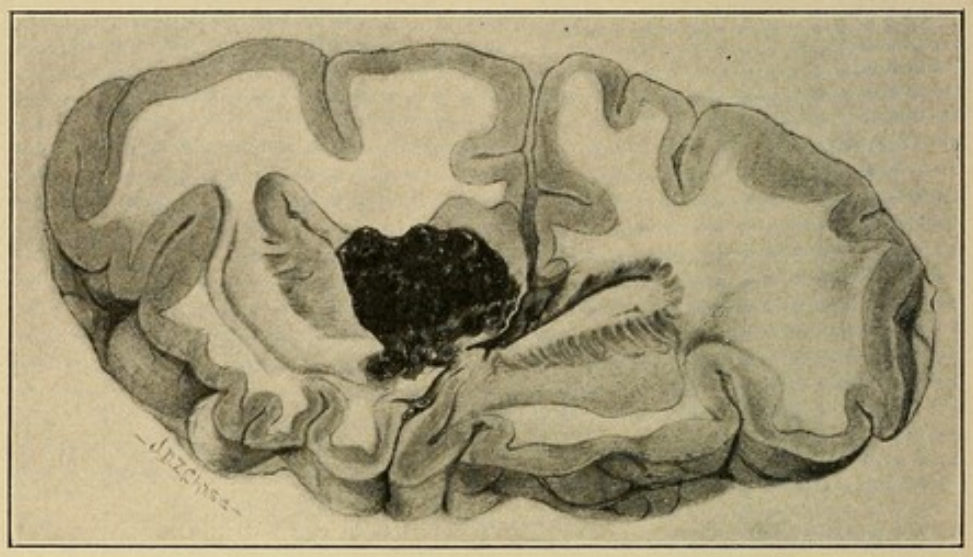
Endothelioma in one occipital lobe (*a*), causing the general symptoms of brain tumor with hemianopsia of the opposite side.

Tumors of the Temporal Lobes.—Growths in this area are of rare occurrence, in most instances the adjoining parietal lobes being also involved. If the lesion is on the left side of the brain in right-handed individuals and the growth is confined to the temporal lobes, the symptoms will be those of pure sensory aphasia, *i. e.*, the patient will be able to talk, but he will have loss of memory for words as to their meaning and his speech will be unintelligible.

If the lesion is on the right side of the brain in right-handed individuals, no localizing symptoms will be present. This is a so-called "silent area" of the brain. There will, of course, be headache, nausea, vomiting, and choked disk. If the growth involves the adjoining parietal lobes, their related symptoms will occur.

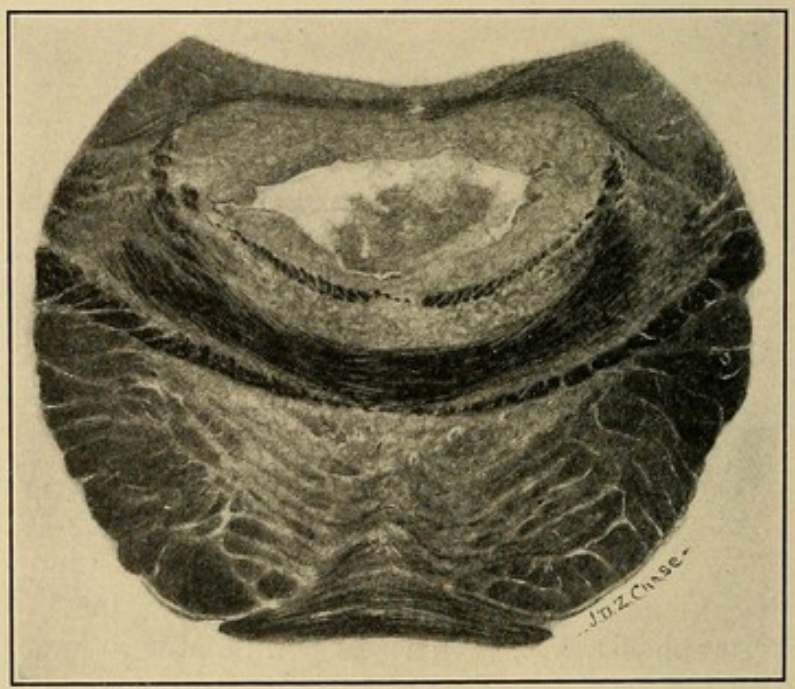
Tumors in the Subcortex, Crus, Pons, and Medulla.—The symptoms of lesions in these areas will not be discussed, inasmuch as surgical removal of tumors in these areas is impossible. The localizing symptoms,

FIG. 62



Tumor of lateral ventricle causing pressure on internal capsule and optic thalamus, with hemiplegia and incomplete disturbance of sensation upon the opposite side, accompanied by headache, vomiting, vertigo, and choked disk.

FIG. 63



Tumor of aqueduct of Sylvius in the pons, causing blocking up of flow of cerebrospinal fluid and secondary internal hydrocephalus. There were only general pressure symptoms.

however, have been discussed under the head of cortical localization. In addition to the symptoms there enumerated there will be the usual symptoms of brain tumor, such as headache, nausea, vomiting, vertigo, and choked disk (Figs. 62 and 63).

Tumors of the Cerebellum.—Growths in the posterior cranial fossa may involve either the substance of the cerebellum or the surrounding structures, the latter giving the symptoms of cerebellar disease because of pressure or involvement of this organ. It is also necessary to consider growths which occur in the cerebrum, but which, because of pressure, give symptoms of cerebellar disease.

The general symptoms of tumors of the cerebellum are headache, nausea, vomiting, vertigo, choked disk, and incoördination.

Headache, as a rule, is present, is more severe in lesions of the cerebellum itself than in extracerebellar lesions, and is generally localized to the back part of the head and neck. Sometimes the pain is so severe as to cause retraction of the head. Occasionally no headache is present.

Nausea and *vomiting* are, as a rule, present early and are more intense in intracerebellar lesions.

Vertigo is present nearly always and is one of the prominent symptoms. It may consist in a feeling of dizziness in which objects may swim before the eyes and the patient feels as if he were losing consciousness, or in a feeling of rotation of objects before the eyes or of rotation of self. Vertigo, as a rule, is more marked in extracerebellar lesions and is probably dependent upon involvement of the vestibular branch of the eighth nerve. It is the opinion of some that when there is a sensation of rotation of objects before the eyes, whether the lesion be intra- or extracerebellar, it is always from the diseased to the healthy side. When there is a sensation of rotation of self, the direction is the same in intracerebellar lesions, but opposite in extracerebellar lesions. This symptom, however, is by no means certain.

Occasionally a sense of dizziness is experienced when the eyes are deviated to one side, generally to the side of the lesion, but there is no dizziness when the head is deviated. In such case the vertigo may be due to a weakness of one of the ocular muscles and is not a true cerebellar vertigo.

Choked disk is one of the early and most constant symptoms of lesions in the posterior cranial fossa. As a rule, it comes on earlier and is more marked than in lesions of the cerebrum. It may be greater on the side of the lesion. Sometimes choked disk comes on after the appearance of other cerebellar symptoms, and, when it does so, its development is usually very rapid. Tumors of the substance of the cerebellum itself usually give a greater choked disk because of the direct pressure exerted upon the fourth ventricle.

Incoördination results from a lesion in any portion of the cerebellum or its connections. As has already been stated, it is probable that the cerebellum is concerned with the coördination of every voluntary movement, and therefore whatever symptoms are produced are dependent upon this.

A lesion in the middle portion or the vermis will produce the greatest amount of incoördination, this being apparent on either side of the body, whereas lesions involving only a lateral lobe will produce a preponderance of symptoms on the side of the lesion. Tumors outside of the cere-

bellum will produce mostly unilateral symptoms unless the middle lobe or the vermis is involved, in which case bilateral ataxic symptoms will be present.

The incoördination of cerebellar disease is manifested only when an effort is made and is not dependent upon peripheral symptoms, *i. e.*, there is never disturbance of sensation and no involvement of muscular sense. This incoördination becomes apparent in the gait, station, position of the head and limbs, movements of the eyeballs, head, and limbs, and in talking, eating, and swallowing. These will be taken up in order.

When considering the ataxia present in cerebellar diseases it is necessary to consider also the possible influence of the *weakness and the atonia* which sometimes results from lesions of the cerebellum. This question is by no means settled, but there is no doubt that in lesions of the vermis itself there may be paresis or weakness in the muscles of the limbs and especially those of the trunk, and in lateral lobe lesions weakness has been found in the limbs and trunk muscles of the same side. This can be readily seen after operations upon the cerebellum in which this organ has been injured. The weakness is not prominent and is not always present. It is also characteristic of cerebellar disease that the limbs, especially on the side of the lesion, lose their accustomed tone and are rather flaccid. This symptom is also by no means constant, and is present especially in lesions of the vermis.

The *gait* in cerebellar diseases resembles that observed in a drunken person. The patient will make a few steps and then will totter or lurch to one side or the other or backward or forward, and, recovering, will repeat this over again. In lesions of the vermis this is most marked, but in lateral lobe and in extracerebellar lesions, in which the former is pressed upon, it will not be so prominent. Generally the patient will have a tendency to walk to one side, usually to the side of the tumor, and will occasionally have a tendency to fall to this side. If such a patient's gait were not corrected he would tend to walk in a circle, the side of the tumor being directed toward the centre of the circle. The patient is generally aware of this tendency to walk to one side, and in his effort to correct this will sometimes walk to the opposite side.

As a rule, the closure of the eyes will not tend to increase the incoordination if the lesion is in the vermis, but sometimes in lateral lobe and extracerebellar lesions the gait is distinctly made worse when the eyes are closed.

If the motor columns are pressed upon, as is not infrequent in extracerebellar lesions, there is added a spastic condition on the side opposite the tumor. A bilateral spastic condition is also often present when there is a complicating internal hydrocephalus. This spasticity to a certain extent will modify the incoördinate gait.

The *station* and *attitude* of a patient with cerebellar disease depends largely upon the position of the growth. In lesions of the vermis itself there may be retraction of the head and extension of the lower limbs with flexion of the upper. There may also be lordosis in the lower por-

tion of the spinal column. It has been supposed that the attitude and position of the trunk and head are considerably modified by the weakness which is supposed to be present in the erector spinæ and other trunk muscles. This is questionable, for the alternate contraction of these muscles is probably only an effort to keep the parts above in their proper position, and is only a part of the general incoördination. Sometimes in tumors of the cerebellum the head is held in certain positions to prevent the growth from pressing directly upon the vermis. In tumors, for instance, of the left lateral lobe the patient will be inclined to lie on his left side, for, when he lies on the right, pressure may be exerted upon the vermis. This symptom, however, is not by any means constant. Very often also patients with cerebellar tumors will hold their heads in abnormal positions, not because of the possible influence the change of position would have upon the vertigo and dizziness, but because they see double and by holding their heads in certain positions they are able to avoid this.

If the patient is placed with his feet together he will have a tendency to fall, generally to the side of the lesion. As a rule, if the eyes are closed, the ataxia will be increased, and this is especially so in extracerebellar lesions.

The incoördination, or *ataxia, which is present in the limbs* is of two types, *i. e.*, it may be made worse with the eyes shut, or this may have no influence upon it. This ataxia is dependent upon the lack of coördination in the muscular contractions and is not dependent upon any sensory disturbances. As a rule, it is greatest on the side of the lesion, but it may also be observed on the opposite side. If the upper limb on the side of the tumor is moved in any direction, for instance, as in supination and pronation, it will be found that the movement will not be so well nor so rapidly performed as upon the other side. The same thing is true if the lower limb is moved. These symptoms are dependent upon the lack of coördinate contraction of the muscles concerned in the movements.

Incoördination in the movement of the eyeballs, or *nystagmus*, is present nearly always in lesions of the cerebellum, and is similar to that observed in any other movement. It is present only when the eyeballs are moved, and is greater when the eyeballs are directed to the side of the lesion. The nystagmus may consist of to-and-fro jerkings of the eyeballs and is greatest in lateral deviation.

Incoördination of the muscles which are concerned in talking, eating, and swallowing occurs occasionally in lesions of the middle lobe of the cerebellum, and must be differentiated from the difficulty observed when an extracerebellar tumor presses upon the cranial nerves supplying the muscles necessary to perform these acts.

Cranial Nerve Symptoms.—The cranial nerves, as a rule, are not involved in lesions of the middle lobe of the cerebellum. In tumors of the lateral lobe it is possible to have involvement of the fifth, sixth, seventh, and eighth cranial nerves on the same side, but, as a rule, such cranial nerve involvement indicates a tumor in the angle between the pons and cerebellum, or the cerebellopontile angle.

The *first*, or *olfactory nerve* is hardly ever diseased. The same is true so far as the *third* and *fourth cranial nerves* are concerned.

The *fifth cranial nerve* may sometimes be involved, especially in extracerebellar lesions. Very rarely a tumor may grow from this nerve.

Unilateral involvement of the *sixth nerve* is a very common symptom in extracerebellar lesions. Bilateral sixth nerve paralysis may sometimes be present in unilateral lesions, but, as a rule, this indicates a tumor in the middle lobe or the vermis.

The *seventh nerve* is nearly always involved in tumors of the cerebellopontile angle, and a fibroma may grow from this nerve. A lateral cerebellar tumor may sometimes cause involvement of this nerve by pressure.

Tumors of the cerebellopontile angle, as a rule, grow from the *eighth nerve* and are generally fibromata. At first there may be such subjective symptoms as roaring, hissing, or buzzing noises in the ear, and later complete nerve deafness. This nerve may be involved by pressure from a growth in the lateral lobe of the cerebellum.

The *ninth*, *tenth*, *eleventh*, and *twelfth nerves* may be involved by pressure from extracerebellar lesions, causing difficulty in talking, eating, and swallowing. Bilateral involvement is uncommon and, as a rule, indicates a lesion in the medulla itself.

Pupillary Symptoms.—Tumors of the cerebellum probably have no direct effect upon the condition of the pupils, alterations in them probably depending upon the presence of optic neuritis or choked disk.

Motor Symptoms.—The weakness or paresis which is sometimes present in cerebellar lesions has already been discussed, and is not dependent upon pressure on the motor columns. An extracerebellar tumor usually compresses the motor fibers of the pons, and this causes the spastic condition on the opposite side with the consequent weakness, increased reflexes, and the presence of the Babinski phenomenon. In complicating internal hydrocephalus this condition may be bilateral.

Lesions of the cerebellum usually have no influence upon the state of the reflexes, which may be increased, lost, or in normal condition.

Convulsions.—Convulsions, either general or limited, sometimes occur in the course of cerebellar disease. If general, as sometimes occurs in lesions limited to the vermis, there is retraction of the head, extension of the lower limbs and flexion of the upper, and the whole body is held in tonic contracture.

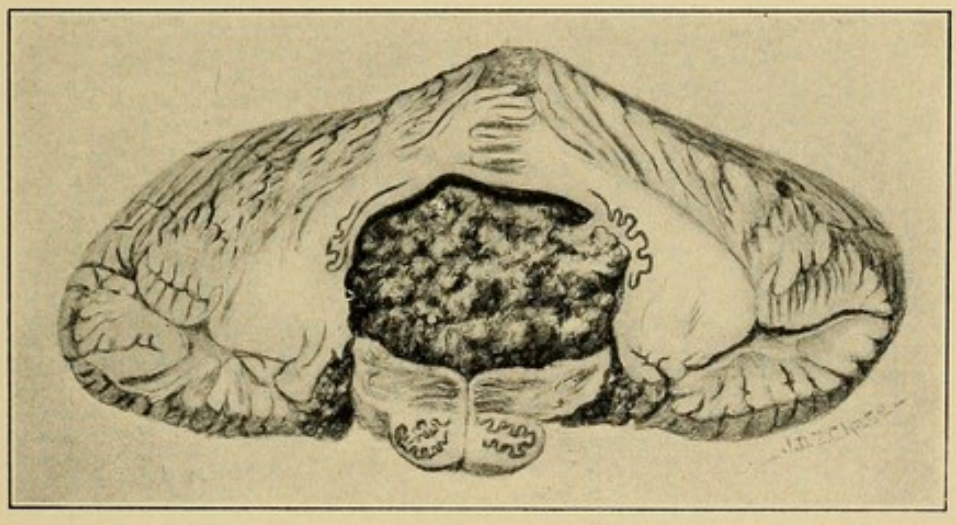
Tumors which involve the seventh nerve may cause tremors in its distribution and sometimes convulsions which are limited to this nerve and are focal or Jacksonian in character. Instead of this there may occur irregular fainting spells, during which time the patient feels giddy and has a tendency to fall. These are not really convulsions and are dependent upon the vertigo common in this disease.

In diagnosticating tumors of the posterior cranial fossa it is necessary to consider whether the growth is cerebellar or extracerebellar, and, if the former, whether the tumor is localized to the centre or to the lateral lobe (Fig. 64).

Summarizing the symptoms of a tumor in the vermis, we have as follows: headache in the back of the neck, excessive nausea and vomiting, intense vertigo, early and marked bilateral choked disk; marked incoördination in every movement of the body, whether in the limbs, trunk, movements of the eyeballs, and sometimes in articulation, eating, and swallowing; sometimes weakness in the limbs and the muscles of the trunk with atonia, an ataxic gait, poor station, and rarely so-called cerebellar fits, during which time the head is retracted, the legs extended, and the arms flexed, all in tonic contracture.

Tumors of the lateral lobe of the cerebellum give headache, nausea, vomiting, intense vertigo, early and marked bilateral choked disk, which may be greater on one side, incoördination in all movements of the limbs is greater on the side of the lesion, a staggering gait with a tendency to lurch toward the affected side, nystagmus, more marked in

FIG. 64



Tumor of the fourth ventricle, causing pressure on the middle and lateral lobes of the cerebellum. There was cerebellar incoördination of the whole body and an ataxic drunken gait, some weakness in the limbs, headache, excessive dizziness, nausea, vomiting, and choked disk.

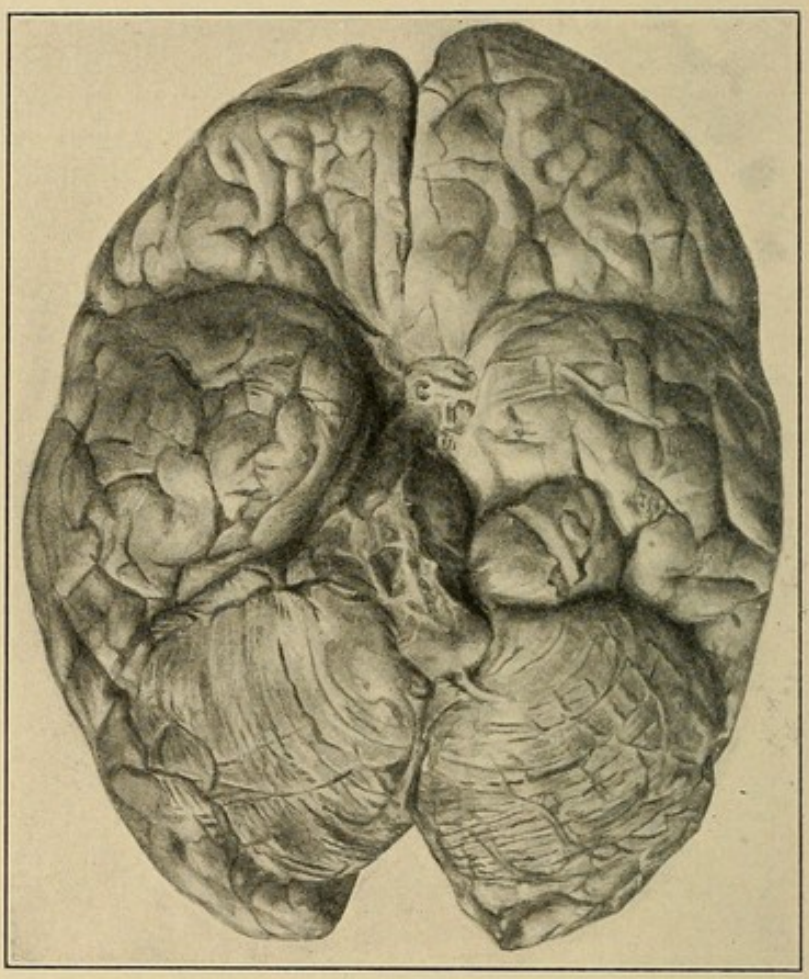
looking toward the side of the lesion, sometimes paresis and atonia in the limbs of the same side, and, if the tumor is large pressure upon the cranial nerves of the same side.

Extracerebellar lesions may arise either in the angle between the pons and the medulla, *i. e.*, the so-called cerebellopontile angle, or may grow from the occipital or temporal bone primarily, and secondarily involve the structures in the cerebellopontile angle and the cerebellum itself.

Tumors of the cerebellopontile angle are usually fibromata and grow from the eighth, seventh, fifth, and sixth nerves in order of frequency, and the first symptom will depend upon which nerve is involved. If the growth is on the eighth nerve, there is first a roaring, buzzing, or hissing noise on the side of the tumor, to be followed by deafness and then the symptoms of paralysis of the seventh and sixth nerves, and more rarely of the fifth nerve, as these nerves are pressed upon. There are, in addition, headache, nausea, vomiting, vertigo, which may be excessive if the eighth

nerve is diseased, and choked disk, which, as a rule, is greater on the side of the tumor. When the cerebellum is pressed upon there are added incoördinate symptoms in the limbs, greater on the side of the lesion, paresis, and atonia, only rarely on the side of the tumor, a staggering and incoördinate gait to the side of the tumor, and less frequently nystagmus, which is greater when the eyes are deviated to the affected side. If the tumor grows from the seventh nerve, spasms in its distribution

FIG. 65



Fibroma growing from the left acoustic nerve compressing slightly the left lateral lobe of the cerebellum and the lower surface of the left temporal lobe.

may be observed. As a rule, the growth will press upon the motor fibers of the pons, causing weakness and spasticity with increase of reflexes in the limbs of the opposite side (Fig. 65).

If the tumor grows from the dura covering the occipital or the temporal bone, the symptoms may be a little more diffuse, being the same as those above enumerated in tumors of the cerebellopontile angle plus involvement of some of the cranial nerves on the opposite side.

Sometimes *diffuse syphilitic lesions* in various portions of the brain or a pial infiltration at the base of the brain may give the symptoms of a cerebellar tumor to such an extent that it is almost impossible to make a differential diagnosis. There may be present all of the general symp-

toms of a cerebellar lesion, but there will be in addition almost always a greater involvement of the cranial nerves, such as that of the third, a very unusual condition in pure cerebellar or extracerebellar lesions. Multiple sarcomatous tumors may also give the symptoms of a tumor in the cerebellum or of the angle, and in such instances it is almost impossible to differentiate the symptoms from those resulting from basal syphilis.

Injuries to the Brain.—This subject is fully discussed elsewhere (p. 223). As a rule, if the injury is severe enough there will be impairment of consciousness. If this is complete, so that the patient cannot be aroused, it is called *coma*. If the patient can be aroused so that questions are answered, it is called *stupor;* whereas an expression of wandering ideas accompanied by stupor is called *delirium*. No matter how slight the injury, there may be an accompanying fright which leaves its mental impression, and furnishes one of the causes of the traumatic neuroses. In those cases in which unconsciousness results from the injury, if the patient rallies, this element of functional disturbance may enter. Its influence will be discussed under the head of traumatic neuroses.

In most instances the *period of unconsciousness* will not last long, and the patient will rally within a few hours, but sometimes the stupor may persist for a number of days and even longer. It is possible for the patient to regain consciousness and again lapse into stupor, especially when there is a progressive hemorrhage. As a rule, if the patient rallies within a few or less than twenty-four hours the prognosis is good, whereas stupor lasting for more than a day will make the prognosis very grave. It is necessary in a great many instances to diagnosticate such a comatose condition from those arising in alcoholism, uremia, diabetes, and hysteria. There should, however, not be much difficulty in making a differential diagnosis if the underlying causes are considered.

Certain general symptoms may always be present whenever considerable *compression* of the brain from any cause exists. They are alterations in consciousness, disturbances in respiration and pulse, specific symptoms, as paralysis, depending entirely upon the position of the lesion; nausea, vomiting, vertigo, and choked disk. The severity of these symptoms will depend upon the rapidity of onset and the extent of the pressure. In those cases in which the pressure is sudden, such as from large hemorrhage, the symptoms will be marked and prompt, whereas in slow bleeding they will develop slowly.

The most important factor in the prognosis is the state of the respiration and pulse. Disturbance in respiration is an early symptom of compression, and there may be slowing in the rate, arhythmical or stertorous breathing or the typical Cheyne-Stokes type, the occurrence of the latter nearly always affording a grave prognosis. The pulse in cerebral compression is nearly always slow, its rate sometimes being as low as 40 to the minute. The blood pressure usually is high, and when measured by the Stanton apparatus it may be 250 or more. The increase in the peripheral blood pressure is an attempt of Nature to equalize the

lessened pressure within the cranial cavity, and therefore such procedure as peripheral bleeding is contra-indicated. A temperature of 105° to 107° is a not infrequent precursor of a lethal termination.

Fracture of the Base of the Skull.—(See p. 228.) It is upon the focal symptoms that the diagnosis of fracture of the base must be made. This will depend upon the line of fracture and upon the possible existence of a hemorrhage. In nearly all cases some of the cranial nerves will be involved, and of these the optic and the sixth, seventh, and eighth nerves are most commonly the seat of injury.

The *first*, or *olfactory nerve* is frequently involved from a fracture in any portion of the skull, probably because of injury to the ethmoid, unilateral or bilateral loss of smell, and impairment of taste resulting.

The *second*, or *optic, nerve* is very frequently injured, either on one or both sides. This may be either because of a hemorrhage in or about the optic chiasm, or, what is more frequently the case, because of fracture through the optic foramina. The impairment of sight will depend upon whether one or both optic nerves are diseased and upon the part of the nerve which is injured. Very frequently there will be neither fracture through the optic foramina nor hemorrhage involving the optic nerve, but a momentary pinching of the nerves. Whether this causes a hemorrhage into the sheath or into the nerve itself, or whether it causes a destruction of fibers with a consequent atrophy, is not known, but the fact remains that such pinching will in many cases result in a diminution and sometimes total loss of vision. In rare instances it is possible to have such an injury of the optic nerve with consequent optic atrophy without any other symptom, and more rarely still this impairment of vision may be in the form of irregular hemianopsia.

The *third*, or *oculomotor, nerve* is rarely involved, but suffers when there is a fracture through the orbit and the middle cranial fossa. The lesion may be unilateral or bilateral. In most instances only part of the distribution of the oculomotor nerve is paralyzed, this resulting in drooping of the upper lid or possibly a weakness of some of the ocular muscles.

The *fourth nerve* is only rarely diseased in injuries of the brain. The *fifth nerve* is sometimes involved in fracture of the middle cranial fossa, but its involvement is also rare.

The *sixth, seventh*, and *eighth nerves* are probably more frequently involved in fractures of the base than the other cranial nerves, and, because the exits of these nerves at the base are so close together, they are often simultaneously affected.

Very rarely the *ninth, tenth, eleventh*, and *twelfth cranial nerves* are injured, causing difficulty in eating, talking, and swallowing and irregularity of the pulse and respiration. These are only present in severe cases and nearly always result fatally.

It is characteristic of these cranial nerve palsies that they are not of permanent duration, for in most instances, if the patient lives, a partial and sometimes a total recovery may be expected.

Sometimes there results in fracture of the base of the skull hemor-

rhage from one of the basal arteries. The symptoms of this will depend entirely upon the place of hemorrhage and upon the structures compressed. In most instances the hemorrhage is in or about the optic chiasm, this causing paralysis of the ocular muscles and impairment of vision, and, if the hemorrhage is large enough, the general symptoms of compression, such as headache, nausea and vomiting, and choked disk.

Summarizing then the symptoms of fracture of the base of the skull, there may be either coma, stupor, or delirium, which may last a few to twenty-four hours or a number of days and from which the patient may or may not rally, stertorous respiration, slow, irregular pulse, bleeding from the nose, throat, or ear, sometimes the escape of cerebrospinal fluid, subconjunctival or subcutaneous ecchymosis, and paralysis of some of the cranial nerves with irregular pupils. If there is an accompanying hemorrhage into the substance of the brain, the symptoms will depend upon whether the motor, sensory, or special fibers are involved; if there is a fracture of the vault, the additional symptoms of this.

The *prognosis* will depend upon the extent of the cranial nerve involvement, whether or not there are hemorrhages in the brain substance, and upon the stupor and the state of the respiration and pulse. The prognosis is always best where the patient rallies within a few or twenty-four hours, and the state of the pulse is the best indication of the results to be expected.

Terminal Effects of Injuries to the Brain.—These will depend largely upon the character of the injury and its effects and the benefit of whatever therapeutics have been employed. Injuries to the skull such as will involve the meninges and brain are among the most frequent causes of traumatic epilepsy. If the injury is over the motor area, Jacksonian convulsions may result, but very often injury anywhere in the brain, especially if this occurs in the young, may be followed by general or idiopathic epilepsy. Such other effects as hemiplegia or diplegia and impairment of vision and sensation need no further discussion.

The mental symptoms are by far the most important. Very often a trivial injury will cause a change in the disposition of the individual and produce more or less irregular headache, dizziness, lack of attention to business details, with the addition of many functional symptoms which will be discussed later.

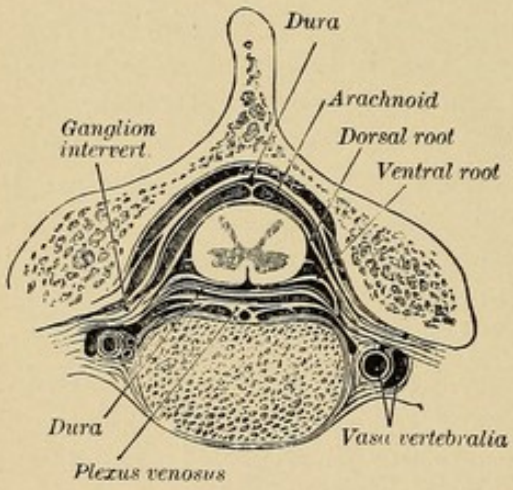
It is also a mooted question whether injuries to the brain can produce insanity. It is probable that in very rare instances it may cause the earlier appearance of insanity where there has been a predisposition for it, but it is hardly possible that direct injury to the brain can cause insanity. There is no denying, however, that mental impairment is not of infrequent occurrence.

DISEASES OF THE SPINAL CORD.

Anatomical Relations.—The spinal cord is situated in the spinal canal and extends from the lower portion of the medulla oblongata to a point opposite the upper border of the second lumbar vertebra. It

consists of eight cervical, twelve thoracic, five lumbar, and five sacral segments. The cord is composed of gray and white matter, the former being in the centre and surrounded by white matter. The gray matter is divided equally on both sides of the spinal cord and is connected by a commissure and consists of an anterior and a posterior horn. It is composed of nerve cells and their dendritic processes, axis cylinders, nerve fibers, and neurogliar tissue which holds these structures in place. The white matter consists of nerve fibers and neurogliar and connective tissue, besides arteries, veins, and lymphatic vessels throughout the whole spinal cord. The nerve fibers which are situated in the white matter are bound together in bundles or tracts, each of which has a definite function. Normally these cannot be differentiated; it is necessary to have pathological processes or what is called secondary degeneration to bring out the different tracts (Fig. 66).

FIG. 66



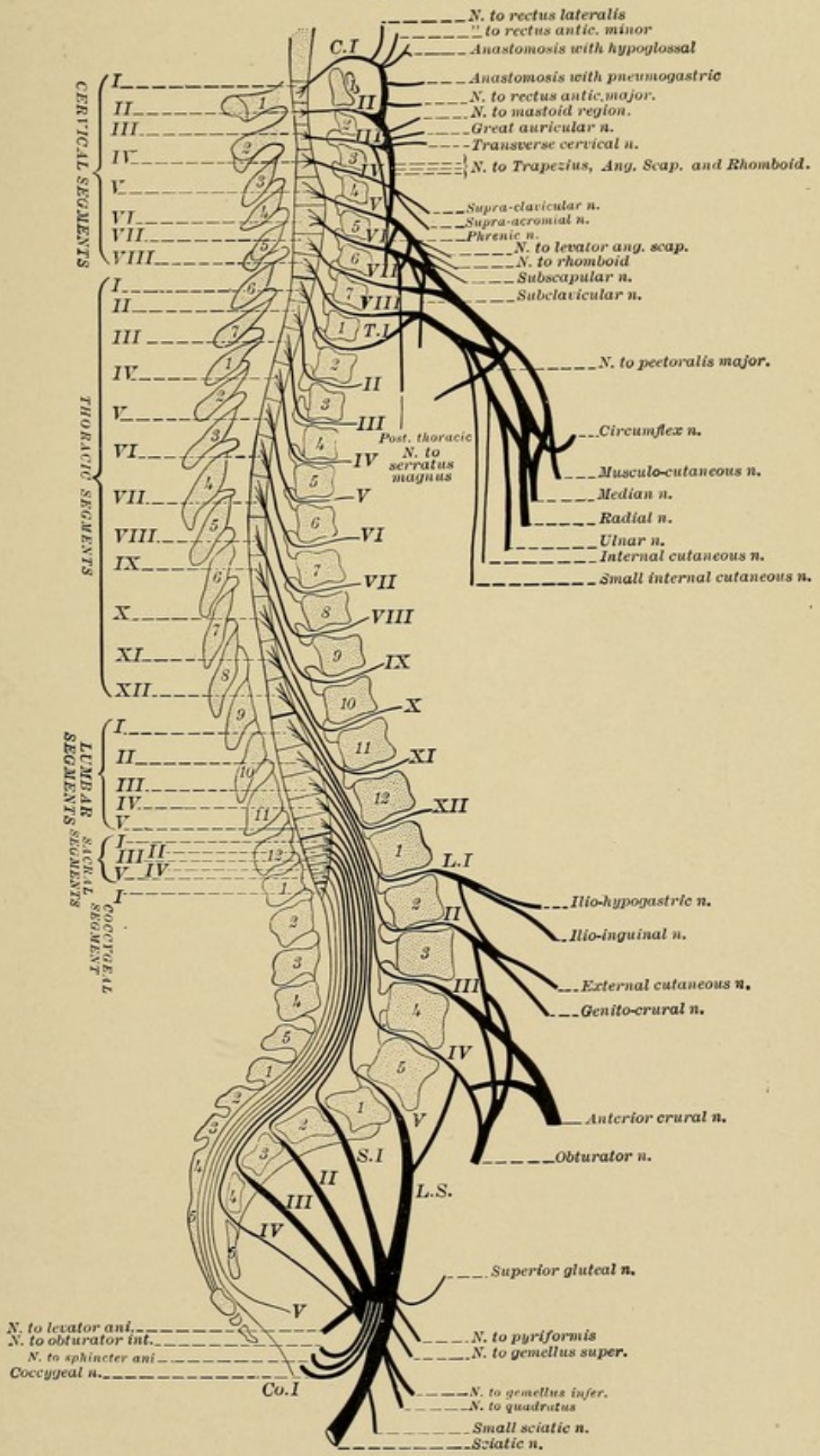
Transverse section of the spinal cord and its membranes. (Gegenbauer.)

From the nerve cells situated in the gray matter of the anterior horn come the so-called anterior roots which are motor in function. The posterior roots enter into the spinal cord in an area called the entrance root zone, this being in the inner surface of the posterior horn of the gray matter. The fibers transmitted by the posterior roots come from the periphery and ascend into the spinal cord, and are sensory in function. On each posterior root is situated a collection of nerve cells called the posterior root ganglion. The anterior and the posterior root then join together to form one nerve which goes through the dura. Each spinal segment has a pair of anterior and a pair of posterior roots which form two nerves coming off from the right and the left side of the cord.

The spinal cord is surrounded by the pial sheath and is held in place by the anterior and the posterior roots and connective-tissue septa and by the cerebrospinal fluid, these structures being attached to and surrounded by the dura, which in turn is held in place in the spinal canal by the attached peripheral nerves (Fig. 67).

Spinal Roots.—The anterior and posterior roots travel within the dura for various lengths before they join to form a peripheral nerve. It is necessary to know the place of exit of each nerve root, and an easy way to remember it is that every nerve root leaves the spinal canal at the bottom of the corresponding vertebra; thus, the second lumbar root leaves at the bottom of the second lumbar vertebra. There is an exception, however, so far as the cervical roots are concerned. There are eight cervical segments and only seven cervical vertebræ, so that the eighth

FIG. 67

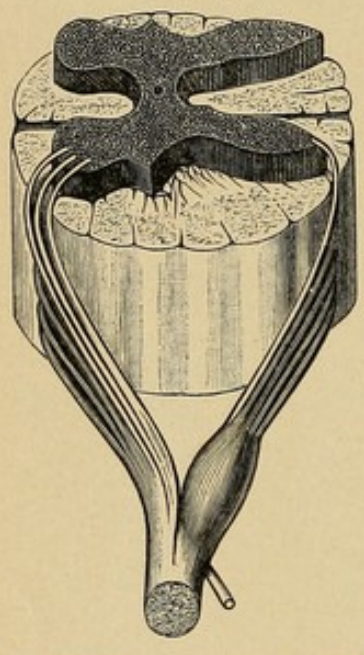


The relation of the segments of the spinal cord and their nerve roots to the bodies and spines of the vertebræ. Dejerine et Thomas, Mal. d. l. Moelle Épinière, Paris, 1902.)

cervical root leaves at the bottom of the seventh cervical vertebra, and the first at the top of the first cervical vertebra, or atlas. The end of the cord is opposite the upper border of the second lumbar vertebra. The course of the cervical roots in the spinal canal before their exit is very short. It is longer for the thoracic roots and still longer for the roots from the lowest portion of the spinal cord; thus, the second lumbar root has a course of three or four inches within the spinal canal (Fig. 68).

Spinal Segments.—It is also necessary from the surgical point of view to know the relations of the different spinal segments to the vertebræ. This, however, is not definite and cannot be fixed by any rule, and reference, therefore, must always be made to charts. It should be remembered, however, that the spinal cord ends opposite the upper border of the second lumbar vertebra, and that sometimes in children it is a little lower. The end of the spinal cord is called the filum terminale.

FIG. 68

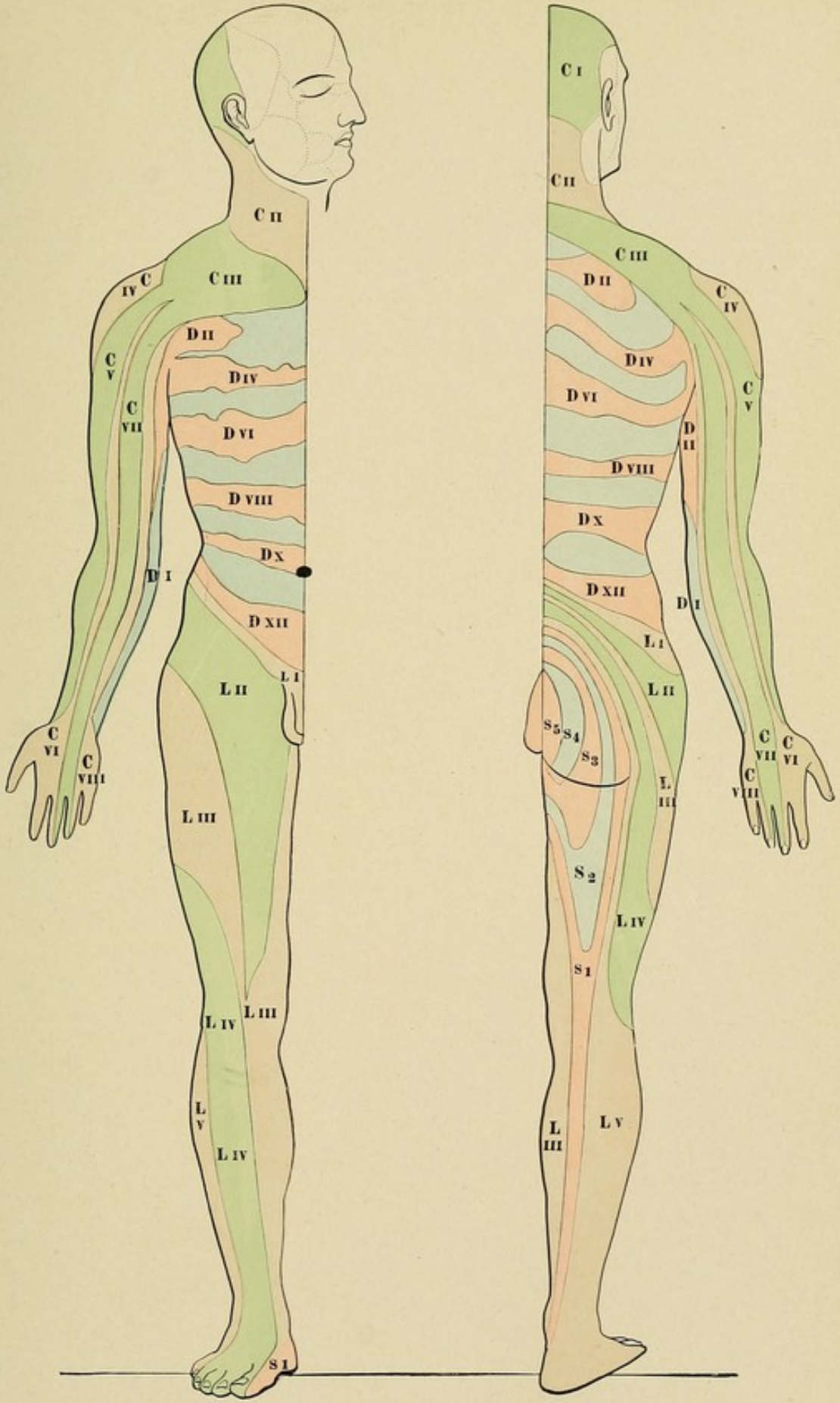


Formation of a spinal nerve. (Testut.)

Functions.—The spinal cord has two functions: one, to conduct impulses to and from the brain; and second, in it are nerve cells which control the motor and trophic functions of the limbs, chest, and abdomen. A better understanding of the cerebrospinal system will be had if it is remembered that there are two sets of centres in the nervous system, and that in the higher, or in the cerebrum, is represented the centre for every motion, sensation, and special act, in this being included also the cerebellum; and that in the lower centres, in which are included the crus, pons, medulla, and spinal cord, is represented the whole surface of the body. For instance, in the crus, pons, and medulla there are collections of nerve cells, or nuclei, which are concerned with the innervation of the movements of the face, eyes, nose, and throat, and eating, talking, and swallowing, whereas in the spinal cord the collections of nerve cells in the anterior horns are concerned with the movements of the limbs, trunk, and abdomen, and that the peripheral nerves which connect the peripheral musculature with the spinal cord have exactly the same function that the cranial nerves have which connect their musculature with the nuclei in the crus, pons, and medulla.

Localization.—There are two enlargements of the spinal cord, the so-called cervical and lumbar. This is because the cells in these parts innervate the muscles of the upper and lower limbs respectively, the cervical enlargement beginning in the fourth and including the fifth, sixth, seventh, and eighth cervical and first thoracic segments, whereas the lumbar enlargement begins in the first lumbar segment and includes the second, third, fourth, and fifth lumbar. From here on the spinal cord gradually tapers off. That part of the cord which includes the second, third, fourth, and fifth sacral is called the *conus medullaris*, and just above this and including the fifth lumbar and first and second sacral

PLATE VIII



Areas of Anæsthesia upon the Body after Lesions in the Various Segments of the Spinal Cord. (Starr.)

The segments of the cord are numbered: C I to VIII, D I to XII, L I to V, S 1 to 5, and these numbers are placed on the region of the skin supplied by the sensory nerves of the corresponding segment.

segments is the so-called *epiconus*. The nerve roots coming from the lumbar and sacral cords, when taken together, have been called the *cauda equina*, from their resemblance to a horse's tail.

Motor Functions.—The nerve cells situated in the gray matter of the anterior horns innervate directly the peripheral musculature, and it is probable that a number of nerve cells are concerned with each fiber. It is necessary to know which cells are concerned with the innervation of each muscle.

Showing the Muscles Represented in Groups of Cells in the Various Segments of the Spinal Cord.

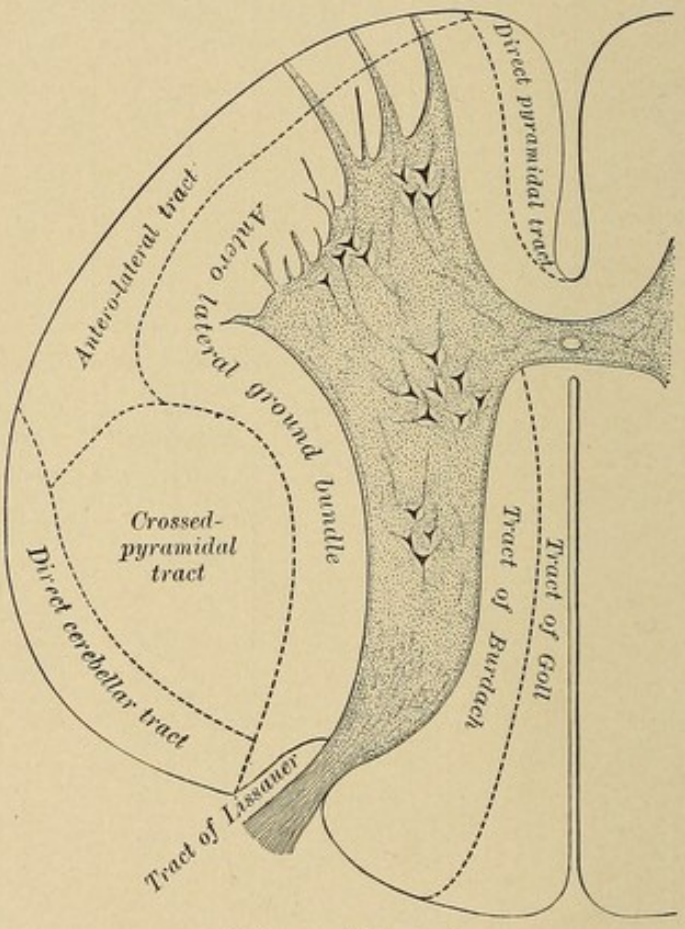
II. and III. Cervical.	IV. Cervical.	V. Cervical.	VI. Cervical.	VII. Cervical.	VIII. Cervical.	I. Dorsal.
Diaphragm. Sterno-mastoid. Trapezius. Scalenus.	Diaphragm. Lev.ang.scap. Rhomboid. Supra- and infraspin. Deltoid. Supin. long. Biceps.	Rhomboid. Supra- and infraspin. Deltoid. Supin. long. Biceps. Supin. brev. Serratus mag. Pect. (clav.). Teres minor.	Biceps. Serratus mag. Pect. (clav.). Pronators. Triceps. Brach ant. Long extensors of wrist.	Pronators. Triceps. Brach. ant. Long extensors of wrist and fingers. Pect.(costal). Latis. dorsi. Teres major. Long flexors of wrist and fingers.	Long flexors of wrist and fingers. Extensor of thumb. Intrinsic muscles of hands.	Extensor of thumb. Intrinsic muscles of hands.

I. Lumbar.	II. Lumbar.	III. Lumbar.	IV. Lumbar.	V. Lumbar.
Quadr. lumb. Obliqui. Transversalis. Psoas. Iliacus.	Psoas. Iliacus. Sartorius. Quad. ext. cruris.	Quad. ext. cruris. Obturator. Adductores.	Obturator. Adductores. Glutei.	Glutei. Biceps femoris. Semitend. Popliteus.

I. Sacral.	II. Sacral.	III. Sacral.	IV. and V. Sacral.
Biceps femor. Semimemb. Ext. long. dig. Gastroc. Tibialis post.	Gastroc. Tibialis post. Tibialis anticus. Peronei. Intrinsic muscles of foot.	Peronei. Intrinsic muscles of foot.	Sphincter ani et vesicæ. Perineal muscles.

It will be seen from this that we do not know exactly this localization and that approximately every muscle has a representation in the nerve cells of one or two segments. Should there be a lesion destroying the cells supplying any muscle or group of muscles, there will necessarily be loss of power, and as these nerve cells are also trophic in function there will be in addition atrophy and loss of tone or flaccidity in the related parts. Besides, in the performance of every movement we have a sensory irritation or impulse, a centre for which is in the nerve cells, and a peripheral, or motor, response; this is the so-called reflex arc, and an interference with it will cause a loss of any form of reflex. Summarizing, then, the symp-

FIG. 69



Columns of the cord.

toms of a lesion destroying the cells of the anterior horn, there will be loss of power or paralysis in the related muscles, atrophy, loss of tone, or flaccidity, loss of reflexes, and electrical reactions of degeneration. Such is the case in acute anterior poliomyelitis, or acute infantile spinal palsy. Should there be a slow or chronic degeneration of the cells in the anterior horn such as occurs in chronic poliomyelitis there will result fibrillary tremors in the related muscle fibers, gradual atrophy and loss of power, loss of reflexes, and gradual reactions of degeneration.

The second function of the spinal cord is that of conduction of impulses either from or to the brain. These are transmitted by means of the different tracts situated in the white matter of the spinal cord (Fig. 69).

The motor functions are transmitted from the motor cortex by means of the crossed and the direct pyramidal tract. For instance, the right crossed pyramidal tract comes from the left motor cortex, the decussation having taken place in the medulla. From the pyramidal tracts these fibers probably go to the cells of the anterior horn of the spinal cord of the same side and from these cells come the anterior roots and from the anterior roots the motor part of the peripheral nerves. A lesion of the motor columns causes weakness, spasticity, increased reflexes, and the Babinski phenomenon. If the lesion involves the pyramidal tracts above the cervical cord, these symptoms are present in both the upper and lower limbs, but, if the lesion is below the cervical enlargement, it is only possible to have these symptoms in the lower limb on the same side.

Sensory Functions.—The sensory fibers which enter the spinal cord by means of the posterior roots take various courses after their entrance. Those fibers which are concerned with touch sensation and so-called muscle sense ascend on the same side of the spinal cord and are first situated in the column of Goll and then are pushed into the column of Burdach by the fibers entering higher up, decussating in the medulla just above the motor decussation. They then go into the sensory cortex.

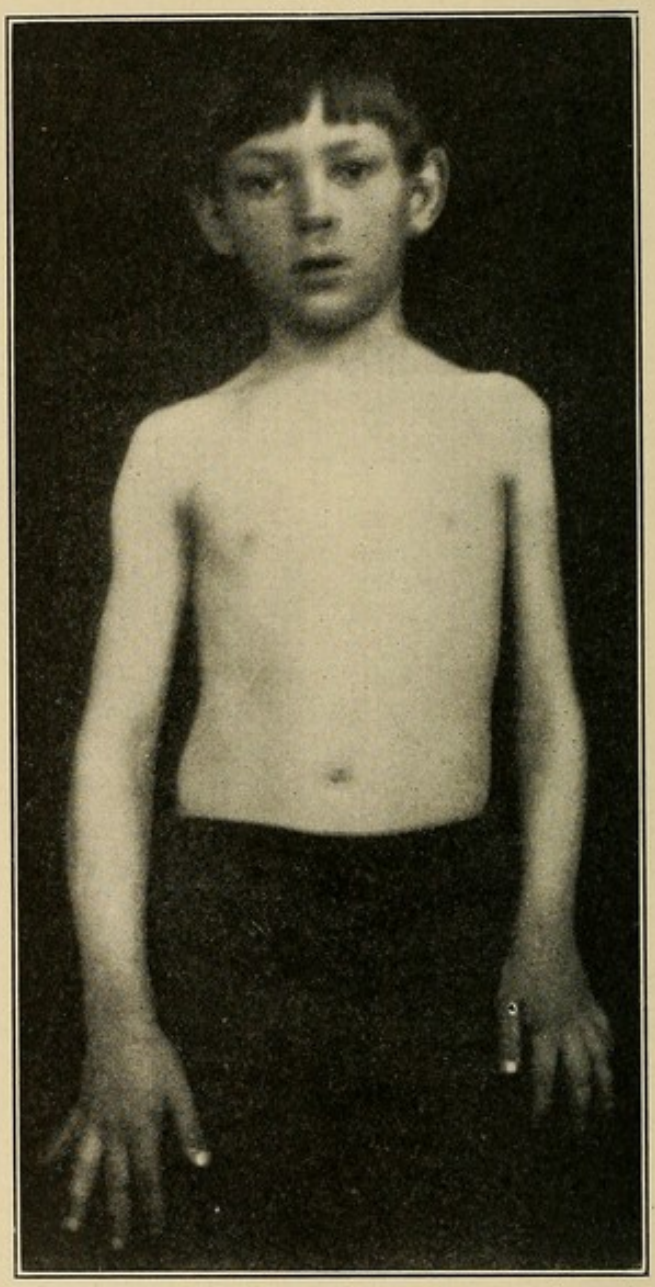
Those fibers which are concerned in the transmission of sensation for pain and temperature enter the gray matter of the posterior horn, decussate almost immediately in it and travel upward in the spinal cord in the so-called column of Gowers. The fibers which transmit touch, pain, and temperature sensations after their respective decussations in the medulla and spinal cord are transmitted by means of the median fillet to the optic thalamus of the same side, and then through the posterior portion of the posterior limb of the internal capsule to the cortical sensory centres in the postcentral convolution of the same side.

If a disease involves a posterior root and destroys its fibers, there will be loss of all forms of sensation in the parts which these fibers supply. The skin areas of sensation which are in relation to a posterior root are fairly well known and run in bands lengthwise in the limbs and in the chest and abdomen horizontally. It is necessary to distinguish the area of sensation in relation with a certain root from that of the segment which this root supplies. In the former the disturbance of sensation will always be unilateral, while in a lesion involving any segment of the spinal cord the disturbance of sensation must be bilateral. It is probable that sensation in any part of the limbs or of the chest and abdomen is in relation with more than one root or segment and in a lesion which destroys only one root or segment the loss of sensation will be very limited.

Bladder, Rectal, and Sexual Centres.—In the second, third, and fourth sacral segments are situated the centres for bladder, rectal, and sexual functions and a destruction of this part of the cord will cause a loss of these functions. It seems also that the fibers concerned with the bladder and rectal functions descend in the lateral columns of the spinal cord, and that lesions in these tracts may cause an impairment in their functions.

It is not the object of this chapter to discuss every disease of the spinal cord, but, inasmuch as tumors or injuries may involve part or all of the cord, it will be necessary to be able to diagnosticate a lesion in any part To make the subject clearer the symptoms of different diseases and possible lesions will be given.

Fig. 70



Atrophy of left upper limb and shoulder in acute anterior poliomyelitis.

Diseases Involving the Cells of the Anterior Horn.—Acute Anterior Poliomyelitis. Infantile Palsy.—A disease of infancy characterized by sudden onset, with or without fever, flaccid paralysis of one or all of the limbs, followed by atrophy, loss of reflexes, and electrical reactions of degeneration.

The disease usually appears in a child previously well, and rarely in the course of or following an infectious disease, such as scarlet fever, measles,

or smallpox. It usually occurs sporadically, but within recent years epidemics have been frequent, especially in the States of Pennsylvania and New York. Several members of the same family, people of certain localities, and lower animals, such as pigs and chickens, may become diseased, leading to the belief that the disease is probably infectious or that it may be transmitted through the water or soil (Fig. 70).

Symptoms.—The disease usually appears in the infantile period, generally between the ages of one and three years, although it may occur later in life, especially in epidemics. Rarely it may occur in adults.

It is usually ushered in by fever with its accompanying symptoms of malaise and chilliness, or the child may have felt sick for only a day or so when the weakness or paralysis is discovered. At first it is quite extensive and may affect all of the limbs, but, as a rule, it involves by preference one or both lower limbs. Within a few days to four or five weeks the extent of the paralysis gradually lessens and there remains what is called a residual palsy. The muscles of the limbs are never all paralyzed, but there seems to be a predilection for certain groups, as, for instance, in the leg, the anterior tibial and the peroneal. Because of this unequal paralysis contractures of various types result. The paralysis is always flaccid in type and it is possible to passively move the limbs. The cells of the anterior horn in the thoracic part of the cord are rarely diseased, this causing weakness or paralysis in the abdominal, lumbar, and thoracic muscles. This sometimes produces inability to sit up or to stand properly. Following the loss of power atrophy develops, the degree depending upon the extent of the destruction of the cells in the anterior horn.

The tendon reflexes as well as the normal electrical reactions will be lost in those parts in which the reflex arcs have been destroyed or interfered with.

Not only will there be atrophy of the muscles, but there will also be an atrophy of the bones of the involved limb. Because of the fact that the cells in the anterior horn are trophic in function, there will also be lessened nutrition of the skin which sometimes becomes dry and the hair may not grow.

It is not at all uncommon in the onset of the disease to have a rigidity of the head, neck, and limbs, with pain in the back and neck and considerable tenderness in the limbs. This is due to an early meningeal involvement which usually does not last very long and subsides within two or three days or a week. In rare instances, however, the pains may persist for a month or longer. There are never disturbances of sensation or of the bladder and rectal functions. When the disease appears in adults (rare) the onset and clinical symptoms do not differ from those already described.

Chronic Poliomyelitis.—A progressive disease of the spinal cord, characterized by gradually increasing fibrillary twitchings beginning in the hand, with gradual atrophy, loss of power, of reflexes, of normal electrical reactions and contractures in the latter end of the disease resulting from chronic degeneration of the cells of the anterior horn of the spinal cord.

Syringomyelia.—A chronic disease characterized principally by typical dissociation of sensation, that is, ability to recognize touch with loss or disturbance of pain and temperature sensations, combined with atrophy, fibrillary tremors, weakness in the upper and sometimes in the lower limbs, with spasticity and exaggerated reflexes, especially in the lower limbs.

The syringomyelic cavity in most instances results from lack of normal development of the spinal cord. Sometimes there is first an overgrowth of neurogliar tissue, a central gliosis, or a tumor which breaks down, forming a cavity. More rarely traumatism may produce hemorrhages into the cord, these breaking down and producing cavities. The normal central canal may be widened, producing what is called a hydromyelia, but, unless it is very large, there may be no symptoms.

Symptoms.—The whole symptom-complex of this disease depends upon the interruption of the fibers concerned with pain and temperature sensations with preservation of touch sensation and the involvement of the anterior cornua and lateral columns. This is because the pain and temperature fibers cross over in the central gray matter, and, as the cavity is nearly always in this area, these functions are interrupted. If the cavity is limited only to the central gray matter there may be present only the dissociation of sensation which is referred to the related peripheral part, usually in the upper limb, but in most cases the cavity also involves the adjacent cells of the anterior horns plus the lateral columns, their related symptoms developing, such as fibrillary tremors, atrophy, weakness, with spasticity and increased reflexes of the lower limbs. It can be readily seen then that the symptoms in different cases may vary.

The disease usually begins in a young adult, the patient sometimes becoming aware of it by the fact that he burns himself without pain. If examined, touch sensation will be found to be normal, but heat or cold or both will not be recognized as such. Sometimes one or the other temperature sensation alone is disturbed, or heat may be referred to as cold and cold as heat. The disturbed areas are usually in the upper limbs, chest, and back, depending upon what spinal segments are destroyed. Coincident with this dissociation, or soon after, atrophy, tremors, and weakness in the small muscles of the hand develop, and there may be present a typical claw hand, its progress being very much like that of either progressive muscular atrophy or amyotrophic lateral sclerosis. Soon after there may develop weakness and spasticity of the lower limbs with exaggeration of the tendon reflexes and the Babinski phenomenon.

The progress of the disease is usually slow and may last for twenty or thirty years, with gradual increase of the wasting, tremors, and loss of power, finally involving all of the upper limbs, shoulders and chest, and sometimes the lower limbs. The areas of sensory dissociation also gradually increase. If the cavity involves the gray matter of the lumbar and the sacral cord, besides the sensory dissociation in the lower limbs and buttocks there will be impairment or loss of bladder, rectal, and sexual functions, and sometimes there may be loss of the knee and Achilles

jerks, because of interference with the central portions of the reflex arcs. If the cavity extends into the medulla and pons the symptoms depend upon the extent of the involvement. Usually in the medulla the cavity is unilateral and there may be partial difficulty in eating, talking, and swallowing, or, if bilateral, typical bulbar symptoms develop, with tremors, atrophy, and weakness in the tongue, facial, masseter, and pterygoid muscles. If the cavity involves the sensory fibers there may be dissociation of sensation in the face. Rarely primary optic atrophy occurs, and more rarely still pupillary symptoms because of involvement of the cervical sympathetic.

Trophic symptoms are very common in syringomyelia. These may consist in different forms of skin eruption or a destruction of the joints either of the fingers or of the wrist and elbow or shoulder, resembling very much the so-called Charcot joint of tabes dorsalis. Occasionally there may be sharp, shooting pains in the limbs and girdle sensation.

Diseases Involving the Motor, or Lateral, Columns.—**Lateral Sclerosis.**—Gradual weakness in the lower and then in the upper limbs, spasticity, increased reflexes, the Babinski phenomenon, contractures in the latter end of the disease, usually with the thighs adducted and flexed and the upper limbs in flexor contracture.

Amyotrophic Lateral Sclerosis.—If the disease involves the lateral or motor columns plus the cells of the anterior horn, there will be weakness in the limbs, spasticity, increased reflexes, and the Babinski phenomenon, plus fibrillary twitchings and gradual atrophy. Contractures will come on in the latter end of the disease.

Diseases of the Posterior Columns.—**Tabes Dorsalis** (**Locomotor Ataxia**).—A chronic progressive disease characterized first by numbness in the lower limbs, then by pains of a sharp, shooting character, girdle sensation, difficulty in walking and in execution of any movement, this being especially made worse with the eyes shut; absence of reflexes, disturbances in the functions of the bladder and rectum, irregular pupils, with failure of the reaction to light and later optic atrophy and disturbance of sensation in various portions of the body.

Syphilis is probably the most important cause of tabes dorsalis, although rarely injuries, especially those which cause pressure or destruction of the posterior roots, may cause identical symptoms. The pathology consists in degeneration of the posterior roots, with consequent ascending degeneration of the posterior sensory columns. There is nearly always an accompanying meningitis, especially in the posterior part of the cord.

The disease is slow in onset, and the symptoms come on gradually over many years. There is nearly always first numbness in the lower limbs and sometimes a sensation as if walking on leather which is accompanied or followed by pains of a sharp, shooting character, usually first described as rheumatic. The pains are not limited to one distribution, but appear at irregular places, and, as the disease progresses, may be present in all portions of the body. When referred to the viscera they are called crises, such as gastric, intestinal, urethral, ocular, etc. Girdle

sensation, or a feeling of tightness, is usually manifested around the abdomen, but may be present elsewhere. The reflexes, especially the patellar and Achilles jerks, become diminished early, and later are lost even on reinforcement. The upper arm reflexes also become gradually lost. Inability to hold the urine, constipation, and lessening of sexual functions are early symptoms.

Disturbances in sensation are prominent and can usually be demonstrated early and involve the deeper structures more than the superficial. It is characteristic that disturbances of touch and pain are nearly always found in the soles of the feet and the anterior portion of the legs and chest. The alterations in sensation are gradual and in association there is always loss of muscular sense, so that the patient is unaware of the position of his toes, feet, or limbs, this causing disturbance in locomotion and ataxia, which is always made worse when the eyes are closed. The disturbance in the gait in tabes is typical, the patient nearly always walking slowly with the head bent, usually with a cane, the knees are bent more than they should be, and the feet placed on the ground forcibly. If the patient should shut his eyes, he would stagger and sometimes fall. Coincident with the disturbance of sensation and muscle sense there is a great amount of hypotonia, this being manifested by the abnormal position in which the limbs can be placed.

Among the early symptoms are the irregularity of the pupil, with diminution and later loss of the iridic reflexes for light, but with motility of the iris on accommodation for distance, the so-called Argyll-Robertson pupil. Temporary oculomotor and external rectus palsy are also common. Optic nerve atrophy, involvement of the fifth nerve, and deafness are occasional complications. Vasomotor and trophic disturbances are not unusual, and consist in occasional herpetic eruptions, disturbance of sweat secretions, and so-called Charcot joints which consist in an alteration in the tissues of the bones and in the articular structures, making it possible to move the limbs in any direction.

Posterolateral Sclerosis.—If the disease involves the lateral and the posterior columns there will be weakness, spasticity, increased reflexes, and the Babinski phenomenon plus disturbance of touch sensation, ataxia, and involvement of bladder and rectum.

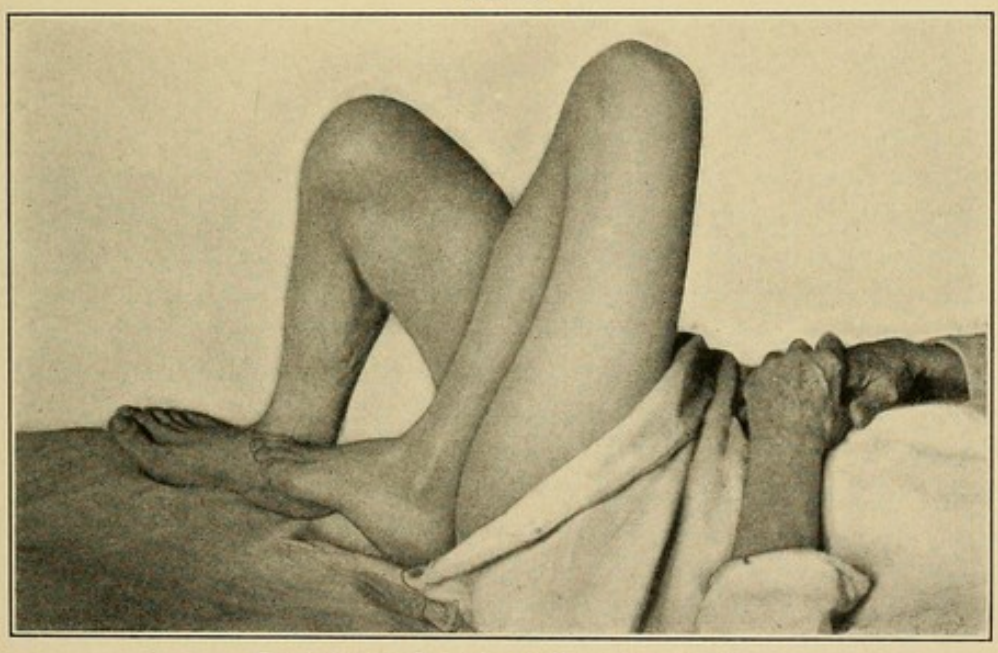
Myelitis.—By this is meant inflammation of the substance of the spinal cord. It may be acute, subacute, or chronic; it may involve the whole diameter of the spinal cord when it is called transverse, or it may involve parts here and there when it is called disseminated myelitis. It may be the result of syphilis or of an acute infection, or the result of an injury (Fig. 71).

Acute Myelitis.—The symptoms of acute myelitis depend upon the part and extent of the spinal cord affected. Usually the dorsal region is most intensely involved. The symptoms may come on rapidly, sometimes in a few hours, or may come on gradually and last for some weeks or months.

When the result of an injury, the symptoms are immediate. There may be a feeling of malaise and even a rise of temperature, and the

patient may complain of a feeling of numbness or of a tingling sensation in the limbs, sometimes, also, of a pain in the back. Following this, or perhaps without these pains, there is a feeling of weakness in the extremities which is rapidly followed by complete flaccid paralysis. At times a total paralysis comes on within a few hours. Sensation in all forms is much affected, the upper limit of the anesthesia depending upon the location of the lesion. The reflexes may be lost at first, but in a short time the limbs will become spastic, the reflexes, such as the patellar and Achilles jerks, will be much increased, and the Babinski phenomenon obtained. The vesical and rectal sphincters are involved from the beginning, there being at first retention of urine and constipation followed by incontinence. Trophic disturbances, such as bedsores, soon appear. Wasting of muscles and the reactions of degeneration are obtained, provided the cells of the anterior horns supplying these parts are destroyed.

FIG. 71



Contracture of the lower limbs in myelitis.

If the affection is intense, the disease extends very rapidly, soon affecting the cells supplying the respiratory muscles and causing death. If the patient survives, the course of the symptoms will depend upon the severity of the lesion. Usually sensation will return before motion, and the patient will gradually show the symptoms of spastic paraplegia.

Myelitis Resulting from Injury.—The symptoms will resemble those already described with the exception that the onset is sudden, there being no premonitory symptoms; and, as the destruction of the cord is nearly always intense, the picture may be that of a complete transverse myelitis, in which case there will be no return of motion and sensation in the parts below the point of injury.

Serous Meningitis.—Sometimes all of the symptoms of myelitis may be caused by pressure due to an increase in the cerebrospinal fluid, the result of a serous meningitis. It is, however, impossible to recognize

this, for the symptoms are identical. Lumbar puncture, however, will demonstrate a great increase in the quantity of fluid and a heightened tension in the spinal canal.

Diseases of the Spinal Roots.—*Symptoms.*—The symptoms will depend upon whether the anterior or the posterior roots are involved and upon the extent of the disease. In most instances it is impossible to tell whether the root or the segment of the spinal cord which the root enters is diseased, and it is important to remember this when the question of surgical procedure is considered, for it will then be necessary to expose not only the spinal segment which the root supplies, but the whole extent of the root in the canal. In such instances it is advisable always to expose first the exit of the root and go upward.

In the differential diagnosis between a root and segment lesion, it is noted that in the former the symptoms are more liable to be referred to definite parts. In the latter they will be diffuse and involve the distribution of other roots, for a lesion of the cord itself is hardly ever unilateral.

Anterior Root Lesions.—As the anterior roots are motor there will be fine tremors or twitchings in the corresponding muscle fibers, to be followed by paralysis when the root is destroyed. If the lesion extends farther into the spinal cord, the symptoms of this will be apparent.

Posterior Root Lesions.—These are more common. As the posterior roots are sensory in function, any lesion will first give irritative phenomena, such as numbness and paresthesia in the skin distribution related to these roots, to be followed by pains of a lancinating character or girdle sensation, and, if the roots are destroyed, anesthesia in the related parts. There will of course be secondary degeneration in the columns of Goll and Burdach.

Unilateral Spinal Cord Lesions, or Brown-Séquard Paralysis.—Sometimes tumors or injuries resulting from bullet or stab wounds will cause a unilateral lesion of one or two segments of the spinal cord. The symptoms will depend upon the part of the cord involved and the extent of the lesion. Should there be, for instance, a unilateral lesion in the eighth cervical and first thoracic segments of the right side of the cord, there will be the following symptoms: Because of the destruction of the nerve cells in the anterior horns, inability to flex or extend the right wrist or move the fingers, besides atrophy and electrical reactions of degeneration in these parts. Because of the involvement of the right motor or pyramidal column, weakness, spasticity, increased reflexes, and the Babinski phenomenon in the right lower limb. Because of the destruction of the sensory roots, loss of all forms of sensation along the under surface of the whole right arm. As the posterior columns transmit the fibers for touch sensation and muscle sense there will be disturbance of touch in the right lower limb and right abdomen and chest, with impairment of muscle sense and ataxia in the right leg. In the left lower limb there will be disturbance of pain and temperature sensations only, because of the destruction of the right column of Gowers.

Influence of Secondary Degenerations.—Whenever there is a lesion in any portion of the spinal cord there will necessarily be secondary degenera-

tion. If the motor columns are involved, the degeneration will be downward; if the sensory, upward. Secondary degenerations do not cause active symptoms, for whatever first produced the original lesion has also caused the secondary degeneration, and this is no more than a mechanical death of the part.

DISEASES OF THE MENINGES.

The meninges, which envelop both the brain and spinal cord, are divided into the outer coat, or the dura, and the inner, or the pia and arachnoid. Inflammation of the dura is called pachymeningitis, and of the inner coats leptomeningitis. With the exception of localized inflammations and those following injury, inflammation of the meninges nearly always involves the coverings of both the brain and spinal cord.

Cerebral Pachymeningitis.—This may affect either the outer or the inner coat, when it is called external or internal pachymeningitis. *External pachymeningitis* nearly always results from injury to the skull, and is not so common as is usually thought. It may be secondary to a growth of the overlying bone, especially in syphilitic, tuberculous, or carcinomatous conditions.

Internal pachymeningitis is rare. It sometimes is hemorrhagic in nature, there being accumulations of blood between the dura and pia, and usually occurs in old persons, especially in those who are either arteriosclerotic or alcoholic. It is rarely found in some forms of insanity. It may be present in conjunction with external pachymeningitis, especially in purulent, syphilitic, or tuberculous inflammation.

Symptoms.—The symptoms of pachymeningitis, whether external or internal, are indefinite and depend upon the pressure exerted upon the brain. Generally the patient complains of headache and, rarely, of tenderness localized to the inflammatory area, the specific symptoms depending upon the part of the brain involved. If in the motor area, there will be irritative symptoms, such as Jacksonian convulsions, which may be followed by greater or less paralysis; if over Broca's convolution, motor aphasia; if over the parietal areas, where pachymeningitis is most common, there may be irritative pains or paresthesia on the other side of the body, accompanied sometimes by disturbance of sensation; if over the temporal lobes, aphasia; if over the occipital convolutions, disturbance of vision on the other side. There may sometimes be loss of consciousness, delirium, or stupor, or there may be no symptoms at all.

Spinal Pachymeningitis.—Isolated inflammation of the spinal dura without involvement of the membranes underneath is very unusual and hardly ever occurs. In some instances, however, the dura is preponderantly involved. As a rule, inflammations of the dura are secondary to disease of the vertebra, as in tuberculous, syphilitic, carcinomatous, or sarcomatous lesions. It is possible to have a syphilitic pachymeningitis without involvement of the vertebra, but in most of these cases the pia and spinal cord are also diseased. The symptoms of a spinal

pachymeningitis secondary to vertebral inflammations will be discussed under the latter heading.

Inflammation of the Pia Arachnoid.—Cerebrospinal Meningitis.—In most cases the pia of the brain and spinal cord are involved at the same time, and it is only rarely that either is involved alone. Inflammations may be of various kinds. The other varieties are purulent, tuberculous, and serous.

Syphilitic meningitis has been discussed under the head of Syphilis (p. 166).

Purulent Meningitis.—In most instances purulent inflammation of the meninges is secondary to septic processes elsewhere, such as infected wounds of the scalp or cranium, sinusitis, middle ear disease, localized abscess of the brain or pia, and general pyemic processes or abscesses in the various parts of the periphery; or secondary to a septic endocarditis or one of the infectious diseases, as pneumonia or typhoid. As a rule, the process involves equally the membranes of the convexity, base of the brain, and spinal cord.

Symptoms.—If the meningitis occurs in the course of an infectious disease, as typhoid, pneumonia, septic endocarditis, or is secondary to pyemic processes, injuries to the head, or middle ear disease, their accompanying symptoms will be present, and very often the early symptoms of meningitis are masked. As a rule, they come on rapidly with headache, which at times is excessive, and a rise of temperature, the patient becoming delirious, stuporous, and then unconscious. The pulse generally at first is rapid and then slow and somewhat irregular, and respiration becomes more or less embarrassed. The head is retracted, the back held rigidly, and often the patient assumes a position of opisthotonos. The arms are retracted, the legs are flexed on the abdomen, and any attempt to extend the legs with the thighs flexed is met with resistance (Kernig's sign). About this time the irritative phenomena become prominent, and there may be general convulsions, or the spasms may be limited to one or more limbs, and be followed by partial paralysis or hemiplegia. The reflexes may be exaggerated, diminished, or lost. Because of basilar involvement the pupils become irregular, their reactions impaired, and there may often be swelling of the optic nerve heads, or choked disk. Cranial nerve palsies are common, especially of the sixth, causing diplopia; the third, resulting in ptosis of the upper lid and inability to move the eyeballs; the seventh, paralysis of the face; and of the vagus, interference with the action of the cardiac and respiratory functions, and ultimately death. Vasomotor phenomena may be present consisting in a flushing of the skin after stroking, or tache cerebrale.

Tuberculous Meningitis.—In this type the inflammation is nearly always confined to the membranes of the base of the brain, although there is some involvement of the convexity. In nearly all cases the tuberculous meningitis is secondary to similar processes elsewhere, especially of the lung, intestines, or glands. It may occur in adults, but in most instances it affects children below the fifth year.

Pathologically there is found tuberculous inflammation, with small miliary nodules, and there is nearly always some serous effusion.

Symptoms.—When occurring in an adult, there are nearly always the accompanying symptoms of a tuberculous inflammation elsewhere, either in lung, pleura, or glands. There gradually develops headache, irritability, vomiting and nausea, rigidity of the head and neck, some disturbance of consciousness, and then the symptoms of involvement of the cranial nerves at the base of the brain. These are choked disk, or optic neuritis; irregular pupils, with disturbance of their reactions; ocular palsies, drooping of the upper lid; facial paralysis; disturbance of hearing and of cardiac and respiratory functions. Sometimes there may be convulsions or paralysis of the limbs of one or both sides. In most instances the disease is fatal.

Tuberculous Meningitis in Infants.—When it occurs in infants there is usually a slow onset with general restlessness, loss of weight, rise of temperature, and gastro-intestinal disturbances with delirium, unconsciousness, and retraction and rigidity of the head, neck, and back, retraction of the upper and lower limbs, and the symptoms of basal involvement which have been described above. Usually the disease terminates in death, but, if the patient lives, there will be closure of some of the ventricular connections with a consequent internal hydrocephalus. Because of this there will be an increase in the size of the head, bulging of the fontanelles, paralysis of one or both sides of the body, impairment of intellect, and a general rachitic condition of the body with its accompanying symptoms of maldevelopment.

Serous Meningitis—Meningism.—This is a form of meningitis only recently described in which there is an effusion into the meninges, but in which there is no exudation such as occurs in the purulent variety.

Under the term *meningism*, *meningismus*, or *pseudomeningitis* has been described that clinical variety in which the symptoms of meningitis are present, but in which pathologically and by lumbar puncture nothing is found beyond a congestion and edema of the vessels. It is probable that it is nothing more than the primary stage of a serous meningitis. If the disease goes farther, or into the second stage of effusion, there will be what is commonly termed serous meningitis.

Meningeal processes, whether of an irritative or of an effusive nature, can be likened to similar pathological conditions occurring in the internal organs, as in the various stages of a pleurisy or pericarditis.

Pathologically, in meningism there will be found a congestion of the bloodvessels with either little or no edema, and rarely the germ of the disease may be found in the meninges. In serous meningitis a similar condition is present, with the addition that there will be a serous effusion with an increase of the lymphocytic elements, and only rarely will a specific organism be found.

Symptoms: Meningism.—This may occur in the course of or follow any infectious disease, such as pneumonia, typhoid, rheumatism, scarlet fever, measles, or la grippe. It is not difficult to recognize, for there will be present those symptoms which are commonly termed meningeal, such

as pain along the back or limbs which may be of a numb character or may be decribed as sharp and shooting, but the principal complaint is headache, especially in the back of the head. Besides, there will be rigidity of the head and back, and unwillingness to move the limbs because of fear of increasing the pain. Sometimes there will also be hyperesthetic areas in different parts of the body. There may rarely be muscular twitchings in the limbs and a general increase of the reflexes. Lumbar puncture is negative. The onset is generally acute. The temperature may or may not be increased, and the pulse and respiration are not much altered. The duration of the disease is usually short and the prognosis always favorable. Sometimes, however, there may be a complicating serous effusion.

Serous Meningitis.—This may involve either the brain or spinal cord alone, or both. There will be in addition to the symptoms enumerated above, which may occur first, pressure symptoms resulting from the presence of fluid, their intensity depending upon the degree of the pressure. When the spinal cord is principally involved, there will be, in addition to the meningeal symptoms, pains in the limbs, girdle sense around the waist, and, because of pressure upon the anterior and posterior roots and later on the spinal cord, disturbance of sensation, increased reflexes, which are later lost, and bladder and rectal disturbances. Lumbar puncture will always demonstrate an increase in the intraspinal pressure, and there will be considerable exudation of fluid. In most cases the disease lasts only a few weeks, the patient getting well.

In the cerebrospinal forms, besides the symptoms enumerated, there will be some disturbance of consciousness and greater rigidity of the head and neck and of the limbs, and sometimes a swelling of the optic nerve heads. More rarely there may be temporary diplopia and disturbances in the temperature, pulse, and respiration. Lumbar puncture will, of course, demonstrate increased intraspinal pressure with increase of fluid. In most instances the symptoms will subside in a few weeks, the patient getting well. If, however, they persist, there will develop a serous effusion in the cerebral ventricles with its accompanying symptoms of intraspinal pressure.

Cerebral Serous Meningitis.—A serous effusion into the ventricles may be the beginning of a general serous meningitis, or may be confined only to them. The same causes which are active in the production of a serous meningitis may produce an internal hydrocephalus.

Pathologically there will always be found an internal and sometimes also an external hydrocephalus, or an increase of fluid in the cortical meninges. Histologically there may be cloudy swelling and proliferation of the ependyma, accumulation of cells under the ependyma, and cellular infiltration in the brain and spinal cord substance and in its meninges, especially along the bloodvessels. The choroid plexus is nearly always diseased, and its overaction is supposed to be the cause of increase in fluid.

Internal hydrocephalus resulting from serous effusion, as a rule, comes on in early childhood and is not difficult to recognize if the process is

active. Very often, however, there may be only mild symptoms, such as have been described under meningism, only to have later in life either an acute or chronic serous meningitis or internal hydrocephalus. In fact, many writers consider that serous meningitis or serous effusion in the ventricles in the adult is only an acute exacerbation of an old process which had its origin in childhood. However that may be, there is no question that in the adult a serous effusion may develop in the ventricles either acutely or gradually and cause symptoms which are usually recognized as occurring in brain tumor, and from which it is sometimes almost impossible to make a differential diagnosis.

If internal hydrocephalus develops acutely there will be, as a rule, an accompanying high fever and the course of the disease will be rapid, it resulting either in cure or death. Headache, nausea, vomiting, vertigo, and disturbance in vision and choked disk, sometimes marked, are prominent symptoms. Besides, there may be paralysis of some of the cranial nerves, especially of the sixth, either on one or both sides, and there may also develop cerebellar ataxia. Consciousness is nearly always clouded. The disease may last a week or two, terminating in quick recovery, leaving behind slight atrophy of the optic nerves, but no other symptoms. Sometimes there may be a recurrence of the disease, this terminating also either in recovery or death. The diagnosis from a brain tumor can usually be made by the rapid onset, high fever, and the quick recovery or termination in death.

If, however, the symptoms of internal hydrocephalus come on gradually, the differential diagnosis from brain tumor will be very difficult. There will be present all the pressure symptoms, such as headache, nausea, vomiting, vertigo, and choked disk, and, because of the pressure exerted upon the motor fibers in the internal capsule, there will result weakness and spasticity of the limbs with increased reflexes and sometimes the Babinski reflex. There may also be paralysis of the external rectus, either on one or both sides. Because of pressure on the cerebellum there will result incoördination in walking and sometimes incoördination of the eyeballs, or nystagmus. The differential diagnosis from cerebellar lesions is sometimes very difficult, but can be made principally upon the fact that in cerebellar tumors there is hardly ever involvement of the limbs on both sides and the ataxia is more acute and much more marked.

It must also be remembered that internal hydrocephalus may also accompany tumors either of the cerebrum or cerebellum, and in such case there will be, in addition to the symptoms resulting from the tumor, spastic paresis of the limbs with increased reflexes and the Babinski phenomenon. The prognosis in most cases of uncomplicated internal hydrocephalus is not very good, but sometimes complete recovery ensues either as a result of operative interference, antisyphilitic treatment, or sometimes spontaneously, leaving behind nothing but a slight atrophy of the optic nerves.

Tumors of the Spinal Cord.—In comparison with tumors of the brain they are rare and may be extradural, intradural, or involve the spinal cord itself. They are mostly intradural, tumors of the cord being

most rare. Pathologically they may be sarcoma, fibroma, glioma, carcinoma, or cystic. Tuberculous and such other tumors, as psammoma, myxoma, endothelioma, and lipoma, rarely occur.

Sarcoma.—Sarcoma of the cord itself is rare and is secondary to that of the vertebra, when it involves the anterior and especially the posterior roots or may infiltrate in the pia. Generally the lower portion of the spinal cord, especially the cauda equina, is the seat of multiple sarcomata. Their characteristics have already been discussed, and it need only be remembered that sarcomata may be soft and infiltrating, and, because of this, may give only a few symptoms.

Fibroma.—These tumors are mostly intradural and grow in the pia or about the roots. As a rule, they are not multiple, and are favorable for operative removal.

Cysts.—These may be limited to the meninges and be simple or may be multiple, as occurs in cysticercus cellulosæ and in echinococcus cysts.

Symptoms.—These will depend upon the location of the tumor and extent of the involvement, either of the meninges, root, or cord. As a rule, most tumors are located in the thoracic cord and are generally situated about the lateral and posterior surfaces. It is impossible to state definitely what symptoms may occur in tumors, but they are either due to involvement of the roots or the spinal cord itself.

Root Symptoms.—Numbness or pain or girdle sensation to be followed by pain are usually among the first manifestations, these being referred to the parts in relation with the posterior root diseased. As a rule, the pains are sharp, shooting, and agonizing in character and may be of such intensity as to prevent the patient from moving. If the growth involves several posterior roots and is large, there may be tenderness and pain on pressure over the involved part, and jarring may sometimes cause excruciating pains. Later, there may be an accompanying disturbance of sensation.

Cord Symptoms.—As the spinal cord itself becomes involved its accompanying symptoms will develop, such as disturbance of sensation if the posterior part of the cord is affected, and, if the lateral columns are compressed, there will be weakness, spasticity with increased reflexes, and the Babinski phenomenon in the parts below. Of course, if the tumor is around the anterior part of the cord the symptoms will be purely motor. This, however, is uncommon.

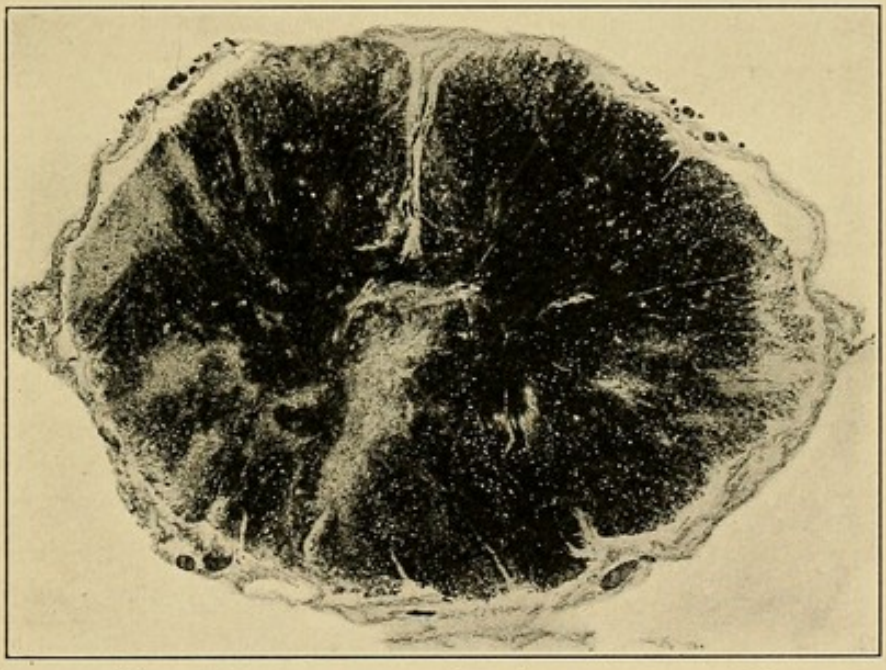
Tumors of the Cauda Equina.—These are generally sarcomatous and multiple. The symptoms will depend upon what roots are involved. There will usually be pain referred to the sciatic distribution of one or both sides, or possibly a localized pain in the lower part of the back, but the most distinguishing feature is the segmental disturbance of sensation around the buttock, perineum, anus, and in the genital organs. There may also be disturbance of the bladder, rectal and sexual functions. Paralysis is not very common, but, if it occurs, will usually be in the distal portions of the limbs.

Tumors of the Vertebra.—These are generally sarcoma or carcinoma, or may be the result of a growth of the bone tissue, when they are called

myelomata. The earlier mentioned tumors are nearly always secondary to growths elsewhere, generally from the lungs, stomach, breast, prostate, or uterus. Such benign growths as osteoma or enchondroma may sometimes occur.

Root and Spinal Cord Symptoms.—As the disease progresses pressure will be first exerted on the posterior roots, and the first symptoms will be those of numbness, to be followed by sharp, lancinating pains, with girdle sensation, referred to the distribution of the diseased roots. Any jarring of the back or pressure will bring on a fresh attack or exaggeration of pain. As the disease involves the dura and the cord, there will be added disturbance of sensation and of bladder and rectal functions, weakness in the limbs, with increased reflexes, spastic condition, and the Babinski phenomenon. The extent of the paralysis will of course depend upon the amount of involvement, there sometimes resulting complete myelitis and total paralysis (Fig. 72).

FIG. 72



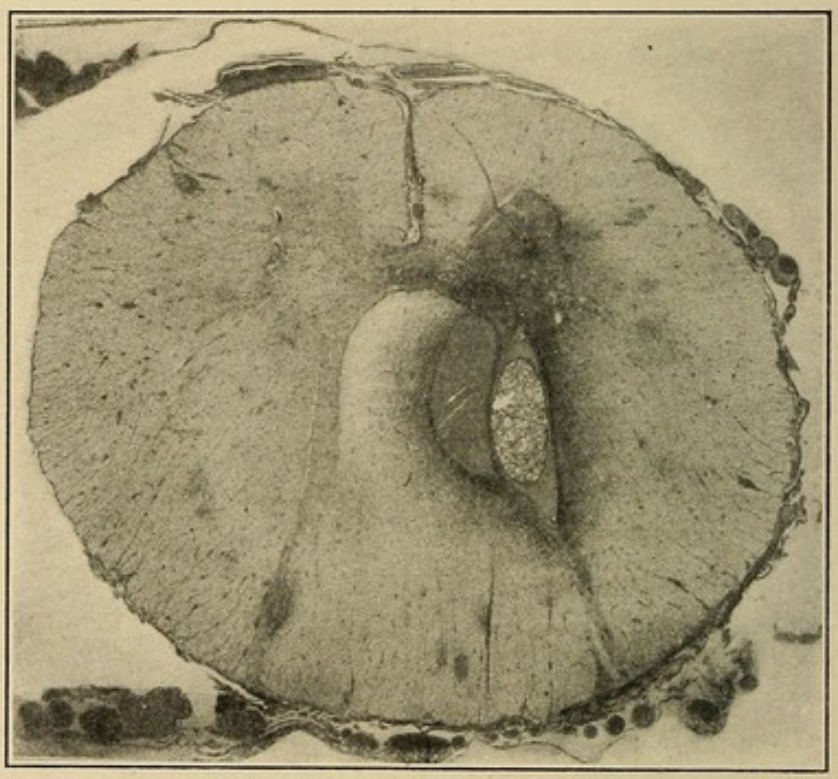
Diffuse myelitis resulting from pressure of carcinomatous tumor of the vertebra.

Injuries of the Spinal Cord.—The result of any injury, no matter how trivial, cannot be foretold. There may be, first, a sprain or injury to the ligaments of the vertebral column, either with or without injury of the cord; second, fracture or dislocation of the vertebra, or both, either with or without involvement of the spinal cord; third, injuries to the cord itself; and lastly, the so-called traumatic neuroses which may enter into all of the above classifications and also are independent of these. The symptoms will be discussed in order.

Sprain or Injury to the Ligaments of the Vertebral Column, with or without Involvement of the Cord.—This generally results from overstretching of the vertebral column or from some severe muscular effort. A direct injury to the back may cause a contusion of the ligaments. As a rule,

the cord itself will not be involved, and the symptoms will be those of pain localized to the affected parts, with accompanying rigidity of the back and pain on movement. There should be no difficulty in making this diagnosis were it not for the fact that in some cases there may be present the symptoms of a traumatic hysteria which may resemble injury of the cord, or there may be what not infrequently occurs, multiple small hemorrhages or areas of softening in various portions of the cord, and sometimes hemorrhages into the substance. Their symptoms will be fully discussed.

FIG. 73



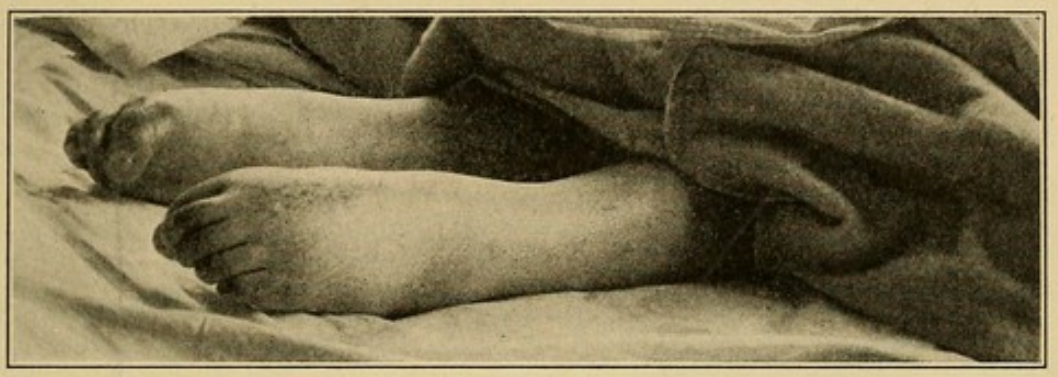
Section of spinal cord, showing diffuse small hemorrhages and one large hemorrhage in one posterior horn resulting from injury to the spinal cord. The section is taken two segments above the injury.

Injuries to the Cord.—In nearly all cases where the injury has been severe enough to cause a fracture or dislocation of the vertebra the cord itself will be severely damaged. This may be either because of a direct pressure exerted upon the cord, the result of forward displacement of the vertebra, or as sometimes happens there will be at the time of injury a sudden torsion or twisting of the spine, this causing momentary pressure upon the cord, with destruction of its elements. Again, there may be severe injury to the cord, with either multiple small hemorrhages or softening or one large hemorrhage, but no evidence of fracture or dislocation or even sprain or contusion of the ligaments (Fig. 73).

The symptoms of compression of the cord will not differ from those described under the head of myelitis. As a rule, the destruction will be intense, and transverse myelitis and sometimes complete severance of the cord will result, this causing complete loss of power and of sensation in the parts below, with bladder, rectal, and trophic symptoms. It must

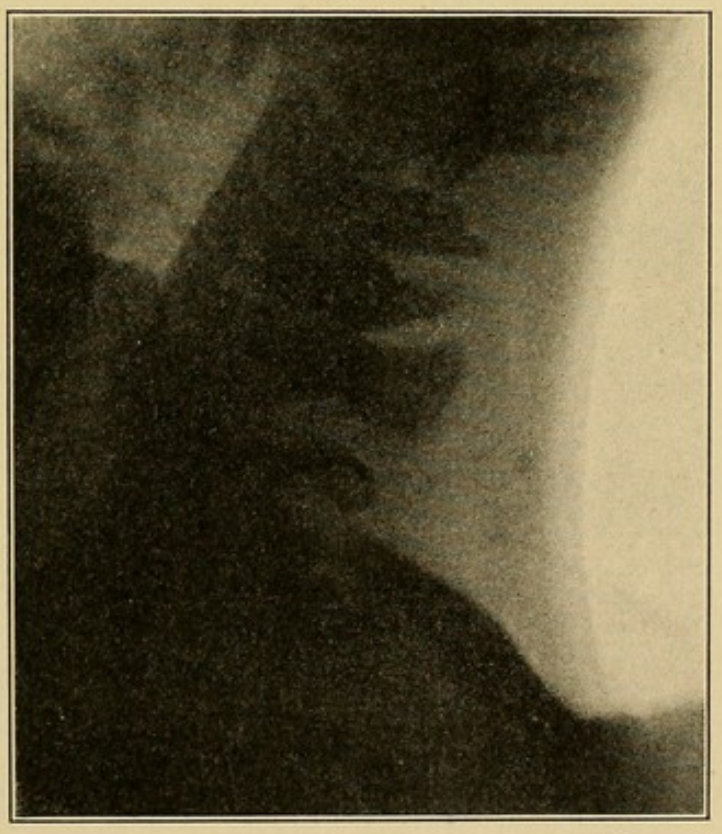
also be remembered that besides the direct destruction of the cord, the result of the injury, there will also be multiple small areas of hemorrhage above and below the point of injury. If there is only a partial destruction, there will be, after the initial complete paralysis of motion and sensation, return of sensation, and then of motion, with increased reflexes, spas-

FIG. 74



Photograph showing complete bilateral foot drop with contracture and trophic changes in a case of myelitis resulting from injury to the cord.

FIG. 75



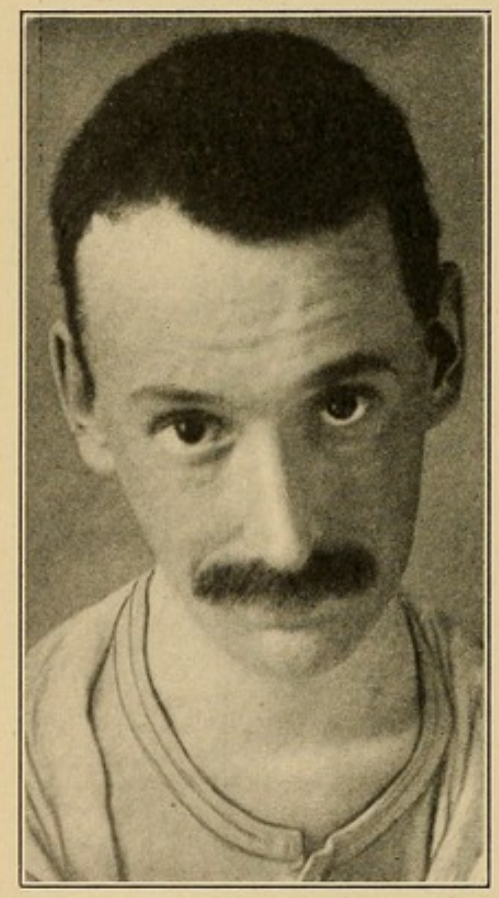
Backward dislocation of fifth cervical vertebra resulting from a fall, causing pressure upon the spinal cord, with partial paralysis of the upper limbs and to a less extent of the lower.

ticity, Babinski phenomenon, and disturbance of bladder and rectal functions.

Hemorrhages into the cord, or hematomyelia, may occur with contusion of the substance of the cord or independently of this as a result of injuries

without an accompanying fracture or dislocation of the vertebra. As a rule, hemorrhages occur into the substance of the cord mostly in the central gray matter, and only very rarely in the outer or inner surface of the dura. The gray matter of the cord seems to be easier to infiltrate than the white matter, and as a consequence any hemorrhage may involve considerable length of the cord. The symptoms will depend largely upon the location of the lesion, whether within the cervical, thoracic, or lumbar parts, and upon its extent. As the hemorrhage involves principally the middle portion of the cord, it will interrupt the fibers concerned with transmission of pain and temperature sensations, and there will result the so-called syringomyelic disturbance of sensation in the lower limbs, *i. e.*, loss of pain and temperature sensations with preservation of touch. Besides, there will be weakness with spasticity, increased reflexes, and the Babinski phenomenon, and, if the hemorrhage involves the cells of the anterior horn, loss of power with atrophy and reaction of degeneration in the related parts.

FIG. 76



Partial dislocation of the second and third cervical vertebra due to injury, showing attitude and rigidity of the head and neck.

If, however, there should be multiple microscopic areas of hemorrhage or softening, no definite symptoms will result, because there has not been sufficient injury to cause disturbance in function unless the injury occurs where marked arteriosclerosis is present, when severe hemorrhages or softening may be brought on any time through the weakening of the vessel walls (Fig. 74).

The Prognosis of Injuries of the Spinal Cord.—This will depend upon the nature and the extent of the injury. If the cord has been severely crushed for several segments, there can be no hope for return of function. If the injury has been partial, some return of power will always result. If a hemorrhage has occurred in the central gray matter, there should be some return of power, and if multiple microscopic areas of hemorrhage or softening, complete recovery may ensue. In all these instances the prognosis depends entirely upon the possible regeneration of fibers in the spinal cord, and this has been the subject of controversy for a long time. It is probable that this cannot occur, and improvement results because the fibers which have been injured have recovered from whatever traumatism they had been subjected to. In every injury there is a certain amount of shock which will tem-

porarily injure the cord but, unless a complete severance or myelitis ensued, there should nearly always be some return of function.

Spina Bifida.—A defect in the closure of the posterior vertebral arches, especially in the lumbar and the sacral region. It is of embryonal origin and is usually detected at birth or very soon after, and, rarely, may interfere with it. The defect may consist only in a lack of union of the posterior vertebral arches, but, as a rule, there is a tumor-like projection in the lower spine which may consist only in a protrusion of the dura, and which may be from the size of a nut to that of an orange or larger and be filled with cerebrospinal fluid; or there may be in connection with the dural protrusion an involvement of the spinal cord itself, consisting either in an enlargement of the central canal, a hydromyelia, or attachment of the lumbosacral cord or its roots to the walls of the sac.

Symptoms.—Most cases of spina bifida die either at or soon after birth. When there is only a dural involvement, there may be no symptoms except the physical evidences of the protrusion. Pressure, however, upon the sac will cause bulging of the fontanelles with the symptoms of cerebral compression. If, however, the cord itself be involved, there will be paralysis of both lower limbs and disturbance of bladder and rectal functions and of sensation. The disease is of long duration, the symptoms having a tendency to increase, and the prognosis is not very good. There are frequently in association embryonal defects elsewhere, such as cleft palate or harelip.

Traumatic Neuroses.—Under this head will be discussed the so-called traumatic neurasthenia, hysteria, and hysteroneurasthenia which occur as the result of injuries to any part of the body, especially to the head and back. No matter how trivial the injury or what part of the body has been injured, there may be a certain amount of accompanying shock, and, even in those cases where the injury has produced unconsciousness this may occur afterward. It can be seen, then, that in every case of injury there may be a certain amount of so-called neurasthenia or hysteria, and the repeated examinations by physicians and the constant attention paid to the patient during the process of litigation may tend to increase and cause new symptoms. It is important from the standpoint of the patient to settle the case as soon as possible.

Traumatic Neurasthenia.—This is generally produced by injury to the back or head, or may follow injuries to other portions of the body. It may also be due to such other causes as fright, the result of lightning and other physical or mental shock. It must be remembered that the symptoms of neurasthenia may be entirely in disproportion to the extent of the injury, for sometimes the most trivial cause may produce the greatest number of symptoms, and vice versa. The symptoms of traumatic neurasthenia do not differ from those the result of other conditions. They are subdivided into mental, sensory, motor, and special.

Mental Symptoms.—The patient at the time of the injury may not have any mental shock, may be badly frightened, or be unconscious. Very often the patient who does not suffer the slightest perturbance at

the time of the accident may become the worst neurasthenic, and in nearly all cases the impression of the accident will remain for some time and will be the dominant topic of thought and conversation. To this may be added the fear of having sustained a severe and irreparable injury. In a short time the patient will be chiefly or entirely occupied in thinking of his accident and of his symptoms to the exclusion of every other topic. Because of this he will complain of loss of memory, of inability to attend to details of business, and insomnia, but the greatest trouble will be that every little symptom will be exaggerated. This mental condition may last for some time, especially if litigation is prolonged, but under proper care most cases should get well.

Sensory Symptoms.—Pain along the back is one of the commonest symptoms, especially if the spine has been injured. It is generally described as dull and aching, and sometimes it is located in the lower portion of the back, when it will have the characteristics of lumbago. Any pressure over the painful spots or bending of the body will increase the pain.

Headache is very frequent and is generally in the back of the head and neck, and sometimes radiates into the frontal region. It is usually described as dull and aching with occasional exaggerations. Sometimes the patient will complain of pains of a numb character in the limbs, and often this is accompanied by pain on pressure over all parts of the body.

Motor Symptoms.—Physical weakness is one of the commonest and most constant manifestations of neurasthenia, the patient complaining of exhaustion and of inability to perform repeated muscular efforts. On testing such a patient it will be found that the grip or resistance against movement may be strong at first, but that the patient is easily exhausted. The reflexes will generally be increased, and very often there may be irregular tremors all over the body of a fibrillary or of a coarser character.

Special Symptoms.—Pain in the eyeballs with dimness of vision and inability to read for any length of time is a very common symptom, as is also some diminution in hearing. Loss of appetite, nausea, vomiting, and constipation are also very frequent.

Traumatic Hysteria.—The same causes which are productive of neurasthenia will also produce hysteria. While neurasthenia is considered as being due to an alteration of function produced by fatigue or exhaustion, hysteria is probably more the result of a cerebral disturbance because the symptoms of it are such as may result from cerebral lesions. It is probable that the two conditions are identical, and that in hysteria we have the severest form of the affection. The symptoms may be subdivided similarly to those of neurasthenia.

Mental Symptoms.—What has been said of the mental symptoms occurring in traumatic neurasthenia will also answer for those of traumatic hysteria, only in hysteria the patient is much more impressionable and the symptoms are generally more marked and numerous.

Sensory Symptoms.—Here, as in neurasthenia, backache and headache and diffuse pains in all parts of the body are very common. It is not unusual to find that the patient has diminution or loss of sensation for

touch, pain, and temperature over a part of a limb, a whole limb, or one-half of the body, and sometimes of all parts of the body.

Instead of diminution of sensation there may be a hyperesthesia. This is generally over certain spots, as over the back of the head, neck, and spine, and in the inframammary, ovarian, and inguinal regions and sometimes over the limbs.

Motor Symptoms.—Here, as in neurasthenia, the dominant symptom will be that of fatigue and easy exhaustion with muscular tremors and increase of the tendon and skin reflexes. Besides, there may be paralysis, which may involve a part of a limb, a whole limb, or a half of the body, giving the symptoms of a monoplegia, a hemiplegia, and more commonly still there may be a paralysis of both lower limbs simulating paraplegia. It is important to diagnosticate these from organic lesions. We may have in hysteria the usual mental and sensory symptoms, but it must be recalled that these may also accompany an organic lesion; the differential diagnosis must be made upon the onset, character, and symptoms of the paralysis. It will be found that the onset is more or less sudden and not commensurate with the extent of the injury, that the paralysis is not complete, and that when the patient is taken off guard considerable power may be manifested. Again, while there always will be a general increase of tendon reflexes and sometimes an ankle clonus, the Babinski reflex never occurs in hysteria. Besides, the patient is always amenable to suggestion, and even an increase in the paralysis may be brought about.

Contractures may sometimes result in a limb, either accompanying an hysterical paralysis or without this. The contractures are usually not of the regular type, and, if general anesthesia is induced, complete flaccidity will result.

Tremors are not unusual and occur in various portions of the body or only in one limb, when they may be of the most violent character and usually out of proportion to the injury, and are accompanied by the usual hysterical symptoms. Sometimes convulsions may result. These may be partial or general and may resemble closely an epileptic attack. A differential diagnosis, however, can always readily be made by the fact that in hysteria there will not be the history of attacks occurring in childhood, there will be no aura or preliminary cry, the patient will never hurt himself, and there will be no biting of the tongue or voiding of urine. Besides, the movements will not have the regular clonic-tonic succession, they being mostly wild and irregular, and most important of all, unconsciousness will not result. Attacks may be brought about by any emotion, and are generally prolonged for a number of minutes and sometimes for hours.

Special Symptoms.—Pain in the eyeballs and visual irritability and fatigue when reading are very common symptoms. Sometimes to this are added such irritative phenomena as flashes of light and spots of various kinds which appear in the field of vision. In grave cases there may be diminution in the fields of vision of one or both eyes which may or may not be homonymous, and at times there may be complete hemianopsia and reversion of the color fields.

Diminution, loss or hyperacuity of hearing sometimes occurs. There may also be perversion in taste and smell or loss of these senses. Disturbances in gastric, bladder, and rectal functions are not infrequent symptoms.

Traumatic Hysteroneurasthenia.—In the majority of cases the symptoms both of hysteria and neurasthenia occur, and only very rarely do we have either condition alone. It will not be necessary to give the symptoms of hysteroneurasthenia, as these have already been sufficiently discussed.

DISEASES OF THE PERIPHERAL NERVES.

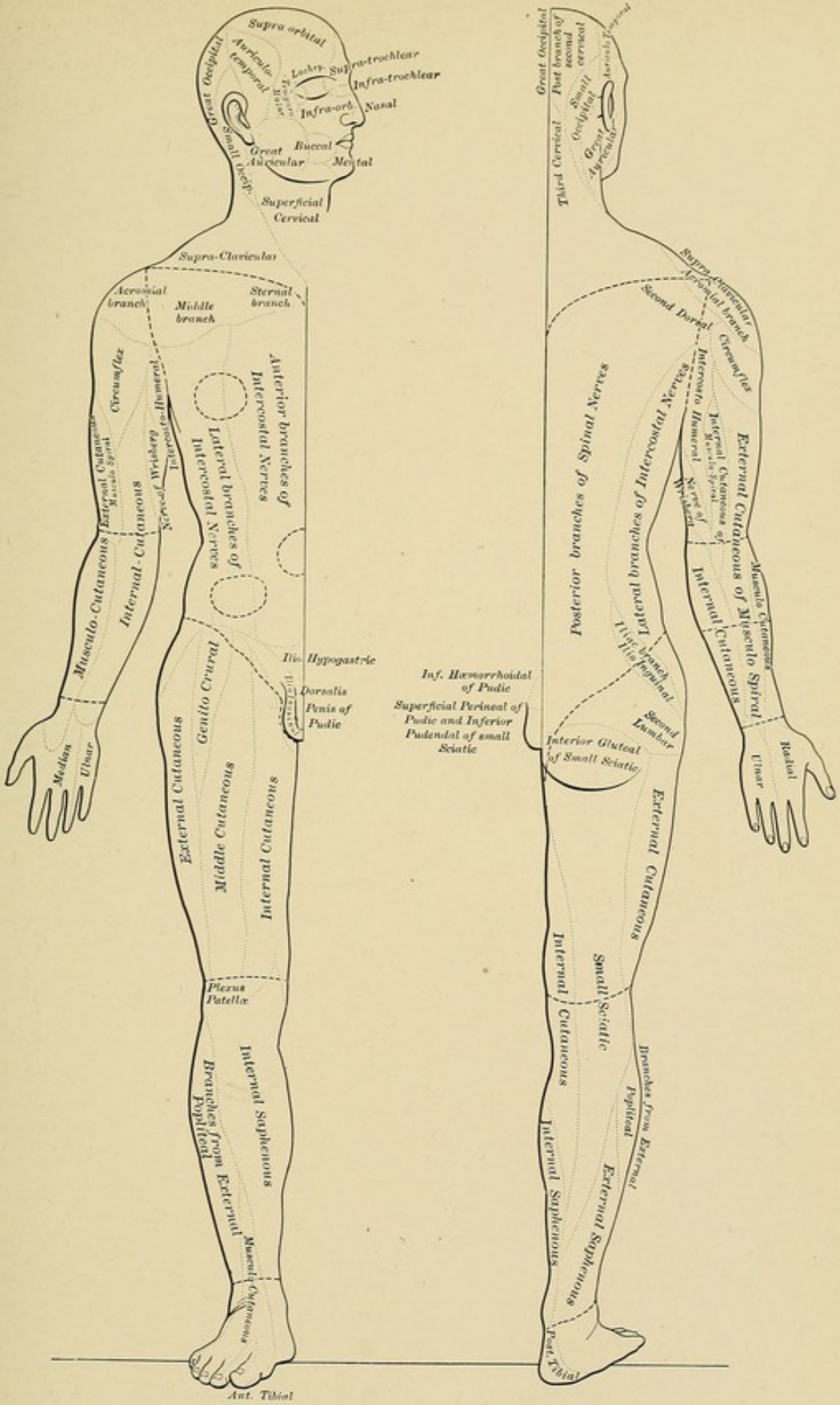
Only those nerves which are commonly injured or diseased will be considered. Any motor or sensory nerve may be inflamed, constituting neuritis. By neuralgia is meant an inflammation of a sensory nerve only, whether this be peripheral or cranial. There are many causes for neuritis and neuralgia, many of these being constitutional disturbances, local causes, contusions, and injuries; but a large number of diseases of the nerves come on apparently without any cause, at least no cause can be found by the microscope, and are thought to be functional in origin.

Every peripheral nerve consists of an axis cylinder, of an enveloping substance called myelin, and of a sheath which surrounds the myelin substance called the neurilemma. The nerves in the brain and spinal cord do not have this sheath, and those of the sympathetic system also do not contain it nor are they surrounded by myelin substance. Regeneration will occur in every peripheral nerve.

Inasmuch as the function of every peripheral and cranial nerve is concerned either with motion, sensation, or with both, the symptoms must depend upon what nerve is diseased. If a motor nerve, there will be paralysis; if sensory, disturbance of sensation, this being manifested by numbness, a tingling feeling, or pin and needle sensation or by pain, and, if the nerve is destroyed, by anesthesia. As most nerves are both motor and sensory there will be both paralysis and disturbance of sensation. There will, besides, be such trophic phenomena as disturbance in skin secretions, with either excess or absence of sweating, drying of the skin and nails, and falling out of the hair. If a motor nerve is diseased there will also be electrical reactions of degeneration and loss of reflexes.

Reactions of Degeneration.—A normal nerve or muscle will respond to any form of electrical stimulation. If it is diseased, it will not respond to a faradic current, but will give an increased and prompt response to a galvanic current, and the reaction obtained will be slow and sinuous in contrast to the quick and prompt response obtained when a nerve is normal. The usual method of testing is to apply first a slowly interrupted faradic current to the corresponding normal nerve, and then try the same current on the diseased nerve. If a nerve is completely diseased or severed, no reaction will be obtained to the faradic current. The galvanic current is then tried, and a minimum current applied to the diseased

PLATE IX



The Distribution of Sensory Nerves in the Skin. (After Flower.)

The areas of the skin supplied by the cutaneous nerves are shown in finely dotted outline. The circles on the trunk show areas occasionally anæsthetic in hysteria. The lines across the limbs at ankle, knee and thigh, wrist, elbow and shoulder show the upper limits of anæsthesia in multiple neuritis of varying degrees of severity.

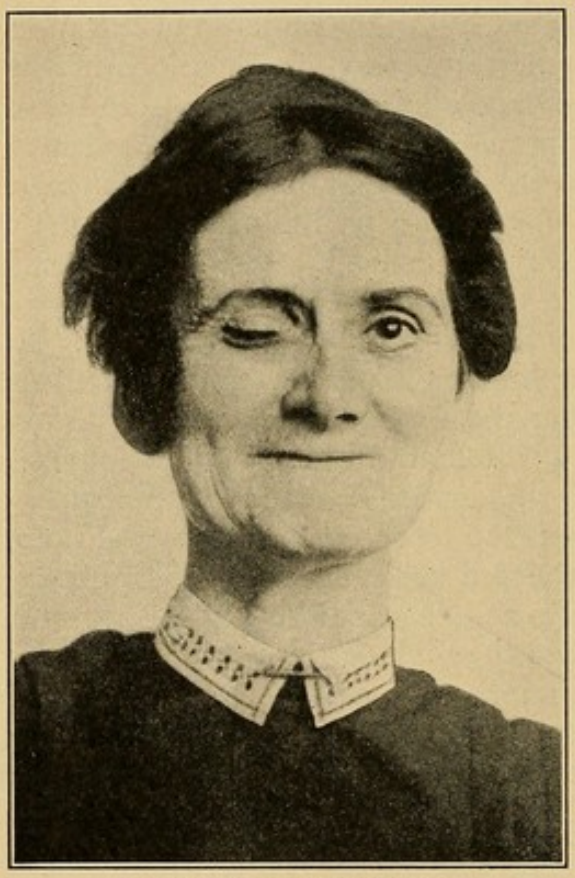
nerve first, when the response will be slow and sinuous. The same current applied to the healthy nerve will not cause any reaction, and to obtain a response it will be necessary to increase the current to such an extent that it will be painful. Reactions of degeneration are not obtained until about one or two weeks after the severance of the nerve, and tests for them should never be made as long as a nerve is inflamed or there is pain on pressure. The presence of these reactions makes the prognosis grave.

Diseases of the Cranial Nerves.—Tic Douloureux.—Painful paroxysms of the fifth nerve are due to many causes, but in the majority of instances no ascertainable factor can be found. Repeated examinations of the Gasserian ganglia have demonstrated occasionally diseases of the nerve cells, but this is not constant and the real cause is not known. Rarely eyestrain, antrum disease, or dental irritation may cause pains in part of the distribution of the fifth nerve, but in a well-marked case of tic douloureux the cause is nearly always undefined. The disease may involve at first or be always limited to one branch of the fifth nerve, usually to the supra-orbital, when it is termed *supra-orbital neuralgia*. As a rule, it begins with an occasional numbness in one of the divisions, this becoming more frequent and severe, the onset of the disease lasting sometimes over a number of years, to be followed by pain which involves two and lastly all the branches. If the disease is limited to the supra-orbital nerve, pain will be marked over the forehead and brow and there will be pain in the eye and sometimes a sensation of a foreign body. Occasionally the pains will be so sharp as to cause closure of the eye with flow of tears. Inflammation limited to the middle or infra-orbital nerve, *infra-orbital neuralgia*, will cause numbness or pain in the upper jaw, palate, and upper teeth, and sometimes in the tongue. If the disease is limited to the inferior branch, the pain will be in the lower jaw, teeth, and tongue, it being aggravated by eating or talking. There will, besides, be pain on pressure over the nerves at their exits. If the disease involves all parts of the fifth nerve, the pain will come on spasmodically and cause the most excruciating pains over the whole side of the face, and contractions or spasms of the muscles. Accompanying this there may be flow of tears and pain on pressure over the exits of the nerve. At such times any irritation, no matter how slight, as talking or eating, will bring on a fresh attack, and there may also be hyperesthesia in the distribution of the trigeminus.

The prognosis in a well-marked case is poor, inasmuch as operative procedure offers the only relief. In such case, whether the Gasserian ganglion be excised or the sensory root cut, relief of pain will be obtained and there will be anesthesia in the distribution of the fifth nerve. It is important to remember that while superficial sensation or the sensation for touch, pain, and temperature is lost, deep sensibility is retained, because of the fact that this sense is transmitted by the deep or muscular nerves, and not by the fifth nerve. It is because of this that very often a mistake is made in believing that the fifth nerve has not been cut, when, as a matter of fact, careful test will demonstrate that superficial sensation is lost, and it is only deep pressure that is appreciated.

Facial Tic and Spasm.—Until recently no differentiation was made between spasm and tic. By tic is meant a movement or movements which are more or less under the control of the will and result from some emotional or functional cause, duplicating or resembling voluntary movements. In whatever part tic takes place the muscular action is complete, as, for instance, in facial tic the contraction is in the whole facial distribution, its occurrence not interfering with the use of the same musculature for other purposes, as eating and talking. The movements are quick, intermittent, have a tendency to become chronic, and cease during sleep. On the contrary, by spasm is meant a movement which is not at all under the control of the will, and which cannot be voluntarily duplicated. Contraction usually involves, at first, part, and later all, of a functionally acting group of muscles, and interferes with their use, as, for instance, in facial spasm, the contraction may be limited first to a part and later involve all the facial distribution. The movement does not resemble a voluntary action and interferes with eating and talking.

Fig. 77



Spasm of right facial nerve.

The causes of spasms and tics are not known, but it is probable that they are functional in origin. Rarely a spasm of the facial nerve may be caused by an intracranial tumor pressing upon the facial nerve just at its exit in the cerebellopontile angle.

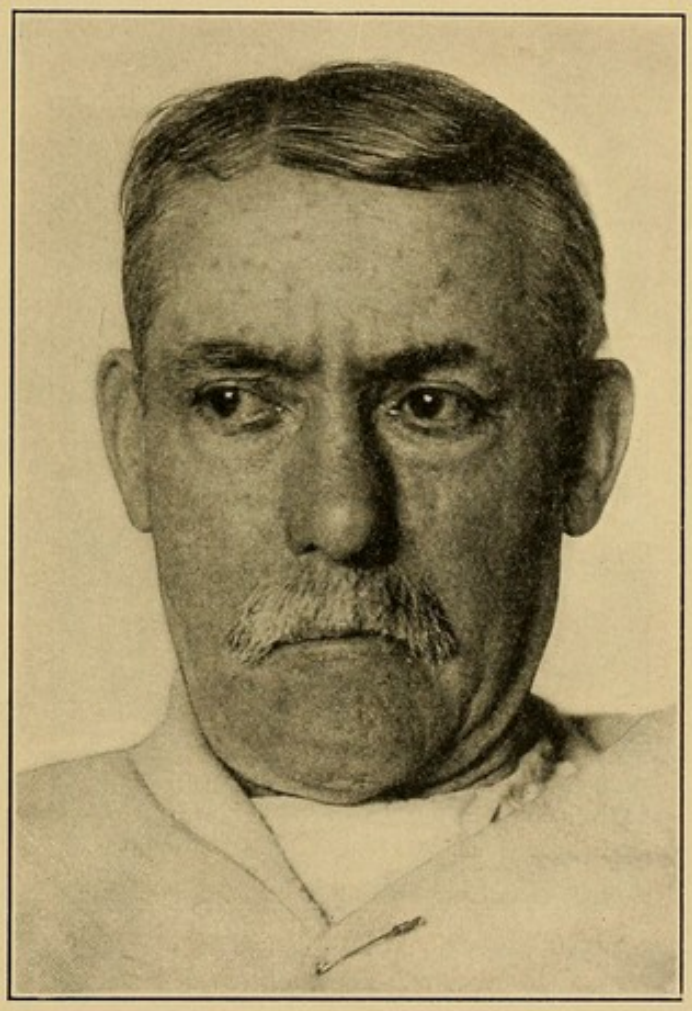
Facial Palsy.—The facial, or seventh, nerve supplies the muscles of the face. Its nucleus is in the lower and posterior portions of the pons, and the nerve in its course outward surrounds the nucleus of the sixth nerve. Its exit is just between the pons and medulla. Because of this anatomical relation, any gross lesion involving the seventh nucleus will nearly always involve the sixth, and vice versa. The usual form of facial palsy is that known as peripheral, or *Bell's, palsy.* Lesions causing this may be either in the pons, at the exit of the nerve, at the base of the brain, in the Fallopian canal, or in its extracranial course

Central facial palsy (Fig. 78) is that form of facial paralysis in which the lower part of the face only is paralyzed and is the result of a lesion in any portion of the central facial fibers between the facial centres in the cortex and its nucleus in the pons, as, for instance, in a capsular hemiplegia.

The reason for the escape of the upper portion of the face in such paralysis is that wrinkling the brow, in common with other bilateral functions, such as chewing, eating, and swallowing, has bilateral cortical innervation, and to cause paralysis of such functions there must be bilateral cerebral lesions.

In a large majority of cases ordinary *peripheral facial palsy* is the result of a neuritis which may be of rheumatic origin or may follow a "cold." Rarely it is due to basal syphilis, tumors, fractures, etc. When resulting from a lesion in the pons, facial paralysis is generally accom-

FIG. 78



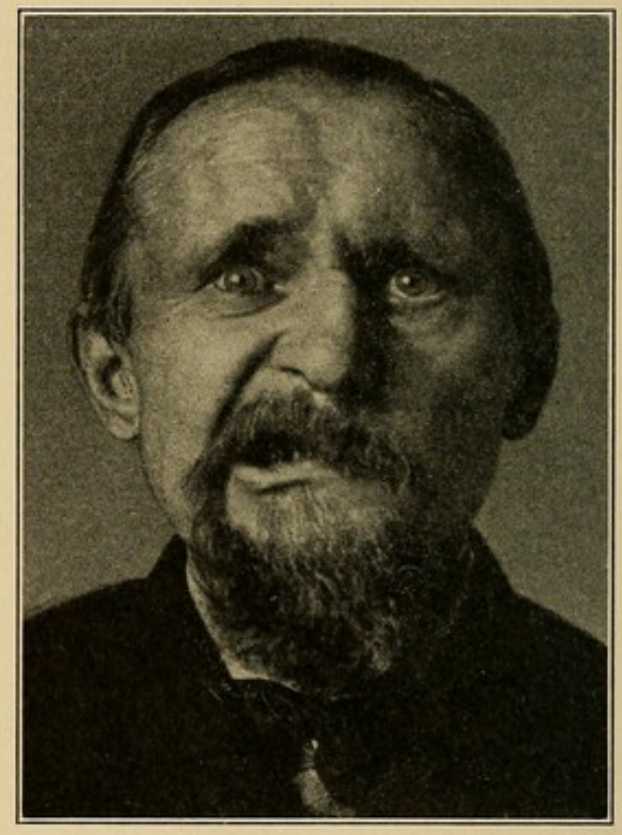
Right central facial palsy in hemiplegia, showing drooping of the right corner of the mouth. There is preservation of the movements of the brow.

panied by other symptoms, such as palsy of the sixth nerve, paralysis of associated ocular movement, or hemiplegia upon the other side. Abscess of the middle ear is a common cause as well as mastoid operations. When the lesion is in the Fallopian canal we have in addition to the usual symptoms temporary disturbance of taste in the anterior two-thirds of the tongue because of involvement of the chorda tympani which runs along with the seventh nerve in the Fallopian canal (Fig. 79).

The symptoms of peripheral paralysis of the facial nerve depend upon the degree of its involvement. When the paralysis is total there is

inability to wrinkle the brow, to shut the eye, to elevate the corner of the mouth, to whistle, or to pronounce labials properly. Besides, there will be drooping of the lower lid and of the corner of the mouth, and the wrinkles on each side of the face will be smoothed out. Because of the drooping of the lower lid there will be widening of the palpebral fissure and excessive flow of tears because of the lack of proper conduction into the nasal cavity. Electrical reactions of degeneration will be found, their degree depending upon the extent of the neuritis. Sensory disturbances may be present at the onset, when the patient may complain of pain in the face, and there may also rarely be herpetic eruptions in the ear because of involvement of the geniculate ganglion.

FIG. 79

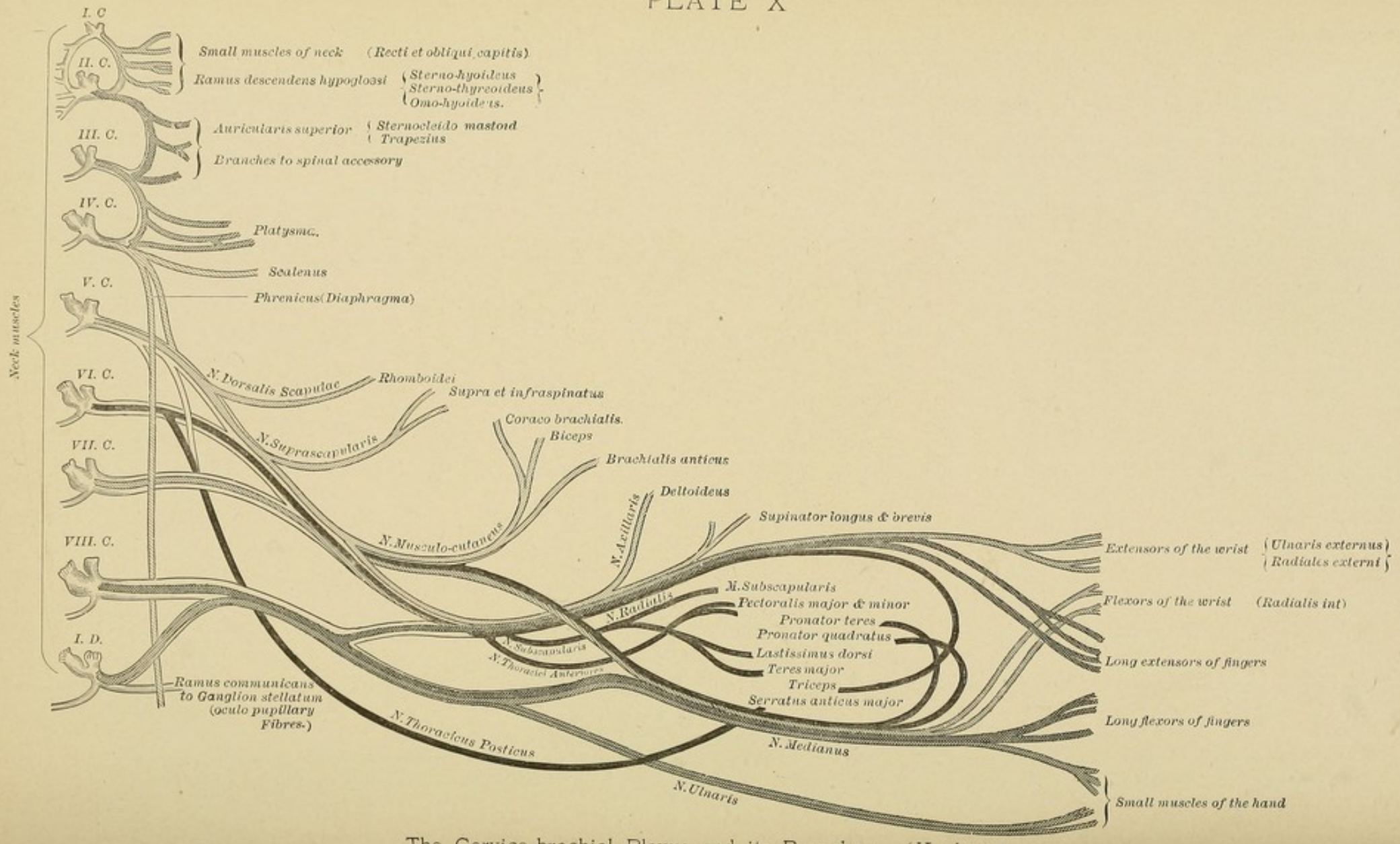


Left peripheral facial palsy, showing inability to wrinkle brow and show teeth on the paralyzed side.

Most cases of peripheral facial paralysis recover, providing the cause is an ordinary neuritis such as results from "colds" or rheumatism and prompt treatment is instituted. In those cases in which the nerve is cut, unless an anastomosis is performed, recovery cannot be expected. Sometimes years after the occurrence of such paralysis there may occur secondary contractures.

Torticollis (Wry Neck).—Inasmuch as the spinal accessory nerve supplies the sternomastoid and trapezius muscles, an irritation of it, such as results from pressure, will cause spasm in its distribution, or torticollis. In most instances, however, the cause is not known. It may come on suddenly as the result of fright, but usually the onset is gradual, the

PLATE X



The Cervico-brachial Plexus and its Branches. (Kocher.)

spasm growing more and more severe, the particular kind depending upon the muscles involved. If the sternomastoid alone is involved, the head is turned to the opposite side, the chin pointing a little upward; if the trapezius, the head is retracted toward the shoulder on the same side, the chin pointing upward; if both the sternomastoid and trapezius, the head is turned to the opposite side, backward, and the chin higher than when either are alone diseased. Very often, in association with the sternomastoid and trapezius muscles, the rotators of the neck, muscles of the shoulder, the rectus capitis, and splenius muscles of one or both sides partake in the spasm, and the movements are complicated. When the rotators alone are involved, the head is turned toward the same side, the chin being on a straight line; when the splenius, the head is retracted, the chin upward, differing from the action of the trapezius in the fact that in the latter the head is retracted toward the shoulder. When both sternomastoids are involved the head will be drawn forward, and if the movements are clonic there will result so-called nodding, or salutatory, spasms, which are especially common in children. The spasms may be tonic, when it is difficult to return the head to its original position, or clonic, the movements being intermittent. Ordinary stiff neck, or rheumatic torticollis, hardly enters into the discussion. The course of the disease, as a rule, is long and the prognosis not very good. It is best in those cases in which treatment is instituted early and in which absolute control of the patient can be obtained.

DISEASES OF THE CERVICAL NERVES.

Cervical, or Occipital, Neuralgia.—The first four cervical nerves are sometimes diseased alone or in association with the cervical nerves which enter into the brachial plexus. When they alone are diseased and the posterior primary divisions are involved, there will be pain along the distribution of the great, third, and small occipital and the auricularis magnus nerves, and the pain will be very marked in the back of the neck and scalp up as far as the vertex. Besides, there will be pain on pressure over this part and especially over the exits of these nerves. The pains may be constant or may come on spasmodically and be so intense as to prevent the patient from moving the head and neck. Occasionally there may be dropping out of the hair from the affected scalp.

Brachial Neuritis.—The brachial plexus is composed of the fifth, sixth, seventh, and eighth cervical and the first thoracic roots, and supplies motion and sensation to the upper limb. A neuritis may involve all of the branches of the plexus or be limited to its parts, especially the fifth and sixth cervical or the seventh and eighth cervical and the first thoracic roots or their continuations. There may be in association with this an involvement of the first four cervical nerves, when it is called a cervicobrachial neuritis. If the whole brachial plexus is affected, the symptoms will depend largely upon the severity of the disease. There will be pain in the shoulder and the axilla, this radiating along the whole arm, and

pain on pressure over the nerve trunks. In fact, there will be pain over the whole upper limb, and any movement or pressure will aggravate it. In association with this neuritis there is always paralysis either of a whole or of a part of the upper limb.

If the upper cords of the brachial plexus, *i. e.*, the fifth and sixth cervical roots, are diseased, the pain will be limited to the neck, shoulder and to the arm as far as the elbow, there being pain on pressure over these parts; if to the lower part of the brachial plexus, *i. e.*, the seventh and eighth cervical and first thoracic roots, or their continuations, the pain will be limited to the forearm and muscles of the hand. In association with both these types of neuritis there will be more or less paralysis in the same parts.

Brachial Neuralgia.—The difference between brachial neuritis and neuralgia is that in the latter the pains are spasmodic in character, there is pain on pressure over the nerve trunks and the arm only at the time of the pains, and there will not be an accompanying paralysis.

Brachial Palsy.—Paralysis of the brachial plexus may be total or partial, unilateral or bilateral. If total, the arm hangs limp by the side, no movements being possible; the muscles are atrophic, electrical reactions of degeneration are obtained, and atrophic phenomena are present. Partial brachial paralysis may be either of the upper plexus type, the so-called Duchenne-Erb form, in which the fifth and sixth cervical roots or the fibers in the plexus coming from these roots are involved, or the Klumpke, or lower plexus, type, in which the eighth cervical and the first dorsal roots are diseased.

In the upper plexus form the deltoid, triceps, brachialis anticus, the supinator longus and brevis, and the infraspinatus muscles are affected. It is impossible to adduct the arm and the forearm is extended and pronated. Sensation, as a rule, is not disturbed. The muscles are atrophic, and there may be reactions of degeneration. In the Klumpke paralysis the small muscles of the hand and a number of muscles of the forearm, especially the flexors, are paralyzed. Sensory disturbances are common in the hand and forearm, especially in the ulnar distribution.

These different types of brachial plexus paralysis are mostly traumatic in origin, and may be due to blows, gunshot or stab wounds, fracture of the head of the humerus, dislocation of the shoulder, and tumors. The so-called obstetrical and most narcosis paralyses are included in the upper arm type. The disease may also occur idiopathically, the cause probably being toxic.

Involvement of the Sympathetic System. Ocular Symptoms.—Oculopupillary symptoms, consisting in a narrowing of the pupil and of the palpebral fissure, can occur only if the first dorsal roots are involved either in the intervertebral foramen or before their separation from the rami communicantes. Therefore, in the lower arm type of paralysis, in which the eighth cervical and the first dorsal roots are diseased, we always have oculopupillary symptoms. It is possible, however, to have this type of paralysis without sympathetic involvement, if the fibers in the brachial plexus, coming from these roots and not the roots them-

selves, are diseased. It is difficult, however, to make such a clinical differential diagnosis because the symptoms are identical, but we can always assume that if the oculopupillary symptoms are present the first dorsal root is diseased.

In the Duchenne-Erb type of paralysis, due to a birth palsy, or the paralysis occurring in the course of etherization, the traction upon the arms may cause an abnormal stretching and tearing of the rami communicantes of the first dorsal root, thus causing sympathetic paralysis without the first dorsal root itself being diseased.

If all of the roots of the brachial plexus are diseased we may have oculopupillary symptoms. As a result of gunshot or stab wounds we may have forms of paralysis which do not conform to any of the known types with sympathetic symptoms. In these cases either the first dorsal roots are involved or the oculopupillary fibers in the cervical sympathetic are injured.

Paralysis of the Circumflex Nerve.—This results from dislocations and injuries to the shoulder, and produces paralysis of the deltoid muscle with accompanying atrophy and inability to adduct the arm. If there is a neuritis, there will be pain on pressure over the shoulder and disturbance of sensation.

Paralysis of the Long or Posterior Thoracic.—This results sometimes from lifting heavy weights or injuries and dislocations to the shoulder, and causes paralysis of the serratus magnus muscle. The lower edge of the scapula, to which the serratus magnus is attached, will be moved nearer the spine and become very prominent and there will be inability to lift up the arm more than to the horizontal plane. There may be pain on pressure over the scapula and neck and disturbance of sensation.

Musculospiral Palsy.—This nerve is very frequently injured or diseased because of its exposed position around the humerus. It generally is found affected after a debauch, the patient, while intoxicated, lying on his arm, thus causing pressure and paralysis. It is sometimes called "Saturday night" palsy. There is wrist drop with inability to extend the fingers, and pain on pressure over the nerve, with disturbance of sensation over the extensor surface of the arm.

Median Nerve Palsy.—Median nerve palsy is generally due to injuries. This nerve supplies all the flexors of the fingers, the flexor carpi radialis and the pronator radii teres, and its paralysis causes inability to flex the fingers or abduct or adduct the thumb or to pronate the forearm. There may be pain on pressure over the nerve and some sensory disturbances over the palm of the hand, to be followed later by atrophy in the involved muscles.

Ulnar Palsy.—This is usually produced by direct injury to the nerve. It supplies the flexor carpi ulnaris, the ulnar half of the flexor profundus digitorum, the muscles of the hypothenar eminence, the interossei, the inner three lumbricales, the adductor pollicis, and the flexor brevis pollicis. In ulnar paralysis there is disturbance of flexion of the hand and of the last three fingers, inability to flex the proximal and extend the terminal phalanges of the fingers. This is especially marked in

the last two fingers, and there is also some weakness in adduction of the thumb, this disturbance causing the so-called "claw hand," it being more marked later when there is atrophy in the involved muscles. Sensory disturbances are not frequent, and, when present, are limited to the flexor and extensor surfaces of the last two or three fingers.

DISEASES OF THE THORACIC NERVES.

Intercostal Neuralgia.—This may be due to a variety of causes, the symptoms, as a rule, being unilateral. There is spasmodic pain around the chest of a sharp, shooting character, tenderness over the nerve and over the foramina, and sometimes an herpetic eruption.

DISEASES OF THE LUMBAR AND SACRAL NERVES.

Only very rarely are the plexuses of these nerves diseased either independently or together. The most frequent nerves to be affected are the sciatic and the external popliteal and its divisions.

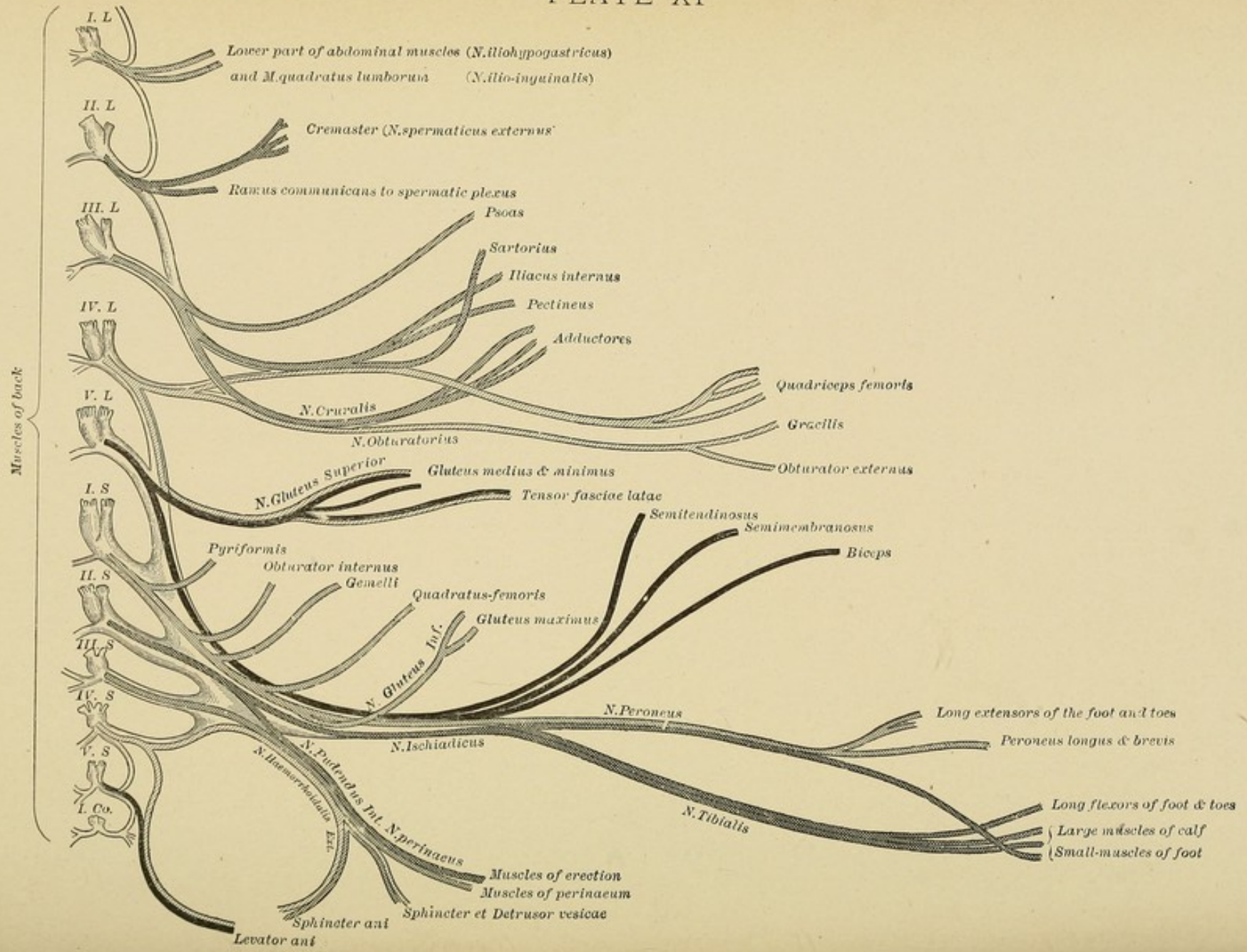
Sciatica.—This may be due to a variety of causes. If there is neuritis, it is generally rheumatic in origin and there is constant pain on pressure over the whole extent of the nerve along the back of the thigh and leg as far as the ankle, pain on pressure over the nerve trunk, also pain when the thigh is extended on the abdomen, causing stretching of the nerve. Because of the pain the patient in walking will bend to the opposite side, and sometimes a scoliosis will result in an effort to save the diseased leg. There will also be loss of the Achilles jerk. Occasionally there is paralysis of the muscles below the knee.

Paralysis of the External Popliteal Nerve.—This is mostly due to direct injury. The nerve has two divisions, the peroneal and the anterior tibial. If both are involved, there will be foot drop with inability to dorsally flex the toes or foot or to deviate the foot outward. If the peroneal nerve is involved alone, there will be foot drop, with inability to deviate the foot outward, but slight dorsal flexion of the large toe will be possible. If the anterior tibial nerve is diseased, it will be impossible to dorsally flex the large or any of the toes, but deviation of the foot outward will be possible.

Tumors of the Nerves.—These are of rare occurrence and are generally fibromata, but sarcoma, angioma, or any of the other usual forms may occur. The tumor may develop within or upon a nerve sheath. The amputation fibroneuroma is the best example of a true nervous tumor; it is possible that pure neuromata do not exist.

Fibroma may sometimes grow upon one nerve, or may rarely involve all the nerves of the body, even the cranial nerves, constituting Recklinghausen's disease.

PLATE XI



The Lumbosacral Plexus and its Branches. (Kocher.)

CHAPTER XII.

THE HEAD, FACE, AND NECK.

THE HEAD.

The diagnosis of surgical affections of the skull and its teguments and accessory cavities is considered under this heading. The surgical affections of the brain and its envelopes, except those which are traumatic and acutely infective, are discussed under affections of the nervous system.

The diagnosis of traumatic lesions of the cranium and its teguments is important mainly only so far as it concerns the presence or absence of injury to the brain or its vessels and nerves.

Contusion.—Head injuries of this nature may be superficial, in which case the scalp and periosteum alone are involved; or deep, producing fractures of the bone and lesions of the brain and its meninges. The brain may exhibit lesions even though the skull has not been fractured, the resiliency of the bony case being sufficient to enable it to withstand a trauma which, by suddenly driving in a part of its walls, bruises or lacerates the brain substance.

Contusions of the scalp are characterized by rapid swelling incident to the free bleeding which is dependent upon the vascularity of the part and the looseness of the tissue texture. This bleeding commonly takes place in the subcutaneous tissue. It then forms a hard, discolored, circumscribed tumor, movable with the scalp.

The vessels torn may lie beneath the aponeurosis of the occipito-frontalis muscle or beneath the periosteum. In the former case the swelling is less sharply defined, and in both instances readily pits in the centre, and does not move with the aponeurosis. It may present around a soft, depressible centre, caused by the impact of a blow, a ring of almost bony hardness, due to coagulated fibrin. To the examining finger the sensation is so like that characteristic of a depressed fracture of the skull that the scalp has often been incised and raised before a correct diagnosis could be made. It is usually possible to form a non-operative differential diagnosis by making firm rubbing pressure continued for several minutes over a part of what is apparently the bony wall of the depressed fracture. As the edema and coagulated blood are gradually pressed aside, the smooth, unbroken surface of the skull can be felt.

Contusions of the scalp in the frontal region are commonly followed by swelling and ecchymosis of both eyelids from gravitation of the blood. When a comparatively large vessel has been torn a pulsating tumor may be formed, or, when free bleeding occurs beneath the aponeurosis, there

may be a fluid accumulation which can be pressed from the occipital to the frontal and temporal regions.

From infection of these effusions abscesses or cellulitis may develop. Usually they undergo prompt resolution; exceptionally they persist as fluctuating tumors, or when they are subperiosteal, they may be followed by bony outgrowth sequent to bone contusion; headache, neuralgia, and epilepsy are recorded.

Depending upon the position and extent of the lesions due to contusion of the brain, this condition is manifested by the symptoms of concussion, of focal irritation, or of compression.

Concussion.—Concussion is, doubtless, a bruising, even though the force be of such slight degree as to produce no demonstrable lesions; in its severer forms the gross lesions may be at the point of impact, opposite to this, or in any part of the brain, but particularly at the tips of the temporal lobes and the base of the frontal lobe.

Concussion may be slight, moderate, or severe. Slight concussion is characterized by a momentary confusion, or insensibility, attended with muscular relaxation, pallor, and a feeble pulse. Nausea and vomiting often accompany return to consciousness. The symptoms are similar to those of fainting from emotional causes.

Moderate concussion is characterized by complete loss of consciousness, pallor, shallow respiration, feeble, often irregular pulse, muscular relaxation. The face is calm, the eyelids closed, the pupils dilated and even. There may be an evacuation of feces and urine. In a few minutes, or within the hour, consciousness is regained, there is some nausea and vomiting, and, after a varying period of muscular weakness and mental irritability and confusion, there is left only a dull headache. The mental impressions immediately preceding the concussion are often abolished.

Severe concussion is characterized by slow and incomplete reaction from the symptoms of moderate concussion. It may terminate fatally. The primal insensibility is followed by a condition of stupor. The first incontinence of urine and feces is followed by retention, with overflow and constipation. The patient often lies on his side with flexed limbs in a condition of hebetude from which he can be momentarily aroused; at times a condition of cerebral irritability develops, characterized by peevishness, restlessness, and active delirium. Gradually consciousness is regained, but clear mind and efficient memory come slowly. The temperature is often subnormal.

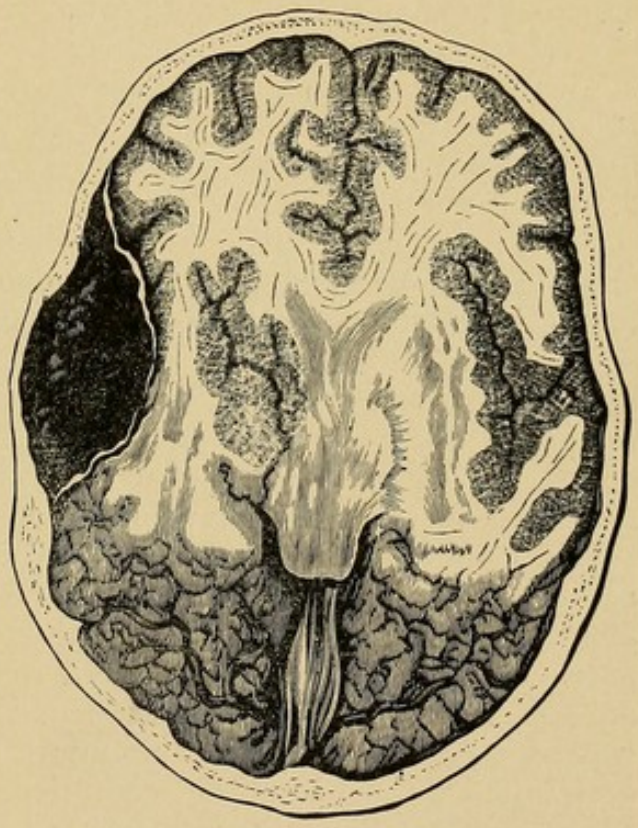
Focal Irritation.—The intracranial lesions of contusion of the skull, if definitely localized, are most likely to appear in the cortical gray matter and to be superficial. When such lesions are not severe enough to destroy function and produce paralysis, they cause focal irritation. The presence of localized moderate bruising can usually be determined only when such foci are placed in or near the motor centres. Thus localized or unilateral twitchings, convulsions, or paralysis would suggest contusion and bleeding the seat of which would be determined by an application of the general principles of cerebral localization. The

stupor or prolonged irritability following concussion is, in the absence of the general symptoms of increased cerebral pressure, evidence of a focal irritation of the psychical centres.

Compression.—The symptoms of acute cerebral compression are caused by a rapid encroachment upon the space which should be occupied by the brain. When compression is incident to contusion and follows such an injury immediately or within a few hours, the cause of the increased intracranial pressure, if not dependent upon depressed bone, must necessarily be hemorrhage.

Acute traumatic compression of the brain in its full development is characterized by coma, tortuous and dilated retinal veins, slow, snoring respirations, hard, slow, full pulse (compensatory increase in blood pressure), paralysis, subnormal temperature in the shock period, followed usually by slight fever. As death approaches the pulse becomes weak and hurried, the respirations are rhythmically irregular (Cheyne-Stokes), the pupils dilate, and the temperature rapidly rises.

FIG. 80



Compression following hemorrhage from the middle meningeal artery. (Helferich.)

The hemorrhage may be extradural, subdural, or cerebral. Extradural hemorrhage, between the dura and the bone, is commonly due to laceration of the anterior branch of the middle meningeal artery. This injury may occur without fissure or fracture of the bone, and exceptionally from the vessel on the side opposite to that which is directly injured.

The specific symptoms of this lesion are usually masked by those of severe concussion, or of compression from subdural or intracerebral bleeding.

When this is not the case, a person who has been injured by a blow which caused a slight transitory condition of concussion seems entirely recovered from the effect of the violence, except for the slight dulness and muscular weakness which are the invariable sequelæ of a cerebral jar. After a brief interval, usually a few hours, there develops a severe headache which becomes steadily worse, is followed by nausea and vomiting, aphasia if the lesion be on the left side, weakness in the hand and arm then in the leg of the side opposite the lesion, stupor, later twitching and convulsive movement which involve the face, hemiplegia,

increased arterial tension and slow pulse, coma, Cheyne-Stokes breathing, and death. The pupils are at first contracted, then dilated, particularly the one on the affected side. To this rule there are exceptions.

The severe headache is due to the stripping and irritation of the dura by the accumulating clot; the aphasia, unilateral paresis, twitching, and paralysis to the pressure focused over the motor centres; the coma and symptoms of cerebral compression to the general increase of cerebral pressure. Paralysis of the cranial nerves of the affected side may be caused by the extravasated blood reaching the base of the cranium and pressing upon the nerve trunks.

The diagnostic features of extradural hemorrhage following trauma are, then: (1) The presence of a contusion in the temporoparietal region; (2) an interval of freedom from symptoms (hours) followed by violent headache; (3) signs of pressure over the motor centres; (4) symptoms of cerebral compression.

There is no non-operative way of determining the origin of the bleeding. If not from the anterior branch of the middle meningeal artery it is usually from the posterior branch. Neither injury to the sinus nor the other dural vessels, which may be torn by contusion, is likely to cause a hemorrhage which will dissect up the dura and exert an irritating then a paralyzing pressure upon the motor centres before it causes symptoms of general cerebral compression.

The diagnosis of subdural hemorrhage can often be made by lumbar puncture, which withdraws a blood-stained fluid. When pressure symptoms are so great as to threaten life, it should be made by a decompression operation in one or both temporal regions unless the symptoms of focal irritation point to another region.

When, after an injury to the head, it is necessary to distinguish between concussion and compression, it should be borne in mind that concussion resembles syncope, with the insensibility which shortly becomes only partial, relaxation, feeble pulse, and shallow respirations of that condition. The diagnosis of pure concussion without brain lesion can be framed only when a patient promptly and completely recovers from such injury without headache, confusion, irritability or any other sign or symptom suggesting a departure from his usual mental health. Extensive lesions may be accompanied at first by the slightest degree of concussion. Compression in addition to the insensibility is attended, at least in its earlier stages, with a full, hard pulse, a slow, snoring respiration, and often hemiplegia.

Following cerebral hemorrhage, whether this be spontaneous or due to trauma, in the course of from one to three days there is an edema which, if diffuse and sufficiently pronounced to interfere with cerebral circulation, accentuates the symptoms of compression should they have been present; or, in case of localized trauma attended with symptoms of slight concussion, causes mental confusion, delirium, stupor, or the slowed pulse and congested tortuous retinal veins of pronounced compression.

Aside from the complications due to infection, *i. e.*, meningitis,

encephalitis, and abscess, there may follow contusion of the brain either immediately or after a long interval; headache, which may be so severe and persistent as to be crippling; loss of the senses of smell and taste; neurasthenia with its typical inconstancy and multiplicity of symptoms; loss of memory and inability for mental application; impotence, palsies, traumatic epilepsy, insanity.

Birth Injuries of the Head.—The *caput succedaneum*, a rounded, pitting, non-fluctuating, edematous swelling of the soft parts, usually in the occipitoparietal region, has attained its maximum at birth and shortly disappears.

Cephalhematoma, due to subpericranial bleeding and incident to difficult labor, is characterized by the development after birth and often progressive increase in size for several days, of a fluctuating cranial area, sometimes bilateral, irregular in peripheral contour, and corresponding with that of the ossified portion of the underlying bone, usually the parietal. Absorption may be slow (weeks) or the tumor may persist.

Indentation and fracture of the cranial bones, usually accompanied by obvious deformity, is of importance as indicating probable subdural hemorrhage and brain lesion.

Intracranial hemorrhage, usually subdural, is characterized by prominent fontanelles, dilatation of the surface veins and those of the retina, slow or irregular pulse, irregular, at times Cheyne-Stokes, respiration, inability to suckle, twitchings or convulsions.

The absolute diagnosis must be made by exploration.

Fracture of the Skull.—Fractures of the skull are conveniently classed as of the vault and of the base. They may be partial, involving either the external or internal table, or complete, involving the entire thickness of the bone. They may be simple or compound, fissured without displacement, or depressed. Depressed fractures are formed at the seat of impact; fissured fractures commonly extend from this, but may through their entire course be remote from it.

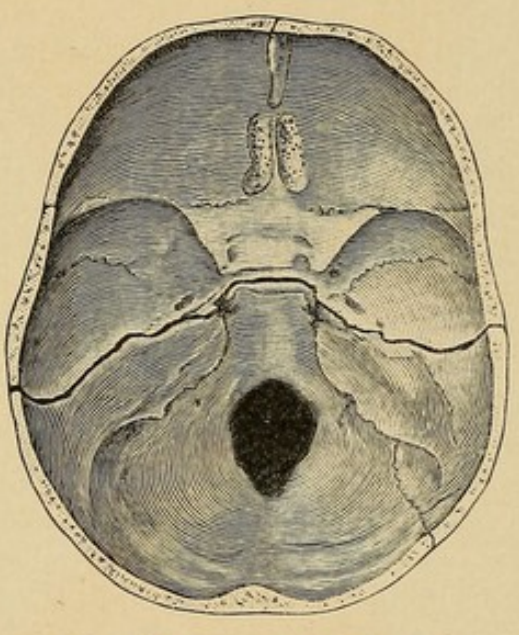
Fractures of the Vault.—When these injuries occur as the result of contusions, they may be positively diagnosticated provided there is depression, crepitus, and a cracked-pot percussion note. This depression must not be mistaken for that sometimes noted in simple contusion of the scalp. The yielding of the broken bone when it is not impacted, the sharp, irregular edge of the depression, and the impossibility of affecting the bony margins of the depression by steady, continuous massage and pressure, are signs peculiar to depressed fracture. Skull deformity incident to previous lesions should not mislead. A fissured fracture of the vault without displacement can, in the absence of a wound, be detected only by exploratory incision or the *x*-rays. It may be suggested by persistent bone tenderness.

When the fracture is compound the area of depression can be both seen and felt. A moderate depression may involve the outer table alone. Over the frontal sinuses a pronounced depression may be present without involving the inner walls of these cavities. This can be determined only by the use of the trephine.

Fissured fractures are manifested by a sharply marked blood-stained line running through the bone. Often there is a distinct edge from slight inward displacement of one fragment. Fracture of the inner table without lesion to the outer may possibly be detected by the *x*-rays; such fractures are much rarer than fractures of the outer table without injury to the inner.

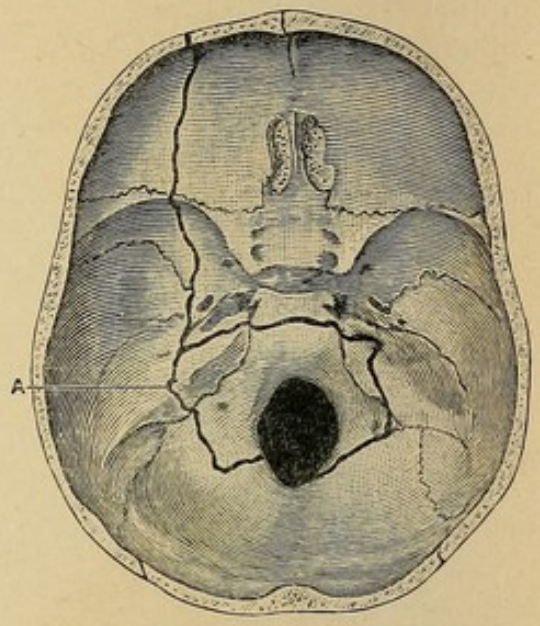
Fractures of the Base.—These are caused by force applied to the vault, by force applied through the spinal column, as from the jamming down of the skull incident to a heavy fall upon the buttocks, or by the direct penetration of a vulnerating body, as a bullet or foil.

FIG. 81



Bursting fracture of the base.
(Von Bergmann.)

FIG. 82



Circular fracture of the base.
(Von Bergmann.)

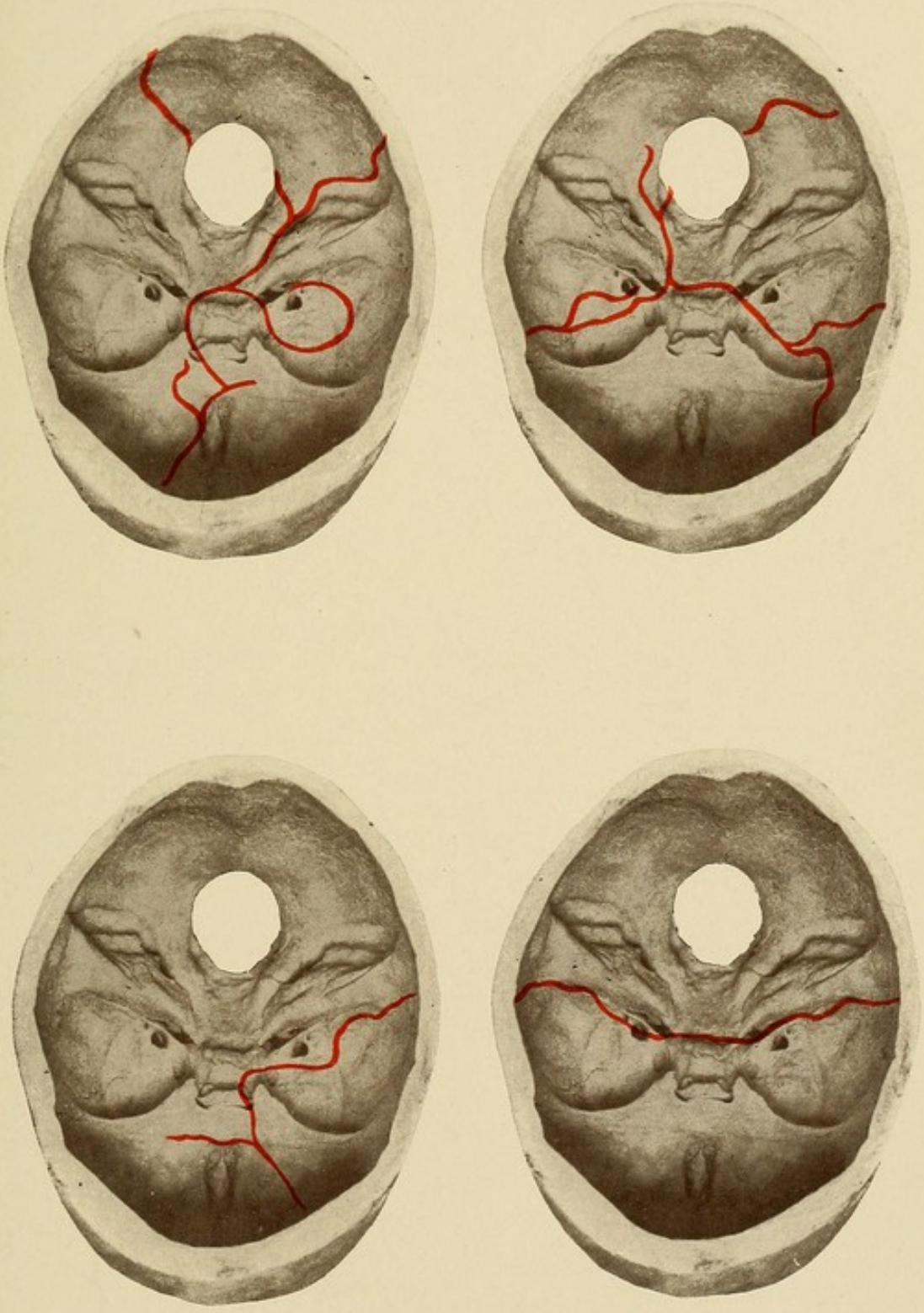
The diagnostic features of fracture of the base of the skull are: Persistent bleeding followed by a flow of cerebrospinal fluid from the nose, mouth, and ears, paralysis of one or more of the cranial nerves, and usually the symptoms of cerebral concussion or compression. All three fossæ are often fractured.

Fractures of the anterior fossa are commonly due to force applied to the front part of the cranial vault. The first characteristic symptom is free persistent bleeding from the nose; the blood may trickle back into the pharynx, and may be followed after some hours by a slow, steady flow of cerebrospinal fluid.

This escape of cerebrospinal fluid from the nose is diagnostic of fracture of the ethmoid or the body of the sphenoid. In the former case there is exceptionally loss of the sense of smell; in the latter there may be partial or complete paralysis of the optic nerve, causing blindness, or of the oculomotor nerves, causing dilatation of the pupil and divergent strabismus.

The bleeding must be distinguished from that due to fracture of the

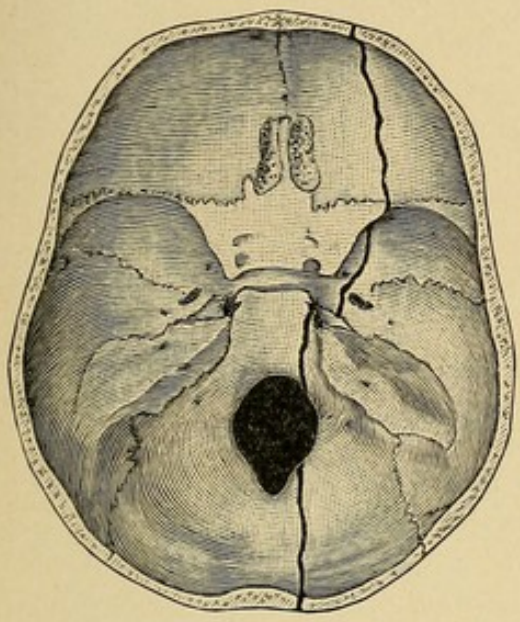
PLATE XII



Fractures of the Base of the Skull. Illustrative lines of fissure or fracture are printed in red. (Park.)

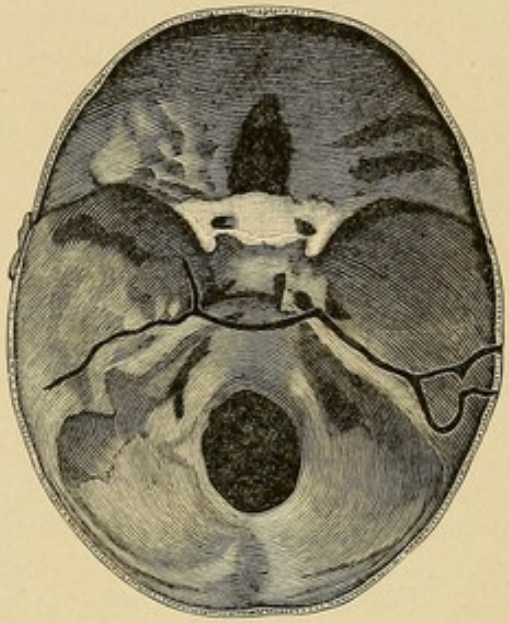
vomer or lesion of the mucous membrane of the nose. In fracture of the nasal bone the force is commonly applied directly to the bridge of the nose; in fracture of the base of the skull the force is applied to the

FIG. 83



Longitudinal fracture of the base. (Von Bergmann.)

FIG. 84

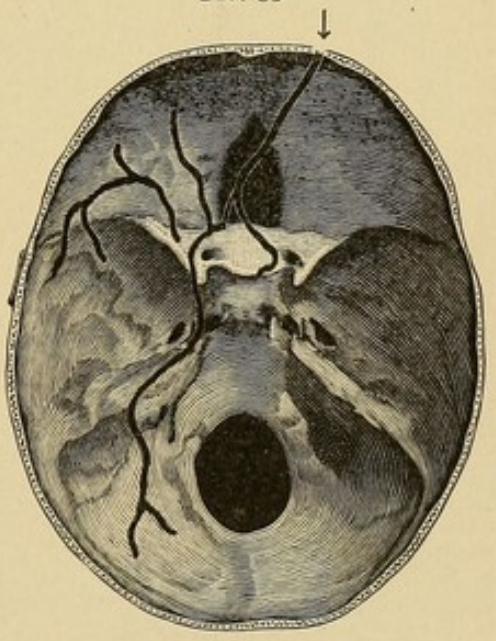


Fracture of base, from fall from scaffolding. Hemorrhage from right ear and nose. Death from meningitis. (Von Bergmann.)

anterior temporal or the frontal region. Fracture of the nasal bones can be detected by direct examination, and sometimes the mucous membrane lesions and the source of bleeding can be seen with the rhinoscope. The bleeding of fracture of the nasal bones is commonly free at first, but is less likely to be persistent and is not followed by a steady, persistent oozing.

When the fracture involves the roof of the orbit, there may develop shortly a projection of the eyeball, and after one or two days subconjunctival ecchymosis followed by palpebral discoloration. The blood lies beneath the ocular conjunctiva and not in its substance, is dark in color, and reaches the lids after it has appeared beneath the ocular conjunctiva. This symptom is not pathognomonic.

FIG. 85



Bursting fracture. Patient slipped, striking head on a stone. Direction of force indicated by arrow. (Von Bergmann.)

Fractures of the middle fossa, commonly due to violence applied to the parietal or the temporal region, is characterized by free, persistent

bleeding from the ear, followed by an oozing of cerebrospinal fluid. There is sometimes facial palsy and deafness. The line of fracture is likely to run in the long axis of the petrous portion of the temporal bone.

When the violence is applied to the occipital region, the fracture is likely to be transverse; and in this case all these symptoms are more marked, especially the flow of cerebrospinal fluid; deafness and facial palsy are more commonly developed.

Fractures involving the apex of the petrous portion of the temporal bone may cause paralysis of the sixth (abducens) nerve, with convergent squint of the affected side. This, a common paralysis, is observed after comparatively slight injuries and may be transitory. Facial palsy is peripheral in type. It may be observed immediately after the injury, in which case it is due to contusion or rupture of the nerve and is often irreparable; it more commonly develops in a few days, and is then due to pressure incident to the congestion of bone repair, and is self-limited.

Free bleeding from the ear is not necessarily a sign of basilar fracture. The blood may come from a fracture involving the external auditory meatus, such injury being usually inflicted by a blow on the point of the chin, which drives the condyles upward and backward; or the blood may come from a ruptured tympanic membrane. In either case examination with an otoscope will show the source of the bleeding. In the latter case the hemorrhage is likely to be slight and soon stops; moreover, it is not followed by the escape of cerebrospinal fluid.

The discharge of the fluid from the ear may be slight, lasting but a few hours, or may be profuse, lasting for a week or more. It is the most constant pathognomonic sign of fracture of the middle fossa.

Fractures of the posterior fossa of the skull, unless compound, present no diagnostic features. The violence causing such injury is applied to the back of the head, as from a fall on the occiput or the base of the skull, or from the jar incident to a fall on the feet or the buttocks. When there has been no direct trauma to this region, ecchymosis above the mastoid and in the back of the neck, developing two or three days after traumatism, would be suggestive of fracture. Effusion of blood and cerebrospinal fluid behind the posterior wall of the pharynx is positively diagnostic when it is practicable to detect it.

Compound fracture of the vault, as well as marked fissured fracture of the base, may be attended with a slight transitory concussion; while fatal contusion of the brain may be caused by a trauma which does not fracture the bones. In itself, fracture of the skull is an injury of minor importance. The need of determining its presence is dependent upon the immediate and remote brain lesions it may cause either by direct pressure or by opening the route to infection.

Traumatic Encephalohydrocele.—In infancy, the softness of the bones allows of great depression without fracture, and this same quality prevents the extension of fissures from the vault to the base. The elasticity of the bones of the vault allows of the infliction of a severe contusion or fracture without any of the deforming incident to the latter.

As a result of such injury or of disjunction of the sutures, traumatic encephalocele or encephalohydrocele may develop. The encephalocele develops immediately. The encephalohydrocele weeks or months after the injury.

The characteristic features of encephalohydrocele are a history of injury to the head of an infant and the formation of a fluctuating pulsatile tumor which becomes tense on expiration and on straining, which is more or less reducible, and which contains cerebrospinal fluid.

Wounds of the Cranium.—Wounds of the cranium may be non-penetrating or penetrating. The diagnosis of non-penetrating wounds of the scalp is obvious. Contused wounds, such as those inflicted by a club, often present the appearance of a clean incision with the exception of a slight line of abrasion along the skin edge. Involvement of the bone is determined by inspection and palpation when the wound is an open one; by probing and enlarging the opening when the scalp is simply punctured.

When such wounds refuse to heal, a discharging sinus persisting at or near the seat of injury, a careful search will nearly always show the presence of dead bone or a foreign body, as a splinter of wood.

Penetrating Wounds of the Cranium.—The diagnosis of penetration may be difficult to establish, as in the case of a blow on the head with the small blade of a penknife, or the thrust of a stick into the orbit or the nose, or through the roof of the mouth. Such wounds are exceptionally followed by a hemorrhage so free as to produce compression, either immediately or within a few hours. Commonly the first sign of penetration is the development of a meningitis or encephalitis (hours, days). Exceptionally there is an interval of weeks or months in which there are no symptoms, followed by the symptoms of brain abscess.

Penetration in case of punctured wounds of the vault is best established by an exploratory operation, the scalp being raised, and, should there still be a doubt, a button of bone being removed. Where punctures of the roof of the orbit are suspected but cannot be verified by the probe a two-inch incision just beneath the superciliary ridge carried down to the bone and deepened by blunt dissection along the surface of the orbital plate will enable the surgeon to determine the presence of a puncture in it. Punctures through the nose or palate, if not followed by immediate cerebral symptoms, and, if their presence cannot be determined by probing, can be suspected only from the nature of the injury and the character of the vulnerating body.

Traumatic prolapse of the brain is characterized by the appearance of brain matter through a fracture, usually of the vault of the skull. There may be escape of brain substance from the orbit or the ear or the nose. The prolapse may occur immediately or may be secondary to the increase of intracranial pressure incident to trauma or infection. It forms a soft, gray, pulsatile, partly reducible tumor. The diagnosis is based on the macroscopic appearance and on microscopic examination.

Fungus cerebri is a mushroom-like growth made up of granulation

tissue and broken-down blood clot. It is caused by infection and grows from beneath the dura. It forms a sloughing, vascular, pulsating, suppurating tumor which exhibits a marked tendency to overlap the opening through which it projects. Unless complicated by diffuse encephalomeningitis it causes no symptoms. Fungus cerebri develops more slowly than cerebral prolapse, is always caused by infection, and a microscopic section of excised portions shows the traces of brain substance.

Gunshot wounds of the cranium are usually penetrating. The bullet commonly pursues a straight course; exceptionally it is deflected, producing a contusion of the bone, a fracture of the outer or inner table, or a complete fracture, the missile then passing between the bone and the scalp. The fact of penetration is determined by the probe. When this fact is established, the course and length of the wound track and the position of the ball remain to be determined. The majority of gunshot wounds of the brain are inflicted by revolvers of 22, 32, 38, or 44 caliber. In the cheaper weapons of these calibers the penetration is poor and varies greatly. The best weapon at close range may be counted to carry a 22 ball through the skull and into the brain; a 32 ball through the brain to the opposite side of the skull, producing a comminuted fracture at this point; a 38 ball through and through, or through the bone and to the skin of the opposite side; a 44 ball through and through, passing out at a wound of exit.

The bullet of the air rifle and the 22 Flobert can penetrate the brain through the orbit, or through the thinnest part of the temporal bone.

The ball, after it has penetrated the skull, usually pursues a straight course. If it reaches the opposite side of the skull, it may pass through, may remain at the point of impact, or may rebound or glance. Its position is best determined by the *x*-rays.

Meningitis is not infrequently a complication of compound fractures, including those of the base.

Acute osteomyelitis after fracture of the posterior fossa is a rare complication. In the absence of an overshadowing meningitis it is characterized by the constitutional signs of sepsis, rigidity of the neck muscles, severe pain radiating down the neck, and edematous swelling of the posterior pharyngeal wall.

Inflammatory Affections of the Scalp and Cranium.—The usual acute superficial infections include furuncle, carbuncle, abscess, and cellulitis. The diagnosis is based upon the obvious symptoms. Acute osteomyelitis is characterized by the violence of constitutional symptoms which precede obvious local manifestations aside from deep pain, tenderness, and edema.

The chronic infections are exceptionally tuberculous, usually syphilitic, or incident to infection of a sebaceous cyst.

Of the superficial skin lesions of the chronic type, those commonly encountered on the scalp are seborrhea, in both its dry and oily forms (p. 91), eczema, and, in children, tinea and the lesions incident to pediculi.

Furuncles disseminated over the scalp, if painless, chronic, and without peripheral redness and edema, are usually manifestations of secondary syphilis.

Abscess of the scalp, usually due to infection of an undrained wound or of a hematoma, is heralded by an increase of swelling and edema, together with pain, heat, and redness. After the first twenty-four hours a wound or contusion should steadily grow less painful and tender, and after forty-eight hours there should be a rapid diminution in the swelling. When this is not the case, infection should be suspected. The absolute diagnosis is established by opening a wound which has closed, or by incision. Pus in appreciable quantities is rarely present before the third day.

Superficial cellulitis, or cutaneous erysipelas of the scalp, is characterized by a hot, red, tender, edematous area of skin with raised, irregular, well-marked borders. Its tendency is toward rapid extension and it often involves the entire scalp. It may be secondary to the superficial infection. It commonly follows infected wounds involving the aponeurosis and the periosteum. If it reaches the ear and forehead, small vesicles may develop in the skin, and the upper eyelids become greatly swollen. The lymphatic ganglia in the neck are promptly enlarged. It is inaugurated by chill, fever, and vomiting, and is often accompanied by intense headache, sometimes by delirium.

It is characterized by the rapidly spreading area of heat, tenderness, and edematous swelling and the constitutional symptoms of pronounced sepsis, often inaugurated by a chill. It has for its chief danger complicating osteomyelitis or suppurative meningitis.

Tuberculosis.—Tuberculous ulceration of the scalp (rare), secondary to tuberculous osteomyelitis of the cranial bones, is a disease of early childhood, and is nearly always associated with other more obvious tuberculous lesions. Local pain and tenderness are followed by the development of a flaccid, fluctuating tumor, without peripheral induration, which slowly opens at one point and discharges tuberculous pus. Through the resulting sinus may be felt a sequestrum usually formed at the expense of the entire thickness of the bone, leaving a round perforation without surrounding hyperostosis, through which the pulsations of the brain may be communicated to the abscess before it is opened. The frontal, parietal, and temporal bones are the usual seats of this rare affection.

The ethmoid, body of the sphenoid, and petrous portion of the temporal bone are secondarily affected by tuberculous processes extending from the nasal cavity or the middle ear.

The symptoms, if any, would be those of tuberculous meningitis, or of pressure from abscess, or of bleeding incident to erosion.

Syphilis.—The papular and pustular lesions of secondary syphilis are common on the scalp, usually as a part of a general eruption.

Nodules on the frontal and parietal bones, causing harassing and even agonizing pain, and extremely sensitive to pressure, develop in the

early period of secondary syphilis, appearing at times even before the exanthemata.

Gummata of the scalp are characterized by small copper-colored, usually painless, nodules, which, in the absence of treatment, break down, forming small, punched-out, wormeaten, indolent ulcers, rounded in shape, grouped, sometimes confluent. They are commonest in the frontal region near the hair line and on the top of the head. The persistence of an ulcer in these regions is in itself suggestive.

Distinction from a non-ulcerating sebaceous cyst is difficult in the absence of a history.

Gummata of the cranial bones, affecting chiefly the frontal and parietal region, and developing in the third year of the disease or much later, are often characterized by agonizing, generally local, pain, which becomes worse toward evening.

When the infiltration is pericranial, one or many small dense tumors may be felt through the scalp, which at first is perfectly normal, and freely movable over them. These tumors may disappear, leaving distinct depressions in the bone, or, the scalp becoming adherent, they may ulcerate and discharge a gummy pus. Dead bone can be felt by probing the sinuses, but sequestra, which may be extensive, show little tendency to separate. Together with the destructive process there is a formative one, the bone becoming thicker about the lesion and exostosis developing.

Gummata which develop from the dura mater are marked by pain more intense than that which accompanies the pericranial infiltration, vertigo, poor mentality, and later by convulsive seizures which may be general or focal, and partial palsies. Should the gumma soften, break through the cranial bone, and form a fluctuating, partially reducible tumor, the diagnosis would be obvious. This penetration is rare.

The history of an hereditary or acquired infection, the presence of other syphilitic lesions or their traces, the induration preceding ulceration, the seat of the lesions, the age of the patients, the chronic course, the persistence of the sequestra, the anfractuous borders of the osseous lesions, the absence of febrile reaction, and the prompt effect of specific treatment are features which characterize the cranial lesions of syphilis.

Tuberculous lesions, in addition to being much rarer, affect children who usually show other unmistakable lesions of tuberculosis. The sequestra often come away spontaneously and there is no exostosis or other formative process about the borders of the lesion.

The ulcerating gummata of hereditary syphilis, commonly placed about the bregma, are much commoner than are the tuberculous infiltrations in this region.

Acute suppurative osteomyelitis is evidenced first by the sudden onset of an agonizing headache, local tenderness to tapping and deep pressure, the constitutional symptoms of violent sepsis, and local edema which shortly becomes diffuse and exhibits the softening of suppuration. This acute bone infection, commonest during or before adolescence, is usually secondary to wounds or contusion, but may occur without

appreciable cause. Its violent onset and rapid progression are characteristic.

From a localized meningo-encephalitis the diagnosis in severe cases may be impossible, probably because this is a common complication.

With the exception of the pachymeningitis of sunstroke, alcohol, or syphilis, characterized chiefly by persistent headache lasting months or years, it may be assumed that the encephalon is more or less involved in all inflammations of its envelope.

Acute Leptomeningitis.—Acute leptomeningitis, traumatic, secondary to an infection of neighboring structures or of systemic origin, is usually inaugurated by intense headache, chill or vomiting, or both, rapid pulse and high fever, often hypersensitiveness of the special senses, muscular twitchings, and active delirium or a condition of apathy or somnolence. The most characteristic features of the affection are either general or local contractures, particularly of the postcervical group of muscles, keeping the head back and rigidly extended, and convulsions, followed by paralysis, which may be local and thus localizing. In progressive cases the delirium or somnolence is succeeded by coma, irregular, hurried pulse, and disturbed, often Cheyne-Stokes, respiration. The course of the affection in its ordinary surgical form is rapid. Pronounced temporary improvement followed by relapse is not uncommon.

The development of rigidity of the postcervical muscles and paralysis of the facial, the oculomotor, or the abducens nerve point to a basilar meningitis.

In framing the diagnosis, a history of a preceeding contusion or compound fracture is of importance. The absolute diagnosis not only as to the presence of meningitis, but the form of infection producing it, can usually be made by lumbar puncture. High fever and leukocytosis are suggestive but not absolutely diagnostic of the non-infectious serous form of acute leptomeningitis.

Secondary leptomeningitis, exceptionally consequent to suppurative lesions of the scalp or the cranial bones, is particularly likely to complicate osteomyelitis, mastoid disease, or suppuration of the middle ear or infection of the frontal, ethmoidal, or sphenoidal cells. It occurs in the course of pyemia, pneumonia, typhoid, or any general infection. The symptoms do not differ from those already given.

Tuberculous meningitis (p. 202) is characterized by a prodromal period of ill health and the absence of a sufficient traumatic or local infective cause. Its development in early childhood, or, if in adult life, its practically invariable association with tuberculous lesions of other parts of the body, its almost constant association with strabismus, irregularity of the pupils, optic neuritis, and other eye symptoms, and its comparatively slow progress, are characteristic features. The diagnosis is based upon examination of the fluid obtained by lumbar puncture.

Inflammation of the Dural Sinuses.—This is rarely primary, *i. e.*, incident to direct infection of a thrombosed vessel through a fracture. It is usually secondary to infection of the orbit, sphenoidal or ethmoidal sinuses, or the tympanum and mastoid cells.

The characteristic features of infection of the lateral sinuses are: A history of chronic ear trouble, the sudden onset of vomiting, fever (the latter often preceded by a chill and headache), marked fluctuations of temperature and recurrence of rigor or chills, edema and tenderness, both over the mastoid and in the neck along the course of the internal jugular vein, a condition of venous stasis in the scalp of the temporal and occipital regions, tenderness and perhaps edema elicited by deep pressure below the external occipital protuberance and posterior to the mastoid process, some stiffness of the neck muscles, and often optic neuritis. Exceptionally there is irritation or palsy of the hypoglossal, glossopharyngeal, and spinal accessory nerves, or even of the pneumogastric. It will be noted that the symptoms are those of septicemia or pyemia, combined with those of meningeal irritation. Metastatic abscesses are likely to develop early in the lung.

Thrombosis (septic) of the cavernous sinus, secondary to suppuration of the orbit, or of the sphenoid or ethmoid cells, is characterized by the sudden onset of septic symptoms, as in the case of thrombophlebitis of the lateral sinus, together with congestion and edema of the retina, swelling about the forehead and eyelids, usually exophthalmos, and paralysis of the third, fourth, and the ophthalmic branch of the fifth nerve.

Infection of the superior longitudinal sinus is secondary to traumatic infection of the adjacent tissues. The only suggestive localizing sign which it might give would be a tendency to nose-bleed, and edema and venous congestion along the course of the sinus.

Abscess of the Brain.—Abscess of the brain is characterized by a preceding history of middle ear disease or of trauma, particularly that incident to penetrating punctured wounds. Abscess is manifested by headache, which may be unilateral, mental asthenia and irritability with somnolence and stupor, percussion tenderness at times, surface heat as shown by the surface thermometer, a normal or even subnormal temperature, with occasional slight transitory rises associated with a slow, sometimes intermitting, pulse; rigors, vomiting, constipation, possibly unequal pupils, and occasionally optic neuritis. If the abscess is situated in the psychomotor centres, or so near as to affect them, its localization is made possible.

Post-traumatic abscesses, if developing within a few days of injury, are usually completely masked by the associated meningo-encephalitis. Their presence, however, might be suspected were clearly marked focal symptoms to develop early. If, after an interval of weeks, months, or even years, pain with remissions, mental inaptitude, irritability, and torpor, and the symptoms just detailed were to develop, the possibility of intracranial abscess should be considered.

Abscess secondary to middle ear disease may present, if cerebral, in addition to the symptoms characteristic of intracerebral abscesses in general, a history of chronic middle ear disease, often peripheral facial palsy, aphasia, twitchings, rigidity or palsy of the arm of the side opposite to the lesion, or hemiplegia or hemianesthesia.

Such an abscess, if cerebellar, might be marked by staggering gait, vertigo, and obstinate vomiting.

An abscess may develop without any localizing symptoms, exceptionally without the general symptoms of septic absorption, cerebral irritation, or pressure, until by rupturing into the ventricles it suddenly causes convulsions, coma, and death, or, reaching the meninges, sets up an acute diffuse meningo-encephalitis.

Secondary to middle ear disease, meningo-encephalitis, sinus thrombosis, and abscess are about equally common. All are characterized by similar symptoms. Moreover, acute inflammation of the middle ear or mastoiditis with retention of pus will cause fever, rapid pulse, severe pain, and often delirium, with symptoms of slight meningeal irritation.

A differential diagnosis may be formulated by considering that meningo-encephalitis is violent in onset and rapid in course, and is evidenced by high fever, rapid, often irregular, pulse, strabismus, and often stiffness of the jaws and the back of the neck.

Thrombosis of the lateral sinus is attended with marked edema and swelling about the ear, especially behind it, and sometimes involving the entire head on the affected side; it may exhibit tenderness and induration along the course of the internal jugular vein and choked disk. The symptoms shortly become profoundly septic, with the chills, fever, and sweats of this condition, and the rapid pulse and metastatic deposits occur early. Intracranial abscess is characterized by a slow pulse, and subnormal or but little above normal temperature, by dulled mentality, often aphasia, vertigo, and signs of irritation or compression of cortical motor and sensory areas in the brain.

Acute otitis media and chronic mastoiditis with retention are characterized chiefly by pain and its systemic effect, nor is there the appearance of serious illness which characterizes the intracranial infections.

When it is impossible to distinguish between these conditions, and this is often the case, since two or more are commonly associated, the diagnosis must be made by exploratory operation above the middle of the bony meatus (measured vertically from Reid's base line, *i. e.*, a line passing from the lower orbital margin through the middle of the bony meatus). Through this opening a probe may be passed between the dura and the roof of the tympanum; by enlarging this opening upward and backward for about 2 cm., access to the temporosphenoidal lobe is facilitated.

In the absence of extradural or subdural pus, or pronounced subdural serous effusion, the substance of the brain is explored by either a grooved director or an aspirating needle with a canal of at least 1 mm. caliber. The hypodermic syringe is inadequate, since the thick pus of cerebral abscesses will not pass through its fine canal. The direction of exploration from a point 3 cm. above and 3 cm. behind the bony meatus is downward, forward, and inward.

The lateral sinus is reached by a trephine opening tangent, in its lower periphery, to Reid's base line, and an inch (2.5 cm.) behind the

middle of the bony meatus. A hypodermic needle thrust into the sinus will show the presence or absence of fluid blood; in the latter case the sinus should be opened.

The cerebellum is reached through a trephine opening tangent to Reid's base line in its upper segment and placed 4 cm. behind the middle of the bony meatus. The direction of exploration into the cerebellar substance should be upward, forward, and inward.

From neoplasm, fungus may be distinguished by its direct, almost immediate, relation to trauma or suppuration and by microscopic examination.

Tumors of the Scalp and Cranium.—Superficial growths which originate in the skin or beneath it, and move with the scalp, are angioma, or birthmark, wart, sebaceous cyst (may become adherent from inflammation), lipoma, gumma, epithelioma, sarcoma, fibroma, keloid, lymphangioma, neurofibroma, enchondroma, and osteoma.

The growths not moving with the scalp attached to the bone and in their early development of dense consistency are gumma, exostosis, tuberculoma, and osteosarcoma. Tumors not movable over the pericranium and fluctuating from the first are subcranial cephalhematoma; dermoid cysts; if partly or wholly reducible, meningocele, perforating tuberculous abscess, or blood cyst communicating with a sinus.

Verruca.—Verrucæ, or warts, of the scalp are common in elderly persons. They are usually single, exceptionally they are multiple and confluent, and a large area of the scalp may be covered by the hypertrophied papillæ. From their position these warts are subject to recurring irritation, they bleed readily, become ulcerated, and are frequently the starting points for epitheliomatous degeneration. Before such transformation they cannot well be mistaken for any other lesion.

Angioma.—The head is a favorite seat for vascular tumors. They are usually congenital, though the lesion may be so slight at birth as to escape notice. They are characterized by red, purple, or deep brown discoloration of the skin, often associated with a growth of hair. From them sarcoma may develop, and lipoma and fibroma sometimes accompany them.

In its slightest form the angioma appears as a red splash upon the skin. When the arteries and veins participate markedly in the dilatation, a soft, depressible, purple, flat or rounded tumor is formed, usually in the frontal and temporal regions of an infant. This tumor can be emptied by pressure, and if, after it is emptied, a ring is pressed firmly about the growth the blood will reaccumulate very slowly.

In the deep form placed beneath the temporal aponeurosis a hemangioma forms a soft, sometimes pulsating tumor, which becomes distinctly larger during crying efforts and on placing the head in a dependent position. The diagnosis is usually dependent upon associated angiomatous manifestations in the skin. Meningocele is not likely to be found in the temporal region.

Cirsoid aneurysm, commonly an affection of early adult life and usually affecting the temporal and parietal regions, forms a flat,

pulsating tumor, made up of many dilated and tortuous arteries, the course of which can be both seen and felt. The overlying skin is thickened and purplish in color.

Arterial aneurysm, usually traumatic and rare since the days of phlebotomy, is marked by the development of a pulsating tumor, usually in the course of the temporal artery, which gives thrill and intermittent bruit, and partly or completely disappears when pressure is made in the arterial trunk proximal to the tumor.

Arteriovenous aneurysm develops in the temporal and the frontal region as a flattened, pulsatile tumor with bosselated surface because of the dilated veins. Thrill, expansile pulsation, and constant murmur, often harsh and loud, with exacerbations synchronous with the systolic impulse, are present. It is distinguished from cirsoid aneurysm by its traumatic origin, the absence of skin pigmentation or alteration, and the fact that pressure at the point of communication between artery and vein, stops the bruit and pulsation. The venous dilatation may be widespread.

A blood tumor communication with a dural sinus forms a small, rounded, soft, or fluctuating tumor, usually in the course of the superior, longitudinal sinus. It is chiefly characterized by the fact that it is reducible, and is made tense by straining efforts or a dependent position of the head. Exceptionally after reduction the bony opening may be felt. The tumor may be congenital, traumatic, or without assignable cause. It gives neither pulsation nor bruit.

Elephantiasis.—Elephantiasis in the few cases observed has affected the skin of the scalp in the occipital region forming a pendulous flap of coarse, greatly thickened, indurated skin.

Fibroma.—Fibroma, in its superficial hard form, appears as keloid, a dense, smooth, pink or white, raised, commonly painless induration about a scar, distinctly outlined, throwing out claw-like projections into the surrounding healthy skin. In its soft form the fibroma forms an infiltration into and beneath the skin. It is often multiple, involving not only the scalp but other parts of the body. The tumors may be extensive, forming pendulous flaps, or may appear as small, single, or multiple infiltrations.

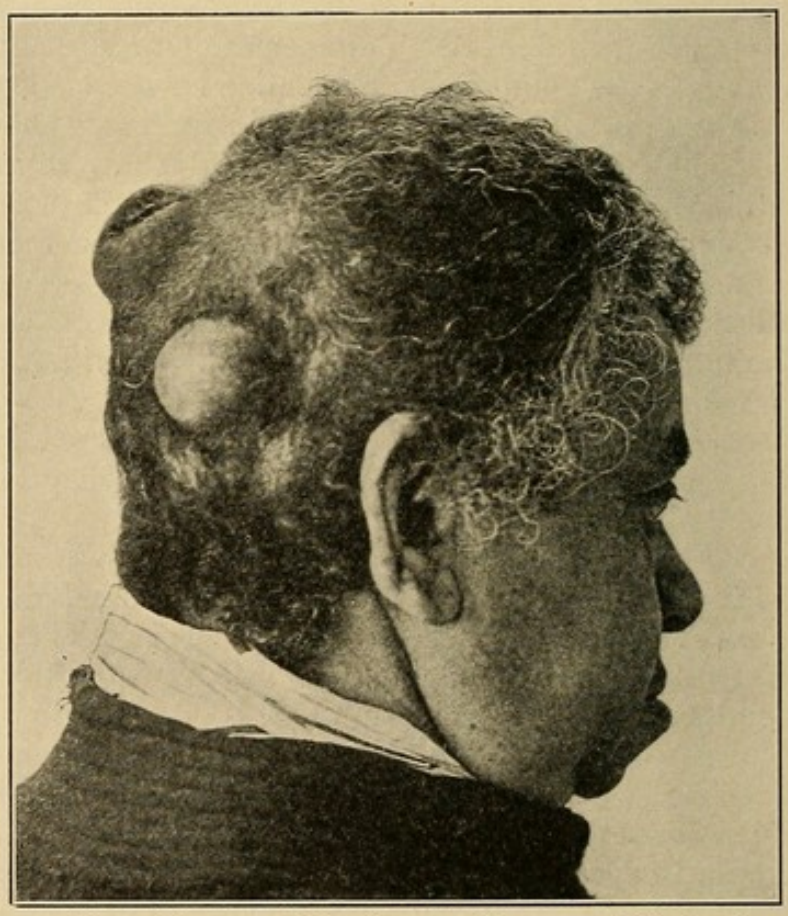
Neurofibroma of the scalp is characterized by the development of a soft, nodular, sometimes very extensive tumor. The nerve or nerves affected are tortuous, beaded, and tender. This is particularly marked about the periphery of the swelling, the skin and subcutaneous tissue being greatly thickened about the centre. The skin may be freely movable over the neuromatous nodules, these in turn being movable over the scalp. This tumor presents the appearance of a thickened, hypertrophied, sometimes pigmented, and hirsute flap of skin; its seat of election is the side of the head.

Fibrolymphangioma, appearing first as a small soft infiltration of the occipital region, when well developed becomes more or less pedunculated, presenting a vermiform surface suggesting the presence of dilated and tortuous vessels. This tumor is always intimately adherent to the skin and does not exhibit the nodulation of the fibroneuromata.

Lipoma.—A rare scalp tumor shows a predilection for the forehead just external to the upper part of the frontal protuberance at the part where the hat brim presses. It forms a soft, rounded tumor which closely resembles a sebaceous cyst. Lipomata, probably congenital in origin, may grow beneath the temporal fascia, forming elastic swellings which may reach great size. These growths commonly develop in middle life (Chipault).

Wens, or Sebaceous Cysts.—These are characterized by the development of one or usually many raised, rounded, tense, semifluctuating, non-inflammatory tumors of varying sizes, from 5 cm. to 10 cm. in diameter, adherent to the skin in their central part, and sometimes

FIG. 86

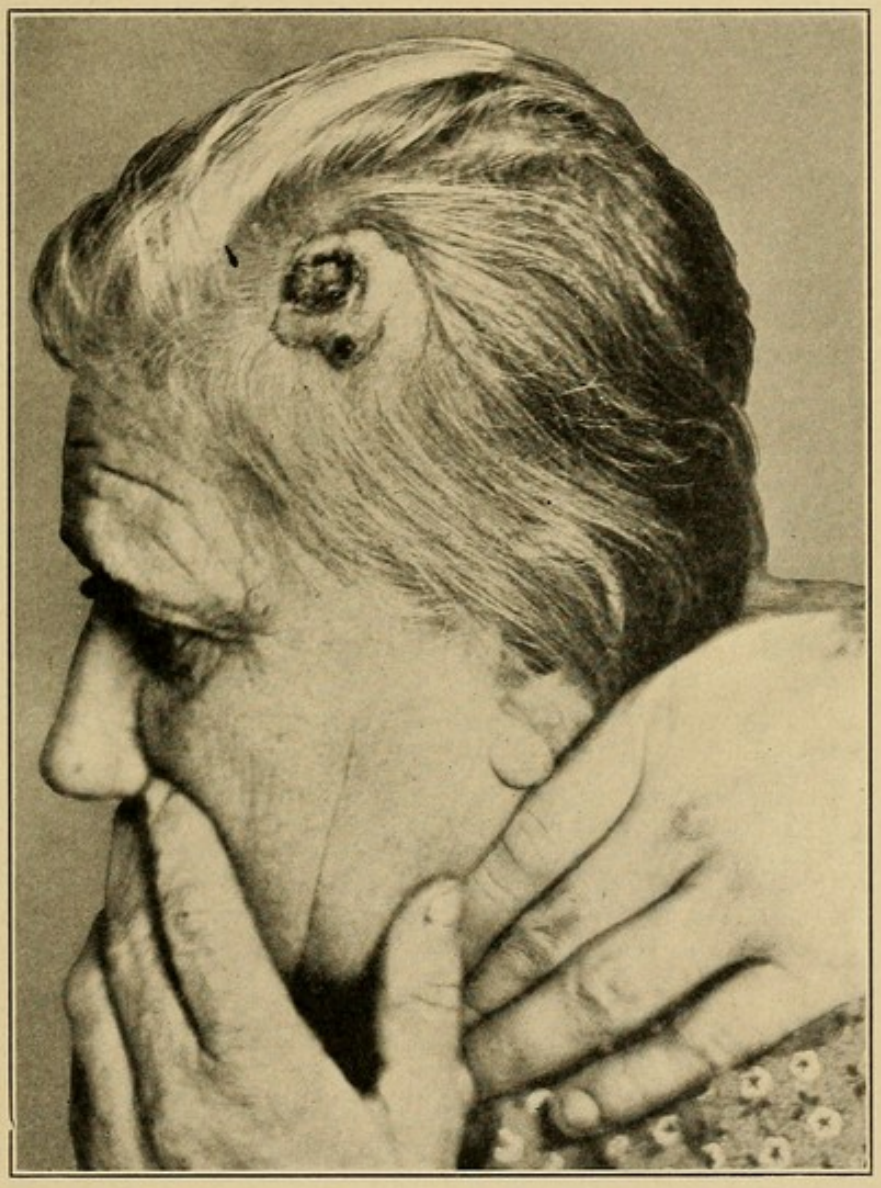


Wens. Many years' duration; movable, non-sensitive, hard.

exhibiting the dilated aperture of a duct from which sebaceous matter can be squeezed out. The adhesion to the skin is often difficult to detect in small tumors which have not been inflamed or exposed to pressure. Nor can the duct leading to the accumulation of sebaceous matter usually be found. Most tumors grow slowly. When they become irritated and infected the symptoms are those of abscess. After evacuation of pus and sebaceous matter there is often left a sinus or an ulcerating surface with indurated borders strongly suggesting gumma or epithelioma. Malignant infiltration may take its starting point from an inflamed sebaceous cyst. These cysts are commonest in women at or past middle life.

Epithelioma, or Skin Cancer.—Epithelioma, commonly beginning as a chronically inflamed wart, patch of keratosis, or sebaceous cyst, is characterized by ulceration which is persistent and slowly (months, years) progressive. Young people are not entirely exempt. The forehead and the parietal region are the points of election. The lesion may

FIG. 87



Epithelioma of scalp. Chronic sloughing ulcer, irregular in outline, with elevated borders and infiltrated reddened areola. Six months' duration. Second point of ulceration beginning at lower periphery of the neoplasm.

appear as a punched-out ulcer which has destroyed everything in its course, even the bone, unaccompanied by lymphatic involvement, and exhibiting a very narrow area of induration about its purple, ragged edges. This form, the rodent ulcer, is slow, lasting for years, and producing appalling deformities.

The epitheliomata characterized by pronounced induration and by fungating granulations and lymphatic enlargements are rapidly fatal.

Senile epithelioma may begin as a hard, cutaneous or subcutaneous, vascular, purplish nodule.

Persistent scab formation and induration of any scalp lesion in an elderly person should always suggest epithelioma. If syphilis can be ruled out, the diagnosis should be made immediately by wide excision of the inflammatory lesion and examination with the microscope.

The cutaneous and subcutaneous gummata, in both their formative and ulcerative stages, may resemble the infiltration of epithelioma. These lesions are, however, fairly rapid in course (weeks), show no peripheral infiltration, do not involve lymphatic glands, are painless, yield to specific treatment, and are associated with a history of syphilis or other signs of the disease.

Tuberculosis in the form of lupus begins in early life, exhibits multiple lesions, no induration, no lymphatic enlargements, is less deeply destructive, and exhibits the peripheral jelly-like nodules.

Osteoma and Chondroma.—Osteoma and chondroma have both been observed free from the bones of the skull and movable with the scalp. The nodulated hardness of these tumors would suggest their structure.

Usually these tumors are fixed to the cranium, exhibiting hard, flat or rounded, single or multiple, sessile or pedunculated outgrowths, often post-traumatic.

They may be external or internal or may project from both surfaces of the cranial bones. The internal osteomata are, since they rarely reach large size, usually symptomless.

Sarcoma.—Sarcoma of the scalp is characterized by the rapid development of a soft, vascular, semifluctuating tumor. The growth may be metastatic, extend from the dura through perforated bone, or may originate in an angioma of the skin or beneath it. In the latter case it may be pigmented and smaller tumors may form about the central one. The superficial sarcomata erode the bone, forming a direct communication with the interior of the skull. They are often pulsatile.

Sarcoma of the cranial bones, frequently post-traumatic, may at first be hard and nodular; later, in the myelogenic forms as the covering shell of bone is thinned, there is crackling on pressure, as of a broken eggshell. There is at times severe pain. The major symptom is tumor which in the beginning exactly simulates gumma and grows about as rapidly. The diagnosis should be made by removal and examination if syphilis can be excluded. The rapid growth of an osteoma should suggest sarcomatous degeneration.

Of the soft, fixed, irreducible tumors of the cranium, sebaceous cyst, which has become adherent from inflammation and erosion, is recognized by the history of its development and its long standing. Gummata sometimes form flat or rounded, boggy, painful swellings on the frontal and parietal regions, accompanied by severe pain. The diagnosis is based on the history and the therapeutic test. Pain and tenderness are well marked.

Encapsulated, translucent serous cysts, sometimes found in the occipital region, are probably the remains of a true meningocele.

Cystic sarcoma which has perforated the cranium from without inward is characterized by its large size, the dilated veins overlying and surrounding it. Perforating sarcomas from the dura in their later stages are neither pulsatile nor reducible.

Cephalocele.—Cephalocele, or projections of the brain and its membranes through congenital bone defects of the skull, are usually flaccid, sometimes tense tumors, springing from the midline in the frontal occipital region. When not obscured by overlying lipomatous or angiomatous growths, these protrusions form smooth, rounded, sometimes large, or fluctuating reducible tumors which become tense when the child cries.

Encephalocele (rare) made up of brain substance without cystic formation usually occupies the frontal region and forms a soft elastic swelling which is generally pulsatile, partly reducible, causing pressure symptoms when this is attempted, and becomes larger on straining efforts. This growth is not translucent.

Encephalocystocele, the usual form of tumor, in which there is brain substance and within this a cavity containing cerebrospinal fluid, may be small or large. The occipital region is the seat of preference. The brain substance may be so attenuated in the walls of the lumen that translucency is obvious.

Cephalocele may project into the orbit, nose, pharynx, or mouth, and has been mistaken for nasal or pharyngeal polyp.

True meningocele is rare.

Angioma, if placed in the midline, may, because of its apparent reducibility by pressure and its change in size and lumen incident to crying or straining, simulate cephalocele.

Dermoid Cysts.—A congenital tumor which may develop in adult life is evidenced by the growth of a rounded tense tumor which exhibits a predilection for the upper midforehead and outer orbital regions. It is adherent to the bone below, and in the latter there may be felt a depression. This tumor closely resembles a sebaceous cyst. Its adhesion to the skull and its development in infancy and early childhood would aid in forming a diagnosis. An intracranial dermoid would give only the symptoms of local or general pressure.

Pneumocele of the Scalp.—Pneumocele of the scalp is characterized by resonance on percussion and reducibility by pressure. It may develop on the frontal or the supramastoid region, and is due to a traumatic or pathological opening into the frontal or the mastoid cells. After these cysts are emptied they can again be filled by holding the nostrils and attempting to blow through the nose. They may gradually attain large dimensions and may be subaponeurotic or subperiosteal.

Hydrocephalus.—Hydrocephalus may be congenital or acquired. In its congenital form, frequently associated with syphilis, rickets, cephalocele, or spina bifida, it is characterized by a disproportion in size between the cranium and face incident to overdistension of the ventricles with fluid and consequent yielding of the cranial walls. The sutures and fontanelles are thus prevented from closing. The soft, bulging,

heavy head, with its enlarged veins; the small face, raised eyebrows, and projecting displaced eyeballs are characteristic at a glance.

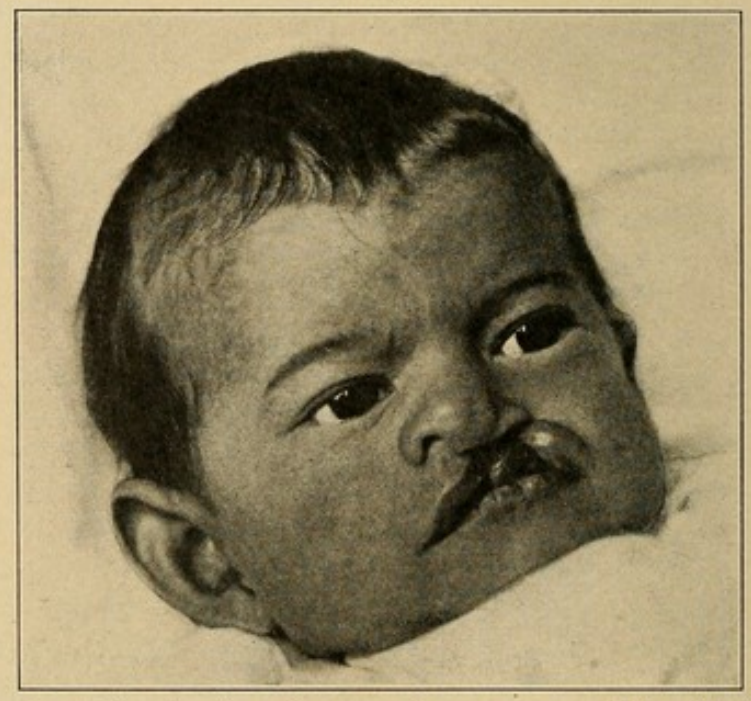
Acquired hydrocephalus, symptomatic of obstruction from inflammation or tumor, if it develops after the period when the skull is closed, will be characterized by the stupor of cerebral pressure, often by muscular rigidity expressed in the extremities. The condition is usually overshadowed by the symptoms of the causative lesion. The diagnosis may be made by ventricular puncture.

Microcephalus.—Microcephalus, or abnormally small head, secondary to congenital malformation of the brain, if pronounced, is obvious at a glance. Normal variations are so great that it is often difficult to decide when the pathological has been reached. Surgical enthusiasm and belief in the efficacy of operative measures has no doubt led to the detection of a microcephalus which would otherwise not have been observed. Exceptionally early closure of the sutures is noticed. These cases are characterized by persistence of the infantile state.

THE FACE.

Malformations.—Harelip, partial, complete, or double, often associated with partial or complete palatal cleft, is the common malformation. It is sometimes associated with symmetrical tumors placed near the midline of the lower lip and discharging each from its duct a salivary fluid.

FIG. 88



Single harelip. Deformity of nose in excess of average case. (University Hospital.)

Other congenital deformities, such as lateral or mesial nasal cleft, oblique facial cleft, clefts in the cheeks, or median cleft of the lower lip or under jaw, are extremely rare.

PLATE XIII

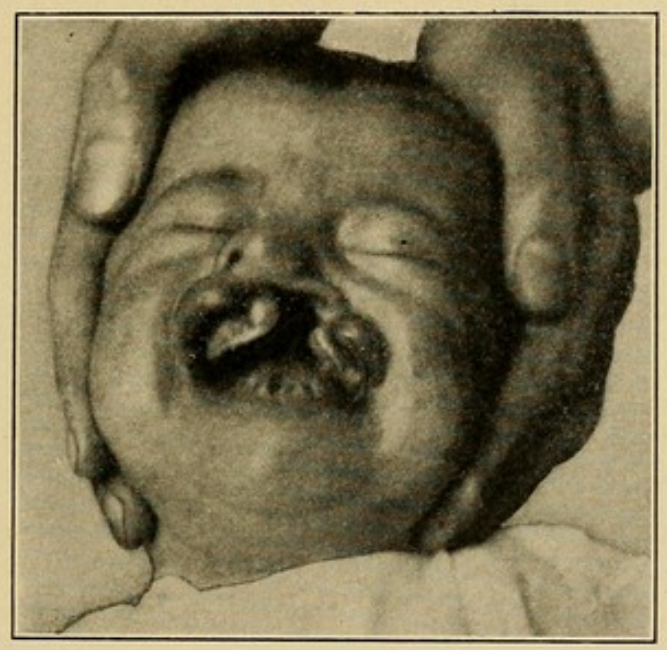
Lupus Erythematosus. (Hartzell.)

Fibrocartilaginous skin tabs upon the cheeks and neck near the ear are not uncommon.

Contusion.—The rapid swelling following contusion may cause underlying fracture of the bones of the face to be overlooked. The zygoma, the orbital ridge, the nasal bones, and the maxillæ should be carefully palpated when injury is so applied as to endanger these structures. Emphysema is diagnostic of a fracture of the nose or of the walls of the nasal sinuses.

Fracture of the malar bone is occasionally characterized by a depression of the zygoma. The deformity may be elicited by careful palpation, even when there is an extensive overlying blood effusion. This is also true of fracture which has driven in the anterior antral wall.

FIG. 89



Cleft palate and harelip.

Skin Lesions.—The skin of the face is subject to a multiplicity of lesions of which the commonest are acne, comedo, milium, seborrhea, the various manifestations of the exanthemata, erythema, herpes, urticaria, syphilides, impetigo contagiosa, dermatitis venenata and medicamentosa, erysipelas, eczema, recurrent hydroa puerorum, xanthoma, tinea, angioma, lymphangioma, fibroma, lupus, and epithelioma.

Acute Inflammatory Affections of the Face.—Furuncle.—Furuncle, though it may occur in any part of the face, has its seat of preference in the upper lip and the inner aspect of the nasal orifice. It may be characterized by edema, pain, tenderness, induration, and constitutional symptoms of infection much more pronounced than are caused by the lesion in other parts of the body.

Carbuncle.—Carbuncle, a conglomeration of furuncles, is accompanied by pronounced local and constitutional symptoms of inflammation. The redness and edematous swelling may be so widespread as to suggest erysipelas. It occasionally terminates fatally in a few days by septic thrombosis and meningitis, extending from the orbit to the cavernous

sinus. Dilatation of the veins about the orbit, exophthalmos, chemosis, and profound sepsis out of proportion to the local lesion would suggest such an extension. Even in favorable cases there may be extensive tissue necrosis.

Maligant Pustule.—Malignant pustule is characterized by a burning nodule, surmounted by a discolored vesicle which bursts and forms a brown scab, about which secondary vesicles form and rupture, leaving a surface of ulceration. The swelling spreads rapidly, quickly involving the associated lymph glands, and in one or two days constitutional symptoms of severe septic infection develop. The diagnosis of anthrax is based upon the presence of the vesicles and their dissemination and the finding of the characteristic bacillus (p. 76).

Glanders.—Glanders, usually primary in the mucous membrane of the nose or throat, may attack an abrasion or wound of the skin of the face, running through an acute or chronic course. It forms characteristic ulcerating nodules, and is diagnosticated by the detection of the bacillus mallei (p. 77).

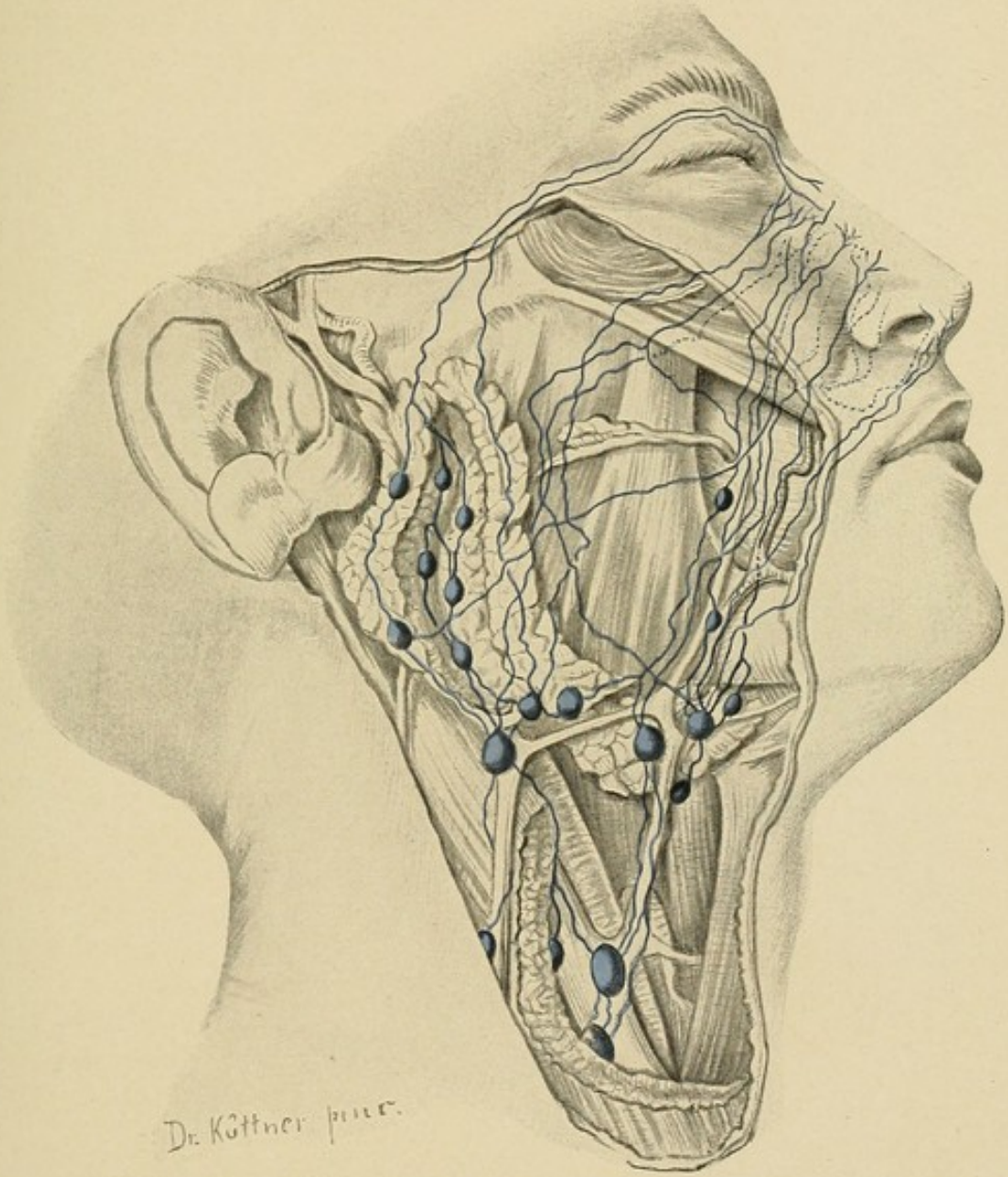
Erysipelas.—Erysipelas commonly begins in a surface break about the opening of the nostrils or the lips and sweeps over the face to the hair line and often beyond. It is usually superficial in type and accompanied by great swelling, redness, slight vesication, glandular involvement, and marked constitutional symptoms of sepsis. It is often inaugurated by vomiting. It lasts about a week, but may clear up in a day or not for a month. Its peripheral, rapidly extending, raised border, representing the seat of greatest inflammation is characteristic (p. 75).

Noma.—Noma is characterized by the development of an acute gangrenous process, beginning as a dirty white patch on the gums or inner surface of the cheek and rapidly (hours or days) causing extensive destruction of both bone and soft parts. A streptothrix is constantly found. It develops in anemic children after measles and scarlet fever, rarely in sucklings or adults. It is characterized in its early development by extensive infiltration, an apparently superficial erosion of the inside of the buccal mucous membrane being attended with a thick hardness of the cheek and a dusky discoloration of the overlying skin.

Acute Lymphadenitis.—Acute lymphadenitis, suppurative in type, not infrequently develops in the gland lying in the front of the ear, in one or more of the group lying in the cheek, or in that placed on the outer border of the body of the jaw, forming an abscess much like a furuncle, excepting that it is preceded by a hard, tender tumor formed by the inflamed gland, causes a more extensive swelling and redness, and the involvement of the skin is secondary.

Angioneurotic Edema.—Angioneurotic edema, usually mistaken for the bite or sting of an insect, is common on the face, particularly in the region of the upper lip, is marked by a sudden swelling, commonly noticed on rising in the morning, accompanied by some heat and burning pain. It subsides in a few hours or at most one or two days. The diagnosis is based upon the sudden, causeless onset, its transitory nature, and the very slight accompanying inflammatory phenomena.

PLATE XIV



Lymphatics and Lymph Nodes of the Face.

Acute swelling of the face may be due to inflammation of the underlying bones or their cavities. Osteomyelitis of the jaws incident to carious teeth, or occurring as a local expression of general infection (p. 284) or inflammation of the maxillary or frontal sinuses, is the common cause of this secondary swelling.

Chronic Ulceration of the Face.—**Tuberculosis.**—Lupus has for the seat of predilection the face. It begins in early childhood, or at least before puberty. It is often associated with other manifestations of tuberculosis.

The disease first appears in the form of small brownish nodules about the nose, cheeks, chin or lips, or forehead. It is extremely chronic (years), and extends by slow destructive ulceration, cicatrization going on at the same time. There is a non-ulcerative form characterized by the development of scar tissue. The ulcerative form reaches the underlying bony or cartilaginous framework, causing deforming cicatrices. It commonly spreads to the mucous membrane. The lymph glands are often involved. The scar tissue is subject to malignant degeneration.

In certain proliferating or destructive forms of lupus, the lesions may closely resemble carcinoma or gumma. The history of the case, its extremely slow course, and the finding of the brownish pinhead-sized nodules will aid in making the diagnosis.

FIG. 90

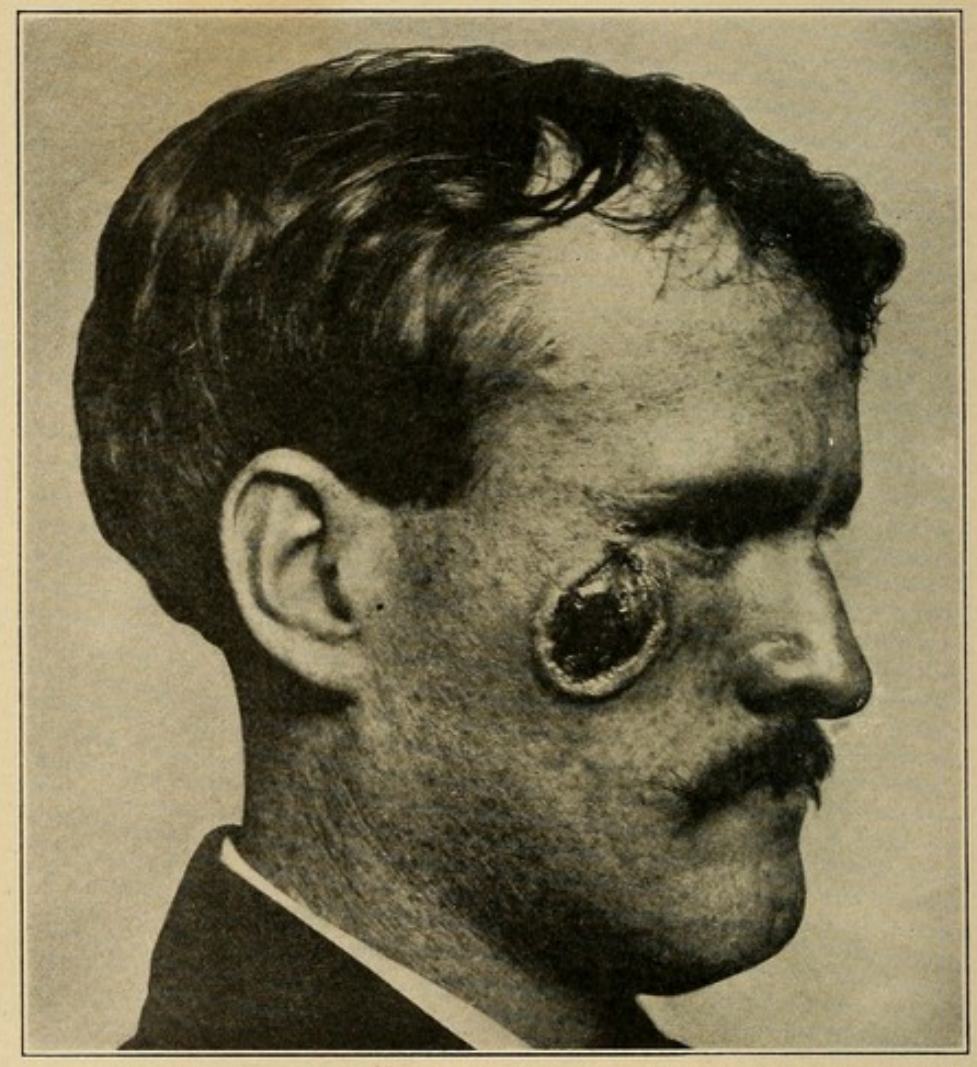
Tuberculous sinus of cheek preceded by induration and softening of mouth gland.

Tuberculous Sinus. — Tuberculous sinus may form on the face as the result of the breaking down of a lymph node or secondary to involvement of the facial bones. The gland in front of the ear is the one which commonly suppurates. Its painless, non-inflammatory enlargement precedes softening, and is usually accompanied by characteristic induration of the submaxillary group. The second common seat of sinus formation is in the middle of the cheek, or lower down over the body of the jaw secondary to tuberculous caries of the bone, commonly found at the outer border of the orbit. A painless, fluctuating swelling forms. On opening this the characteristic cheesy pus is discharged and necrosed bone can be felt.

Chancre.—Chancre, commonest on the upper lip, may be found on any part of the face, is characterized by its comparatively rapid and relentless development (one to three weeks), the absence of acute inflammatory symptoms, induration, and the early and pronounced enlargement of the associated lymph glands. It is often accompanied, especially

on the lips, by pronounced edema, and may reach a size much larger than is characteristic of it when it develops upon the genitalia. This is particularly true of chancre of the cheek. It so closely resembles epithelioma that it has more than once been excised on the basis of this diagnosis. However, it attains a size and development in two weeks not reached by the epithelioma in as many months.

FIG. 91



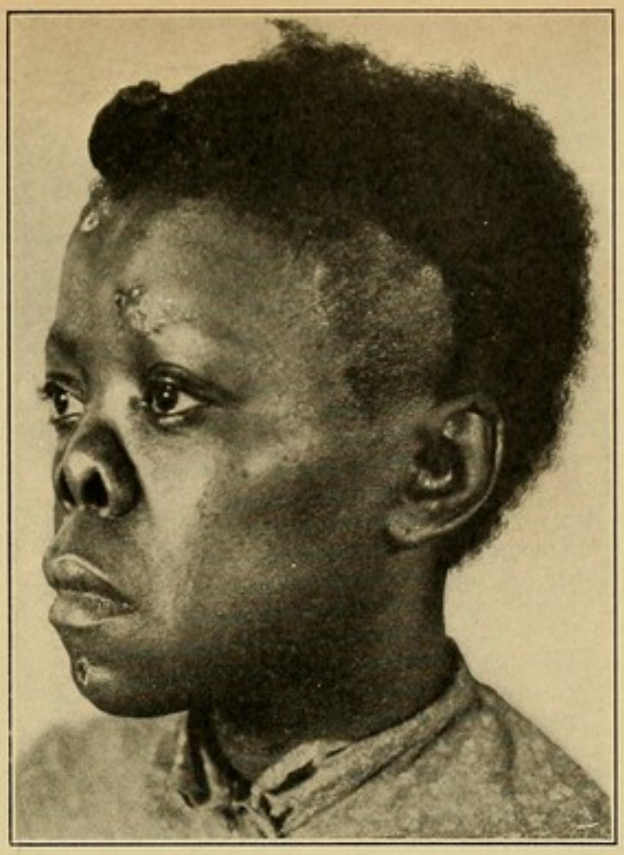
Chancre of cheek. Duration, weeks. Painless, indurated, marked enlargement of submaxillary glands. Healed with very slight scar. (Hartzell.)

Papular and pustular syphilides, especially when they occur about the nose and lips, may closely resemble lupus, but are characterized by their much more rapid development associated with the history of syphilis and the effect of constitutional treatment.

The lesions of hereditary syphilis are more difficult to differentiate; their destructive effect is more manifest upon the bones of the nose than are those of lupus.

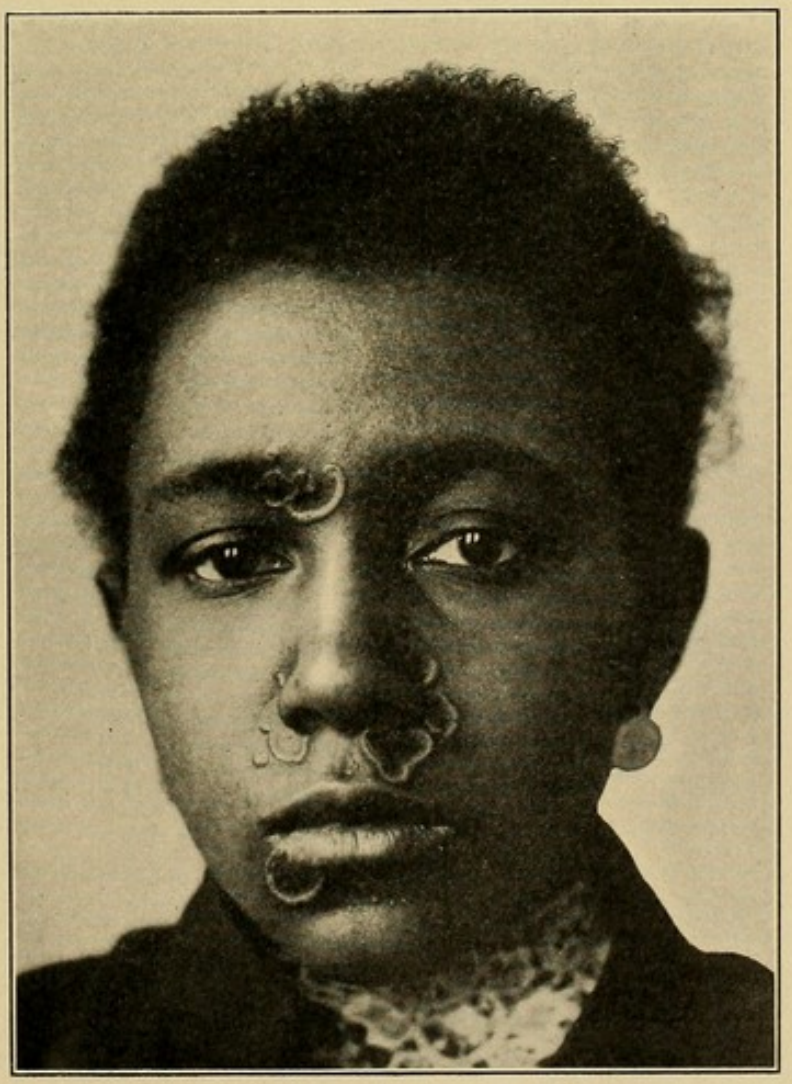
Gummata of the Face.—Gumma of the face is characterized by painless infiltration, which, untreated, breaks down rapidly (weeks), forming rounded, punched-out, non-indurated ulcers, unaccompanied by glandu-

Fig. 92



Syphilitic necrosis of the bones and cartilages of the nose. Gumma of forehead (frontal bones) and of chin (skin and subcutaneous tissues).

Fig. 93

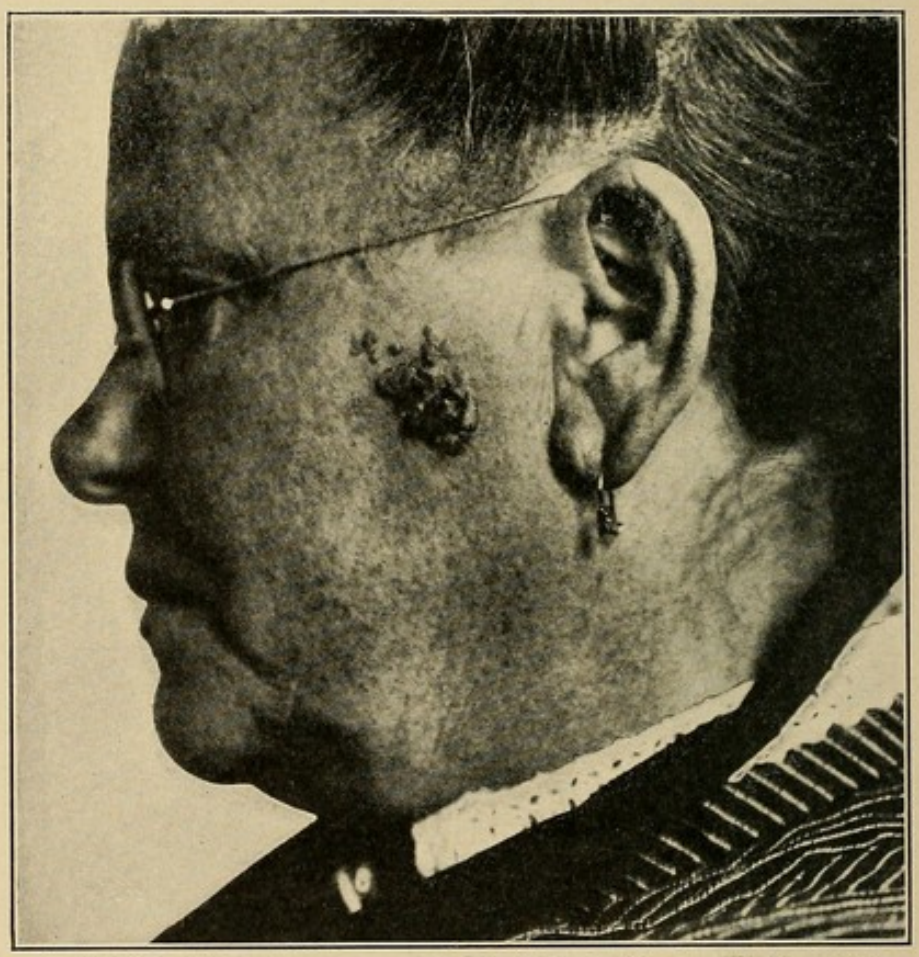


Circinate syphilide. (Hartzell.)

lar enlargement. They occur about the nose, lips, and forehead, and by confluence may produce extensive destruction of both soft parts and the underlying bone and cartilage. They are distinguished from carcinoma by the history of syphilis where this is obtainable, their rapid destructive course, absence of induration, and absence of glandular involvement. Gumma causes in weeks, exceptionally in days in the hyperacute form, destruction which epithelioma may not accomplish for months or years.

Actinomycosis.—Actinomycosis of the face is usually secondary to infection of the jaw. It is often associated with the inflammation incident to a carious tooth. As elsewhere, it is characterized by extensive induration and the development of one or more sinuses (p. 76).

FIG. 94



Epithelioma. Duration, years. No glandular involvement. (Hartzell.)

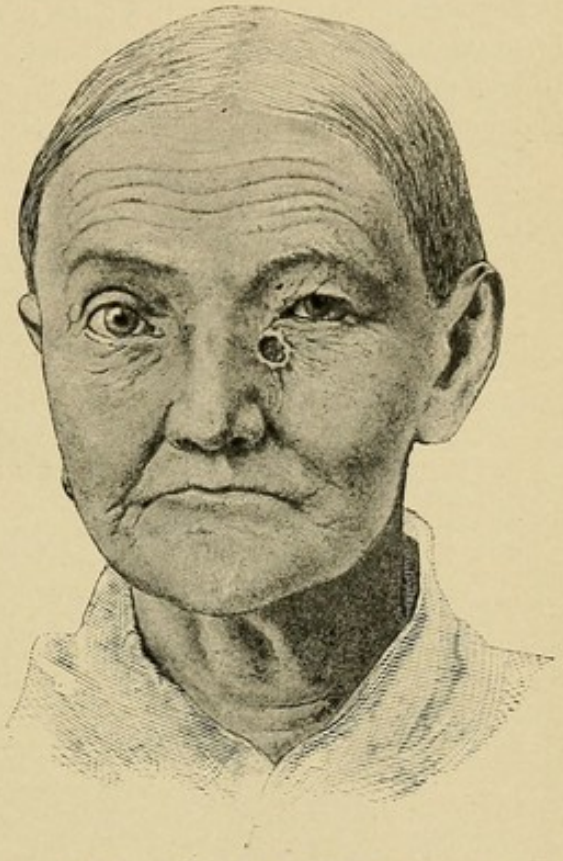
Epithelioma.—Epithelioma, commonest on the lower lip of middle-aged and old men, usually begins in a spot of leukoplakia about the lips or in pigmentations, seborrheic scales, patches of keratosis, or warty growths about the face.

The flat form (rodent ulcer), particularly common about the forehead, temple, and nose, forms at first a crust beneath which lies a superficial ulcer which exhibits a cicatricial tendency, drawing the skin into fine radiating wrinkles. The growth may remain small, superficial, and stationary for many years, or may gradually extend in all directions,

involving not only the soft parts, but the bones beneath, producing extensive destruction. The glands are not involved.

The fungating form, common about the lower lip, begins as an induration or as a persistent crusted ulcer which extends in all directions (months), is fungating, infiltrating, and destructive, and is attended by early gland involvement.

Fig. 95



Epithelioma. (Von Bergmann's clinic.)

The diagnosis of cancer of the face is based upon the presence of a persistent or recurring ulceration which is neither syphilitic nor tuberculous. It should be formulated while the ulcer is still small by excision under local anesthesia and microscopic examination. The fully developed lesion can be recognized across a public square, but the diagnosis is no longer serviceable.

Affections Characterized by Tumor of the Soft Parts without Inflammatory Phenomena.—**Lipoma.**—Lipoma (rare), when subcutaneous, exhibits the characteristic features of this growth. Exceptionally, it grows from the pad of fat lying along the anterior border of the masseter muscle, forming an obscurely fluctuating tumor projecting either externally or within the mouth. Diagnosis will be suggested by the extremely slow growth, but must be made by incision.

Fibroma.—Fibroma is often congenital, forming flat, wart-like indurations, associated with pigmentation, capillary dilatation, and local growth of hair. These growths may slowly increase, forming in the course of years pendulous and deforming flaps. The plexiform neurofibroma (congenital) involves the skin and underlying tissues in a highly characteristic nodular growth.

Hemangioma.—Hemangioma, present at birth, affecting by preference the faces of girl babies, in its capillary form appears as a red blotch, made more prominent by crying, often associated with pigmentation and overgrowth of hair. Its growth may be commensurate with the general increase in size of the body or it may extend with great rapidity.

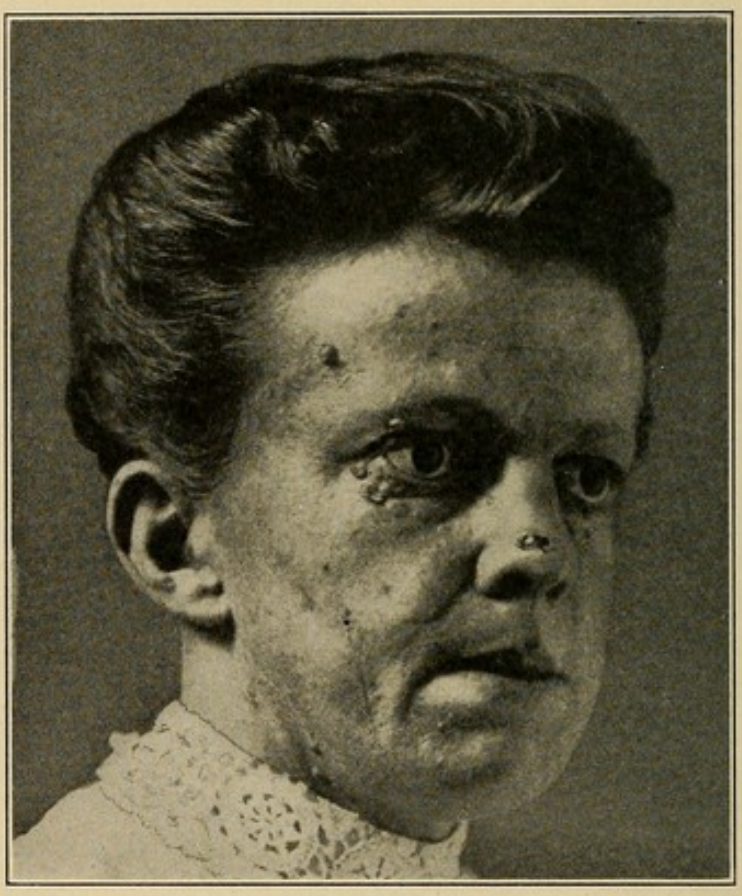
Cavernous hemangioma forms a typical, soft, ill-defined, dark bluish tumor which may be reduced by pressure and which increases in size from cephalic congestion. This growth is commonly associated with diffuse fibroma, and may cause great deformity. When placed beneath the temporal or the occipitofrontal fascia it may simulate meningocele.

Racemose angioma (rare) exhibits pulsation and dilated and tortuous bloodvessels.

Lymphangioma.—Lymphangioma forms diffuse, pasty infiltrations covered by normally colored skin, usually congenital, sometimes cystic. This dilatation of lymph vessels, often associated with hemangioma and fibrous infiltration, is the common cause of macroglossia and macrocheilia.

Sarcoma.—Sarcoma of the skin and underlying soft tissues of the face is marked by its rapid growth. Congenital multiple forms have been described. The orbit is the common seat, and it is distinguished by its rapid growth and prompt metastasis.

FIG. 96



Tricho-epithelioma. Benign cystic epithelioma. (Hartzell.)

Diagnosis should be based upon the excision and examination of an apparently causeless inflammation or enlargement of a mole or a pigmented spot, or the appearance of a tumor not obviously benign.

Sebaceous Cyst.—Sebaceous cyst, comparatively rare in the face, forms a small, hard, shining, round growth in the skin, often with a central aperture. It may become acutely inflamed or undergo calcification or malignant degeneration.

Dermoid.—Dermoid, usually at the upper outer quadrant of the orbit, forms a hard, round tumor beneath the skin and unattached to it. It indents the bone, and at times projects through this structure into the orbit. When placed on the bridge of the nose dermoid grows downward

beneath the nasal bone, displacing the cartilage. It is distinguished from sebaceous cyst by its deeper attachment, its position, and, when ulceration takes place, by the discharge of hair. Differential diagnosis cannot always be made.

Echinococcus and cysticercus cysts (rare) developing on the face may be diagnosticated as such only by associated lesions or by excision.

Cutaneous horns are recognized on sight.

Adenomata.—Adenomata of the sweat and sebaceous glands occurring in old people cause nodular infiltration, particularly near the angle of the eye. These superficially ulcerating may resemble beginning epithelioma. Diagnosis can be made only by excision.

Benign cystic epithelioma, usually appearing before puberty, form hard, indolent tumors, exhibiting little tendency to ulceration. The diagnosis is based upon the clinical course and microscopic examination.

Facial Neuralgia.—Facial neuralgia may be due to toxic conditions such as those incident to gout and rheumatism, may be a local expression of a general neuropathy, such as tabes, may be due to neuritis, or may be secondary to local causes such as carious teeth, otitis media, eye defects, inflammation of the maxillary or frontal sinus, or the pressure of growths.

Trifacial neuralgia independent of these causes is epileptiform in its manifestations. It is nearly always unilateral, usually spares the first division of the nerve, though radiations of pain may take place to this, and is often accompanied by slight spasm of the muscles of the neck and face. The disease is characterized by recurring violent attacks of pain, sometimes preceded by an aura, often sudden in onset, accompanied by reddening of the skin of the affected side, perspiration, and hypersecretion of saliva and tears. Between the paroxysms, which may be brought on by eating, talking, touching of sensitive points, there are intervals of complete relief. The affection attacks by preference middle-aged men. The diagnosis is suggested by the severity of the symptoms and the persistent recurrence. Hysteria must be excluded and from the therapeutic standpoint the epileptiform attacks, which are cured only by formidable operations, must be distinguished from those due to a peripheral source of irritation.

THE EAR.

The meatus and drumhead of the ear are examined by means of a conical speculum, light being furnished by a head mirror provided with a central aperture. This examination is facilitated by drawing the pinna upward and outward, since thus the meatus is straightened. The drumhead lies at about the depth of one inch in the adult.

The condition of the Eustachian tube as to its perviousness is determined either by inflating through the nose while the patient is swallowing,

or, more readily, though less accurately, by directing him to take a deep inspiration, close the mouth and nose with the hand, and endeavor to blow out through both at the same time. This, if the Eustachian tube be open, will cause a sense of fulness in the ears.

Hearing can be roughly tested by the watch, the patient being directed to close his eyes during this test. If impaired, the question as to whether the deafness be due to abnormality in the conductive or the receptive apparatus may be determined by means of a tuning fork. If this, while vibrating, have its handle pressed firmly upon the forehead, it will be heard most distinctly in the ear in which the conductive apparatus is deficient. In the normal ear the tuning fork should be heard by air conduction after the bone conduction has ceased to convey impression.

The symptoms of surgical affections of the ear are pain, alteration in the sense of hearing, and discharge, supplemented in the case of acute inflammation by the local and general symptoms of this condition.

Malformations.—**Congenital Deformities of the Auricle.**—These are sufficiently obvious to inspection. The tragus may depart from the normal either in size or conformation. Rolling in of the helix and flaring of the pinna are perhaps the two commonest congenital deformities.

Auricular appendages appearing as cartilaginous skin tabs are found on a line with the tragus and the angle of the mouth. The external ear may be entirely absent.

Congenital fistula from which there is an oily crusting discharge has been observed in the lobe of the ear.

Sebaceous cysts, angiomata, and fibromata are the usual benign tumors. Of the malignant ones, epithelioma is comparatively common as compared to sarcoma.

Wounds of the Ear.—**Contusion.**—Subcutaneous blood effusions, sometimes without history of trauma, especially frequent among the insane, reach their greatest size on the posterior outer surface, from which they are rapidly absorbed. When they develop on the inner surface they are usually associated with lesion of the cartilage, and, if the ear be subjected to repeated trauma, result ultimately in a thickening which obliterates the normal folds.

Wounds of the external auditory canal, if severe, are usually complicated with other more immediately urgent injuries.

Fracture of the bony meatus is most likely to be caused by force applied to the chin, driving the condyle upward and backward, at times to such an extent that it entirely obliterates the canal The characteristic symptoms are hemorrhage from the ear, pain located in front of the tragus and greatly aggravated by movement of the jaw, extreme tenderness at the same point, and subcutaneous blood effusion or actual break in the skin surface of the meatus, though the drum membrane is likely to be intact, nor is there interference with hearing. Trauma sufficient to cause this injury is usually associated with concussion of the brain and often with basilar fracture.

Wounds of the Tympanic Membrane.—Wounds, if from direct violence, are often due to maladroit efforts at extraction of foreign bodies. Violent

air concussion may produce rupture of this membrane. It is sometimes broken by insufflation, by a violent upward pull on the pinna, as the result of paroxysmal cough, or from excessive air pressure or the reverse.

The ruptures from indirect violence are usually incident to fracture of the base of the brain; exceptionally, to blows on the head in the absence of fracture. The lesion is characterized by severe but transitory pain, and bleeding from the ear, at times very free. Dulness of hearing is, as a rule, but slightly marked. Direct examination shows the lesion, the lips of which are commonly closed by a small blood clot.

Foreign Bodies.—Often found in children, they may occasion no symptoms excepting slight interference with hearing. As a reflex, persistent cough is frequently noted. As a rule, foreign bodies cause acute inflammation characterized by severe pain, swelling, and discharge of pus. Perforation of the drumhead and suppuration of the middle ear are likely to follow. Diagnosis is based upon direct examination.

Concretions of cerumen in the ear are characterized simply by deafness which comes on very slowly; at times with great rapidity. This is not infrequently associated with tinnitus and with headache and vertigo which closely simulate cerebral affections.

Acute Tympanic Congestion.—Acute tympanic congestion incident to exposure to cold, moderate trauma, or blocking of the Eustachian tube is characterized by an initial pain as severe as that which ushers in otitis media, and differs from the latter only in the fact that it shortly subsides under almost any treatment. It is common in children.

Acute Inflammation of the Auditory Meatus.—Acute inflammation of the auditory meatus may be circumscribed or diffuse. Furuncle usually begins with an itching sensation in the ear, followed by extreme pain, greatly aggravated by movement of the jaws. Usually the swelling is sufficient to entirely close the meatus, and deafness results. The affection is likely to be recurrent. Its diagnosis is based upon inspection. Diffuse inflammation of the auditory meatus is frequent in infants and a common accompaniment of cutting the teeth. It is often due to traumatism inflicted by ignorant nurses in their attempts to clean the ear, supplemented by infection through vomited matter or sometimes through milk directly injected. It is at times a complication of the exanthemata.

The characteristic symptoms are severe pain aggravated by movements of the jaw, great tenderness on touching the external ear, swelling obliterating the depression in front of the tragus, slight fever; deafness and tinnitus only when the meatus is swollen shut. The skin of the meatus is reddened and swollen and the tympanum is usually inflamed. The herpetic form is characterized by vesicles. In two or three days there is a moderate seropurulent discharge, sometimes only sufficient in quantity to cause crusting.

According to the particular form of infection the duration of the attack will be short or long. Exceptionally the disease involves both the tympanum and the bony canal of the meatus.

Distinction from furuncle is made by noting that the entire canal is swollen. The immunity of the middle ear can be determined only if the swelling be of such moderate degree as to allow the direct examination of the drumhead. When complicated by osteoperiostitis the distinction from middle ear disease is possible only on operation.

Chronic external otitis is usually a complication of chronic otitis media. There is often superficial caries of the bone, causing pain, swelling, and tenderness on deep pressure and the development of fungous granulations. Infection is sometimes conveyed to the temporomaxillary articulation. Nor is extension to the brain uncommon.

Tumors of the Ear.—*Polyps* have been observed in the external meatus. Many of the reported cases are, however, instances of exuberant granulations.

Exostoses, commonest among men, may be single or multiple. They grow slowly, causing inconvenience only when they obliterate. Diagnosis is based upon the density of the tumor, its indolent course, the absence ulceration or infiltration.

Inflammation of the Middle Ear.—Common in infancy and youth, is usually secondary to nasopharyngeal catarrh. It may be primitive in the tympanum incident to traumatism. It is a common sequel of influenza, typhoid fever, scarlet fever, measles, indeed of all the exanthemata. It may be catarrhal or frankly suppurative. In the latter case there is commonly inflammation of the surrounding bone.

Acute otitis media is characterized by severe pain and tension referred to the ear, which is tender to pressure on the tragus; pronounced deafness and tinnitus. These symptoms are aggravated by swallowing motions, coughing, or any change of air pressure in the nasopharynx. In the suppurative cases these symptoms become rapidly and progressively worse, the pain being unbearable in its intensity and referred to the whole side of the head. Constitutional symptoms of sepsis develop, together with those of meningeal irritation.

The attack sometimes begins with headache, vomiting, vertigo, and symptoms strongly suggesting meningitis, which in these cases is doubtless present. Facial palsy may develop early. The tympanic membrane, at first reddened, becomes dull and opaque, nor, excepting in the early congestive stage. can the handle of the malleus be seen. Because of the accumulation of inflammatory exudate the posterior part of the membrane is bulged outward.

When suppuration takes place, there are tenderness and swelling in the mastoid region and about the external ear, the drumhead ruptures, and pus and blood are discharged from the meatus. This is followed by immediate subsidence of symptoms and usually by cure with restoration of hearing which may be complete.

If pus is retained because of thickened, resisting tympanic membrane, acute osteomyelitis becomes a complicating factor with meningitis, sinusitis, thrombosis or brain abscess, profound sepsis, and pronounced swelling of the meatus and surrounding soft parts, most marked in the mastoid region. If death does not occur from sepsis and brain complica-

tions, there will be fluctuation, abscess formation, and exposure of dead bone.

Perforation of the tympanic membrane is rare in infants, nor can they intelligently voice their subjective symptoms; hence, when they present symptoms of sepsis and brain involvement, the ear should be carefully examined (Duplay). This rule should also hold good in case of children suffering from exanthemata, typhoid fever, and la grippe who exhibit marked symptoms of cerebral irritation.

FIG. 97

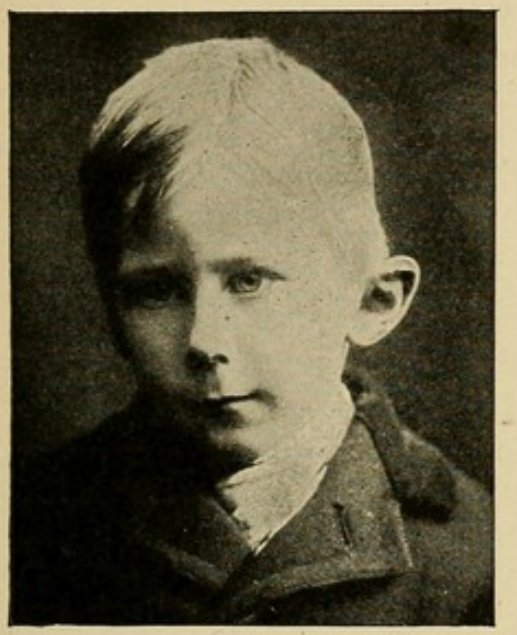
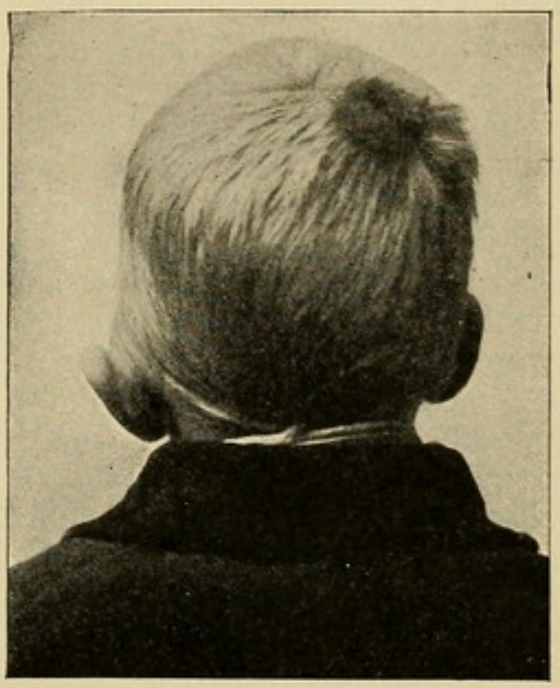


FIG. 98



Front and rear view of external swelling in otitis media. (Alderton.)

Chronic Suppurative Otitis Media.—Chronic suppurative otitis media is characterized by constant or recurrent, offensive, often blood-stained discharge from the middle ear, which escapes through a defect in the drumhead. The affection is indolent, subject to occasional painful exacerbations, and may interfere very little with hearing. It is often an expression of necrosis, and then presents exuberant granulations and an especially stinking discharge.

The diagnosis of middle ear disease is made by direct examination.

Polypi.—Polypi of the tympanum are usually mucous in character, and may be evidenced by vertigo, syncope, vomiting, and various nervous manifestations. They are usually characterized by mucopurulent discharge and deafness. The diagnosis is made by direct examination.

Cancer.—Cancer of the tympanum (rare) may be primary or secondary by invasion from neighboring tissues.

Symptoms are those of cancer elsewhere, *i. e.*, rapid progress and invasion of all tissues.

Cholesteatomata.—Cholesteatomata form yellowish grains made up of partly dried pus, epithelium, fat, cholesterin crystals, and detritus.

Symptoms are those of a chronic suppurative middle ear disease. The diagnosis is based upon the finding of the yellowish masses which are stinking and sufficiently soft to crush between the fingers.

Mastoiditis.—Mastoiditis, secondary to middle ear disease, is a common, often unrecognized, cause of high temperature and meningitis in infants. It is characterized by pain, swelling over the mastoid region, tenderness on tapping, and redness and infiltration of the posterior wall of the bony meatus, associated with constitutional symptoms of septic absorption.

The complications of acute or chronic inflammation of the tympanum, antrum, or mastoid cells are meningitis, sinus thrombosis, brain abscess, and non-suppurating encephalitis. Infection is usually direct, even in case of apparently deeply placed brain abscess.

These complications may develop in the course of an intercurrent acute attack of otitis, or in the absence of this, and long after discharge has entirely ceased.

Acute encephalitis appears as a limited area of hemorrhagic softening, and leaves on recovery a sclerotic patch (Starr). It exhibits the symptoms of cerebral abscess, nor can the differential diagnosis from this condition be made except by the progression of septic and pressure symptoms in the latter case.

Cerebral abscess usually in the temporosphenoidal lobe or cerebellum (p. 236) is characterized by an initial period of severe constant or recurring headaches, mental lethargy, irregular temperature and pulse, followed shortly (days or weeks) by pressure symptoms, *i. e.*, slow pulse, abnormal temperature (usually low), and late optic neuritis. If the temporosphenoidal lobe be involved, localizing symptoms may develop in the form of sensory or motor aphasia, cortical epilepsy, facial palsy.

If the abscess is in the cerebellum, staggering gait and vertigo and vomiting may be leading symptoms. Death in coma may occur quite suddenly without any of these localizing symptoms.

Meningitis is evidenced by its severe pain, rapidly progressive course, continued high temperature, rapid irregular pulse, general hyperesthesia, rigidity of the muscles of the back of the neck, and the presence of microörganisms and polymorphonuclear leukocytes in the cerebrospinal fluid obtained by lumbar puncture.

Sinus thrombosis (*exceptionally sterile*) is characterized by the symptoms of meningitis plus a more rapid and virulent systemic infection. The high temperature is subject to sudden and violent fluctuations with recurring chills. There is at times venous congestion of the side of the head, exophthalmos, and early development of choked disks. Extension into the neck is denoted by induration and tenderness along the jugular vein.

The differential diagnosis of these complications, one from the other, is of no importance if acute encephalitis be excepted, since they all require operative treatment which is successful in proportion to its timeliness.

THE EYE.

There are some skin lesions which exhibit a special predilection for the skin in the region of the eyelids.

Herpes.—Herpes, an occasional expression of fever, is characterized by vesicular lesions which usually appear in the form of a cluster or a coalescent patch. Herpes zoster is a specific exanthem the painful vesicular lesions of which are grouped in irregularly shaped inflamed patches along the cutaneous distribution of the frontal or nasal nerve. The area supplied by the supra-orbital nerve is the one commonly affected.

If the eruption involves the distribution of the nasal branch, conjunctival vesicles and corneal blebs, followed by ulceration and inflammation of the iris and ciliary body, are common accompaniments.

Furuncle, or Stye.—Furuncle, or stye, a marginal boil, usually acute in onset, rapid in course, and prone to recur, originates in a sebaceous gland or hair follicle, usually near the free border of the dermal surface of the upper lid.

The pre-auricular lymphatic gland is often enlarged.

Acute Chalazion.—Acute chalazion presents much the appearance of a stye. It arises in a meibomian gland.

Blepharitis.—Blepharitis or marginal inflammation of the eyelids may be non-ulcerative or ulcerative.

Ciliary, or non-ulcerative, blepharitis, the commonest form is characterized by redness and slight thickening of the margins of the lids with the formation of scales and small crusts. It is a form of seborrhea of the lid margin and is often accompanied by seborrhea of the eyebrows and scalp.

Ulcerative blepharitis is a special localization of eczema on the lid border. The discharge is more obvious than in the previous variety, the crusting more marked, and pustules and ulcers develop along the lid margins which in their cicatrization cause marked deformity. The eyelashes may be turned in or out or may be entirely shed. The external commissure is usually ulcerated, and cicatrices form here, while a similar condition about the internal commissure causes deviation of the lacrymal points or even their entire obliteration, with consequent epiphora.

Chancre.—Chancre forms an ulcerating, indurated surface which may manifest pronounced inflammatory swelling. The rapid course (days or weeks), the induration, the presence of the specific microörganism, and the glandular adenopathy are characteristic (pre-auricular if the lesion involve the outer portion of the lower lid; submaxillary if elsewhere).

Lupus.—Lupus attacks the lids by extension from neighboring parts, and appears in the form of reddish tubercles which usually terminate in ulceration and cicatrization.

Milium.—The eyelids are especially the seat of minute cysts due to obstruction of the sebaceous glands, forming whitish grains at times so numerous as to occasion considerable disfigurement.

Small translucent tumors from the sudoriferous glands are occasionally seen at the borders of the eyelids.

Chalazion, a benign newgrowth occurring in connection with a meibomian gland, and commonly attended with retention of the secretion, forms a rounded, yellowish or red, semitranslucent, dense tumor, usually about the size of a pea, and closely adherent to the tarsal cartilage. The direction of growth may be inward or toward the skin.

Xanthoma.—Xanthoma is characterized by the development, usually on the upper lids, of flat, slightly raised, non-indurated, non-inflammatory concentric patches of yellow discoloration.

Molluscum Contagiosum.—Molluscum contagiosum forms typical flat, rounded, split-pea sized, waxy elevations exhibiting a dark colored aperture from which curdy material can be expressed, and is associated with similar lesions elsewhere.

Angioma.—Angiomata, particularly in the form of birthmarks, are frequent.

Plexiform neuroma forms a disfiguring tumor, involving the skin and subcutaneous tissue, sometimes associated with diffuse lymphangioma and hemangioma.

Papilloma.—Papilloma is fairly common on the lids. It may become pedunculated, or on an elderly person undergo epitheliomatous degeneration.

Cutaneous horns have been observed.

Epithelioma.—Epithelioma, fairly frequent, is observed most commonly at the inner portion of the lower lid after the fortieth year. Blepharitis is a predisposing factor. A wart or seborrheic patch is often the starting point. It begins as a small, superficial, persistent ulceration. It is slow (years) in progression and usually of the rodent ulcer type, ultimately destroying all the neighboring structure including the eyeball. The diagnosis should be made early by wide excision and microscopic examination.

Sarcoma and Carcinoma.—Sarcoma and carcinoma of the lids (rare) conform to type in that they grow rapidly (weeks, months). Diagnosis should be made early by wide excision and microscopic examination. It would be suggested by exclusion of other causes for tumor formation and the absolute failure of less radical means of treatment.

Epiphora.—Epiphora, or habitual overflow of tears upon the cheeks, may be due to deviation of the puncta lacrymalia incident to inflammatory swelling, cicatricial contracture, or paralysis of the orbicular muscle; to narrowing or closure of the puncta or canaliculi, by inflammation, polypoid growth, or tear stone, to dacryocystitis or inflammation of the lacrymal sac, or to stricture or obliteration of the lacrymal duct.

Deviation or obstruction of the puncta or canaliculi can be detected by inspection and gentle probing.

Dacryocystitis.—Dacryocystitis is characterized by a swelling just below the inner canthus of the eye from which pus or mucus can be pressed through the puncta lacrymalia.

Acute inflammation is marked by pronounced swelling centring in

the position of the sac, but spreading widely and giving constitutional symptoms of septic absorption.

Fistula may follow suppuration, much resembling the sinuses not infrequent near this position as the result of syphilitic or traumatic caries of the lacrymal bone.

Stricture of the Nasal Duct.—Stricture of the nasal duct usually at its extremities is consequent upon a chronic catarrhal condition of the mucous membrane. It may be caused by nasal catarrh, necrosis of the bone, trauma, or the pressure of growing tumors. Its presence is determined by the use of lacrymal bougies, or by injecting fluid through the canal with an Anel syringe.

Affections of the Conjunctiva.—**Hyperemia.**—This affection, sometimes called dry catarrh, since it is unaccompanied by discharge, is characterized by an injection chiefly of the bulbar vessels and some swelling of the conjunctival follicles. Its chief causes are eyestrain, exposure to local irritants (for example, dust and smoke), the abuse of alcohol, nasal catarrh, acute coryza, or hay fever.

Sometimes an acute hyperemia is sudden in onset, and is associated with profuse lacrymation and a gritty sensation when the eyelids are moved. The presence of a foreign body is suggested, nor can this possibility be eliminated except as the result of careful examination, including eversion of the lid and inspection of the upper cul-de-sac.

Certain stubborn hyperemias of the conjunctiva are of constitutional origin, and may be significant of gout and, in general terms, lithemia.

Conjunctivitis.—This is a true inflammation of the conjunctiva, and is evidenced by redness and swelling of this membrane, increased and usually altered secretion, lacrymation, some photophobia, and burning pain. Certain definite varieties of this disease require special mention:

Simple, or Catarrhal Conjunctivitis.—In this affection there are congestion and loss of transparency of the tarsal conjunctiva, moderate dread of light, and a mucous and later mucopurulent discharge which slightly glues the lids. Such a conjunctivitis may be associated with eczema, nasal catarrh, bronchitis, and various fevers, or may be of mechanical origin from exposure to wind and dust, and is not specially contagious, nor are microörganisms of specific character found in its secretion, although the ordinary pus organisms, for example, staphylococci and streptococci, may be demonstrated. All ages of life are liable to catarrhal conjunctivitis, but it is more frequently observed in children and young persons.

Acute Contagious Conjunctivitis.—There are several varieties of this disease which in its symptoms resembles an exaggerated catarrhal conjunctivitis. After an incubation period of about thirty-six hours a severe form of inflammation develops, with thick, stringy, mucopurulent discharge, swelling of the retrotarsal folds, and not infrequently small, subconjunctival hemorrhages. Occasionally the inflammation is sufficiently violent to produce a distinct chemosis of the conjunctiva. The acute stage lasts from four to ten days. The disease may occur at any

age, is commonest in warm and changeable weather, and is markedly contagious. The active microörganism is the so-called Koch-Weeks bacillus.

Another form, which in all clinical respects resembles the one just described, is due to the presence of the pneumococcus, and like the Koch-Weeks bacillus conjunctivitis, is intensely contagious, and may occur in epidemics.

Another form is characterized by less marked inflammatory symptoms, the discharge is thinner and more copious, and the majority of the cases occur in young children, even in infants, in whom the affection is much more severe than in adults. The active microörganism is the influenza bacillus, which has many morphological characteristics resembling the Koch-Weeks bacillus.

Diplobacillus conjunctivitis, due to the Morax-Axenfeld bacillus, usually runs a subacute, rather tedious course, especially characterized by soreness of the commissural angles. It may also appear in acute manifestations with free discharge. It is quickly cured by lotions of sulphate of zinc which is practically a specific remedy in this affection.

Diphtheritic Conjunctivitis.—Diphtheritic conjunctivitis, at least the deep-seated or necrotic variety of the disease, is characterized by a board-like, painful swelling of the lids, a scanty, seropurulent or sanious discharge, and exudation within the layers of the tarsal conjunctiva, which may spread to the ocular conjunctiva. It is commonest between the ages of two and eight. At one time chiefly seen in France and Northern Germany, in recent years it has become more frequent in America and in England. The Klebs-Loeffler bacillus is found in the secretion, and, unless the process is checked, there will be rapid sloughing of the cornea.

Gonorrheal Conjunctivitis.—This may occur in babies and is usually known under the term *ophthalmia neonatorum*, the infection being derived during birth from the genital passages of the mother. In adults it is called *gonorrheal ophthalmia*, and is inoculated by fingers soiled by a gonococcal discharge.

The disease is characterized by a rapid, acute course. An abundant secretion of thick, greenish pus rapidly supervenes, pronounced swelling of the conjunctiva appears, which in its ocular portion may overlap the cornea, and in its palpebral portion may project as a thick, edematous fold beneath the enormously swollen lids. The diagnosis can be promptly made by examining the secretion and finding the gonococcus of Neisser.

All forms of acute purulent conjunctivitis may be complicated by corneal ulceration. This is uncommon in acute contagious conjunctivitis, but is exceedingly likely to occur in diphtheritic or gonococcic inflammation.

From the therapeutic and prognostic point of view an early determination of the cause of the acute conjunctivitis is of major importance. This can be made only by microscopic and bacteriological examination of the secretion and the detection of the microörganism which

is active, though a history of exposure to diphtheria or gonorrhea will be suggestive.

Many forms of purulent conjunctivitis, also in newborn infants, are due to microörganisms other than the Neisser coccus, for example, the pneumococcus, the Koch-Weeks bacillus, the bacterium coli, etc., and are not so serious in their prognostic import.

Phlyctenular Conjunctivitis.—This is characterized by pinhead-sized yellowish or dirty white spots on the ocular conjunctiva, each forming the apex of a triangle of dilated bloodvessels radiating from this point to the conjunctival cul-de-sac. These points may suppurate or become implanted on the cornea and develop into corneal ulcerations. The symptoms are aggravated when the phlyctenulæ are multiple, or are complicated by corneal ulceration. They are probably a manifestation of tuberculous infection.

Granular conjunctivitis, or *trachoma*, is a contagious affection among those poorly nourished and closely crowded. It is commonest among the Russian and Polish Jews and the Italians. Children under ten years old are less liable to the disease than adults.

Trachoma is evidenced by slight swelling and ptosis of the upper lid which on eversion exhibits small red or yellowish, semitranslucent, fleshy elevations which have been compared to grains of tapioca. There is ultimately always an associated conjunctivitis followed by cicatricial deformity of the lids, and vascularization (pannus) and ulceration of the cornea.

Follicular conjunctivitis due to lymphoid overgrowth of the follicles appears in the form of a catarrhal conjunctivitis of moderate severity associated with a linear arrangement of minute semitranslucent, light red grains in the conjunctiva of the lower lid which externally is reddened and swollen.

It differs from trachoma in that it causes neither cicatrices of the lid nor corneal vascularization nor ulceration.

Xerosis, or preternatural dryness of the conjunctiva, one of the sequels of neglected trachoma, is obvious on inspection.

Chancre has been observed primarily on the conjunctiva. Lipoma or angioma, polyps, small cysts movable with the conjunctiva, and dermoids have been noted.

Epithelioma and sarcoma are usually secondary.

Affections of the Orbit.—**Contusions.**—Contusion of the orbital margin is characterized by abundant subcutaneous blood effusion which may swell the lids shut in a few minutes. The vulnerating force may cause fracture which makes a direct communication between the orbit and the nose or its sinuses. The resultant hemorrhage may be expressed in the form of bleeding, subconjunctival hemorrhage, chemosis, and, if extensive, exophthalmos. Crackling on pressure is indicative of communication with the nasal cavities.

Fracture.—Fracture of the orbital brim may be detected by palpation, gentle massage enabling the surgeon to reach the bone even through a considerable blood effusion.

Fracture of the roof of the orbit, usually caused by violence applied to the forepart of the vault of the skull, in addition to the brain symptoms consequent upon trauma sufficiently severe to cause this injury, may be characterized by subconjunctival hemorrhage and at times blindness, since the optic foramen and consequently the optic nerve may be involved in this fracture.

Inflammation.—Acute inflammation of the cellulo-fatty tissue of the orbit, characterized by chemosis of the conjunctiva, exophthalmos, red, swollen, projecting lids, and pronounced constitutional symptoms of infection is usually secondary to inflammation of neighboring parts. Accessory sinus empyema, and the orbital thrombosis or lymphatic extension from carbuncle, boil, or erysipelas of the face are the common causes. The orbital cellulitis may be secondary to contusion with fracture into the sinuses, to direct wound, or to systemic infection (scarlet fever, typhoid, influenza, erysipelas). The most common cause is infection from the accessory nasal sinuses.

The diagnosis suggested by the symptoms given and usually by a preceding adjacent infection, and is corroborated by incision.

In the virulent forms of orbital cellulitis secondary to facial erysipelas or carbuncle, or to the extension of septic thrombosis from the cavernous sinus, death usually occurs before free pus formation.

Edema, chemosis, and exophthalmos incident to blood effusion or non-infected cavernous sinus thrombosis would not be attended by septic symptoms.

Tumors of the Orbit.—The diagnosis of tumor of the orbit is usually based upon a visible, palpable, circumscribed, non-inflammatory swelling, which in the case of vascular tumors varies in size and consistency in accordance with vascular tension and which may pulsate.

The benign tumor grows slowly, the malignant rapidly. When the diagnosis between these is doubtful it should be made by excision and microscopic examination.

Osteomata or exostoses appear as bony outgrowths from the orbital walls, often from the frontal sinus, and are characterized by slow growth, density of structure, and displacement of the eyeball. The *x*-ray picture is diagnostic.

When too deeply placed to be seen or felt, the symptoms which may suggest diagnosis are pain, displacement of the eyeball, interference with the action of the extrinsic eye muscles, and venous congestion of the eyelids and surrounding skin.

Tumors which arise from the orbital contents include hemangioma, lymphangioma, lipoma, fibroma, lymphoma, neuroma, simple and plexiform, and sarcoma, with which should be included endothelioma.

Simple angioma usually starts from a nevus of the lids extending inward. Sometimes it follows trauma. It forms a soft, pendulous, usually harmless mass in the upper part of the orbit, the tension of which is increased by straining efforts.

Cavernous angioma, of slow development, causes exophthalmos markedly increased by straining efforts. This, together with its ill-

defined outline, its apparent reducibility, and its change in size incident to vascular tension, is characteristic. Varices are described, particularly in the upper inner portion of the orbit.

Pulsatile tumor of the orbit, or pulsating exophthalmos, usually traumatic in origin, incident to basal fracture, is characterized by tinnitus, followed by venous congestion about the lids, bruit, pulsation, exophthalmos, usually unilateral, and chemosis. The usual cause is an arteriovenous aneurysm (internal carotid and cavernous sinus).

Palpation may reveal a tumor in the upper inner portion of the orbit made up of dilated vessels in which thrill can be distinctly felt. Vision is not always interfered with, though there is commonly palsy of the extrinsic muscles, particularly the external recti. In many cases, however, there are retinal hemorrhages and often neuritis and optic nerve atrophy.

Plexiform neuroma (rare) is a congenital tumor associated with a similar growth in the surrounding skin.

The lymphoma (Hochheim) may be simple, pseudoleukemic, or of doubtful nature. Leukemic tumors in both orbits occasionally appear in the form of multiple nodules associated with the symptoms of general leukemia.

Growths that have been called tuberculous are really extensions into the orbit from a tuberculous periostitis often at the orbital margin where an induration forms which softens and discharges a purulent material unassociated with inflammatory signs.

Sarcoma of the orbit, rare as a primary tumor and usually observed in young persons, may appear as spindle-cell, round-cell, or angiosarcoma, or most exceptionally as melanosarcoma. The growth develops rapidly (weeks or months), at times following trauma, and sometimes projects externally beneath the conjunctiva as a soft, elastic, lobulated tumor, which, depending upon its structure, may pulsate and apparently fluctuate. Osteosarcomata may develop slowly (months, years). Metastasis occurs early in the small round-cell growths, taking place through the blood stream; at a later period in the fibrosarcomata. True endotheliomata, often classified with the sarcomata, have only a local malignancy.

Primary sarcomata must not be confounded with those which appear in the orbit as extensions from the neighboring sinuses and from the choroid after rupture of the sclera. Under the last-named circumstances the growth is almost invariably pigmented.

Carcinoma grows from the lacrymal gland and closely resembles sarcoma in its development.

The diagnosis of malignant orbital tumors should be made by excision and microscopic examination of all tumors not obviously benign.

Cysts of the orbit are congenital or acquired. The congenital cysts include dermoids, teratoid cysts, inclusion cysts, meningoceles, and encephaloceles.

Teratoma (rare) appears obviously at birth associated with marked deformity of the eye.

Encephalocele and meningocele, common at the upper inner angle

of the orbit and the position of the lacrymonasal canal, are present at birth, and exhibit an underlying bony defect, though this cannot always be felt. Characteristic symptoms are usually absent, and the tumor may readily be confounded with lacrymal hydrops or cold abscess of the bone. Reducibility and changes in tension incident to straining efforts would be diagnostic if present.

Dermoids, the commonest form of orbital cyst, are commonly placed in the upper outer angle of the orbit. They are indolent, rounded tumors, usually not detected until about the age of puberty, when they begin to grow. They produce trouble only by mechanically displacing the tissues of the orbit.

The acquired cysts include implantation cysts derived from the conjunctiva, and serous cysts, which are of obscure etiology and may possibly arise in connection with the sheaths of the extrinsic muscles in the form of bursæ. Serous cysts may also be derived from hemorrhage in the orbit after degeneration of a blood clot. Extravasated blood in the retrobulbar tissue may become encapsulated and simulate a blood cyst.

Inflammatory Affections of the Cornea.—The cardinal symptoms of these affections are corneal opacity, usually associated with a pericorneal ring of injected bloodvessels, pain, photophobia, blepharospasm, hypersecretion of tears, and obscured vision.

Foreign Body.—Foreign body embedded in the cornea causes first the symptoms of hyperemic conjunctivitis with severe pain on motion of the lids, usually referred to the position of the superior cul-de-sac. Corneal ulcer with its characteristic symptoms develops later.

The detection of a minute body is accomplished by obliquely illuminating the cornea from the side by focussing light upon it through a lens while the observer inspects from in front through a hand magnifying glass; or by dropping upon the cornea a solution of fluorescein (2 per cent.) which colors green the abraded cornea and surrounds the dark foreign body by a green colored area.

Phlyctenular keratitis, common in strumous, catarrhal children who are convalescent from an exanthem, is characterized by the formation of minute disseminated vesicles or pustules in the outer corneal surface resulting in superficial ulcers. The deeper forms leave scars. Photophobia is intense, relapses are frequent. Eczema of the nares and scalp and the lesions and symptoms of an infective rhinitis are commonly present.

Ulcerations.—Ulcerations, superficial or deep, acute or chronic, centrally or laterally placed, may perforate the cornea, or, if they be acutely infected or sloughing (pneumococcus), may be complicated by pus in the anterior chamber. The ulceration occurs in those vitally depressed and as a result of traumatism or acute inflammation (conjunctivitis).

Neuropathic ulceration, characterized by central necrosis and perforation, is secondary to direct irritation of an eye which has lost its sensibility and is no longer protected by the lids, because of blocked innervation (trigeminal). It is a common sequel of Gasserian ganglion removal.

Vascular Keratitis.—Vascular keratitis is secondary to trachoma and recurrent phlyctenular keratitis. Over the clear corneal window there sweeps from above and below (weeks or months) a veil of fine blood-vessels preceded by a fringe of opacity.

Interstitial Keratitis.—This is usually due to hereditary syphilis, not infrequently to tuberculosis, and is characterized by corneal opacity due to a central infiltration, resembling ground glass. There is always pronounced vascularization, forming reddish patches, which may invade the entire cornea. Ulceration is rare.

Inflammatory Affections of the Iris.—**Iritis.**—Iritis is characterized by change in color and blurring of striation, a circumcorneal zone of congestion, contracted pupil reacting sluggishly or not at all to mydriatics, with adhesions to the capsule of the lens (posterior synechium), haziness of the cornea, impaired vision, severe pain in the eye, temple, and forehead, tenderness of the eyeball, and photophobia.

Plastic iritis, the usual form of the disease, is common in the first year of acquired syphilis. As an expression of rheumatism, gout, or gonorrhea, it is recurrent in type.

Uveitis.—Serous iritis is characterized by a pupil of normal size or, in its early stage, by one even moderately dilated, absence of early adhesions to the lens, haziness of the aqueous humor and cornea, with the deposit on the inner surface of this structure of dirty gray points grouped in triangular form with apices down. The anterior chamber is deepened. It occurs in late syphilis and in other infectious diseases, and may be a manifestation of intestinal autointoxication. A large percentage of the cases are due to tuberculous infection.

Acute Glaucoma.—Acute glaucoma, an affection of middle and old age, is characterized by increased hardness of the eyeball, swelling of the conjunctiva and eyelid, anesthetic and hazy cornea, clouded aqueous humor, fixed discolored iris with partly dilated pupil, rapid loss of vision, and intense headache. The attack may be preceded by a rapid failure in accommodation for near objects characterized by a frequent change of glasses, recurring periods of failing vision, and the perception of spectral halos about artificial light. It should be distinguished from iritis by the absence of synechiæ, the semidilated pupil, and by the marked elevation of intra-ocular tension.

Sympathetic Inflammation.—Sympathetic inflammation of one eye secondary to traumatic or perforating lesions involving the ciliary body of the other, usually develops within the first six weeks of the original lesion, and is characterized by the symptoms of iridocyclitis. A tender spot on the ciliary region may precede obvious symptoms.

Sympathetic irritation is characterized by photophobia, failure of accommodation, and tenderness of the sympathizing eye, and is promptly relieved by removal of the exciting eye. It may be regarded as a neurosis or else as an early stage of the infective uveitis just described, which it sometimes precedes.

Contusion of the Eye.—Sudden force applied to the eye may cause a flashing sensation followed by dilatation of the pupil, obscuration of

vision, or even temporary loss of sight; this in the absence of demonstrable lesion. The diagnosis is based upon the transitory nature of the symptoms and the exclusion of intra-ocular lesions by ophthalmoscopic examination.

Severe contusion usually causes hemorrhage into the anterior chamber, obscuring deeper lesions, the commonest of which are dislocation of the lens, detachment of the ciliary margin of the iris, and blood effusion between the retina and the choroid.

Rupture of the sclera is characterized by prolapse of the choroid, or escape of the vitreous into the subconjunctival space where it may appear as a yellow-green jelly. There is usually abundant subconjunctival hemorrhage.

Foreign Body.—Foreign body in the eye is characterized by a wound of entrance and intra-ocular bleeding. When the latter is marked, the presence and position of the foreign body must be determined by the *x*-rays, provided it is of such nature that it will cast a shadow on the plate, *i. e.*, if it is iron or steel. Its presence may also be determined by the use of a large magnet, with which it is drawn either into the anterior chamber, through the wound of entrance, or through a scleral incision placed according to the findings of the *x*-ray plate.

Paralysis of the External Ocular Muscles of the Eye.—Paralysis of an ocular muscle may be caused by an intracranial or an orbital lesion. The intracranial lesion may be cortical, nuclear, fascicular, or basal in situation. The palsies of basal or orbital origin are due to inflammatory lesions, tumors, aneurysm, hemorrhage, or fracture.

Syphilis is the most frequent cause of extra-ocular muscle palsy, and is the potent factor in about one-half of the cases. Other causes which may occasion nuclear or peripheral lesions are rheumatism, gout, diabetes, whooping cough, influenza, herpes zoster, and certain toxic agents, for example, lead, alcohol, gelsemium, carbonic acid and various ptomains.

A paralysis of the external ocular muscles is seen in connection with locomotor ataxia, paretic dementia, disseminated sclerosis, and bulbar paralysis.

Tabetic paralysis is often transitory in nature, but prone to relapse, and is usually associated with the pupillary changes and motor and sensory symptoms characteristic of this affection.

Paralyses of the orbital muscles of cerebral origin may result from degenerative, hemorrhagic, or neoplastic lesions affecting the cortex of the brain, the corticopeduncular region, the nuclei of the nerves, or the nuclear fibers.

Palsy of traumatic origin may be immediate and complete incident to direct injury, or to lesion consequent upon basal fracture or to pressure due to hemorrhage. A rapidly (days) developing palsy following injury may be due to traumatic reaction; or, should it come on more slowly (weeks), to formative periostitis.

A number of cases of congenital paralysis are on record, and occasionally congenital syphilis is an etiological factor.

Paralysis of the abducens supplying the external rectus is most frequently encountered; next in order of frequency is unilateral paralysis of the oculomotor. After these come in order paralyses of the superior oblique, inferior rectus, superior rectus, internal rectus, and inferior oblique.

The general symptoms common to paralysis of the external ocular muscles are the following:

1. Loss of binocular single vision, or diplopia; always most manifest in that portion of the field to which the affected muscle normally rotates the eyeball.

2. Strabismus, quite evident if the paralysis is complete, demonstrable, at times, only when the eye is turned toward the affected side, due to the unresisted action of the antagonist of the paralyzed muscle.

3. Limitation of that movement which is given to the eye by the affected muscle. The deviation of the eye is always in a direction opposite to the action of the muscle.

4. False projection of the field of vision. This depends upon an inaccurate estimation of the position of an object situated in such a portion of the visual field that it requires an effort on the part of the affected muscle to turn the eye toward it. For example, if a patient with a paretic left external rectus is required to touch an object to the left of the point of fixation, he will pass his hand beyond it, that is, to the left of it. Other marked symptoms are vertigo and an altered position of the carriage of the head, which is placed in such a position as to give the patient the least trouble with his double images.

If there is complete paralysis, a diagnosis is easily made by remembering the dominant action of each ocular muscle, namely, that the external muscle rotates the eye outward, the internal rectus inward, the superior rectus upward, and the inferior rectus downward, while the superior oblique has for its muscular actions intorsion, that is, it rotates the vertical meridian inward and also lowers and abducts the eye, while the inferior oblique produces extorsion, that is, it rotates the vertical meridian outward and also elevates the eye and abducts it.

Single ocular muscle palsies are often so incomplete that the defects in the rotations of the eyeball are not appreciable on inspection. The affected muscle must then be determined by applying the law of diplopia.

The patient seated with the head and eyes in the primary position, about 4 meters from a test object, for example, a candle flame, has one eye covered with a piece of red glass. If diplopia is developed, one image will be yellow and the other red. The lighted candle is then moved from the median line to the right, to the left, upward, downward, and in oblique positions. Double images are chiefly seen when the eyes are turned in the direction requiring an action of the affected muscle. The image of the affected eye, that is, the false image, is projected in a direction toward which the paralyzed muscle normally rotates the eye. When the test object is moved in the direction of the paralyzed muscle, the distance between the double images increases.

There are two varieties of diplopia, according to the relation which the double images bears to the eyes. If the right image pertains to the right eye and the left image to the left eye, the diplopia is homonymous; if the right image pertains to the left eye and the left image to the right eye, the diplopia is crossed. If the images are side by side, that is to say, there is lateral diplopia, either the external or the internal rectus is affected. If the diplopia is homonymous and is most marked when the test object is carried into the right field, the right external rectus is affected. If the diplopia is crossed, there is paralysis of an internal rectus, the internal rectus of the left eye if the images separate to the right, and the internal rectus of the right eye if the images separate to the left.

Vertical diplopia in the upper field indicates paralysis of the superior rectus, or the inferior oblique; if the vertical diplopia is chiefly noticed in the lower field, there is indication of paralysis of the inferior rectus or the superior oblique. If the diplopia is homonymous and vertical in the upper field, there is probably paralysis of an inferior oblique, the right if the image of the right eye is higher, the left if the image of the right eye is lower. If the diplopia is crossed and vertical in the upper field only, there is probably paralysis of a superior rectus, the right superior rectus if the image of the right eye is higher, the left superior rectus if the image of the right eye is lower. If there is vertical diplopia chiefly in the lower field and it is homonymous, there is probably paralysis of a superior oblique, the right superior oblique if the image of the right eye is lower, the left superior oblique if the image of the right eye is higher. If the diplopia is crossed and vertical in the lower field only, there is probably paralysis of an inferior rectus, the right inferior rectus if the image of the right eye is lower, the left inferior rectus if the image of the right eye is higher.

A certain number of ocular paralyses are *associated*, that is to say, the eyes cannot make certain movements in which they are usually associated, although the directing power of the muscles may be uninjured when they exercise their function in a different association. For example, the internal recti may be unable to draw the eyes together in the act of convergence, although they may act normally in helping to move the eyes from side to side. These are the *conjugate lateral paralyses*, and depend upon lesions affecting the centres of combined movement, or upon symmetrical disease of the nuclei of the affected nerves.

Sometimes, for example, in apoplexy the head is drawn from the paralyzed side and the eyes are also turned to the sound side, that is, there is *conjugate deviation of the head and eyes*. In lesions of the hemisphere the eyes are turned toward the lesion and away from the paralyzed side, but in lesions of the mesencephalon they are turned away from the lesion and toward the paralyzed side.

When there is complete paralysis of all the muscles of the eye, the term *ophthalmoplegia* is applied, that is to say, there is ptosis and complete immobility of the eyeball. Such conditions may depend upon diseases of the nuclei, for example, a hemorrhagic polioencephalitis,

tuberculosis, syphilis, ptomain poisoning, acute poliomyelitis, bulbar palsy, etc.

If only the branches of the oculomotor are affected, either peripherally or centrally, there is ptosis and complete immobility of the eyeball except in so far as the movements of the external rectus, which is supplied by the abducens, and the superior oblique, which is supplied by the fourth nerve, are concerned; outward movement and intorsion, that is to say, wheel movement inward, are preserved.

Paralysis of the ophthalmic division of the fifth nerve causes anesthesia of the conjunctiva and cornea and strongly predisposes the latter tissue to ulceration. It has often been noted after excision of the Gasserian ganglion.

Paralysis of the sympathetic in the neck causes contraction of the pupil, slight sinking inward of the eyeball, and is sometimes a symptom of cervical fractures, tumors, and aneurysm.

The practitioner should be able to make a differential diagnosis between a concomitant squint, one in which the squinting eye follows in all particulars the movements of the non-squinting eye, and a paralytic squint, one in which the rotation in the line of direction of the action of the affected muscle is limited. The common crossed eye of childhood which depends upon the presence of refractive error, usually hypermetropia, amblyopia of one eye, and failure of proper development of the fusion sense, is readily differentiated from a strabismus caused by paralysis of the external rectus by noting that in the paralysis the outward movement of the eye would be lost or diminished, while in the concomitant strabismus it is unimpaired. Diplopia in association with concomitant strabismus is unusual. If sought for it is always found in the various types of paretic or paralytic strabismus.

THE NOSE.

The nose forms the channel for normal respiration, contains the organs of smell, is an important adjunct to the sense of taste, and imparts resonance to the voice. The symptoms of its disease are deformity, anterior or posterior discharge, nasal obstruction, attested, if bilateral, by mouth breathing and nasal speech, and loss or diminution of the sense of smell. Because of the great vascularity bleeding is common.

Chronic mucous or mucopurulent discharge is symptomatic of hypertrophic or atrophic rhinitis, or of catarrh secondary to obstruction from polyps, tumors, deviated septum or non-ulcerating, syphilitic infiltration. Chronic, frankly purulent, abundant discharge is usually due to sinus empyema, dead bone, or foreign body.

Free hemorrhage (epistaxis) is usually traumatic. If slight but dangerously persistent, is hemophilic. It is symptomatic of Bright's disease, cirrhosis, cardiopathies, gout, typhoid, indeed, all eruptive fevers. It is common in children, and is in them usually due to a slight underlying mucous membrane lesion. It is at times menstrual. Excep-

tionally, it is associated with intranasal angioma. Free serous discharge is observed in the early stage of acute coryza; if continuous and not associated with inflammatory symptoms, it is cerebrospinal fluid (fracture of the base, hydrocephalus).

Examination of the nasal cavities is conducted by means of a headlight, a dilating speculum, and long-handled rhinoscopic mirrors. It is preceded by swabbing the nasal mucous membrane, the base of the tongue, both surfaces of the soft palate, and the nasopharynx with a 10 per cent. solution of eucaine lactate, containing adrenalin chloride 1 to 10,000.

Digital examination of the nasopharynx is serviceable when the mirrors cannot be used.

Congenital Deformities.—The nose may be double or bifid. The nostrils may be narrowed or occluded, in the latter case usually far back, by a diaphragm.

Acquired deformities incident to traumatism or inflammation (usually syphilitic) are characterized by lateral deviation, or sinking in of the bony or cartilaginous framework, or both, or occlusion of the nostrils by septal overgrowth or adhesions between the septum and the turbinates.

Traumatisms.—**Contusion.**—This is characterized by free bleeding from the nostrils, usually moderate, subcutaneous blood effusion, and swelling. There may be found a septal hematoma forming a dark, rounded, soft projection partially or completely obstructing the nostril. When these blood bosses are found on both sides of the septum, and particularly when there is intercommunication between them, fracture is present.

Fracture.—Fracture of the nose is usually found in the lower third of the nasal bones and the cartilaginous septum. The nasal process of the superior maxillary, the lacrymal, the sphenoid, or the ethmoid may be involved. These fractures are often comminuted, and, because of the closely applied mucous membrane, there is free epistaxis, often subcutaneous emphysema which may appear in the orbit and produce exophthalmos. In the absence of great swelling, deformity and crepitus are elicited without difficulty.

The septum should always be examined, since a break in its cartilaginous portion or disjunction of this portion from its union with the vomer is common. In either case, if there be overlapping, the nose will be sunken, deviated, and preternaturally mobile. Bilateral septal bosses are characteristic, and, by means of a probe or the finger, deformity can be felt and corrected.

Force sufficient to fracture the base of the nasal bone is usually complicated by a basal fracture and brain symptoms. It is also likely to involve the perpendicular plate of the ethmoid.

Affections of the Nasal Orifice and Vestibule.—**Erysipelas.**—Erysipelas has its common point of departure from about the nose (see p. 75).

Furuncle.—Furuncle commonly placed just within the nasal orifice, often recurring, is characterized by the severe pain which it causes in this position.

Acute erythema and eczema are common accompaniments of nasal catarrh.

Acne Rosacea.—The thick, vascular, closely adherent skin overlying the alæ and tip of the nose is peculiarly subject to acne and vascular dilatation, producing a red, nodular overgrowth common in habitual drinkers but not confined to them.

Ulcerations.—Ulcerations are syphilitic, tuberculous, or malignant. Chancre may begin on the skin surface or just within the nostril; in the latter case incident to infection carried by the finger. The apparent causelessness, the rapid growth (weeks), the induration, the subjective symptoms, and particularly the characteristic adenopathy, should at least suggest a diagnosis. A septal chancre is usually not suspected until secondary eruptions develop.

Tuberculous ulceration in the form of lupus has already been described (p. 247).

Malignant ulceration, common about the nose of the elderly, begins as an indolent, persistent, scabbing, superficial ulcer, the true nature of which can be detected at a serviceable time only by excision and examination.

Elephantiasis.—Elephantiasis exhibits a predilection for the nose, producing hideous disfigurement.

Affections of the Mucous Membrane Characterized by the Rapid Onset (Hours or Days) of Inflammatory Symptoms.—Acute Rhinitis (Coryza).—Commonly attributed to exposure to cold, it is usually an expression of a toxemic condition (measles, typhoid, etc.), or of a reaction against an irritant, such as pollen (rose cold, etc.), or bacteria.

It is characterized by heat, redness and swelling of the mucous membranes of the nasal cavities, accompanied by first serous then mucopurulent dischage. The swelling obstructs nasal breathing, lessens or entirely suspends the sense of smell, and diminishes the acuteness of the sense of taste. Tinnitus and dulled hearing are the expressions of an accompanying nasopharyngeal catarrh. Involvement of the frontal sinus is evidenced by dull frontal headache, which becomes extremely severe if the infundibulum be blocked, and is then subject to sudden remissions often preceded by a bubbling sound. This infection, if grippal, commonly extends to all the nasal mucous surfaces and downward to the lungs, and is accompanied by the general pains and fever of septic toxemia.

Diphtheritic rhinitis is characterized by the severity of both the local and constitutional symptoms and the finding of the bacillus. This infection may occur in the absence of throat involvement, and may assume a chronic form with persistent toxemia as its most pronounced manifestation.

Foreign Bodies and Nasal Calculi.—Foreign bodies are characterized by obstruction of one fossa and a unilateral, purulent, blood-streaked discharge often associated with recurring slight attacks of epistaxis. It is commonest in children. Diagnosis, suggested by discharge from one nostril, is confirmed by careful examination. A foreign body, if

not removed, may lie embedded in a mass of granulation tissue closely resembling cancer.

Maggots have been observed in the nasal fossa.

Nasoliths cause the symptoms of foreign body—with, however, a more gradual onset.

Affections Characterized by Chronic Nasal Discharge.—All obstructive lesions are accompanied by chronic rhinitis, including under this heading septal deflections or overgrowths, foreign bodies, diseases of the accessory sinuses, and syphilitic or tuberculous infiltration and ulceration.

Chronic Rhinitis.—Chronic rhinitis may be hypertrophic or atrophic.

Hypertrophic rhinitis is characterized by mucopurulent discharge and nasal obstruction aggravated by slight causes. Examination shows a vascular, freely secreting, sometimes crusted, mucous membrane, so thickened as to fill the nasal cavity. The turbinals are often edematous, suggesting the appearance of a sessile polyp.

Atrophic rhinitis, common in the female, and to an extent hereditary, is characterized by a sweetish, sickening stench appalling to everyone but the patient. The nasal fossæ are unduly roomy, and to the atrophied mucous membrane adhere foul crusts which come away reluctantly, leaving eroded mucous membrane. Syphilitic, neoplastic, and foreign body rhinitis may all give an offensive odor, but resemble atrophic rhinitis in no other respect.

Tertiary Syphilis.—Tertiary syphilis in the form of gummatous infiltration may rapidly destroy both the bones and cartilages of the nose. The intranasal affection begins insidiously and painlessly. It is usually symptomless until it reaches the ulcerating stage, where it is characterized by a discharge which is peculiarly offensive, often streaked with blood and shortly contains fragments of bone or cartilage.

Diagnosis is based upon profuse offensive discharge, direct examination which either to the eye or to the probe may evidence the existence of exposed bone or cartilage, and the history of preceding syphilis with the associated signs of this affection. Deformity produced by ulcerating gumma is highly characteristic, nor is there any other affection which can cause this in the same insidious manner.

Gummatous infiltration of the cartilaginous septum is the usual cause of perforation. This result may also follow abscess or simple ulcer due to the habit of picking the nose.

Perforations of the palate are usually due to the gumma beginning on the nasal aspect of this bone, and not appearing as a swelling on the roof of the mouth until the bone has been destroyed.

Tuberculosis of the Nose.—Usually in those suffering from advanced tuberculosis elsewhere, has for its seat of preference the cartilaginous septum forming at this point usually a single, irregular, superficial, persistent, chronic ulcer near the nasal orifice. Around this ulcer small, semitranslucent tubercles are sometimes seen.

A rare form of nasal tuberculosis occurring in those without other signs of the disease is in the form of ulcerating vegetation also placed on the

cartilaginous septum and at times causing perforation. This is accompanied by enlargement of the submaxillary glands. The distinction from syphilis and early carcinoma can be made only by microscopic examination of the exsected tissue.

Tumors of the Nose.—Nasal Polypi.—Nasal polypi, the commonest tumors of the nose, constitute jelly-like, usually pedunculated, sometimes sessile masses, single or growing like a bunch of grapes, and varying in size from that of a pinhead to that of a pigeon's egg. They usually grow from the middle meatus or the corresponding turbinal bone. Exceptionally they are more posteriorly placed on the extremities of the turbinals, though they may grow from the frontal, maxillary, or sphenoidal sinuses.

The affection is one of the adult. It is characterized by discharge, obstruction, tendency to bleed slightly on blowing of the nose, and loss of the sense of smell, usually unilateral and worse in damp weather.

When the polyps reach large size they produce pressure distortion or frog-like expression to the face. Examination shows the shining gray, jelly-like, freely movable masses.

Osteoma.—Osteoma (commonest in the frontal sinus) may grow from any portion of the nasal wall or its accessory cavities. It forms a hard, bosselated, irregular tumor of slow growth, which may be very slightly or not at all adherent to its point of original outgrowth. Its symptoms are those of obstruction if it grows into the breathing passages, or of pressure expressed in the form of headache, neuralgia, and deformity, the latter dependent upon the direction of growth. Usually manifest in the orbit when the growth is from the frontal sinus, pushing the eye downward, forward, and outward. Osteoma from the maxillary sinus usually projects the cheek. The growth may come from the sphenoid or ethmoid sinuses. The diagnosis is based upon the *x*-ray picture.

Epithelioma.—Epithelioma attacking the inner surface of the nostril in the form of rodent ulcer is characterized by a slow but destructive persistence. Syphilitic lesions are all more rapidly destructive, and yield promptly to treatment. The diagnosis should be made, after excluding syphilis, by wide removal and microscopic examination.

Sarcoma.—Sarcoma, particularly upon the septum in young people, is characterized by its rapid infiltrating growth, by recurrent bleedings, and stinking discharge. The diagnosis should be made on excluding syphilis by wide removal and microscopic examination.

Affections of the Sinuses Communicating with the Nose.—Inflammation of the Maxillary Sinus.—This is secondary to erysipelas or abscess of the face, inflammation of the mucous membrane of the nose, or to caries of the teeth, especially the first and second molars.

When the opening from the antrum into the middle meatus is sufficiently patulous to prevent tension from retained secretions, the symptoms may be confined to a profuse, purulent, intermittent nasal discharge running freely when the head is bent well forward, and turned toward the sound side, and coming from the middle meatus.

When the opening into the nose is blocked, in addition to constitutional

symptoms there is severe suborbital pain, often involving the teeth, rapid, edematous swelling of the cheek of the affected side, obliteration of the canine fossa, and shortly (days) crackling on pressure in this region due to erosion of the bone.

Transillumination, accomplished by an electric bulb held in the mouth with the lips closed, will show in a darkened room a shadow in contrast to the pink of the healthy side.

In the direct examination of the nasal cavity the pus is cleared away from the middle meatus and the patient is directed to tip the head well forward and toward the normal side. A free flow of pus from the middle meatus is characteristic of suppuration of the maxillary sinus.

Finally, if other diagnostic means fail, or in corroboration of these, a needle of large caliber attached to an aspirating syringe is passed along the inferior meatus to the depth of one and one-half inches, and is driven obliquely outward and upward into the maxillary sinus, which is then washed out with a boric acid solution.

As a result of suppuration of the maxillary sinus, particularly that due to periostitis of dental origin, fistulæ may form, opening into the face or the cavity of the mouth.

Mucous Cysts of the Sinus.—Mucous cysts of the sinus, due, in part, to obliteration of its orifice or cystic dilatation of its glands, cause no symptoms, except perhaps preliminary toothache and pressure upon the infra-orbital nerve until their growth is sufficient to cause tension. There then develops a tumor due to yielding of the bony wall of the sinus in all directions. The thin crackling bone finally allows fluctuation to be detected.

Mucous cyst is an affection of young people, and cannot be distinguished from malignant growth except by its slow progression, its absence of infiltration, and the result of operation.

Tumors.—Tumors originating in the maxillary sinus cannot be recognized until, by their growth, they displace or infiltrate the bony walls and produce deformity, though the frequently associated signs of sinus suppuration with pain in the cheek and teeth may even early in their course suggest an exploratory operation.

Myoma, osteoma, fibroma, enchondroma, have all been observed. Sarcoma is the commonest malignant tumor starting from the septum or the walls of the accessory sinuses, and characterized by rapid progress, infiltration, and destruction of the bony envelope, progressive invasion of the surrounding soft parts, and, in the case of carcinoma, early involvement of the cervical ganglia.

In the carcinomatous form these tumors develop in people past middle life, and all are usually characterized by extreme pain.

Both the benign and the malignant growths cause a sense of weight and tension in the face, swelling of the cheek, bulging of the palate, obstruction of the nasal fossa, exophthalmos, and loosening and falling of the teeth, all expressions of their eroding or infiltrating growth.

Inflammation of the Frontal Sinus.—Inflammation of the frontal sinus, exceptionally traumatic, is secondary to infection of the mucous mem-

brane of the nose, particularly that of the middle meatus or to syphilitic inflammation of the surrounding bone.

Acute inflammation, with the infundibulum not entirely occluded, is characterized by a nasal discharge and dull pain in the forehead and at the root of the nose, greatly aggravated by blowing the nose. When the infundibulum is occluded, the pain is severe and may be agonizing in its intensity, tenderness over the sinus is marked, best elicited by upward pressure at the upper inner angle of the orbit, internal to the supra-orbital notch, and there shortly develops swelling in this sensitive region. Or, if the septum be incomplete, the swelling may be bilateral. An associated osteitis and necrosis allows of pus escape either into the nasal cavity or into the orbit, causing in the latter case exophthalmos, orbital swelling, and usually the presence of a fluctuating tumor.

The diagnosis of acute sinusitis with obstruction is obvious.

Chronic empyema of the sinus gives a free discharge of pus on rising in the morning, a dull shadow on transillumination, usually frontal headache, often most severe in the morning and subsiding at night, much aggravated by intercurrent attacks of nasal catarrh and relieved by free discharge, and supra-orbital tenderness and neuralgia. A positive diagnosis can be made by catheterizing the infundibulum. This is often not practicable until a portion of the midturbinal has been excised. Direct examination shows the discharge coming from the middle meatus. The *x*-rays and transillumination are helpful, at times diagnostic. Meningitis, brain abscess, and sinus thrombosis are occasional sequelæ.

Tenderness of supra-orbital neuralgia is most marked over the nerve trunk, that of frontal sinus disease within this point.

Tumors.—Tumors of the frontal sinus cannot be detected until they cause marked deformity usually of the upper inner orbital wall.

Inflammation of the Sphenoidal Sinus.—Inflammation of the sphenoidal sinus, secondary to rhinitis, particularly that incident to la grippe, polyp, and syphilitic necrosis of the body of the sphenoid, is characterized by purulent nasal discharge, headache, often referred to the occiput or the region of the mastoid, at times by lacrymation, blepharospasm, photophobia, and optic neuritis. The pus runs back into the pharynx, and, being moderate in quantity, crusts in this position. Meningitis, cerebral abscess, thrombosis of the cavernous sinus, orbital phlegmon, amaurosis, fatal hemorrhage, and retropharyngeal abscess are complications.

Inflammation of the Ethmoid Cells.—Inflammation of the ethmoid cells secondary to nasal infection is characterized by escape of pus from the middle meatus if the anterior group be involved, from the superior meatus if it comes from the posterior group. There is severe pain felt behind the globe of the eye, greatly aggravated by pressure upon the base of the nasal bones, and a condition of chronic sepsis. Necrosis is a common accompaniment, with intracranial complications.

Diagnosis is based upon exclusion of involvement of the larger sinuses, and particularly the detection of dead bone by means of a probe.

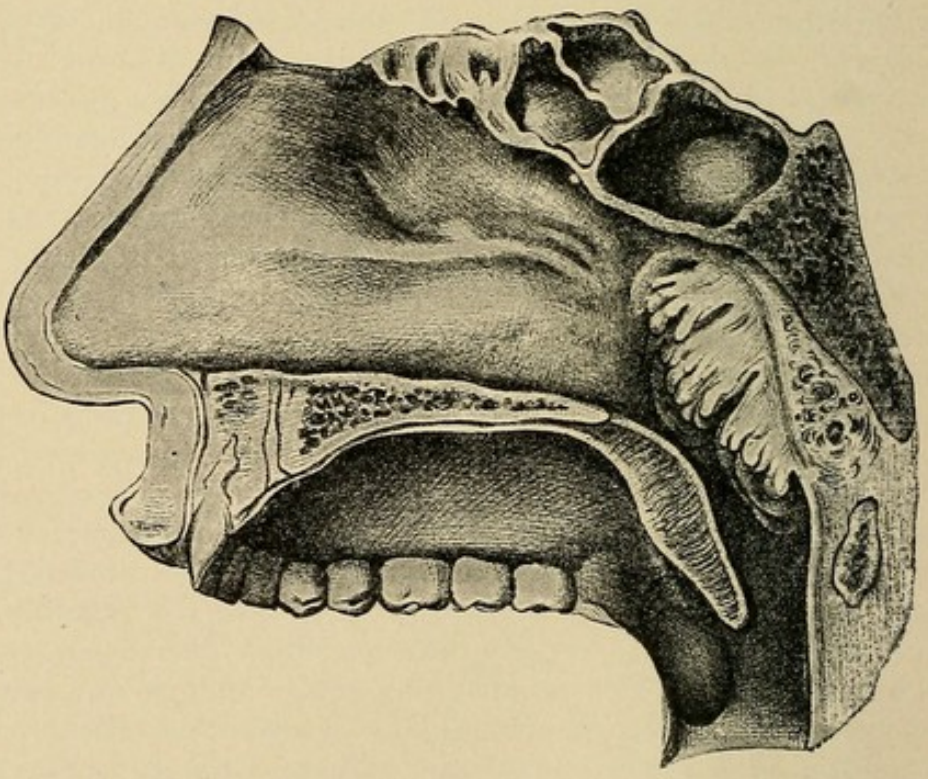
THE NASOPHARYNX.

The inflammatory affections of the nasopharynx are those of the nose. In addition, it is subject to adenoid and fibromatous growth.

Adenoid Growth.—Adenoid growth is particularly common in catarrhal children with big tonsils and enlarged glands of the neck. Heredity is a predisposing factor.

The characteristic symptoms are mouth breathing, which may be of immediate serious moment in an infant, snoring, and difficulty in articulating the nasal consonants and their combinations. Children thus afflicted sweat easily and have a stupid apathetic expression. The flaccid lower jaw, always swung open, and the short upper lip exposing the incisor teeth are characteristic. The ears are often affected from the associated nasopharyngeal catarrh.

FIG. 99



Anteroposterior section of the head of an adult, showing the situation and gross structure of hypertrophy of the lymphoid tissue of the nasopharynx. (Zuckerkandl.)

If the turbinals be not enlarged these adenoids can be seen by anterior rhinoscopy; usually the posterior examination will be necessary, or, if this be resisted, the diagnosis can be made by digital examination, though in well-marked cases an immobile palate pushed well forward will demonstrate the presence of growth behind it.

Nasopharyngeal Fibroma.—This grows usually from the basilar surface of the occipital bones of males between the fifteenth and twenty-second

years. This age limit does not obtain in the few cases observed in the female. It may also grow from the internal pterygoid plate or from the upper cervical vertebræ. The symptoms are those of nasopharyngeal tumor, *i. e.*, obstruction to breathing, loss of taste, often headache, and mucous discharge from the nasopharynx. The examination at this stage will usually show the palate depressed and the whole nasopharynx filled with a red, nodular, hard, highly vascular, slightly movable growth, bleeding readily on examination. The growth is slowly progressive (years), displaces and erodes the bones, and invades all the neighboring cavities, producing exophthalmos and hideous deformity and ultimately signs of intracranial pressure.

From malignant infiltration the affection is characterized by mobility, its comparatively slow growth, absence of ganglionic enlargement and its density of structure. It pushes all before it and destroys by pressure, but does not infiltrate. These tumors in some cases are fibrosarcomata. In the pure fibromata a recessional tendency has been observed after the twenty-fifth year.

Angioma.—Angioma has been observed as a rounded, smooth, dark-blue, elastic tumor, bleeding readily and freely.

Chondroma.—Chondromata (rare), characterized by their cartilaginous hardness, grow slowly from the cartilages and are prone to recur after removal. They are usually mixed tumors.

THE LIPS.

Acute Inflammatory Affections.—One or both lips may become suddenly hot and swollen without obvious cause as an expression of urticaria.

Herpes in the form of fever blisters, which, if numerous, are accompanied by distinct swelling, is a frequent accompaniment of gastro-intestinal disturbance and may form by confluence one or more thick, black crusts, strongly suggesting chancre. The herpetic ulcerations should last a week at the most, and appear first as vesicles.

The crusted lesions of impetigo contagiosa are common about the lips. Their sudden development and brief course are characteristic.

Ulcerations.—A simple ulcer, weather crack, or traumatic fissure of the lips may persist for weeks, getting almost well, then recurring. There is, however, always a tendency toward progressive betterment. When the lesion occurs on the lower lip of a middle-aged man, and in the course of weeks slowly grows worse, the diagnosis of its benignancy should be made by excision.

Chancre.—Chancre, characterized by the development (days) of a raised indurated ulcer, externally crusted, exhibiting a dirty white, closely adherent pseudomembrane on the mucous surface and causing disfiguring swelling of the entire lip and early adenopathy, may be mistaken for a simple fissure or a cancer. No simple ulcerative lesion develops without obvious cause nor does it progressively increase in size. Cancer is much slower in development (months).

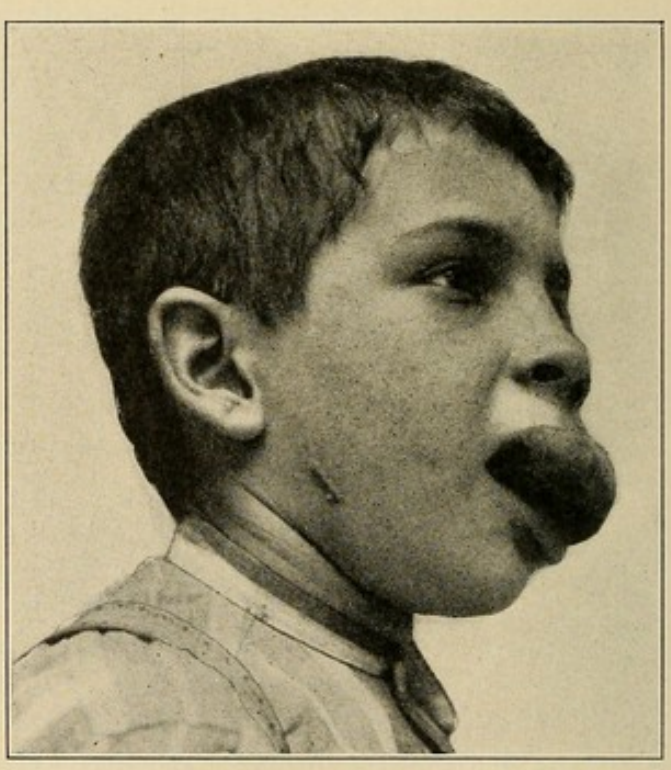
Mucous Patches.—Mucous patches on the inner surface of the lips and the corners of the mouth are extremely common. The distinction from aphthæ is made by their association with other signs of syphilis. In children syphilitic ulceration is often deep enough about the corners of the mouth to be followed by radiating cicatrices which form characteristic remnants of this disease.

Gumma.—Gumma of the lips is rare. When it occurs it exhibits the features of this affection as seen on other mucous surfaces.

Tumors of the Lips.—Epithelioma.—Epithelioma usually begins at the mucocutaneous junction, sometimes on the mucous surface of the lower lip of middle-aged or old men. Exceptionally it is seen in young men, in women, and on the upper lip.

The diagnosis should be made by examination of the excised lesion when it is apparently a simple chronic induration, persistent fissure, or erosion, or an inflamed scabbing papilloma.

FIG. 100



Lymphangioma and hemangioma of the lip and cheek. A soft, bluish tumor exhibiting shot-like nodules due to phleboliths. Markedly increased in size by venous congestion of the head.

Infiltration, fungous outgrowth, rapid extension and involvement of lymphatics make the diagnosis absolute and futile. Early glandular enlargement should be detected by bimanual palpation, the finger of one hand being placed on the mucous membrane of the floor of the mouth, but the diagnosis should not be kept in abeyance until this sign develops.

Hypertrophied labial glands, either congenital or acquired, may cause a roll of mucous membrane, producing the appearance of a double lip,

PLATE XV

Epithelioma of the Lip. (Grünwald.)

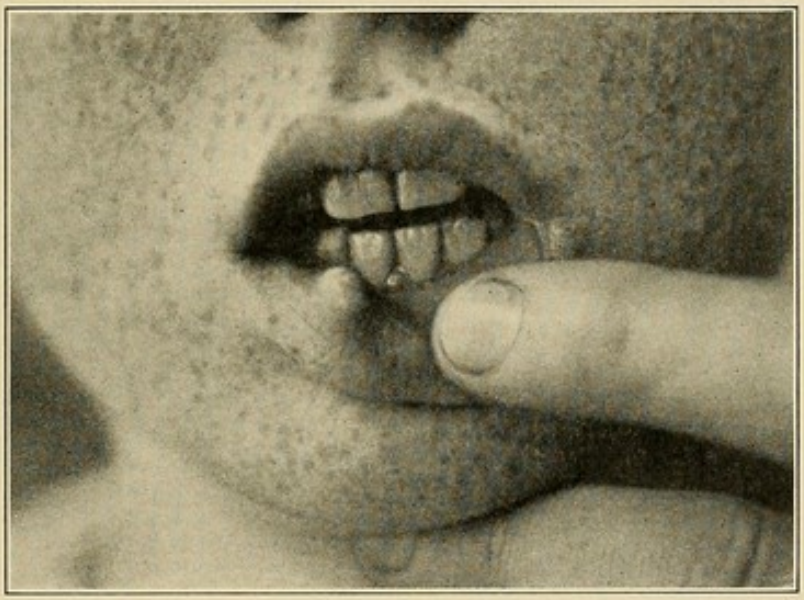
most perceptible when the upper lip is retracted as in laughing, sometimes large enough to form a projecting mass simulating cancer.

Angiomata, both venous and arterial, producing great enlargement of the lips, are observed in this region. They are often associated with lymphangioma producing a condition of deforming hypertrophy called macrocheilia. The lymphangioma is usually present at birth, but may not constitute a distinct deformity until puberty or afterward.

Lipoma is shown by its soft consistence and yellow color. It is often associated with angioma.

Adenomata appear as small, hard tumors, single or multiple, placed just beneath the mucous membrane.

FIG. 101



Mucous cyst of the lip. Duration, months. Opened twice, discharging a viscid, clear mucus. Soft, translucent, painless, non-inflammatory. (Hoban.)

Cysts of the labial salivary glands form small, semitranslucent, rounded, non-inflammatory tumors placed beneath the mucous membrane.

Mixed tumors sometimes develop in this region and are characterized by their rapid growth and large size.

THE JAWS.

Fractures.—Fracture of the upper jaw, due to direct violence, usually involves the alveolar border. Transverse fracture, or detachment of the vault of the mouth with the teeth, is characterized by deformity and unnatural mobility of the entire dental arch and crepitus.

Guerin states that tenderness and mobility elicited by pressure upon the inner pharyngeal plate are almost diagnostic of this fracture.

Fracture of the lower jaw, usually in adults, is commonest at about the position of the mental foramen and is usually oblique. It may

be multiple or fissured. The condyloid process is not an unusual seat of this injury.

Fracture of the body of the jaw is usually attended by a deflection of the chin toward the affected side and by a marked irregularity in the line of the teeth. The anterior portion of the bone is pulled downward and backward. The mucous membrane will be found torn at the point where the dental arch is broken and crepitus and preternatural mobility are readily elicited.

To elicit mobility and crepitus the jaw is grasped with the thumb placed behind the dental arch and the fingers beneath the body. The two hands are used, one holding each fragment, the surgeon standing behind the patient, who is seated. A break in the continuity can often be detected by external palpation alone.

Fractures of the ramus, attended with little deformity, may be detected by combined internal and external palpation. Persistent pain on use and deep, fixed, localized tenderness on palpation may be the only symptoms.

Fractures of the coronoid process are characterized by tenderness, slight anterior displacement of the condyle, swelling, and crepitus felt immediately beneath the finger, and by great pain consequent upon every motion of the joint.

FIG. 102[1]

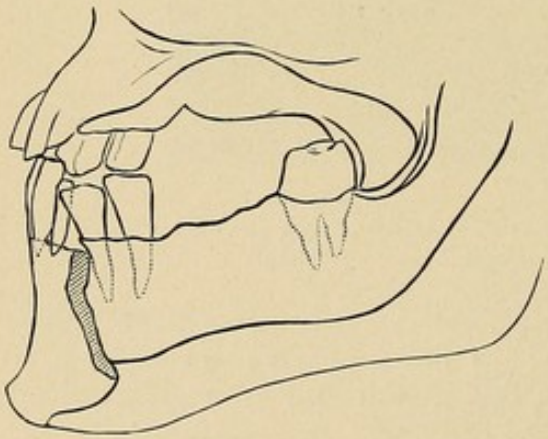


FIG. 103

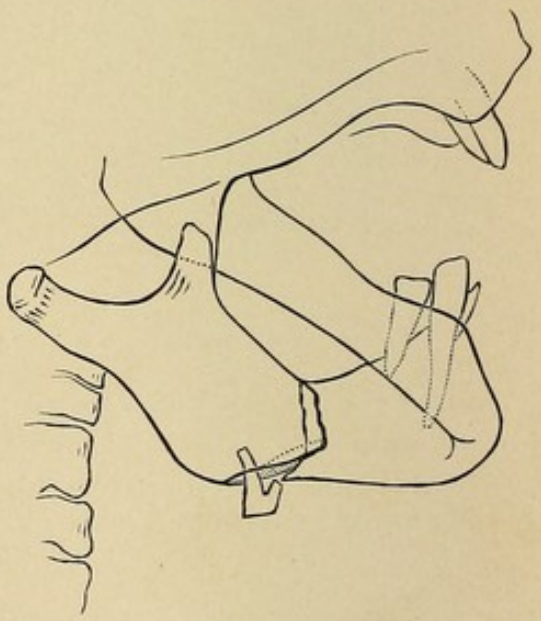
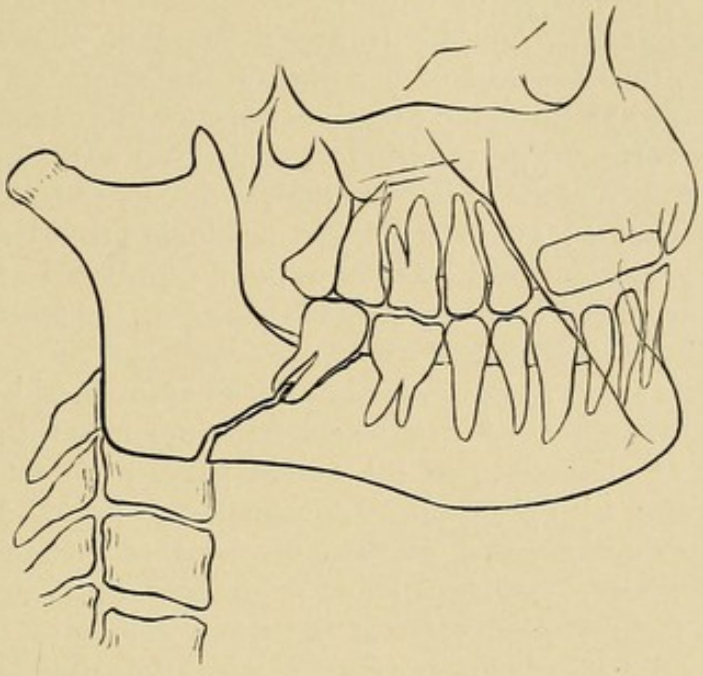


FIG. 102.—Fracture of lower jaw, through anterior portion of body, in region of canine fossa. (Somewhat anterior to the more common seat—see Fig. 103.) Patient an adult male. Note the typical deformity—downward displacement of the anterior fragment and elevation of the posterior portion.

FIG. 103.—Fracture of lower jaw, comminuted, at about middle of lateral aspect of body. (A very common seat of fracture.) Note the angular deformity and slight over-riding, the loose fragment, and the atrophy of the alveolar border in conformity with the age of the patient—a female, aged sixty-eight years—and following the loss of the teeth.

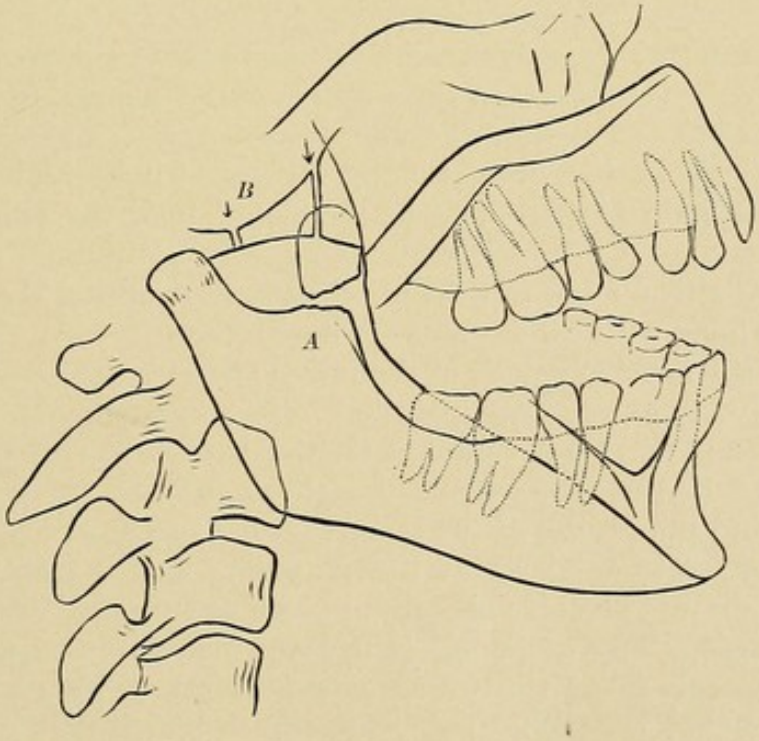
[1] Figs. 102 to 105. Fractures of the head and neck. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. White, Martin, and Carnett, and from dispensaries, and private cases of Dr. Pancoast.

FIG. 104



Fracture of lower jaw slightly in front of angle. (A frequent seat of fracture, but less common than farther forward.) Fracture fissured and line oblique and involving socket of second molar tooth. There is neither separation nor displacement. Male, aged twenty-two years.

FIG. 105



(*a*) Fracture of the coronoid process of the lower jaw, with separation and upward displacement of the fragment by the temporal muscle. (*b*) Multiple fracture of the zygoma of the same side. The lines of fracture, indicated by arrows, are posteriorly near the root of the process and anteriorly near its junction with the malar bone. There is no displacement vertically, but depression would not be indicated in this view, although it could be shown in an anteroposterior picture. The injury was due to direct violence. Patient a young adult male.

Inflammation of the Jaws.—Diffuse osteomyelitis of the jaw may be either acute, subacute, or chronic.

Acute Osteomyelitis.—Acute osteomyelitis may be secondary to traumatism, to exanthemata and other systemic infections, or may develop suddenly without ascertainable cause. It occurs in young people about the time of puberty. The eruption of a wisdom tooth has seemed to be a predisposing factor. The infection, commonest in the lower jaw, may involve a part or all of the bone, producing rapid and complete necrosis. It is characterized by intense pain, rapid edematous swelling, symptoms of profound toxemia, and loosening of the teeth with escape of pus from their sockets.

The prognosis is grave in proportion to the amount of bone involved.

Acute Osteoperiostitis.—Acute osteoperiostitis, usually secondary to dental caries, is characterized by severe pain, local tenderness, and swelling associated with pronounced edema of the cheek. The resultant abscess usually develops as a gumboil discharging into the mouth. It may open externally, forming a sinus communicating with dead bone. Exceptionally the infection reaches the deep tissues of the neck and spreads rapidly through them, causing brawny infiltration and symptoms of profound sepsis.

Occupation osteoperiostitis and necrosis are observed in those working in phosphorus, arsenic, mercury, and mother-of-pearl. Phosphorus osteitis, slow in progression and beginning with a toothache, results in necrosis characterized by foul discharge of pus from the sides of the teeth.

Arsenical osteitis is characterized by its more rapid course.

Mercurial osteitis begins as a suppurative gingivitis, and is not usually attended by wide destruction of bone.

Pearl-grinder's osteitis, developing at the age of puberty, is characterized by severe pain and swelling at the junction of the epiphysis and diaphysis.

Osteoperiosteitis may be of the formative type, resulting in great thickening of the bone with consequent deformity.

Syphilis of the Jaw.—Syphilis of the jaw is characterized by the formation of periosteal gummata, which may result in permanent exostoses. Gummata are particularly common on the hard and soft palate, and are the usual causes of perforation. Diagnosis is based upon the history of the case and the results of treatment.

Tuberculosis.—Tuberculosis of the maxillary bones may appear in the form of chronic alveolar abscess in patients suffering from pulmonary tuberculosis. The diagnosis is usually made by the microscope. Primary tuberculosis of the lower jaw is marked by an indurated swelling, attended with little pain, sometimes by stiffness of the jaw. Necrosis and fistulization follow, together with cervical glandular enlargement. The disease is slow in progression (years), and the diagnosis is made by the *x*-rays and the tuberculin test. Distinction from sarcoma may require an exploratory operation. Sarcoma is more rapid in progression, and does not involve the lymph glands, nor does actinomycosis.

Actinomycosis.—Actinomycosis of the jaw, usually due to an extension from the gums, is characterized by hard, nodulated infiltration of both the soft parts and the bone, exhibiting a tendency to multiple sinus formation and slow (months, years) but steady extension. In its beginning the disease is evidenced by an alveolar abscess differing from those incident to ordinary infection only from the fact of its persistence and extension to both the soft parts and the bone. Affection of the upper jaw is characterized by more rapid extension, loosening of the teeth, and early involvement of the antrum.

The diagnosis is based upon multiple sinus formation, the presence of the yellow granules in the pus, and the detection under the microscope of the characteristic fungus. When these are not found, cultures may be needful.

Tumors of the Jaw.—Epulis.—Epulis forms a red, easily bleeding, irregularly lobulated tumor, growing from the gum or the alveolar border between the teeth. It may be fibromatous or sarcomatous in nature, as it appears in the young, or carcinomatous in the middle-aged and elderly. Diagnosis should be made by complete excision.

Fibroma.—Fibroma, commonest in the upper jaw, forms a dense tumor characterized by indolence, lack of infiltration, and absence of glandular involvement. Developing from the interior of the bone it can be distinguished from malignant infiltration only by the extreme slowness of its progress.

The diagnosis from sarcoma should be made by excision.

Chondroma.—Chondroma is characterized by nodular tumor of almost bony hardness, extremely slow in progression, and unattended by inflammatory symptoms. It is essentially an affection of early maturity. The growth may take place into the maxillary sinus or from the nasal process into the nasal chambers. The diagnosis should be made by excision.

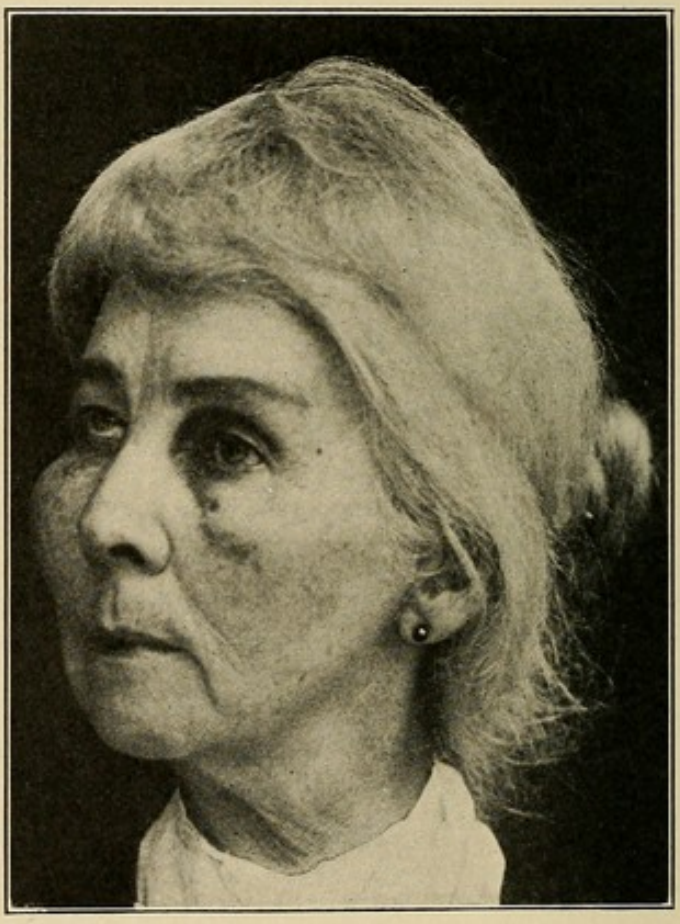
Osteoma.—Osteoma, when situated on the surface, is characterized by extreme density and slow growth. Exceptionally, the growth is rapid and can then be distinguished from sarcoma only by operation.

Odontoma.—Odontoma, dependent upon perverted tooth growth, is seen at an age before the teeth reach their complete development. It may be soft and cystic, fibrous or eburnated. It is extremely slow in growth (years), unattended by pain, and exhibits a nodular or bosselated surface involving the alveolus and projecting on both the outer and inner surface of the jaw. The distinction from malignant growths should be made by prompt excision.

Dentigerous Cyst.—Dentigerous cyst, due to the retention of a tooth within its follicle, is characterized by a somewhat sharply circumscribed swelling, usually of the lower jaw, extremely slow in growth (years), and projecting externally. Its growth is most obvious at or after the time of second dentition. The cyst may break through the bone, forming a tumor of considerable size. The diagnosis will be suggested by the absence of a tooth not otherwise accounted for, by the *x*-rays, and by exploratory operation. Similar cysts, unilocular or racemose, may develop in connection with a carious tooth.

Sarcoma.—Sarcoma, commonest in the young, may appear in any of its forms, usually growing from the alveolar processes about the incisor or canine teeth in the form of epulis. Arising from the upper jaw, it exhibits a marked tendency to grow into the maxillary sinus, nose, orbit, pharynx, and base of the skull. In the beginning of its development sarcoma cannot be distinguished from fibroma. Its rapid growth should suggest diagnosis. The variety which begins within the bone substance is characterized by persistent pain and localized tenderness. When the tumor thins the bone and breaks externally into the soft parts, the diagnosis is not difficult.

FIG. 106



Osteosarcoma of maxillary sinus. Dense, hard swelling. Four months' duration. Skin normal. Bulging of hard palate. No glandular involvement. (Carnett.)

Carcinoma.—Carcinoma, an affection of old age, may be primary in the bones of the jaw or secondary to lesions of the surrounding glandular structures. The affection is characterized by pain, which remains fixed and is often most severe. Because of the comparatively rapid growth (weeks or months) pressure symptoms shortly develop. In the case of the upper jaw the nostril of the affected side becomes blocked, there is swelling of the corresponding side of the face, and the tumor shortly erodes the palate. Exophthalmos and fixation of the eye are comparatively early. Cancer of the lower jaw occasions an earlier involvement of the cervical lymph glands than does that of the upper jaw.

The Temporomaxillary Articulation.—The temporomaxillary articulation allows of both a hinge and a gliding motion, facilitated by interposition of an interarticular cartilage, provided on its upper and the lower surface with an independent synovial sac.

Sprains.—Sprains of the temporomaxillary joint are expressed in the form of local tenderness and pain on forceful movements. As the result of sprain or overuse, or without obvious cause, there may develop a noisy joint in the form of a soft or rough crepitus on motion. This condition is often not attended with pain, disability, or the subsequent manifestations of deforming arthritis.

Luxation of the Lower Jaw.—The unilateral or bilateral dislocation, intracapsular and always forward, may be incident to the muscular exertion of opening the mouth widely, to traumatism, producing the same effect, or to force exerted from behind when the mouth is open.

It is characterized by fixation of the jaw with the mouth partly open and the chin preternaturally prominent and great pain felt in the temporomaxillary articulation. A hollow can be felt directly in front of the tragus in the normal position of the head of the bone. In front of this will be found the projection formed by its displacement. In unilateral displacement the jaw is deflected away from the injured side. In either unilateral or bilateral displacement the lower dental arch projects beyond the upper.

Recurring subluxation incident to a preternaturally mobile interarticular cartilage is attended with a sharp click or jar when the mouth is opened widely; at times by pain and fixation readily relieved. The condyle is not displaced forward beyond its physiological limit. Many people can voluntarily produce subluxation without experiencing pain or subsequent discomfort.

Acute Arthritis.—Acute arthritis, commonly secondary to external otitis, suppurative parotiditis, or osteomyelitis of the inferior maxilla, may be gonorrheal, rheumatic or a local expression of the infection or toxemia of the exanthemata. The symptoms are those common to joint inflammation. The jaw is held slightly open and projecting; any movement causes severe pain. In suppurative cases the pus has a tendency to burrow toward the surface of the cheek through either the skin overlying the joint or the external auditory meatus.

The pyogenic and gonococcal infections often terminate in ankylosis. The rheumatic arthritis usually undergoes resolution without subsequent stiffness.

Tuberculous Arthritis.—Tuberculous arthritis is extremely rare. Pain and limitation of motion in the temporomaxillary joint, with a slow, non-inflammatory swelling exhibiting an ultimate tendency to soften and form sinuses are the characteristic features of the affection.

Chronic Osteoarthritis.—Chronic osteoarthritis, characterized by crepitation in the joint on forceful movements, and often recurring subacute attacks of tenderness and pain, ultimately exhibits the obvious and crippling deformities of this condition.

Fixation of the Jaw.—This may be of muscular, fibrous, or bony origin.

Muscular fixation in its temporary form may be an expression of hysteria or of central irritation, as in tetanus and trismus. It is usually due to inflammation of the jaw, its joint, or the structures about it. Osteoperiostitis and osteomyelitis in either their acute or chronic form are the common causes. It is a typical symptom of the eruption of the wisdom teeth and accompanies mumps or other parotid inflammation. The contraction may be reflex or due to direct extension of inflammation. In the latter case the inflammation, if it be long continued, may result in permanent contracture.

The fixation due to cicatricial contracture incident to extensive destruction of soft parts is evidenced by the scars.

The fixation incident to joint lesions may be fibrous or bony and is usually accompanied by contracture of the muscles. Joint lesions of the growing period may be followed by imperfect bone development characterized by receding chin. The distinction between the fixation incident to a contractured muscle and that due to fibrous or bony ankylosis of joint origin is dependent upon the history, the *x*-ray findings, and examination under ether.

THE MOUTH.

Inflammatory lesions of the mucous membrane, if multiple and superficial, are usually thrush or aphthæ. Occasionally they are syphilitic. The usual cause of stomatitis is defective or erupting teeth. In its ulceromembranous and gangrenous forms it attacks the cachectic, following certain of the exanthemata. The chronic ulcers of the mouth are usually syphilitic or malignant. The usual tumors are of the same nature.

Thrush.—Thrush, an affection of young infants, is characterized by stomatitis, associated with diffuse, dirty white, superficial patches of pseudomembrane, in which can be found the oidium albicans.

Aphthæ.—Aphthæ appear in the form of one or multiple superficial, painful, tender ulcerations presenting either a red granulating, or gray, pseudomembranous surface. Their rapid development, usually in the course of some febrile or digestive disturbance, and prompt subsidence (days) as the result of cleansing and stimulating treatment, distinguish them from mucous patches, which in appearance they may exactly resemble. Recurring single aphthous ulcers are common in nursing mothers.

Mucous Patches.—Mucous patches resemble aphthæ and are distinguished from the latter by the history of the case, associated signs of syphilis, and resistance to cleansing treatment.

Stomatitis.—Stomatitis, secondary to eruption of the teeth, is characterized by heat, redness, and swelling of the mucous membrane, particularly that of the gums, together with profuse salivation. In a localized form it may precede and accompany the appearance of the wisdom teeth or dental caries.

Mercurial stomatitis is characterized by metallic taste, foul breath, profuse salivation, swelling and bleeding of the gums, and multiple,

superficial ulcerations of the mucous membrane appearing as gray patches. There is often severe toothache. The submaxillary glands are enlarged and necrosis is a common sequel. Diagnosis is based upon the history of the case, the local appearance, and the finding of mercury in the urine and the saliva.

Ulceromembranous stomatitis is characterized by the formation of an edematous, non-indurated, superficial, pseudomembranous ulceration, usually on the inner surface of the left cheek and gums of ill-nourished children and young adults, accompanied by enlargement of the submaxillary lymphatic glands. The affection may spread to the tongue or the palate. Exceptionally it causes alveolar necrosis and shedding of the teeth. It is distinguished from gangrenous stomatitis by its more benign course.

Gangrenous stomatitis (noma) is an affection of infancy, common after measles, sometimes following diphtheria, whooping-cough, or scarlet fever, and is an expression of profound dyscrasia. It usually begins as a hard, gray, ragged ulcer in the middle of the mucous surface of the cheek, and promptly indurates its entire thickness, causing a dusky discoloration of the skin surface. Septic symptoms and rapid, deep, and widespread sloughing are characteristic. It is distinguished from ulceromembranous stomatitis by its rapidly destructive progress, greater induration, more extensive edematous swelling, and the more pronounced constitutional symptoms. It usually causes shedding of teeth and necrosis of bone.

Mechanical ulcers on the cheeks are fairly frequent as the result of sharp or irregular teeth.

Mucous patches and psoriasis are very commonly placed on the inner surface of the cheek, exhibiting here no special characteristics. Retention cysts of the mucous glands form small bluish vesicles which may be traumatized by the teeth.

Epithelioma.—Epithelioma of the inner surface of the cheek is commonly on the inner dental line, often upon a patch of leukoplakia. It extends with extreme rapidity.

THE TEETH.

Dental Caries.—Dental caries, the usual affection of the teeth, is noted particularly in the occlusional fissures of the molars and on other surfaces not subject to attrition, or readily cleansed. It is in its gross form characterized by obvious discoloration, roughening and softening, and reaches the maximum of incidence during the growing period.

The subjective symptoms are incident to exposure of the sensitive dentine, and consist of transitory pain caused by sweets, acids, heat, or cold.

The diagnosis is made by direct examination, transillumination, and the use of instruments for the detection of softened and sensitive surfaces or cavities.

When caries has extended to such depth as to involve the dental pulp in inflammation, there develops a continuous pain which may have its seat of maximum intensity referred to any of the branches of the trigeminal nerve, particularly to the region of the orbit. This pain is increased by the application of heat or cold to the diseased tooth.

A pulp swollen by chronic inflammation may grow through a carious perforation of the neck of a tooth and closely simulate epulis. The distinction should be made by removal of the fungating mass which will be found growing directly from the tooth cavity.

The symptoms of abscess and gangrene of the pulp are those of root abscess with which it is usually associated, together with a loss of normal translucency and an insensitiveness to heat and cold.

Inflammation and Abscess of the Root.—Inflammation of the root of a tooth usually incident to caries which has destroyed the pulp without providing adequate drainage, or dental procedures which have accomplished the same end, hence commonest in filled teeth, is characterized by severe localized pain, aggravated by percussion and pressure upon the diseased tooth. The gum is swollen and congested; percussion, if this be permissible, gives a dull note instead of the normal resonance, and the tooth becomes loosened and slightly extruded.

Inflammation may be due to traumatism, syphilis, gout, intestinal toxemia, or the injudicious use of mercury or iodine. If an abscess forms it commonly opens between the gum and the neck of the tooth, or at the inner or outer surface of the gum near the affected root. There is often an alveolar necrosis, usually limited in extent.

In the absence of prompt drainage the cheek or submental region becomes greatly swollen and an abscess may open externally, or may cause a diffuse and fatal form of cellulitis of the neck.

Severe pain in the region of a tender tooth and marked edematous swelling of the cheek of the affected side are the diagnostic symptoms. Developing at the roots of the upper teeth, an abscess may open into the nose (central incisors) or the maxillary sinus (first and second molars).

Chronic Abscess.—Chronic abscess usually following the acute, at times developing in the absence of symptoms of the latter as an expression of deficient drainage, is characterized usually by few local symptoms other than occasional pain from subacute attacks and some tenderness on forceful biting of a hard substance. This lesion is not infrequently accompanied by the general toxic or slightly septic condition expressed by the term cryptogenic infection.

The diagnosis is made by passing a probe to the root apex of a tooth through a carious cavity and finding pus on the end of the probe, or the milking by pressure of a drop of pus either from the space between the gum and the neck of a tooth or from a sinus communicating with its apex. These sinuses are usually associated with an area of alveolar caries and not infrequently open upon the cheek.

Softening or complete absorption of a tooth root may result from apical abscess. Occasionally an extensive osteomyelitis develops.

Hyperplasia of the Cementum.—Hyperplasia of the cementum, incident to slight trauma, or the hyperemia of chronic inflammation, is usually expressed in the molar roots, appearing in the form of a thickened or distinct nodulation. Recurring pain, often severe, without the symptoms of inflammation, bettered by biting hard upon substances, may be regarded as significant symptoms.

This overgrowth is an occasional underlying cause of facial neuralgia, and may be attended with a great variety of neuroses. The diagnosis should be made by the *x*-rays.

Gingivitis, in its interstitial form, involves both the gum and the pericementum. It may be caused by local irritation, such as that incident to uncleanliness, and the deposit of calcareous material upon the teeth, may be an expression of a systemic condition, such as acute or chronic infections, gout, rheumatism, intestinal toxemia, or may be of drug origin, as from mercury, iodine, and lead.

The process is expressed by swollen, tender, easily bleeding gums, followed by absorption of the alveolar process, the cementum, or both, and ultimately resulting in loosening of the teeth.

Salivary Calculi.—Salivary calculi, appearing in the form of soft, dirty white or hard, dark deposits, are made up in the main of phosphate of lime, which is readily deposited upon the exposed roots of teeth. The outer surfaces of the upper molars and both surfaces of the lower incisors are the seats of preference. These deposits occasion gingivitis and often alveolar resorption and recession of the gums.

Pyorrhea Alveolaris.—Pyorrhea alveolaris is predisposed to by gingivitis and all conditions which form pockets which favor retention and fermentation of food. The affection is characterized by calculous deposits either at the gum margins or below them, upon the neck and root of the tooth, and purulent discharge which can be milked from between the gum and the tooth. In its further development the gums may either recede. allowing of comparatively free drainage, or the pus pockets may progressively deepen. Ultimately the teeth become tender and loosened, the pulp is inflamed and destroyed, and apical abscesses may develop. Some cases are accompanied by alveolar necrosis discharging by sinus near the margin of the gum.

This condition is at times the underlying cause of profound anemia, endocarditis, and the joint and systemic expressions of chronic sepsis.

Impacted Teeth.—An impacted tooth may cause severe pain, either at the point of pressure or referred to the distribution of the branches of the trigeminus. The lower third molar, the one commonly at fault, is closely related as to its roots with the proximal portion of the inferior dental nerve; when, because of transverse position, or because of absence of room between the second molar and the ramus of the jaw, obstruction is offered to the eruptive efforts, pain, both local and reflex, reaches a degree of maximum and crippling intensity. This reflex pain may be expressed in the form of tic which may closely simulate that of ganglion origin. There is usually an associated local swelling, which may involve the whole side of the face, and muscular spasm (trismus).

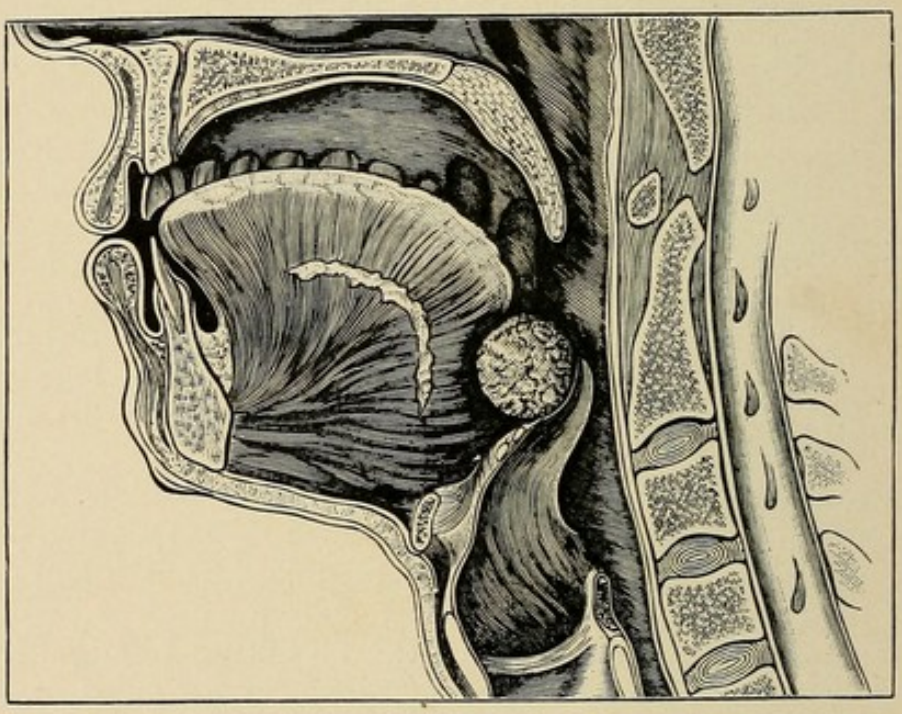
The diagnosis is based upon the absence of the wisdom tooth, local tenderness, and an *x*-ray picture. Similar symptoms, but less severe, may be characteristic of an unobstructed eruption.

THE TONGUE.

The tongue may be absent or may contract vicious adhesions, either laterally or to the base of the mouth.

The frenum may be extremely short or inserted too far forward (tongue-tie). These conditions are obvious on inspection.

FIG. 107



Showing accessory thyroid gland at base of the tongue. Tumor is nearly spherical, 2.5 x 3 cm. Color, grayish red. Microscopic examination shows structure like thyroid.

Acute Glossitis.—Acute glossitis, due to a spread of infection from the mucous membrane, often secondary to erysipelas, typhoid or systemic infection, is characterized mainly by rapid (hours) swelling of the tongue, accompanied by severe pain greatly aggravated by motion, and fever. This infection may start from the lingual tonsil, in which case there is rapid edema of the glottis with stridor and dyspnea. It usually subsides spontaneously. It may progress to diffuse suppuration or circumscribed abscess. In the former case the infiltration extends down the neck and commonly results fatally either from edema of the glottis or septic absorption.

Mechanical Ulcer.—Mechanical ulcer may be kept up by the irritation of a misplaced or irregular tooth, causing first local tumefaction, later ulceration, with some swelling of the adjacent tissue.

Diagnosis is based upon the disappearance of the ulcer or tumor after the removal of the exciting cause, or, more safely, when this is chronic

in type and has lasted some time, by excision of the ulcer and its microscopic examination.

Tuberculosis.—Tuberculosis of the tongue is an affection of the adult already extensively infected. Ulceration is usually single, at first round and superficial, later undermined or punched-out, and extremely irregular in shape. About its borders are seen semitranslucent tubercles. The submaxillary glands are enlarged. Functional troubles are pronounced and the lesions are usually extremely painful, especially from contact with irritating foods.

Diagnosis is based upon the association of the ulcer with other tuberculous lesions, on the tuberculin test when this is applicable, but most safely upon excision and microscopic examination, since these growths may closely resemble cancer, or, if originally tuberculous, may be the seats of malignant degeneration. Exceptionally tuberculosis of the tongue appears in the form of small nodules which soften and discharge their cheesy contents. Distinction from gumma is based upon the presence of associated symptoms.

Chancre.—Chancre of the tongue, much rarer than chancre of the lips, usually forms a single flattened, circular, or oval rounded lesion with indurated base. It exhibits the characteristic features of chancre and is distinguished from cancer by its rapid development and early adenopathy (days, weeks).

Mucous Patches.—Mucous patches are usually placed on the borders and dorsal surface of the tongue. As a result of irritation from carious teeth, they may become distinctly ulcerated and inflammatory. There is at times a papillary overgrowth.

Diagnosis is based upon associated symptoms, rapid course, extent and multiplicity of lesions, detection of the spirochete, and the results of specific treatment.

Tertiary Syphilis.—Tertiary syphilis is expressed in the forms of diffuse infiltration or gumma. Diffuse infiltration during the process of involution causes fissuring and deformity. The tongue presents a cracked and irregularly lobulated appearance with patches of epithelial desquamation and leukoplakia.

Gummatous tumors which develop slowly (months), usually on the dorsum, are often multiple, occasion but slight subjective symptoms, and are prone to soften and discharge before reaching the size of a cherry. Distinction from cancer must be based upon the syphilitic history, the test of treatment, and, in case of doubt, prompt excision and examination, since a differential diagnosis cannot be made from the appearance of the lesion.

Leukoplakia.—Leukoplakia, common in middle-aged men, particularly those who smoke and drink and have had syphilis, is an expression of chronic inflammation of the mucous membrane. It is characterized by the formation of white patches made up of keratinized epithelial layer placed upon an area of submucous sclerosis. These patches are often combined with ulcerating cracks and fissures. It is an occasional predecessor of cancer of the tongue.

Cancer of the Tongue.—Cancer of the tongue is commonest in men between the fortieth and fiftieth year and becomes rare after seventy. Heredity exercises some influence.

The favorite seat is on the border of the tongue, particularly that part lying close to the molar teeth. When placed farther back and concealed by the palatoglossal fold the infiltration and ulceration may not be detected until the period for operation is past. Pain on movement or from the contact of acid foods, and slight bleeding, should suggest a careful examination of this region, both by palpation and the use of the mirror, since the rapid extension of the growth thus placed makes early operation imperative.

In its well-developed form cancer is unmistakable. It appears as a fungating or eroded ulcer, these two conditions being often combined, bleeding readily, densely indurated, infiltrating the surrounding tissues, and accompanied by an enlargement and hardening of the lymphatics in the neck which are prone to suppurate, leaving foul cavities in the midst of the infiltrated tissue. There is an atrophic form comparable to the scirrhus of the breast in which the progress is slow and cicatricial deformity with pronounced atrophy takes place.

Adenopathy is developed more slowly in the papillary epitheliomata which have become implanted on patches of leukoplakia. At times the adenopathy is acutely inflammatory in type and is due to infection carried from the ulcerating surface and not to cancerous infiltration. In all cases it occurs comparatively early in the suprahyoid region and in the carotid group of glands.

Pain of cancer of the tongue rarely becomes prominent until the affection is beyond surgical help. When infiltration limits the motions of the organ and interferes with both speaking and eating, pain may be almost intolerable. It often radiates toward the ear.

The prognosis of lingual cancer is extremely good, providing it be recognized early, *i. e.*, when the diagnosis is made by excision of an ulcer simply on suspicion and before it has assumed the malignant type. In advanced cases the prognosis is nearly hopeless.

Actinomycosis of the Tongue.—Actinomycosis may develop primarily on the tongue. It is usually secondary to infection of the jaw. It is characterized by indurated nodules, at first covered with healthy mucous membrane, later softened and discharging pus containing actinomycotic granules. Distinction from syphilis and other infiltrations of the tongue can be made only by microscopic and cultural examination.

Tumor and cysts of the tongue, other than carcinoma, angioma, and ranula, are rare.

Arterial and venous angiomata are usually associated with similar conditions elsewhere, and are occasionally found at the base of the tongue.

Congenital macroglossia, often unperceived at birth, an affection of girl babies, due to lymphangioma, may cause enlargement so great that the tongue cannot be contained in the mouth. The part exposed to the air presents a hard, dry, corneous surface; that kept moist by mucous

membrane may exhibit papillary outgrowth or an appearance suggesting fish-roe.

Acquired lymphangioma incident to inflammation and developing about adolescence may occasion only moderate swelling. The fish-roe-like surface is characteristic.

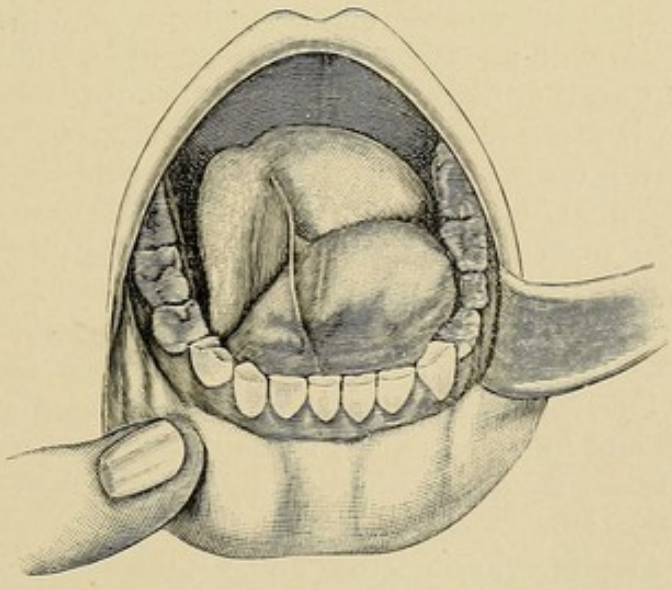
Lingual Goitre.—Lingual goitre, an affection confined to young women, forms a rounded, elastic, vascular tumor in the region of the foramen cecum. Its growth is usually associated with an abnormal condition of the thyroid. Its position is characteristic.

Sarcoma of the Tongue.—Sarcoma of the tongue (rare) is characterized by the appearance of a rounded, soft, elastic tumor, appearing on and part of the tongue, extremely painful, usually growing rapidly, any ulcerating before it reaches a considerable size. Exceptionally the growth may be extremely slow. Diagnosis is based upon the prompt excision of a growth not obviously benign.

Lipoma.—Lipoma (rare) may be submucous or intramuscular. Because of its soft consistency it is usually mistaken for a cyst. The growth is slow (years). The diagnosis, unless obvious, should be made by excision.

Fibroma.—Fibroma (rare), found on the dorsal surface of the tongue toward its base, may be sessile or pediculated, forming rounded, sharply circumscribed, non-inflammatory, very slow growing masses which may be soft or hard. The diagnosis, unless obvious, should be made by excision.

FIG. 108



Ranula.

Ranula.—Ranula, a retention cyst, usually of the lingual salivary gland, forms a sausage-shaped, translucent tumor beneath the tongue and on the floor of the mouth. It causes no symptoms nor functional disturbance until it reaches large size. It is frequently observed in children.

A similar cyst due to obstruction of Wharton's duct is character-

ized by the difficulty experienced in probing this channel and by the associated swelling of the submaxillary gland. The distinction between ranula and dermoid when the latter has reached large development may be difficult.

Dermoid forms a soft, rounded, fluctuating tumor, palpable through the floor of the mouth, and shortly forming an external swelling. The symptoms are purely mechanical and incident to the size of growth. Diagnosis is made by operation.

THE TONSILS.

Hypertrophy of the Tonsil.—Hypertrophy of the tonsil, usually symmetrical and associated with chronic lacunar tonsillitis, is obvious on inspection. It is mainly troublesome because of recurring acute attacks, unless the overgrowth be extreme, in which case there is interference with nasal breathing, and swallowing may be difficult. Dependent upon it, even in the absence of symptoms, there is often a condition of impaired health, and in adults a tendency to recurring attacks of joint inflammation of the non-infective type.

Acute Tonsillitis.—Acute tonsillitis, characterized by swelling, pain aggravated by swallowing, often tenderness on external pressure, and lymphatic involvement, with constitutional symptoms of acute infection, may be catarrhal, lacunar, or parenchymatous.

The catarrhal affection is characterized by moderate symptoms, both local and general, and prompt subsidence.

The lacunar tonsillitis is characterized by usually sudden onset of fever preceded by chill, marked systemic depression, and the appearance on the swollen tonsils of dirty white spots or small patches, the presenting surfaces of lacunar plugs. These spots may coalesce to a slight degree, but exhibit no tendency to invade the whole tonsillar surface or to spread to the pharyngeal walls.

The distinction from diphtheria should be made by microscopic examination of the cultured exudate.

In its chronic form this inflammation is characterized by repeated and causeless recurrences of subacute attacks, often impaired general health in the interval, and the appearance of dilated tonsillar crypts, some distended and inflamed, others exhibiting yellowish, cheesy masses of exudate. These may be concealed by the half arches which, in a thorough examination, should be drawn aside.

Peritonsillar Abscess.—Peritonsillar abscess, the condition to which the term quinsy is usually applied, doubtless accompanied by at least a local suppuration of the tonsil, is characterized by the symptoms which inaugurate an ordinary acute tonsillitis; they are mainly suggestive of abscess because of their persistence and aggravation. The pain steadily increases, making swallowing impossible. Tumefaction is likely to be particularly pronounced at first in the lateral region of the soft palate. The uvula from edema resembles a large polyp. There may be associated edema

of the epiglottis and the aryepiglottic folds. The diagnosis is based upon the sudden onset and rapid (days) progression of symptoms. Incision and evacuation of pus with the relief of symptoms is the final test.

A swelling of the peritonsillar tissues and soft palate may be caused by an erupting wisdom tooth.

Chancre of the tonsil or sarcoma may cause pain equally as great and a peritonsillar swelling closely simulating that of abscess. In the former case the presence of an ulcer, in the latter the slower onset and non-inflammatory character of the growth, is characteristic.

Ulceromembranous Tonsillitis.—This is usually inaugurated by chill and fever and is characterized by the rapid formation of sloughing ulceration which may involve tonsils, half arches, and the pharynx, but is usually confined to one tonsil. It closely resembles diphtheria and syphilis. From the former distinction should be made by bacteriological examination of the exudate. The sudden onset, the rapid course (days), and the absence of specific history or other signs of disease distinguish it from the secondary manifestations of syphilis.

Diphtheritic Tonsillitis.—This is characterized by the formation of a pseudomembrane with or without pronounced constitutional symptoms of acute infection and enlargement of the cervical glands. The characteristic feature of the disease is the comparatively rapid spread of the pseudomembrane from its area of first appearance to the surrounding structures, particularly to the soft palate. At the edge of the spreading exudate there is a red inflammatory border of mucous membrane.

Diagnosis is based upon finding in the exudate the specific bacillus.

Syphilis.—*Chancre.*—Chancre of the tonsil is characterized by the formation of an ulcer at times phagedenic in type, accompanied by pronounced enlargement of the gland and the peritonsillar tissues. The diagnosis is based upon the finding of the specific organism in the scrapings from the ulcer, the type of early glandular adenopathy, the rapid extension of the ulcerating process, often upon the development of secondaries.

Secondary syphilitic lesions of the tonsil are characterized by their extreme pain and their destructive tendency. They can be distinguished from phagedenic tonsillitis only by the presence of more characteristic associated lesions and by the prompt curative effect of constitutional treatment. Ulcerating gummata of the tertiary period are usually, but not always, painless. They are deep and destructive in type, and can be distinguished from neoplasm only by a history of syphilis, the presence of other more characteristic lesions or their scars, and the result of constitutional treatment.

Tuberculosis.—Tuberculosis of the tonsil exhibits no characteristic features other than those of chronic inflammation. The diagnosis is suggested by associated tuberculous involvement of the cervical lymphatic glands. Lupus of the pharynx is an occasional complication of a similar condition of the face and is due to direct extension.

Malignant Disease of the Tonsil.—Malignant disease of the tonsil is an affliction of adult life. *Sarcoma* is the commonest form. In its early stage it appears much as an hypertrophied tonsil, the swelling being

suggestive only because of its rapid development without adequate cause and without inflammatory symptoms. Later, the large, readily bleeding, infiltrated tumor projecting in the neck is characteristic.

In the form of lymphosarcoma the tonsil presents a pale, nodular appearance.

The rapid development of other enlarged lymph glands establishes the diagnosis of pseudoleukemia.

The round-cell and spindle-cell sarcomata appear at first simply as hypertrophies exhibiting rapid growth. Exceptionally the spindle-cell form may be encapsulated.

Diagnosis is based in the early stage of the affection upon the causeless increase in size.

Carcinoma, an affection of middle and old age, exhibits an early tendency to ulcerate, involves the cervical lymphatic glands promptly, and extends toward the tongue and palate rather than toward the neck.

The diagnosis should be made by excision.

In the early stage of malignant infiltration diagnosis should be made by excision if syphilis can be excluded.

THE PHARYNX.

Pharyngeal Diverticulum.—Pharyngeal diverticulum, due to imperfect closure of the branchial clefts, is found with its internal opening either in the tonsillar fossa or the pyriform sinus (between the aryepiglottic fold and the wing of the thyroid). These diverticulæ usually occasion no symptoms unless they become converted into cysts or fistulæ. The openings of the latter are usually found anterior to the sternomastoid muscle and may be as low as the suprasternal notch.

Foreign Bodies.—Foreign bodies in the pharynx, if large, commonly offer no diagnostic difficulty either in regard to their presence or their seat. Small foreign bodies often lodge in the recesses of the half arches or below the tonsil in the sinus pyriformis, the depression to the side of the laryngeal entrance. Placed here they cause a grating feeling, slight pain on swallowing, and edema of the aryepiglottic folds often of such extent as to occasion dyspnea.

Diagnosis can be made by palpation or by laryngoscopic examination after thoroughly anesthetizing the mucous membrane, unless the swelling be so great as to obscure the cause of it.

Inflammation.—Chronic superficial inflammation of the pharyngeal mucous membrane may appear in the hypertrophic or atrophic form. The former, usually spoken of as granular sore throat, exhibiting characteristic glandular and follicular hypertrophies, the latter showing smooth, glazed, atrophic mucous membrane.

Retropharyngeal Abscess.—Acute or subacute retropharyngeal abscess, beginning as a periadenitis of the lateral pharyngeal lymphatic glands, may be caused by infection of the skin or of any part of the nose or mouth, including the tonsil, or may be secondary to the exanthemata

or to osteomyelitis of the base of the skull. It is characterized by fever, dysphagia, and later dyspnea. Inspection and palpation demonstrate the presence of an edematous or fluctuating tumor. It is usually observed in childhood, and in the subacute or chronic form is distinguished from tumor by its rapid onset and its age incidence.

The cold abscess due to tuberculous spondylitis is characterized by dysphagia and dyspnea and the formation of a fluctuating, non-inflammatory, postpharyngeal tumor.

Gumma of the Pharynx.—Gumma of the pharynx, often multiple and confluent, forms deep, usually painless, destructive ulcers, followed on recovery by marked cicatricial deformity. When the soft palate is also involved, and this is common, it may be partly or wholly destroyed, or become adherent to the pharyngeal wall.

THE PALATE.

The palate, particularly its soft part, is the favorite seat of the early secondary lesions of syphilis, these appearing in the form of mucous patches and reaching their most typical development when placed here and on the half arches. Diagnosis is based upon associated symptoms of the disease.

Gummata, the usual cause of perforation of the palate, are characterized by the appearance of painless, rounded nodulations which shortly rupture, discharging, when placed upon the hard palate, a fragment of bone. These gummata first appear upon the nasal surface of the palate. If the soft palate is thus involved, a characteristic symptom, nasal regurgitation of food on attempting to swallow, should, if the history of syphilis be given, lead to a timely diagnosis. Gummata are followed by extensive destruction and troublesome adhesions.

Perforation of the palate may be caused not only by syphilis, but by the erosion of aneurysm, or the infiltration of a tumor from the maxillary sinus.

The *tuberculous* infiltrations and ulcers of the soft palate are usually complications of pulmonary tuberculosis. They form typically indolent, slowly destructive ulcers, and are usually so painful as to interfere with deglutition.

Polyps, dermoids, angiomas, and retention cysts are observed in the region of the soft palate and pharynx. They occasion no symptoms except from their size.

Hypertrophy of the uvula, obvious on inspection, is sometimes the cause of an obstinate unproductive cough. Enormous edema is a common accompaniment of the acute anginas, particularly of peritonsillar abscess.

The abscess of dental caries not infrequently forms a gumboil on the hard palate some little distance from the alveolar border. The diagnosis is readily made by inspection or by probing the resultant sinus.

Mixed tumors develop in young people and may remain almost stationary for years. The only symptoms produced are those incident to mechanical interference. The growth is usually in the soft palate and is slightly nodular, distinctly circumscribed, is hard in some portions and soft in others, and is covered by a movable mucous membrane. Rapid growth is significant of malignant transformation. The diagnosis should be made by removal.

Melanosarcoma (rare) may in its beginnings simulate the discoloration of an angioma.

THE SALIVARY GLANDS.

Parotid Gland.—The parotid gland, roughly triangular in shape, lies with its base extending forward from the cartilage of the external auditory meatus to a point on the cheek, half an inch to an inch in front of the condyle of the lower jaw, and its apex limited by a line drawn from the angle of the jaw to the tip of the mastoid process. It dips beneath the ramus of the jaw, the temporomaxillary articulation, and the mastoid process, and is enclosed in a dense layer of fascia, except at its inner portion.

Lymph glands lie in close contact with both its outer and inner surface and also within the substance of its lower extension.

The salivary secretion is carried into the mouth by Stenson's duct, about two and one-half inches long, which lies on the outer surface of the masseter muscle, a finger's breadth below the zygoma, curves around the anterior border of this muscle, and obliquely penetrates the buccinator muscle and the mucous membrane of the mouth, opening opposite the second molar tooth of the upper jaw. Near the beginning of this duct there is sometimes placed an accessory parotid gland which may be present as a separate lobe.

In the substance of the parotid gland and traversing it lie the external carotid artery with its terminal branches, the facial nerve and its branches, the great auricular nerve joining the facial, and the auriculotemporal branch of the inferior maxillary nerve.

The normal parotid gland cannot be outlined by palpation. Through its duct a fine probe or filiform bougie can be introduced to a depth of one or two inches.

When swollen as a whole, it forms a tumor involving the cheek and causing a characteristic projection of the ear; sometimes causing deafness by closure of the auditory meatus.

The Submaxillary Gland.—The submaxillary gland lies in a pocket of the deep cervical fascia to the inner side of the body of the jaw just anterior to its angle. Its upper posterior border is grooved by the facial artery. It discharges its secretion through Wharton's duct, about two inches in length, opening through a small slit in the side of the frenum near its lingual attachment. Into this opening a fine probe can be introduced. Because of its position beneath the muscular floor of the mouth swellings of glands are apt to appear externally. The

submaxillary gland is best palpated between the index finger of one hand passed to the floor of the mouth and the index and middle finger of the other hand pressing upward beneath the jaw.

The Sublingual Gland.—The sublingual gland, placed just beneath the mucous membrane of the floor of the mouth, forms at the side of the frenum a ridge-like projection which can be seen and felt. It frequently sends extensions into the mylohyoid muscle. It discharges its secretion through numerous ducts opening at the side of the frenum behind the termination of Wharton's duct through an overlying mucous membrane projection called the plica sublingualis. Swellings of the sublingual gland project prominently into the mouth.

General Symptomatology.—The chief characteristic of surgical affections of the salivary glands is swelling. This may be inflammatory or non-inflammatory in type, may be rapid or slow in onset, may be general, involving the whole gland, or may be local, appearing as a tumor.

General enlargement of the parotid gland, if acute in onset, is usually due to mumps or to obstruction of Stenson's duct (calculus or foreign body) or to acute infection.

A general enlargement of gradual onset is incident to chronic inflammation which may be secondary to duct obstruction. It may be an expression of syphilitic or malignant infiltration or may be a feature of Mikulicz's disease.

A localized tumor of the parotid gland, if this be acutely inflammatory in type, may be due to an abscess of a portion of the parotid gland; more commonly it is incident to suppuration of the lymphatic glands in its substance or upon its surface. Tumors formed in the absence of inflammatory symptoms are usually due to inflammatory hyperplasia of the lymph glands lying within and upon the parotid. Mixed tumors are the next common source of such localized swellings, while cysts, carcinoma, gumma, tuberculosis, and actinomycosis are rare.

Mumps.—Characterized by the rapid (hours) development of a non-indurated, extensive, usually bilateral parotid swelling which quickly reaches its maximum (one or two days) and subsides without the local or general symptoms of pus formation. The submaxillary gland may be attacked alone or with the parotid. It may be complicated by orchitis, pancreatitis, ovaritis, or mastitis.

A non-suppurative parotiditis less sudden in onset and more persistent in course may be caused by mercury or the iodides, may follow trauma, or may develop as an expression of gout or other toxemic condition.

The diagnosis is suggested by the sudden, apparently causeless onset, the exclusion of the usual causes of swelling in this region, *i. e.*, dental caries and an erupting wisdom tooth, often by the prompt subsidence of the inflammation.

Acute General Swelling of the Parotid Secondary to Sudden Obstruction of Stenson's Duct.—This may be the result of salivary calculus, foreign body, or an acute exacerbation of a chronic inflammation.

Calculus, aside from mumps, is the commonest form for an acute swelling of the parotid attacking a person in previous health. The pain

and tumefaction come on while eating, or are greatly aggravated by this, and usually subside with a free flow of saliva, to recur again and again. The calculus, commonest in young and middle-aged men, may be lodged into the duct or one of its subdivisions. It can be palpated by passing the thumb into the mouth and the index finger of the same hand on the cheek along the course of Stenson's duct (a finger's breadth below the zygoma). It is usually shaped like a thin olive stone.

Foreign body is characterized by the same suddenness of onset; both it and calculus are more common in the submaxillary than in the parotid duct. Foreign body is a cause of stone and of chronic inflammation of the duct, causing thickness, ultimate dilatation, and purulent discharge which can be squeezed out. This chronic duct inflammation is characterized by intermittent attacks of salivary colic. It is sometimes associated with emphysematous crackling on pressure over the gland (glassblowers).

In all forms of obstruction the orifice of the duct is swollen and inflamed and pain and swelling are markedly increased while eating.

The cause of the obstruction, whether it be calculus, foreign body, stricture, or chronic inflammation, can be determined by cocainizing the orifice of the duct, milking it of its contents, which should be carefully examined, and introducing into it fine probes and bougies.

Parotiditis secondary to operation or systemic infection develops, as does possibly mumps, in a gland predisposed to infection, by extension of infection from the mucous membrane of the mouth. It follows, usually within a week, abdominal operations, particularly those upon the genital tract of women, and is an occasional complication of puerperal fever, typhoid, pneumonia, indeed, any of the infectious diseases.

It begins with pain, swelling, and tenderness of the parotid gland, usually of one side, attended with symptoms of sepsis. The jaw may be fixed. In patients of dulled sensibilities because of intercurrent disease swelling may be the only symptom. The inflammation may gradually subside as one, usually many, abscess forms. There may be sloughing of the entire gland. Pus, if not evacuated, may burst into the ear, may form a postpharyngeal abscess, involve the temporomaxillary joint, or burrow to the mediastinum. If recovery takes place, facial palsy and salivary fistulæ may follow.

If only the lower part of the parotid be involved in acute suppurative inflammation, this condition cannot be distinguished from a similar one attacking the lymphatic glands placed in the parotid or deeply along its under surface. A lesion of the nasopharynx, Eustachian tube, or middle ear might suggest the probability of a secondary adenitis.

Syphilitic parotiditis, developing in the secondary stage of the disease and characterized by swelling, pain, tenderness, and salivation, has been described by Newmann.

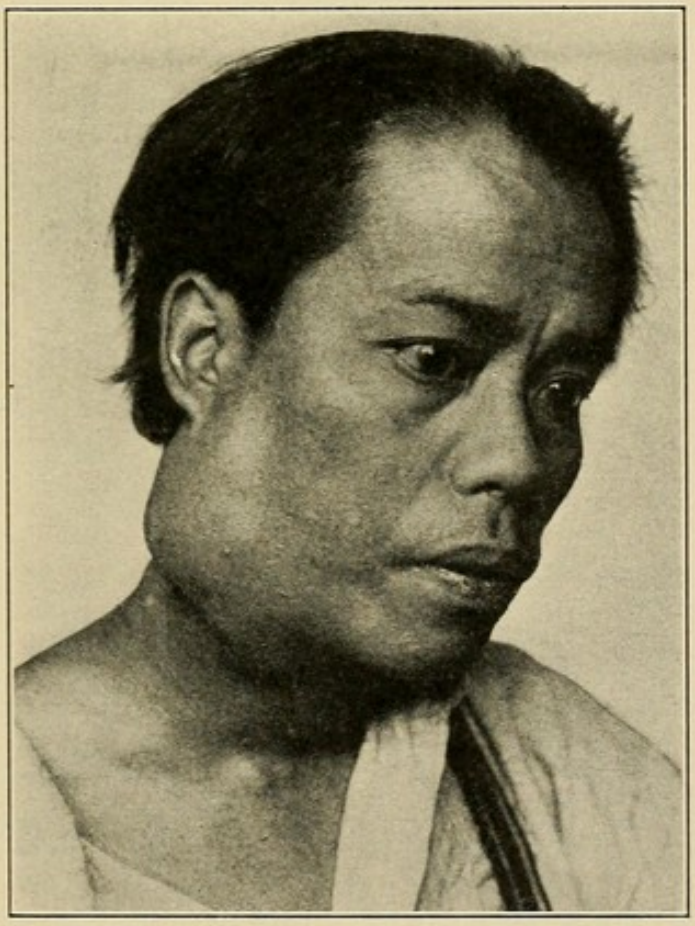
Chronic parotiditis may come on with acute symptoms of moderate severity, the primary swelling persisting for weeks and months and gradually subsiding uninfluenced by treatment. The constitutional symptoms of suppuration are wanting. The condition is diagnosticated by

the absence of demonstrable cause and its persistence. It cannot be distinguished from an infiltrating malignant growth except by its more rapid onset (hours or days), the prompt involvement of the whole gland, and the circumstance that it is not progressive after the first week.

Symmetrical Enlargement of the Lacrymal and Salivary Glands (Mikulicz's Disease).—Mostly observed in the third decade, it is characterized by a slow (months or years) enlargement of the salivary and of the lacrymal glands. All three of the larger salivary glands, together with the palatine, the buccal, the labial, and the Blandin Nuhn gland on the under surface of the tip of the tongue may be synchronously involved.

Malignant infiltration exceptionally causes fairly rapid (weeks), almost symmetrical enlargement of the parotid gland which cannot be distinguished from that incident to inflammatory hyperplasia, and may be an immediate sequel of the latter. The diagnosis to be of service can be made only by excision.

FIG. 109



Mixed-cell sarcoma of lymph glands. Duration, six months; non-inflammatory; no pain; no tenderness; skin non-adherent; numerous glands enlarged, soft and adherent to one another; mouth, nose, throat, ear, eye, and scalp normal. (Hearn.)

Lymph Glands.—Lymph glands, if enlarged from either inflammatory hyperplasia or tuberculous infiltration, when placed in the parotid or beneath its deep surface, cannot be distinguished from a beginning parotid tumor. Malignant lymphoma, lymphosarcoma, and leukemic lymphoma may each begin in the parotid lymphatics.

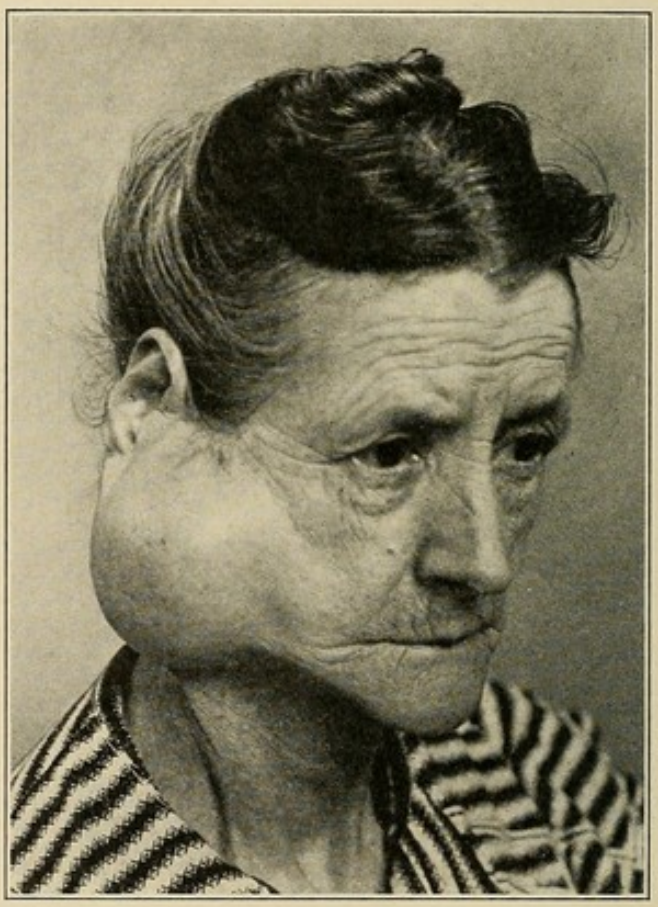
Salivary Cysts.—These may form at the expense of the duct or of the gland substance, and are due to narrowing or obliteration of the passages.

The duct cyst forms a fluctuating, fusiform swelling in the course of Stenson's duct, often associated with enlargement of the gland.

The gland cysts grow very slowly (years), and are not recognized as such until they reach moderate size. They form single, soft, fluctuating tumors, incision into which is followed by fistula.

Congenital Cysts.—*Lymphangioma* forms an ill-defined, lobulated, fluctuating tumor (see Lymphangioma of the Neck), the seat of which in the salivary glands can be detected only by excision and examination. The same may be said of angioma.

Fig. 110



Mixed sarcoma of the parotid, showing typical displacement of the external ear. Duration, months. Lobulated and varying greatly in density in the various parts.

Lipoma may be infiltrating or simply adjacent, lying in the parotid space and displacing the gland. In either case the growth is slow (years). There is pseudofluctuation and the tumor seems superficial. It has been confounded with cyst.

Fibroma and *chondroma* exhibit the symptoms of mixed tumors.

Mixed Tumors.—These may be benign or malignant. They begin at any period of life as painless, rounded, movable nodules, often discovered accidentally because of a favoring arrangement of lights and shadows. They may remain indolent for months or years. This latent period

may be followed by one in which the tumor rapidly increases in size, usually toward the surface, exceptionally toward the pharynx, forming a bosselated mass, soft in one place, of bony hardness in another, which does not infiltrate the surrounding parts, and remains freely movable even when the growth has reached large size.

Pressure symptoms are late in developing. Increased salivation is sometimes so pronounced as to be most distressing. The cervical lymphatic glands are not involved. These tumors may reach huge size.

The diagnosis should be made by excision.

Sarcoma of the parotid should be diagnosticated by excision and microscopic examination. In its origin and clinical course it closely resembles mixed tumor, except the round-cell form, which by a rapid infiltration of the whole gland may simulate a subacute parotiditis. This form quickly invades the surrounding tissues.

Carcinoma, either secondary by direct extension from neighboring parts or primary in the salivary glands. is predisposed to by previous inflammation. It occurs in the encephaloid and scirrhous forms.

It begins as a hard, at first painless, tumor. The encephaloid form, which may develop at any time of life, grows rapidly, forming a large, soft, lobulated tumor which shortly breaks through the skin, resulting in foul, fungating, bleeding ulcers attended with extensive ganglionic enlargement.

The scirrhous form, an affection of old men, densely infiltrates the entire parotid region, retracting the skin and so involving the muscles that fixed jaw and wry-neck may be produced. In both forms of carcinoma facial palsy, extreme pain, venous engorgement, and difficulty in mastication and deglutition develop.

Diagnosis should be made in the early stage of growth by excision and microscopic examination.

Gumma.—Gumma (rare) forms in the parotid gland a painless, indurated, slowly growing (months) tumor, infiltrating the skin and surrounding parts, and either softening and ulcerating or undergoing absorption. In its early development it exactly simulates malignant infiltration, nor can it be distinguished from the latter except by the therapeutic test of mercury, time for which should not be taken unless there is a perfectly clear history of syphilitic infection.

Tuberculosis.—Tuberculosis (rare), usually of the lymphatic glands lying in or on the parotid, forms an ill-defined tumor which in the course of months softens and discharges through one or several sinuses. It cannot be distinguished from other tumor formations in the early stages, since it may develop in persons free from other signs of tuberculosis.

Actinomycosis.—Actinomycosis is usually secondary, characterized by the typical, dense infiltration, multiple sinus formation, and the finding of the characteristic granules in the discharge or in the infiltrate removed by operation.

Salivary Fistula.—Salivary fistula may form in consequence of traumatism or necrotic inflammation of either the gland or its duct and usually closes spontaneously. The diagnosis is readily made by the flow of

saliva through an abnormal opening, increased in quantity by the act of eating.

The Submaxillary Gland.—The submaxillary gland is subject to the affections observed in the parotid gland, including mumps. It is in its duct particularly that foreign bodies and salivary calculi are found.

The entrance of a foreign body (fish-bone, fruit-seeds, etc.) is characterized by sudden pain and swelling of the gland, felt by external or bimanual palpation.

Salivary stone is evidenced by a lump in the floor of the mouth and by intermittent attacks of pain and swelling coming on during meals. Whether the obstruction be due to stone or foreign body, there is a catarrhal condition of the duct with a red, swollen papilla. Inspection, palpation, and probing will formulate the diagnosis.

Mixed tumors of the gland project primarily toward the skin surface internal to the body of the jaw just in front of its angle.

The sublingual glands are particularly subject to cystic dilatation, forming the affection called ranula, characterized by a painless, slowly growing, semitranslucent, fluctuating tumor in the floor of the mouth, commonest in women (see p. 295).

THE NECK.

Congenital.—*Malformations and Distortions.*—(1) Branchial fistulæ or cysts; (2) skin tabs; (3) teratoma; (4) cervical rib; (5) congenital wryneck.

Branchial Fistulæ.—Branchial fistulæ or cysts are due, when placed laterally, to imperfect closure of the second branchial cleft; when placed centrally, to a persistent thyroglossal duct. They may be complete, opening upon both the skin and the mucous surface, or incomplete, opening upon one surface, or without either opening forming a cyst. Though present at birth, they may not produce symptoms until long after.

The lateral fistula, usually on the right side, forms an indurated cord which passes upward beneath the sternomastoid and discharges intermittently a turbid, mucous secretion, which keeps the surrounding skin in an eczematous condition. The surface opening is placed along the inner border of the sternomastoid muscle; the internal opening is in the lateral wall of the pharynx near the base of the tonsil, the tract passing between the internal and external carotid beneath the digastric muscle and being adherent to the sheath of the vessels.

The injection of an ill-tasting fluid from the external orifice will establish the diagnosis.

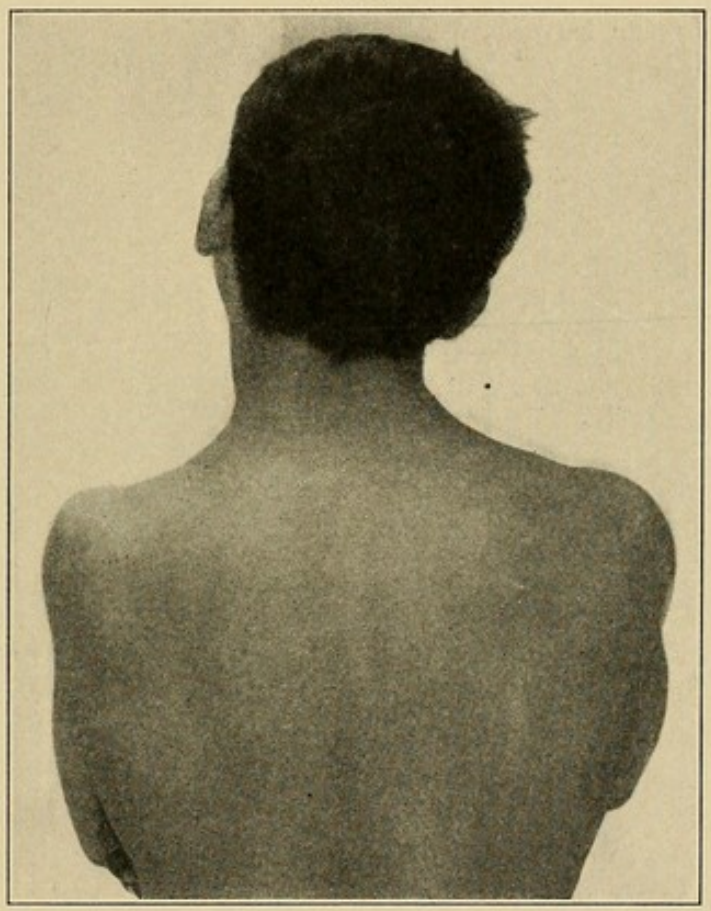
Median fistula very rarely manifests its presence at birth. Palpation shows an indurated cord in the midline with the external opening between the hyoid bone and the suprasternal notch.

Skin Tabs.—Skin tabs, containing cartilage, at times bilateral, symmetrical, and resembling supernumerary ears, are found along the anterior border of the sternomastoid muscle.

Teratoma.—Teratoma (rare) forms a congenital tumor in the antero-lateral region of the neck which cannot be distinguished from goitre, since it moves with the larynx.

Congenital Wry-neck.—The expression of a traumatic or toxic myositis resulting in fibroid degeneration and contracture of the sternomastoid muscle is characterized by drawing of the head toward the affected side, while the face, if the sternomastoid be the only muscle contractured, is turned toward the healthy side. Any of the muscles of the neck may be

FIG. 111



Congenital torticollis. Right sternomastoid muscle. Typical position.

involved. Motion is limited and the contracted muscle becomes prominent when an effort is made to correct the position of the head. As a result of the fixed faulty position there is facial asymmetry and later curvature of the spine.

Cervical Rib.—Cervical rib, a malformation growing from the seventh cervical vertebra, and with its end free or attached to the first dorsal rib, usually causes no symptoms. Exceptionally after puberty in its growth it presses on the brachial plexus, causing pain and weakness of the arm and a prominence of the subclavian artery which, on examination, is found to depend upon an underlying bony swelling distinguishable from outgrowth of the first rib or the vertebral processes by the x-rays.

Traumatisms.—Contusions.—Contusions or sprain of the sterno-mastoid muscle causes a blood effusion into its sheath, noted in the

newly born after difficult labor. Trauma of the vertebral column may cause contusion or sprain with or without injury to its contents, or luxation or fracture with or without injury to the cord (see p. 336).

Contusions of the Brachial Plexus.—This may follow direct trauma, occupation, as from carrying heavy weights on the shoulder, or position (anesthesia palsy), the nerves in the latter case being compressed by the clavicle thrown upward and backward, as in the Trendelenburg position with arms suspended. It is characterized by anesthesia and by palsy of motion. This form of palsy is observed in the newly born even when the clavicle has not been broken.

Contusion of the larynx, such as that produced by a sudden blow with the outer border of the hand, may, even in the absence of gross lesions, cause sudden death by cardiac inhibition. There are usually distinct lesions characterized by blood effusion beneath the mucous membrane, by edema, and more or less fixation of the cords. The immediate effect is dyspnea and intense pain, aggravated by all movements of the larynx (p. 322).

A cricothyroid luxation is characterized by intense pain and dyspnea, and deformity, usually masked by swelling.

Fracture of the Larynx.—Fracture of the larynx may occur in children and in adults. It usually involves the thyroid cartilage, next in order the cricoid, not infrequently both (see p. 322).

Emphysema favored by coughing may come on immediately, and by rapid extension to the mediastinum may destroy life.

As a result of trauma or forced expiratory efforts, as in coughing, a pneumocele may develop. It forms a resonant, sometimes crepitant, tumor, the tension of which is increased by expiratory effort. It is placed near the course of the trachea or, when it is due to hernia of the lung, in the supraclavicular fossa.

Fracture of the Hyoid Bone.—Fracture of the hyoid bone, commonly due to pinching force, is characterized by great pain, local tenderness, difficulty in talking or swallowing, and often cough and dyspnea, sometimes bloody expectoration from injury of the pharyngeal mucous membrane. Either the cornua or the body may be broken. Unnatural mobility, and even crepitus, can be detected either by external palpation or by examining with a finger of one hand introduced into the mouth while those of the other make external pressure. The *x*-rays will usually show the nature of the injury.

Vascular Wounds.—Wounds of veins are characterized by free bleeding and sometimes the entrance of air by aspiration, particularly if the vein walls are adherent to a surrounding infiltration. Ligation of one or both jugular veins is not entirely devoid of danger incident to back pressure. Ligation of either one or both common carotid arteries is likely to be followed by acute cerebral softening, apoplexy, and death.

Injury of the thoracic duct, suggested by a continuous flow of chyle from the wound, is rarely of grave moment, the flow ceasing spontaneously because of cicatrization and accessory openings.

Injury to the vagus, if unilateral, is followed by laryngeal hoarseness and palsy of the vocal cord, often by pulmonary edema.

Injury to the cervical sympathetic causes contracted pupil and congestion and increased temperature on the side of the face.

Injury of the spinal accessory results in paralysis of the sternomastoid and trapezius muscles.

Affections Characterized by Fixed Positions of the Head.—Acquired Wry-neck.—Torticollis may suddenly develop as a result of traumatism. It is then due to luxation characterized by bony deformity, to myositis incident to blood clot in the substance of the muscle itself, evidenced by localized swelling and tenderness, or to deeper blood effusion causing irritation of the nerve roots.

It may be rapid in development and non-traumatic, coming on often in the night and due to a myositis, usually termed rheumatic, but possibly secondary to any infection. This form of torticollis is common in children with slight sore throats and is characterized by a fixed position of the head, usually in lateral flexion with slight rotation. The muscle affected is tender and rigid to palpation and there is pain on motion. The condition is usually transitory, but may become chronic, resulting in permanent contracture.

A similar form of torticollis develops as an expression of rheumatism of the vertebral articulations, and is marked by tenderness over the spine.

Torticollis due to gummatous infiltration of the sternomastoid muscle, either circumscribed or diffuse, is characterized by the painless progression of such an infiltrate in a person giving a syphilitic history.

Torticollis secondary to caries of the vertebræ is evidenced by more gradual onset, fixed position, tenderness over the involved vertebra, also elicited by jarring the head downward, and tonic contraction of the involved muscles.

Torticollis secondary to deep cervical adenitis exhibits the additional symptoms of glandular inflammation.

The torticollis symptomatic of a basilar meningitis, mastoiditis, and parotitis, or a cerebral hemorrhage involving the motor centres, exhibits, in addition to wry-neck, the symptoms of a major condition.

Spasmodic torticollis characterized by tonic and clonic contractions of the muscles supplied by the spinal accessory nerve, occurs in neurotic individuals, often without definite cause. In the variety characterized by tonic spasm, the diagnosis can be formulated by excluding the usual recognized causes of the contracture, the absence of tenderness or other symptoms of myositis, and often by the development of an hypertrophy of the muscles involved.

Acute Inflammatory Affections of the Neck.—These are manifested by the rapid development (days) of well-marked local and constitutional symptoms of inflammation. If the skin infections be excepted, they usually begin in lymphatic glands, and secondarily involve the surrounding tissues. Acute osteomyelitis, particularly of the lower jaw and mastoid process, exceptionally of the vertebra or

base of the skull, is an occasional underlying cause. Exceptionally the infection may occur through puncture or erosion of the esophagus or the air passages.

The acute superficial infections are represented by furuncle and carbuncle commonly placed at the back of the neck at the collar line and beginning as a follicular infection. Anthrax occasionally develops. All of these infections run a characteristic course.

Acute Adenitis.—Acute adenitis, commonest in children before the tenth year, and secondary to a focus of infection in the area from which the lymphatics drain into the affected glands, usually develops beneath the lower jaw, just behind its angle, or in one or more of the group of glands lying high in the neck close to the great bloodvessels.

Submental adenitis (acute), sometimes called sublingual abscess, limited in its extension by the sides of the jaw, forms a tender tumor beneath the skin just behind the symphysis. The glands involved are the submental group placed between the anterior bellies of the digastric on the surface of the myelohyoid muscles. Into them are drained the lymphatics of the midportion of the lower lip, chin, gums, and floor of the mouth, and the tip of the tongue. They communicate with the submaxillary group of glands.

Submaxillary adenitis (acute) forms a tender tumor beneath the chin limited in its extension by the body of the jaw and the hyoid bone. The submaxillary glands are placed along the inner border of the body of the lower jaw, with often one or two glands on its outer surface. Lymph to these submaxillary glands flows from the face, the lips, the gums, the anterolateral border of the tongue.

Since the swelling of submaxillary adenitis is likely to extend from beneath the jaw slightly on to the cheek surface, it may readily be confounded with an osteoperiostitis of the lower jaw. In the latter case, the greatest swelling is to the outer, rather than to the inner, side of the base of the jaw and the tumor will be found firmly adherent to the bone. The two conditions are, however, often associated.

Exceptionally, virulent and rapidly infiltrating infection from a carious tooth or inflamed tonsil may invade the deep cellular tissues of the neck. This is characterized by brawny submaxillary infiltration, followed shortly by chill, fever, and symptoms of profound toxemia, dysphagia, dyspnea, and fixation of the jaws and head. The floor of the mouth is elevated and edema of the glottis is likely to occur.

This affection is distinguished from an ordinary submaxillary suppurative adenitis by the violence of the local and constitutional symptoms.

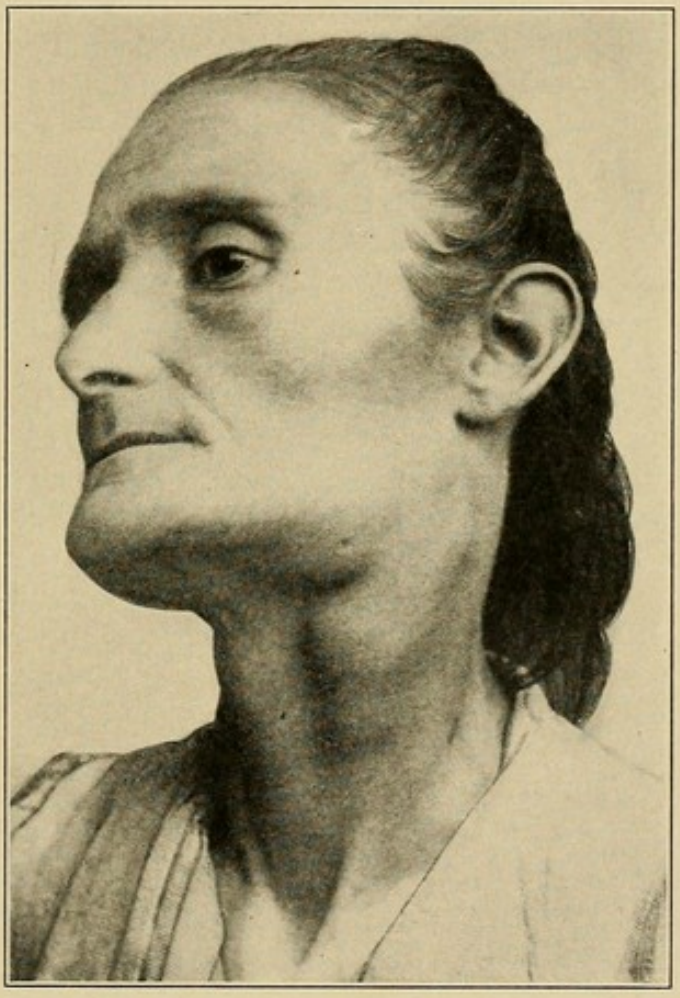
A tender swelling, near or behind the angle of the jaw, accompanied by a severe pain, often radiating to the ear, and inability to open the mouth, occurring after puberty, and without obvious surface lesion, is usually due to an erupting wisdom tooth. The diagnosis is best formulated by the *x*-rays.

Superficial Cervical Adenitis.—Superficial cervical adenitis is secondary to infection of the area draining primarily into the subauricular

or suboccipital glands, or of the external ear and back of the neck, draining directly into the cervical glands placed along the posterior border of the sternomastoid and superficial to it. Between these glands and the deep set there is a free communication.

Deep Cervical Adenitis.—Deep cervical adenitis involves the chain of glands which pass along the course of the internal jugular vein. The upper group of the deep set is made up of many small glands behind the sternomastoid, and a few large glands in close relation to the internal jugular vein.

FIG. 112



Chronic cervical adenitis. Fifteen years' duration; submaxillary group and anterior cervical chain of lymph glands enlarged, hard, non-sensitive, and slightly adherent, with normal overlying skin. (Carnett).

Into them is drained the lymph from all the glands placed superficially and above, and also that from the gums, tongue, tonsils, nasal cavity, pharynx, thyroid gland, larynx, and esophagus. The lower deep cervical set of glands receives all the lymph from above and that from the back of the neck and scalp, the breast and the axilla.

There develops a swelling beneath the sternomastoid or behind it which shortly infiltrates this muscle, fixing the head in a position of wry-neck. Since the inflammation is beneath the deep fascia, both

dyspnea and dysphagia may be observed, together with marked constitutional symptoms. The pus may burrow into the mediastinum, may erode a large bloodvessel, or may discharge through the esophagus or the air passages. Suppuration of the lower deep group may burrow into the axilla.

The deep cervical glands are subject to suppurative adenitis secondary to infections of the throat, particularly that incident to the eruptive fevers.

Acute thyroiditis (p. 327) and osteomyelitis of the cervical vertebræ (see p. 340) are elsewhere described.

Affections Characterized by Tumor Formation with Inflammatory Symptoms Slight or Wanting.—Inflammatory Hyperplasia.—Secondary to peripheral infection, or engendered by the irritation incident to blood absorption, as from simple contusion, or following la grippe or other form of toxemia, there may be found one or more small ovoid, tender nodules in the position occupied by the lymphatic chains. Usually, the hyperplastic glands develop insidiously as the result of prolonged irritation, such as that incident to chronically inflamed tonsils, catarrh of the mucous membrane, middle ear disease, or pediculi of the head.

These glands may undergo slow resolution with the removal of the source of irritation, or may soften, with practically no inflammatory phenomena other than the surrounding induration of a chronic periadenitis, and either become absorbed or discharge externally. Softening takes place before they reach the size of the last joint of the thumb.

This chronic lymphadenitis resembles, absolutely, the early stages of tuberculous adenitis, except that it generally attacks children under ten years of age. It predisposes to tuberculous infection.

If, after the cure of peripheral irritation, the glandular enlargement does not subside, the diagnosis should be made by the tuberculin test or by excision.

Tuberculous Lymphadenitis.—Tuberculous lymphadenitis is characterized by the slow (months), painless enlargement of usually an associated group of glands, at times all the glands of the neck. This enlargement may remain for a long period hyperplastic in type. It may soften and discharge thin curdy pus through a ragged non-indurated sinus, or it may extensively invade the periglandular tissues, forming an infiltrated, nodular mass discharging through many sinuses. It is commonest in the second and third decades of life, and is usually observed in the upper superficial or deep cervical group of glands from which it extends downward. The tonsil is the common port of entrance, and, though in the early stage (weeks) there will be found on palpation, perhaps, not more than two or three smooth, movable, ovoid nodules, the longest less than the size of the last joint of the thumb, at the time these patients are seen by the surgeon the entire side of the neck may be found occupied by a nodular infiltration containing upward of a hundred diseased glands.

Tuberculous glands cannot be distinguished from simple inflamma-

tory hyperplasia in the earliest period of their course. The persistence of a chronic enlargement after removal of the focus of infection, particularly its increase in size, and the progressive involvement of associated lymphatic glands, occurring in one of tuberculous heredity or environment, would strongly suggest the nature of the affection.

Early diagnosis is important since operation on advanced cases shows not more than 75 per cent. of cures. Moreover, lymphosarcoma and malignant lymphoma and tuberculous lymphoma, all present precisely the clinical picture of simple inflammatory hyperplasia in their beginnings. The diagnosis should be by excision and microscopic examination.

Malignant Lymphoma.—Malignant lymphoma is characterized by hyperplasia, unattended by inflammatory phenomena or characteristic blood change except that common in all lymphatic hypertrophy (eosinophilia). It is common in children and comparatively young people. It begins in the neck, ultimately involving all the glands of both sides in a growth at first slow, then at an interval varying from months to years, becoming suddenly rapid and progressive. Glands elsewhere may or may not be involved.

The affection is marked by intermittent fever lasting from one to three weeks, coming and going without cause. The anemia is toxic.

In some cases tuberculous adenitis pursues precisely the course of malignant lymphoma.

Lymphatic Leukemia.—Lymphatic leukemia exhibits similar symptoms together with an enormous increase in the blood leukocytes.

Lymphosarcoma.—Lymphosarcoma often begins in a gland which has been previously enlarged and indolent for a long time. It is characterized by the rapid growth of a single gland, thus simulating the early stage of malignant lymphoma. The size of the original tumor steadily progressing, it breaks through its capsule, infiltrating the surrounding parts and is likely to ulcerate through the skin by pressure or infiltration. The associated chain of glands is not involved.

A huge soft tumor, occupying the side of the neck, fungating, and with metastases, may readily be called sarcoma, but this is no longer helpful to the patient.

The rapid (weeks) and causeless increase in the size of a chronically hyperplastic gland, or one previously healthy, should suggest immediate removal for diagnostic purposes. This rule should be imperative if the gland has, when first seen, reached the size of a pigeon's egg without signs of inflammation or softening.

Carcinoma.—Carcinoma of the neck is practically always secondary, though there is a primary form developing from a branchogenic cyst (rare). Exceptionally the disease develops primarily in the thyroid or the thymus. In any event, the presence of a hard, infiltrating tumor of the neck, at first non-inflammatory in type, suggests a most careful search of the area drained by the lymphatic glands involved. This must include the nose, mouth, pharynx, larynx, and esophagus.

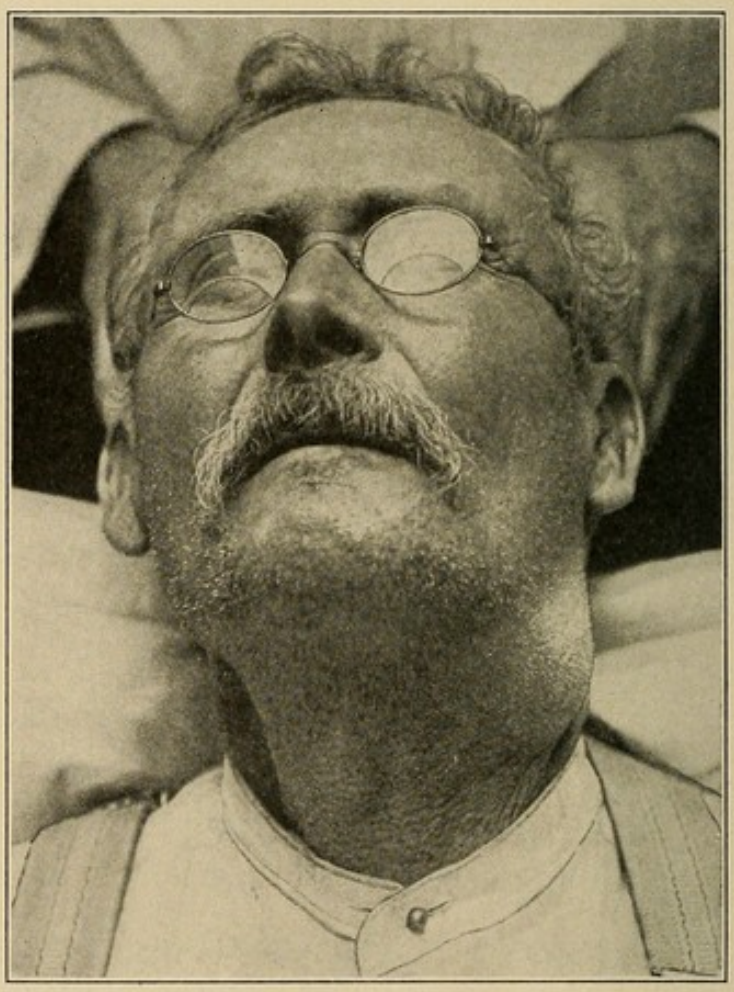
In its earliest stage, carcinoma simulates inflammatory hyperplasia.

It is at this stage that the diagnosis should be formulated by removal of the glands and microscopic examination.

The late stage is characterized by areas of softening, the formation of multiple fungating sinuses discharging from the extensive induration, and the progressive involvement of the glands toward the thorax.

In the case of an extensive infiltration, often bilateral and riddled with sinuses, the diagnosis between actinomycosis, tuberculosis, and malignant growth may be difficult. It may be established by finding the ray fungus, by no means easy; by the discovery of the tubercle

FIG. 113



Carcinoma of lymph glands. Slow development during a year after destruction with "cancer paste" of an epithelioma of the lower lip. Tumor indurated, nodular and adherent to skin and adjacent structures.

bacillus, often difficult or impossible from the discharges alone; by the excision and microscopic examination of a portion of the growth. Even this is not always absolutely conclusive. Cervical carcinoma of this type is practically always secondary to a primary focus.

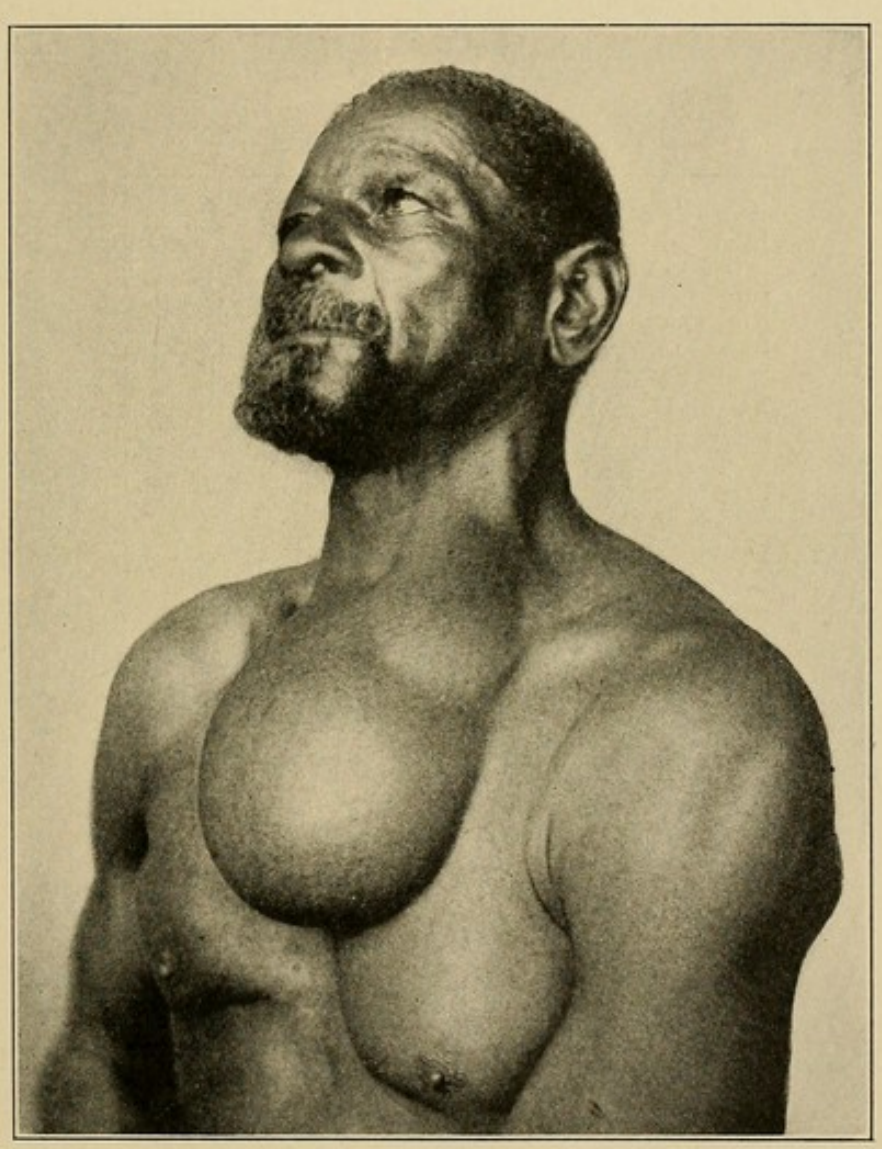
Actinomycosis.—Actinomycosis of the neck is secondary to that of the jaw.

Vascular Goitre.—Vascular goitre may give thrill, bruit, and expansile pulsation, and, if it involve an aberrant lobe laterally placed, may closely

simulate an aneurysm. It can, however, be lifted away from the carotid artery, does not affect the time and tension of the pulse distal to the tumor, and is usually associated with symptoms of Graves' disease.

The Carotid Body.—The carotid body, a small ductless gland of unknown function, placed at, or near, the bifurcation of the carotid artery, vascularized from this and closely adherent to it, when enlarged exhibits a pulsation so pronounced as to suggest aneurysm. Tumor

FIG. 114



Bilobular lipoma. Twenty-five years' duration; freely movable; doughy consistence, not connected with thyroid; skin dimples when made tense; travelled downward from the neck. (Carnett.)

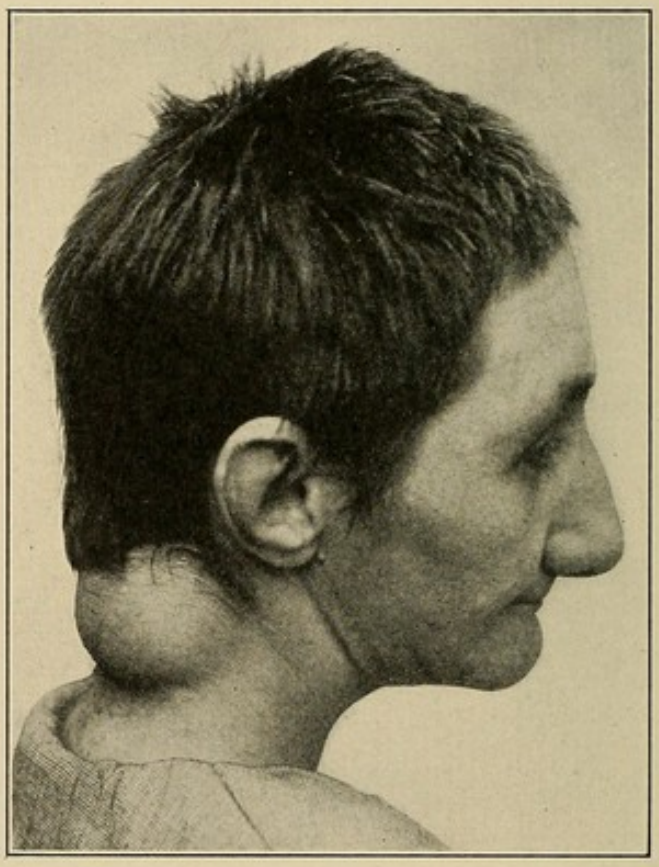
of the carotid body arises from the region of bifurcation of the common carotid artery beneath the sternomastoid muscle about the level of the upper border of the thyroid cartilage. It is moderately movable horizontally, but not vertically. It is usually ovoid in shape, is smooth and not lobulated, is single and not made up by the coalescence of several tumors, exhibits transmitted but not expansile pulsation, may

give both bruit and thrill, may cause bulging of the wall of the pharynx, occasionally contracts the pupil of the same side, grows slowly at first, then rapidly, exists for a number of years before causing trouble, and is moderately dense in consistence. Inflammatory and subjective symptoms are usually absent. The difficulty encountered in its extirpation makes the diagnosis important.

The pulsation of a cold abscess placed close to the carotid artery may so closely simulate that of aneurysm as to require the use of an exploratory needle for the formulation of a diagnosis.

Syphilitic Adenopathy.—The early stages of the disease are characterized by a moderate hyperplasia particularly of the postcervical group of glands.

FIG. 115



Lipoma of neck. Common situation; soft, semifluctuating; skin normal.

Gummatous adenopathy of the neck is extremely rare. Gummata of the skin and subcutaneous tissues of the back of the neck are fairly common, and are characterized by skin infiltration followed by early softening (weeks) and the formation of one or more deep, punched-out ulcers. The diagnosis must be made from epithelioma (rare) by associated lesions of syphilis, and by the rapid course, absence of enlarged glands, and the characteristic resultant ulcer.

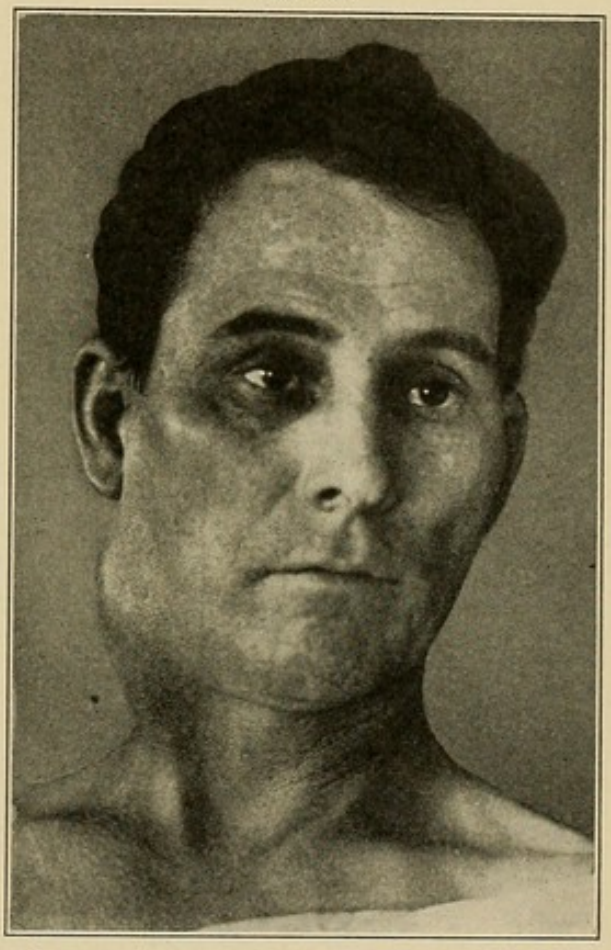
Lipoma.—Lipoma, commonest in the back of the neck, forms a clearly outlined, slowly growing tumor, which, until it has reached large size, closely resembles a sebaceous cyst.

The diffuse form of lipoma, noted in middle-aged working men, not otherwise fat, appears in the form of huge, double chins, supraclavicular pads, and great bosses on the back of the neck which may penetrate the deep fascia. The diffuse, subfacial lipoma is often congenital, and hence may be seen in children as well as in adults. It penetrates muscular interspaces deeply, sending prolongations along the line of least resistance. It often gives the sensation of a cystic growth. Its nature can be determined by operation.

Fibroma.—Fibroma, if superficial and circumscribed, arises from the nerves (neurofibroma) or bloodvessels (angiofibroma) of the skin and subcutaneous tissue, presenting the appearance of *fibroma molluscum*. The diffuse, superficial form appears as an elephantiasis.

The deep form, having for its seat of predilection the back of the neck, but developing elsewhere, is characterized by density of structure and slow growth.

FIG. 116



Suppurating branchial cyst. Man, aged forty-three years; duration four months; slight tenderness; occasional discomfort on swallowing; firm, ill-defined, non-fluctuating mass, closely connected with surrounding tissue. Overlying skin normal and freely movable; regional lymph nodes not involved. Diagnosis, microscopic. (Frazier.)

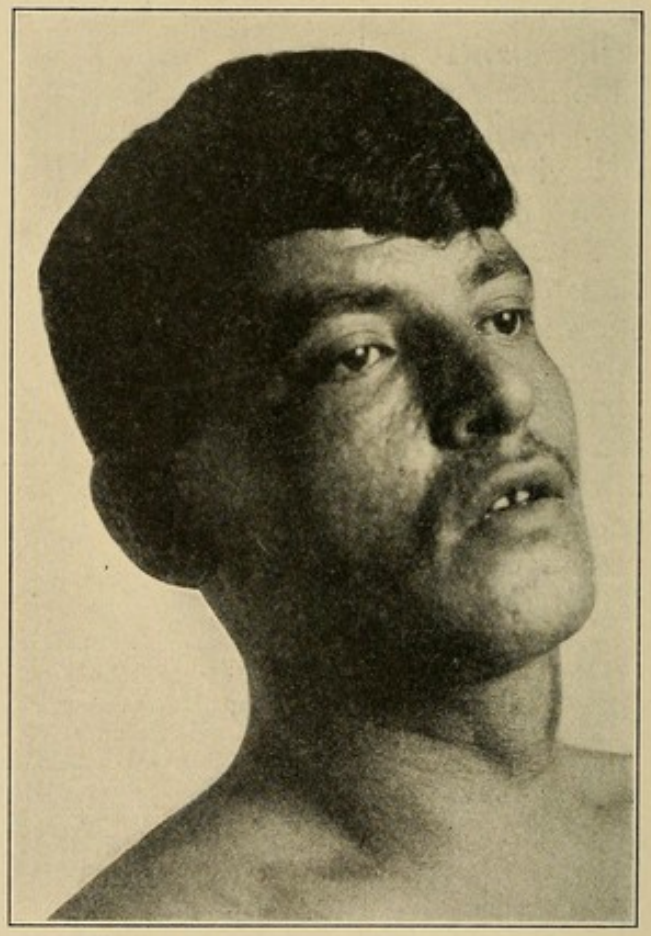
Affections Characterized by Fluctuating, Non-inflammatory Tumor.—**Branchial Cysts.**—Branchial cysts, usually developing after puberty, are the remains of the thyroglossal duct and the second branchial cleft. In the latter case they are placed at first along the anterior border of the sternomastoid muscle. They may form large, soft tumors occupying the greater part of the anterolateral cervical region. The growth is slow and non-inflammatory, giving pain or discomfort only on pressure. Such a fluctuating growth developing in an adult, and not preceded by a solid tumor, can scarcely be other than a branchial cyst. Because of their close relation to the vessel sheaths the removal of the cysts may be difficult.

The cyst due to an unobliterated thyroglossal duct is found in the midline, between the sternal notch and the foramen cecum at the base of the tongue. It can be distinguished from subhyoid or suprahyoid bursa only by microscopic examination of its contents.

Dermoids.—Dermoids form small, soft, subcutaneous tumors of slow growth, usually in the anterolateral region of the neck, developing after infancy. The diagnosis can be made only by excision.

Congenital Serous Cysts.—Congenital serous cysts, usually observed in infants at birth, are due to dilatation of the lymphatic vessels. They are multilocular, filled with serum which coagulates on being drawn, are sometimes discolored by blood, have no distinct capsule, and penetrate deeply and intimately among the various structures of the neck, much as does a lipoma. These cysts begin along the inner and outer margin of the sternomastoid, and increase in size, often rapidly, forming large, soft, fluctuating, at times semitranslucent tumors, which may occupy the entire side of the neck and bulge into the axilla. The loculation and varying consistency and the presence of fibrous bands in these cysts is characteristic.

Fig. 117



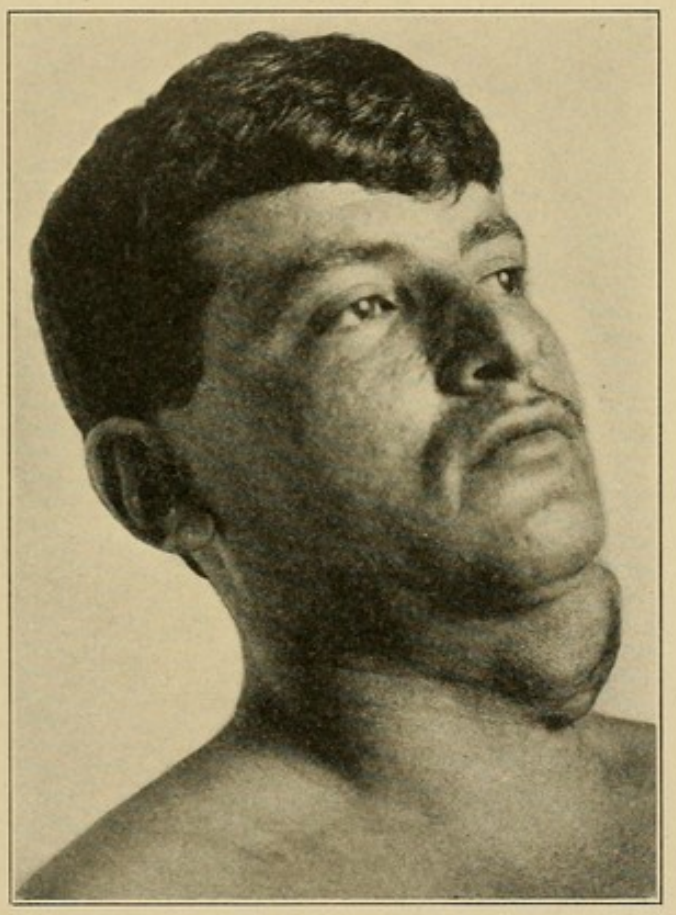
Subcutaneous cavernous angioma. Slightly elevated compressible tumor of indefinite outlines on left front of neck, simulating a fibrolipoma on palpation; slow growth since early childhood; possesses erectile properties as shown by comparison with accompanying photograph (Fig. 118) taken after prolonged expiratory straining effort with glottis closed. (Carnett.)

Blood Cysts.—Blood cysts of congenital origin may not develop until late in life. They form soft tumors often communicating directly with large veins, sometimes made up of a mass of varices which may attain a size so large as to involve the whole side of the neck, reach to the axilla and extend down the anterior wall of the chest. The tension

of these cysts is increased by straining efforts, and they can be partly emptied of their contents by surface pressure. They do not pulsate. There is often an overlying skin angioma. Aspiration may be needful for diagnosis.

Sebaceous Cysts.—Sebaceous cysts form indolent, at first hard, tumors, the nature of which is suggested by the distinctly rounded form, superficial position, close adhesion to the skin, and often the enlarged duct entrance from which can be squeezed the sebaceous matter. They are commonly placed at the back of the neck near the hair line. Lipoma similarly placed may present most of the same characteristics.

FIG. 118



Subcutaneous cavernous angioma. Same case as Fig. 117 during expiratory straining; tense, soft swelling showing slight lobulation but no discoloration of skin; scar from an exploratory operation during childhood; percussion note higher pitched than opposite side, but tympanitic from underlying air passages; spontaneous subsidence of swelling on cessation of straining effort. (Carnett.)

Subhyoid Bursa.—Subhyoid bursa develops slowly and indolently beneath the hyoid bone, and cannot be distinguished from a cyst of the thyroglossal duct or an accessory thyroid excepting by operation. The *suprahyoid* bursa is indistinguishable from accessory thyroid in this position or overdevelopment of the lingual tonsil, since it may be impossible to elicit fluctuation.

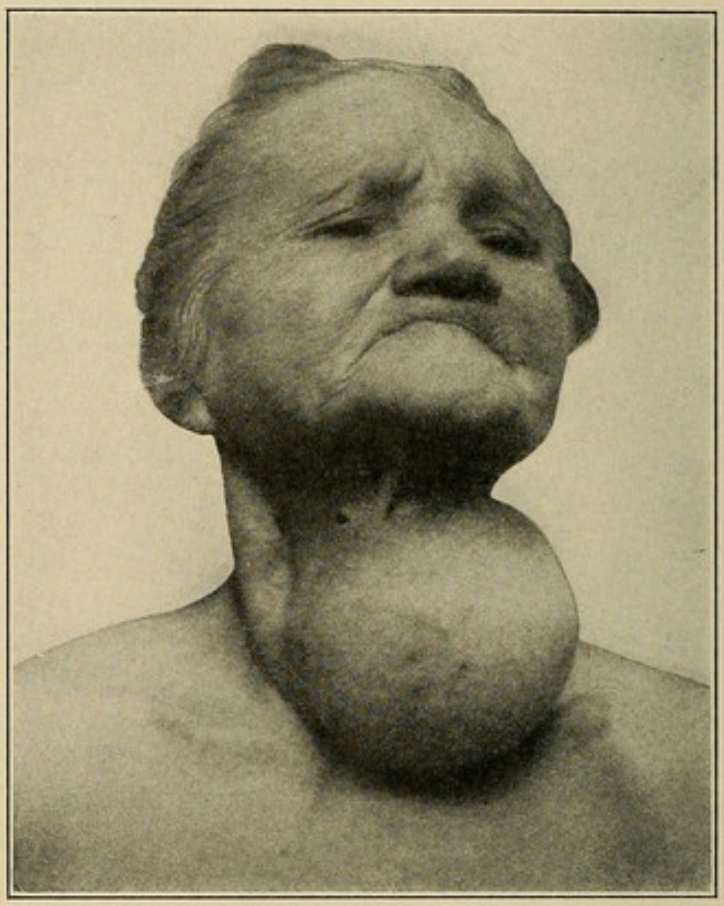
Chronically Inflamed Glands.—At times glands hyperplastic either from long-continued simple irritation or from tuberculous affection, form

fluctuating tumors entirely wanting in all the obvious signs of inflammation. These tumors are, as a rule, multiple rather than single, are surrounded by the induration of a chronic periadenitis, and will be found to have developed at the seat of former hard nodules.

Sarcoma.—Sarcoma may become so markedly cystic as to obscure on examination the solid elements of the growth. This is, as a rule, a late development, and follows at the seat of a solid or semisolid infiltration.

Cystic Goitre.—Cystic goitre usually gives the characteristic signs of its thyroid origin. When an aberrant lobe undergoes cystic degeneration, the diagnosis may be impossible without operation.

FIG. 119



Cystic goitre. Duration, years. No subjective symptoms.

Lipoma.—Lipoma which may be superficial or deep, circumscribed or diffuse, usually presents such characteristic features that the diagnosis is obvious. It may, however, especially when placed beneath the fascia, appear as a somewhat irregularly outlined tumor, giving a sense of fluctuation so distinct as to deceive the elect. It is not infrequently combined with congenital serous cysts. In doubtful cases the diagnosis can be made only by operation.

Affections Characterized by Pulsating Tumor.—Aneurysm.—Any tumor of the neck placed near a large artery may exhibit transmitted pulsation. When this pulsation is of the expansile type, is associated with thrill and bruit, is placed in the course of an artery, and the pulse in

this artery and its branches distal to the tumor is slowed and lessened in tension, the tumor is necessarily an aneurysm. The tumor may be formed by the locally dilated wall of the artery (true aneurysm) weakened by syphilitic or alcoholic arteritis, or by a condensation of fibrous tissue adjacent to the wall (traumatic).

The artery involved is usually the common carotid. Aneurysm of this vessel exhibits less of a sex predilection than is noted elsewhere, though it is more common in men than in women. It may be associated with aneurysmal dilatation of other regions.

In addition to the typical symptoms of aneurysm (see p. 98), there are highly characteristic pressure symptoms expressed in the form of vertigo, syncope, and either somnolence or insomnia, pain referred along the brachial plexus, hoarseness of the voice, dilatation of the pupil, dyspnea and dysphagia, sometimes unilateral palsy, and atrophy of the tongue.

In the aged, especially those who are emaciated, there is commonly a fusiform dilatation of the carotid at its point of bifurcation, causing a palpable tumor with an expansile pulsation so marked as strongly to suggest aneurysm. There is no thrill, but an artificial bruit may be caused by even slight pressure of a stethoscope.

Aneurysm of the internal carotid (rare) forms a pulsating tumor which projects into the pharynx.

An aneurysm of the external carotid is usually traumatic in origin, and exhibits the characteristic features of this affection.

Aneurysm of the subclavian artery forms a transversely elongated tumor projecting above the clavicle at the outer side of the sternomastoid, its bruit is carried into the axillary artery, and this vessel, together with the radial, shows a slowed and softened pulse as compared with the corresponding vessels of the healthy side.

Aneurysm of the innominate artery forms a tumor projecting behind the sternoclavicular articulation and often palpable at the suprasternal notch; its bruit is carried by both the carotid and subclavian, and both those vessels exhibit the characteristic pulse alterations. As in all aneurysms, pressure symptoms are well marked and are expressed by venous engorgement, muscular spasm or palsy, pain, bone erosion, alteration of the voice, cough, dyspnea and dysphagia. The right recurrent laryngeal nerve is usually involved.

Aneurysm of the aorta exhibits little tendency to extend upward into the neck. The symptoms due to pressure upon the brachial plexus and the veins are left-sided. The presence of this tumor may be determined by the pressure symptoms, tracheal tug, the results of auscultation and percussion, and finally by the *x*-rays.

Arteriovenous aneurysm of the neck is usually traumatic and extremely rare. It exhibits the characteristic symptoms.

THE LARYNX.

The symptoms common to affections of the larynx are pain, alteration of the voice, cough, and difficulty in breathing.

The pain is felt in the larynx and may be aggravated by swallowing or speaking. Except it be neurotic, it is usually expressive of infiltration or inflammation.

Alteration of voice is characterized by difficulty in striking the true note in the case of singers, by hoarseness, or by complete loss of the spoken voice.

Cough due to laryngeal irritation is, in the absence of an ulcerating lesion, harassingly recurrent and fruitless. When it is symptomatic of trauma or of ulcerative lesions, it is accompanied by an expectoration of bloody or sanguinopurulent mucus.

Respiratory obstruction, if slight, is marked only by noisy breathing. In the severe form there is cyanosis and mental perturbation, and the noisy breathing is accompanied by violent inspiratory efforts and retraction of the suprasternal notch and the intercostal spaces with each inspiratory effort.

Edema of the Glottis.—This is expressed by a swelling of the ary-epiglottic folds and base of the epiglottis, narrowing or occluding the superior laryngeal orifice, and is a common expression of acute inflammation of the tongue, throat, tonsils, or laryngeal mucosa, and of laryngeal trauma. It occurs as a part of a general edema, may be secondary to tumor pressure, and is an occasional dangerous expression of angioneurotic edema.

The symptoms are those of laryngeal obstruction. The diagnosis, if not obvious, is made by a laryngoscopic examination.

Contusion.—Contusion of the larynx is characterized by violent cough, dyspnea, and aphonia, exceptionally by sudden death, apparently due te cardiac inhibition.

The diagnosis of contusion will be based upon the failure to elicit the symptoms of fracture by external manipulation. Laryngoscopic examination may show swelling or even blood extravasation, and limitation of motion of the vocal cords. The aphonia which frequently results is usually transitory.

Fracture.—Fracture of the larynx, due to direct force, commonly involving the thyroid, and appearing as a median or lateral vertical break, is characterized by dyspnea, usually dangerous in its intensity, cough, often with bloody expectoration, and aphonia. The diagnosis is based upon deformity, which is usually obvious, preternatural mobility, and crepitation readily elicited except in case of simple fissures or of fracture with wide displacement, swelling, tenderness and often the fine crepitation of emphysema. The laryngoscopic examination shows blood extravasation.

Tracheal fracture due to direct violence, sometimes to overstretching, or to violent coughing, and often associated with laryngeal fracture,

usually appears in the form of a transverse tear, which may be complete. Profound dyspnea, rapid emphysema, pain, cough, and bloody expectoration are the symptoms which suggest the diagnosis.

Burns or Scalds.—Burns or scalds of the larynx, if not immediately fatal from cardiac inhibition, cause the dyspnea and aphonia of rapid edema.

Foreign bodies of the larynx are characterized by the sudden onset of violent cough and dyspnea.

Usually the body is extruded by the first coughing act. It may, however, become lodged in the larynx, remain movable in the trachea or pass into one of the bronchial tubes, usually the right, and remain fixed there.

If the body be lodged in the larynx and not of sufficient size to entirely obstruct, it causes recurring paroxysmal cough. There is a temporary amelioration of the spasmodic dyspnea after the accident, followed shortly by increased difficulty in breathing incident to edema.

If the body be loose in the trachea, it causes recurring violent paroxysms of cough and dyspnea similar in violence and suddenness of onset to that characteristic of the first insufflation.

Lodgement in a bronchus is marked by pain in one side of the chest, alteration in the respiratory murmur of the blocked lung, and whistling or wheezing at the point of lodgement.

Diagnosis as to the seat of the body is based upon the history of the case, laryngoscopic examination, the use of the bronchoscope, and, where this is applicable, the *x*-rays.

Inflammation.—Laryngitis.—Acute laryngitis is characterized by pain on swallowing or even speaking, referred to the larynx, usually cough and hoarseness or loss of voice.

In its acute congestive form it is exemplified by the croup of children. There is usually here an associated spasm. Diagnosis is based upon the usual preceding slight catarrh, suddenness of the attack and its rapid disappearance.

Diphtheritic laryngitis causes obstruction both by edematous swelling and the inflammatory exudate. The diagnosis is based upon the presence of the membrane containing the specific microörganisms.

Laryngismus stridulus is characterized by an inspiratory arrest after a few straining noisy breathing efforts, followed by cyanosis and shortly the resumption of normal breathing. As it is purely spasmodic, the attack is sudden in onset and is neither preceded nor followed by the symptoms of a laryngeal catarrh.

Perichondritis.—Perichondritis, usually secondary to gumma, typhoid fever, intubation, or tuberculous or malignant infiltration, is characterized by abscess formation, with exposure or discharge of dead cartilage, often followed by stricture. Sometimes the rings of the trachea are involved. The larynx may be obstructed during the suppurative stage or, after healing, incident to scar formation.

The characteristic symptoms are alteration of the voice, dyspnea, and the discharge of pus from an abscess covering dead cartilage.

When the abscess points externally, diagnosis is not difficult. When it points internally, the early symptoms are those of obstruction.

The diagnosis of obstruction, when this occurs to an alarming extent, is obvious, but, since the inflammation may be subacute or chronic, and attended with few symptoms, a recognition of the cause of obstruction is usually dependent upon laryngoscopic examination when this is possible, and a consideration of the fact that perichondritis in its obstructive form is usually syphilitic or typhoidal, or post-typhoidal.

Tuberculosis.—Tuberculosis of the larynx is characterized by the chronicity of the inflammatory process. It is common in young adults, is often unilateral, and attacks by preference that side on which the lung is principally involved. It is nearly always secondary to tuberculosis of the lungs.

The characteristic symptoms are alteration of the voice, cough, difficulty, often pain, in swallowing, so great as to interfere with the patient's nourishment, and the presence of ulcerating infiltrations, particularly of the posterior wall of the larynx, the arytenoid cartilages and the epiglottic folds.

The diagnosis from malignant disease is made by examination for the tubercle bacilli, and association of these ulcers with other tuberculous lesions.

Lupus.—Lupus is usually secondary. It has been described as forming papillomatous and ulcerating patches.

Syphilis.—Syphilis, in its secondary stage, may appear in the form of mucous patches, and by a complicating edema may threaten life.

Gummatous infiltration forms one or more tumors which ulcerate before reaching the size of a gooseberry. The usual expression of late syphilis is in the form of a disseminated infiltration involving the perichondrium and ulcerating in patches. The trachea is rarely attacked.

The diagnosis is formulated on change of voice or its loss, purulent blood-stained expectoration, usually little pain (exceptionally severe) on swallowing, the detection of ulceration and infiltration on examination, the therapeutic test and excision and examination of a portion of the infiltrate.

Stenosis of the Larynx and Trachea.—Stenosis of the larynx and trachea may be secondary to any ulcerative or destructive process. Traumatism, syphilis, and the perichondritis of infectious fevers, particularly typhoid, are the common causes. Tracheotomy, with subsequent long-continued wearing of the tracheal tube, is the usual form of traumatism.

The characteristic symptoms are alterations in the voice, dyspnea, and noisy respirations. When the stenosis is due to external pressure, as from an enlarged thyroid, aneurysm, or cervical or mediastinal tumor, auscultation will usually detect the seat of stridor, there will be signs of a mass in the neck or thorax, and the laryngoscope will show a clear laryngeal opening. There may be multiple strictures of the larynx and trachea.

Laryngeal Fistulæ.—These, when secondary to wound or necrosis of the cartilage opening externally, are readily recognized. When

opening into the esophagus, usually secondary to the ulceration of a foreign body or a carcinomatous infiltration, they are attended by the coughing up of ingested food. Gerhardt passes a tube into the esophagus not quite to the supposed seat of fistula. Through this tube the patient can force air by expiratory effort, as shown by holding its external end under water.

Paralysis of the Recurrent Laryngeal Nerve.—Paralysis of the recurrent laryngeal nerve, earliest evidenced in the abductor muscles of the arytenoids, leaves the vocal cords in a midline position, and, if bilateral, occasions inspiratory dyspnea. Unilateral involvement may be without symptoms other than alteration of voice. Diagnosis is made by laryngoscopic examination. Unilateral palsies are often significant of innominate aneurysm, mediastinal tumor, or malignant growth.

Tumors of the Larynx.—Tumors of the larynx are generally benign. Of this class, fibroma and papilloma are the usual ones. Fibroma rises from the vocal cords of adults, forming small, rounded, pedunculated or sessile growths (years).

Papilloma, often multiple, presents a characteristic warty appearance, attacking the vocal cords by preference. Papillomata may be single, grouped, or multiple and disseminated. They are commonly observed before middle life.

Retention cysts and angiomata have been observed.

The characteristic symptoms of benign tumor, if it gives any, are alterations of the voice, and the evidences of a persistent or recurring slight laryngitis. Exceptionally there is dyspnea. The diagnosis is based upon the findings of a laryngoscopic examination, excision, and microscopic examination.

Malignant Tumors.—*Sarcoma* attacks men of early middle age. In its beginning stage it cannot be distinguished from fibroma. Its seats of predilection are the bone and false cords and the epiglottis. It is not prone to ulcerate or give glandular metastases. Its rapid growth (months) is characteristic.

Carcinoma develops in the middle aged and old (fortieth to the eightieth year), exhibiting a predilection for men. The disease is characterized by an infiltration which may slowly spread as such. Commonly it ulcerates.

Involvement of surrounding structures and glandular metastases are earliest observed in cancer of the vestibule.

The early symptom of malignant tumor of the larynx is change in voice. The diagnosis is based upon laryngoscopic examination by which the presence or absence of tumor may be determined. The nature of the tumor, unless it be unmistakably benign (papilloma in a young person), should be determined by removal and microscopic examination.

THE THYROID.

The thyroid, a highly vascular, ductless gland, is made up of two lateral lobes placed on either side of the trachea and thyroid cartilage,

and an isthmus connecting these two by passing across the front of the trachea. Each lateral lobe, about two inches long, extends, with the head in its normal position, from the middle of the thyroid cartilage to within half an inch of the top of the sternum. The isthmus, about half an inch wide, lies in front of the second, third, and fourth tracheal rings. From it there is an upward extension, called the pyramidal lobe, a remnant of the thyroglossal duct, from which are developed the accessory thyroids, found in the region of the hyoid bone or in the base of the tongue. There are other accessory glands having slight connection or none at all with the thyroid, the commonest position of which is behind the sternum. The thyroid may completely encircle the trachea, pass behind the esophagus, or by its accessory lobes extend laterally into the neck. It varies considerably in size, within normal limits, being proportionately larger in infants and in females than in male adults.

Destruction of the secreting substance of the thyroid, either by disease or operation, is followed by myxedema. Its congenital absence or disease produces cretinism. Some forms of hypersecretion and overvascularization, and glandular growth, are accompanied by Graves' disease.

The normal thyroid cannot be readily palpated, and any gland which may be distinctly outlined, either in part or in whole, is abnormal.

Aside from the constitutional effect of its glandular degeneration or hyperactivity, its enlargement may cause pressure upon the veins of the neck, the recurrent laryngeal nerve, the trachea, or the esophagus, resulting in cephalic congestion, changes in the voice, and dyspnea; dysphagia is rare except from cancer of the thyroid or enlargement of a post-esophageal accessory thyroid.

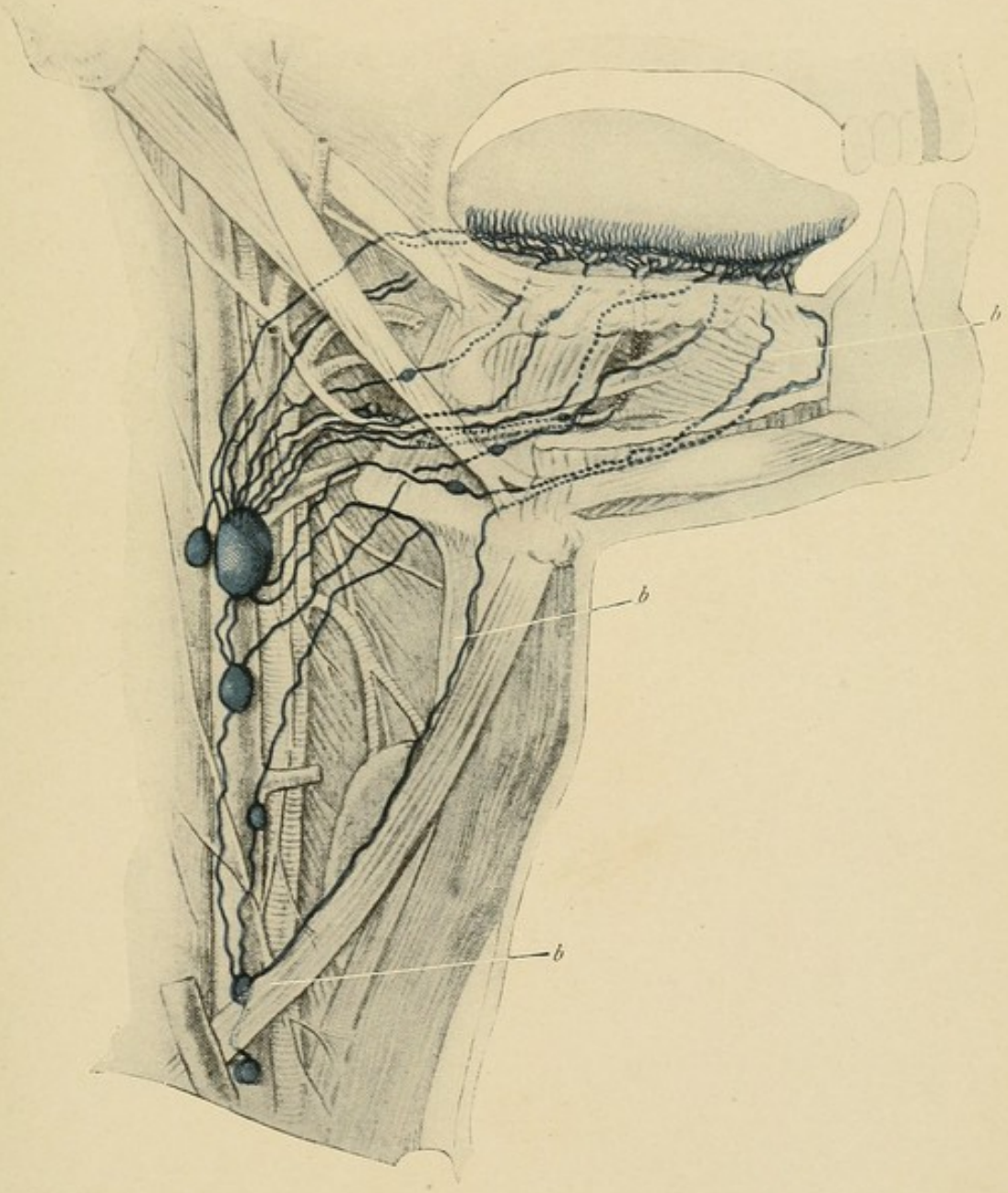
Lying close to the thyroid capsule, to the outer side and behind the lateral lobes, each about the size of a small bean, are the parathyroid glands, structures so small as to escape notice, as a rule, and yet fulfilling an important function, since the removal of these glands in animals causes tetany. There is reason to believe that the same result follows when, in the course of operation, they are removed in man.

The cardinal local symptom of diseases of the thyroid gland is tumor in the thyroid region, attached to the trachea and moving with it in deglutition.

Cretinism.—Where goitre is endemic, children are born who, because the thyroid gland is either absent or diseased, exhibit characteristic dystrophies. There is a dwarfed stature, due to failure of the long bones to develop in length, though they reach their normal thickness; leathery, loose, dry, hairless, pasty skin, an infantile condition of the genitalia associated with sterility, usually idiocy, deafness, and inability to articulate.

Myxedema.—Myxedema, incident to removal or destruction by disease of the gland in adults, does not affect stature, but blurs the features, indeed, all the body outlines, by a progressive, non-pitting thickening of the subcutaneous tissues. From the dry, pasty skin, the hair and nails are shed. The pulse is slowed, the hemoglobin below

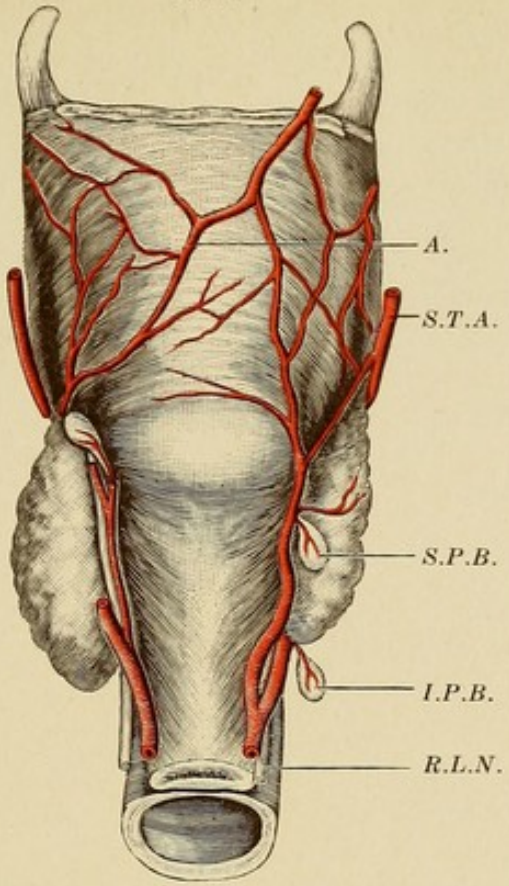
PLATE XVI



Lateral View of the Lymphatics of the Tongue Emptying into the Deep Cervical Lymph Nodes, some perforating and others passing between the genioglossi.

PLATE XVII

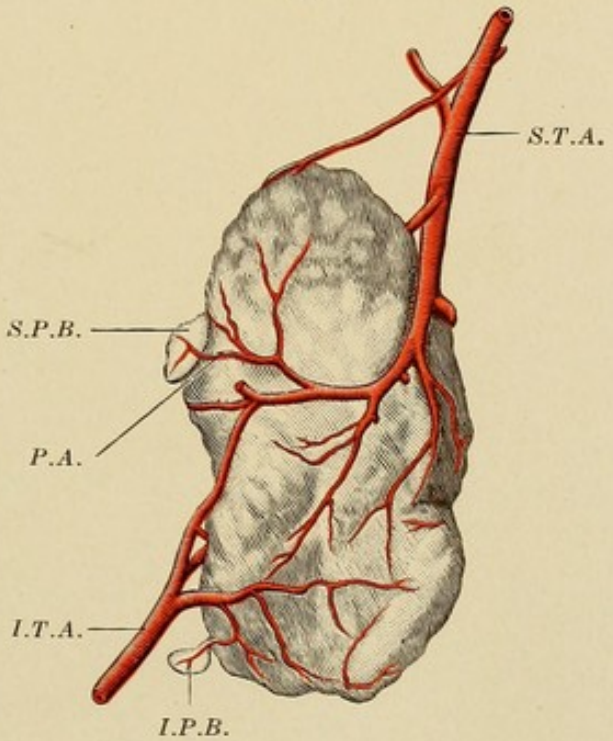
FIG. 1



Posterior View of Thyroid Gland. Anastomosis between parathyroid bodies on both sides.

A., anastomosis in posterior surface of pharynx; *S.T.A.*, superior thyroid artery; *S.P.B.*, superior parathyroid body; *I.P.B.*, inferior parathyroid body; *R.L.N.*, recurrent laryngeal nerve. Reduced one-sixth natural size.

FIG. 2



Left Thyroid Lobe Viewed from Behind. Shows unusual position and blood supply of superior parathyroid body, rendering body likely of removal in lobectomy.

S.T.A., superior thyroid artery; *S.P.B.*, superior parathyroid body; *P.A.*, parathyroid artery; *I.T.A.*, inferior thyroid artery; *I.P.B.*, inferior parathyroid body. Reduced one-sixth natural size.

normal, the mentality dulled, the virility gone. Puberty is retarded, or does not develop when the thyroid is destroyed before this period. These symptoms have followed partial thyroidectomy after an interval of years.

Graves' Disease.—Graves' disease is dependent, in part at least, upon hypersecretion or perverted secretion of the thyroid. Although it is true that experimental lesion of the central nervous system (restiform bodies) may produce all the symptoms of Graves' disease, these do not develop if previous to such lesion the thyroid be removed. Moreover, they are cured if after having developed in consequence of such lesion the thyroid be extirpated.

The dominant symptoms of Graves' disease are thyroid enlargement, tenderness and murmur, tachycardia, exophthalmos and tremor, sweating, vomiting, diarrhea, and often enlargement of the lymphatic glands of the neck. These may be present to a degree in any form of goitre. Palpitation of the heart is the most distressing and dangerous symptom. Soon it becomes complicated by myocarditis, and may be associated with angina pectoris.

Exophthalmos, obvious on inspection, is attended by movement of the upper lid, slower than normal, when the patient looks up or down (Gräfe's sign), abnormal width of the palpebral fissure (Stelwag's sign), and impaired accommodation without diplopia (Moebius' sign). Kocher regards as an early important symptom a leukopenia (particularly of the neutrophilic polymorphonuclears), a percentage and absolute increase in the lymphocytes, and an upward flick of the lid, preceding by a distinct interval the movement of the eyeball if the examiner's hand, held in front of the eye, be suddenly raised.

Tremor involves the muscles of the trunk as well as those of the extremities.

Neurasthenia is aggravated and pronounced, and usually precedes the exophthalmos. Headache and insomnia are common. Exceptionally myxedema develops.

Postoperative Tetany.—Postoperative tetany, incident to complete removal of the parathyroids, closely resembles lockjaw. It has been noted immediately after the etherization; usually within the first ten days of operation. Stiffness in the legs and arms is prodromal, as is sudden contraction of the muscles of distribution on tapping a nerve trunk (facial, Chvostek). It is characterized by tonic spasm, particularly of the arm and forearm muscles. The attack may pass off in a few minutes, may recur frequently, may cause death by spasm of the respiratory muscles, or may gradually subside in violence.

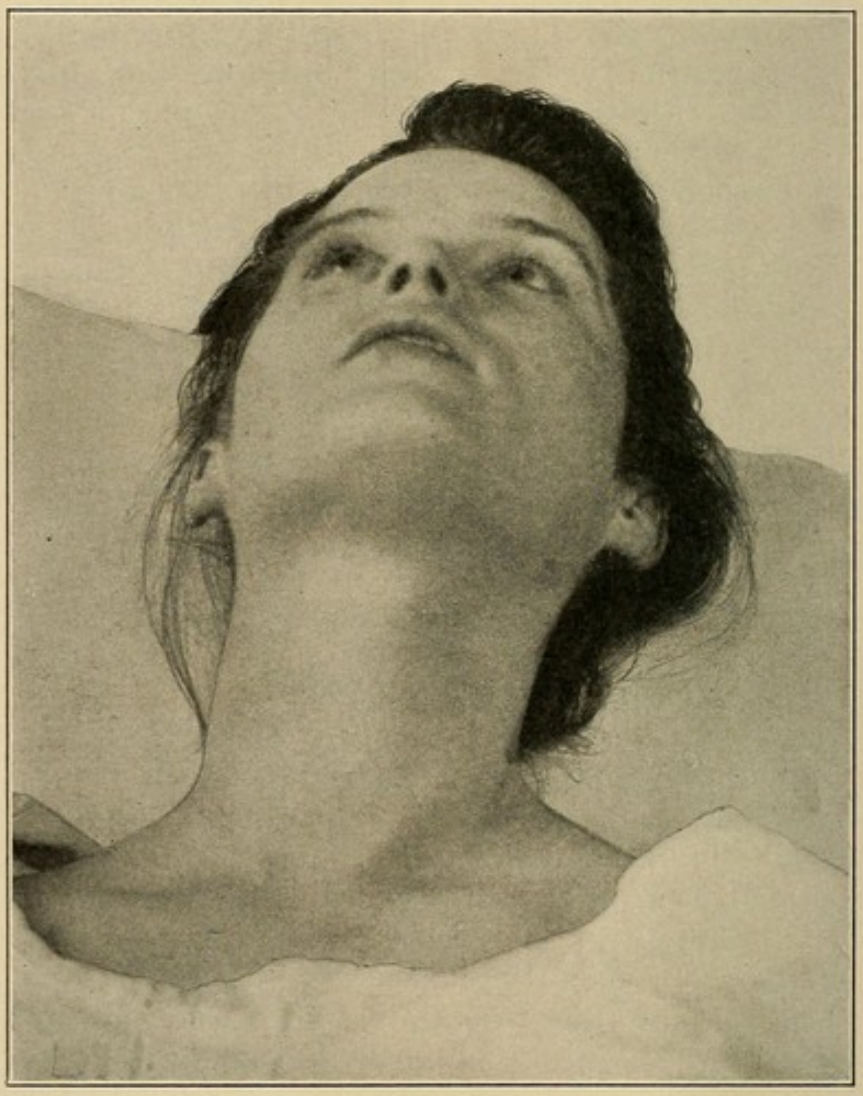
Acute Thyroid Congestion.—Enlargement of the thyroid gland, rapid in onset, usually transient, may occur in females at puberty or at any time during the period of pregnancy and parturition. It is characterized by slight heat, enlargement sufficient to become palpable and often visible, possibly some tenderness, and tendency to shortness of breath.

Acute Thyroiditis.—Either the normal thyroid or its enlargements are subject to acute inflammation from trauma or as a local expression

of systemic infection, such as that incident to pyemia, typhoid, articular rheumatism, persistent constipation, etc. The diagnosis is easily made by the rapid inflammatory swelling of the gland associated with signs of pressure, particularly venous congestion of the face, and dyspnea. It may undergo resolution, but more commonly suppurates and is not infrequently attended with tissue necrosis. Abscess may open externally or burrow deep. Its presence will be indicated either by fluctuation and surface redness, or by well-marked and progressive systemic symptoms of pyogenic infection.

The inflammation exceptionally assumes a chronic type, resulting in an induration with adhesions to surrounding parts, quite impossible to distinguish from cancer, except on microscopic examination.

FIG. 120



Parenchymatous goitre. Duration, months. Subjective symptoms, heart hurry, insomnia, and neurasthenia.

Goitre.—Goitre is usually an acquired affection; occurring congenitally and associated with cretinism where the disease is endemic.

It affects mostly women, is distinctly hereditary, is predisposed to by congestion, hence often develops during or after pregnancy, especially

when this condition is rapidly recurrent, and in its endemic form is supposed to be due to drinking water contaminated with the maritime deposits of the "paleozoic and triassic period and the tertiary age" (v. Eiselsberg). It may progressively increase in size until it has reached huge proportions, may attain a moderate size and remain stationary, or may even retrograde. The increase in size may be due to glandular proliferation, hypersecretion, or vascular or connective-tissue overgrowth, commonly to an association of all these conditions. Thus are formed parenchymatous or adenoid, colloid (increased secretion), fibroid, cystic, and pulsating goitres. The growth may appear as a diffuse hypertrophy, the entire gland being enlarged, or in a lobular form.

The Distinguishing Characteristic of Goitre.—A painless, slowly growing (years), freely movable tumor occupying the position of the thyroid, attached to the larynx and moving with it, lobular, doughy (colloid), fluctuating, or giving pulsation thrill and bruit. Involvement of the accessory thyroids, if these be unattached and the thyroid itself be healthy, might be suggested by the position of the tumor at the base of the tongue, behind the sternum or clavicle, or behind the pharynx or esophagus. The administration of iodothyroid might be helpful.

In the newly born teratoma may move with the larynx and correspond in position with an enlarged thyroid. Even in benign goitre of moderate size there is usually sufficient venous congestion to cause visible enlargement of superficial veins.

A highly characteristic symptom is dyspnea and noisy breathing on slight exertion incident to the sudden swelling due to increased blood tension. Sudden attacks of severe dyspnea and acute swelling of the goitre are characteristic of hemorrhages into its substance.

Alterations in the voice, spasms of coughing incident to involvement of the recurrent laryngeal nerve and dysphagia suggest malignant infiltration, especially if the symptoms be rapid in progression. Dyspnea is rarely dependent upon recurrent palsy, since this must be bilateral to cause inspiratory closure of the larynx.

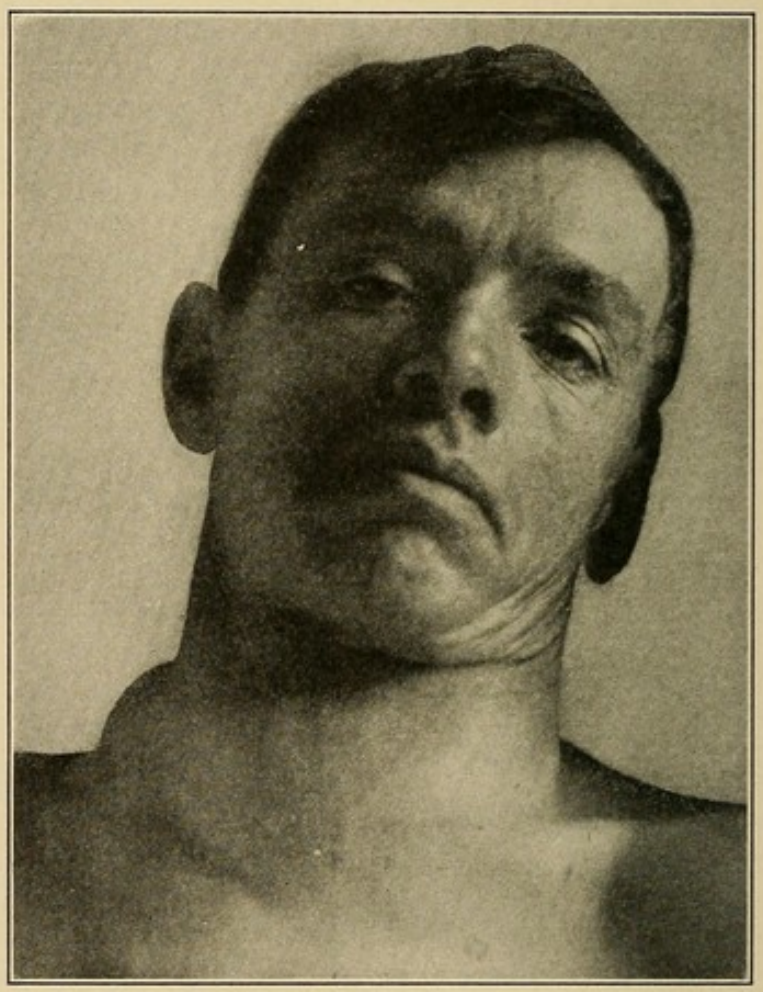
Toxic symptoms are always present. Insomnia, headache, neurasthenia are commonly associated with rapid heart action. The fibroid and cystic forms with destruction of secreting cells and absence of colloid are characterized by tetany and myxedema. The hyperplastic glandular form with overvascularization by the typical symptoms of Graves' disease.

Malignant Infiltration.—Malignant infiltration usually develops in glands already enlarged by goitre. Induration, pain, alteration in the voice, dyspnea, dysphagia, and cough with bloody expectoration are characteristic of malignancy. Sarcoma and carcinoma are about equally common; both exhibit infiltrating tendency and are rapid in growth, become shortly fixed, and are prone to metastases in the lungs and bones, particularly the sternum, ribs, and skull.

Sarcoma.—Sarcoma, found in the thyroid in every known variety, attacks young people and in the beginning exactly resembles parenchy-

matous growth of one lobe. It may from the first infiltrate the entire gland. Its rapid and progressive increase in size is commonly unilateral. Infiltration, fixation, and prompt development of pressure symptoms (dyspnea, dysphagia, loss of voice, bloody expectoration) establish the diagnosis when it is no longer helpful to the patient. During the operative stage, *i. e.*, before infiltration and metastases, the diagnosis is possible only by excision and examination.

FIG. 121



Carcinoma of thyroid. Nodular, fixed, dense, indurated, and of rapid growth (months). (C. H. Frazier, service of A. C. Wood.)

Carcinoma.—Carcinoma customarily begins in one lobe, though exceptionally, as in sarcoma, it may attack primarily the entire gland. The growth is characterized by rapidity, infiltration, and the prompt and progressive development of pressure symptoms. At times the microscope fails to detect malignancy, this being shown only by metastases. Even the metastases may appear benign on section, and from their clinical course may functionate as a normal gland, since at least in one such case cachexia developed after a sternal metastatic carcinomatous growth was secondarily removed (v. Eiselsberg). Metastasis may occur when the original growth is very small.

Scirrhus.—Scirrhus (rare), often of small size, is extremely dense, and by infiltration causes early pressure symptoms and enlargement of lymphatic glands.

Malignant infiltration of a benign goitre is characterized by rapid growth, increased hardness, pressure symptoms, and lymphatic enlargements.

Echinococcus of the Thyroid.—Echinococcus of the thyroid (rare) cannot be distinguished from cystic goitre except that adhesions to surrounding tissues are more marked and dyspnea develops early. It exhibits a tendency to discharge into the trachea.

THE THYMUS GLAND.

The thymus gland, supposed to disappear at puberty, sometimes persisting through life, lies close to the trachea in the anterior mediastinum and front of the neck, in infants extending from the base of the pericardium to the thyroid gland. Its function is unknown.

There are a number of cases of thymus death, by which is meant a sudden death from inadequate cause, often preceded and always attended by venous engorgement and at times by tracheal stridor, occurring in children apparently in vigorous health. These cases of death are apparently incident to pressure upon the bloodvessels of the neck and secondarily the trachea due to the sudden engorgement of the thymus gland. The theory of spasm due to nerve pressure cannot be excluded. In children thus afflicted there is usually the condition known as status lymphaticus, the enlarged thymus is associated, as a rule, with general lymphatic enlargement and a flaccid physique. There have been reported some cases of chronic dyspnea in early life associated with marked venous engorgement and demonstrable enlargement of the thymus gland For the relief of this dyspnea the thymus has been removed without subsequent changes in the growth or nutrition.

Sarcoma of the thymus has been observed as a cause of mediastinal tumor, the true nature of which could not be detected by any clinical sign.

CHAPTER XIII.

THE SPINAL COLUMN.

The spinal column is made up of a number of closely articulated bones firmly bound together, but flexible, allowing a considerable range of motion, as a whole, in the direction of anteroposterior and lateral flexion and rotation. The position of the spinous processes is marked by a median dorsal groove, in which the examining finger, passing from the occiput downward, first detects the spinous process of the sixth cervical vertebra; next below this, but not always more prominent, lies the seventh; the first thoracic spine may be more prominent than either of these.

The spinous process of the third thoracic vertebra is marked by the midpoint of a line connecting the two scapular spines, the arms hanging to the sides; of the seventh dorsal vertebra by the midpoint of a line drawn across the back between the inferior angles of the scapulæ, while a line similarly drawn between the highest points of the iliac crests marks the position of the fourth lumbar spine.

The cord terminates in the adult at the lower border of the first lumbar vertebra, the dorsal sac continuing as far as the third sacral vertebra lying just below a line joining the posterior superior iliac spines.

At birth the spine has but two curves, the thoracic and the sacral, both concave forward and but slightly marked. The two secondary curves that develop later are convex forward and placed in the cervical and lumbar portions of the spine. There is in addition a slight lateral dorsal curve convex to the right.

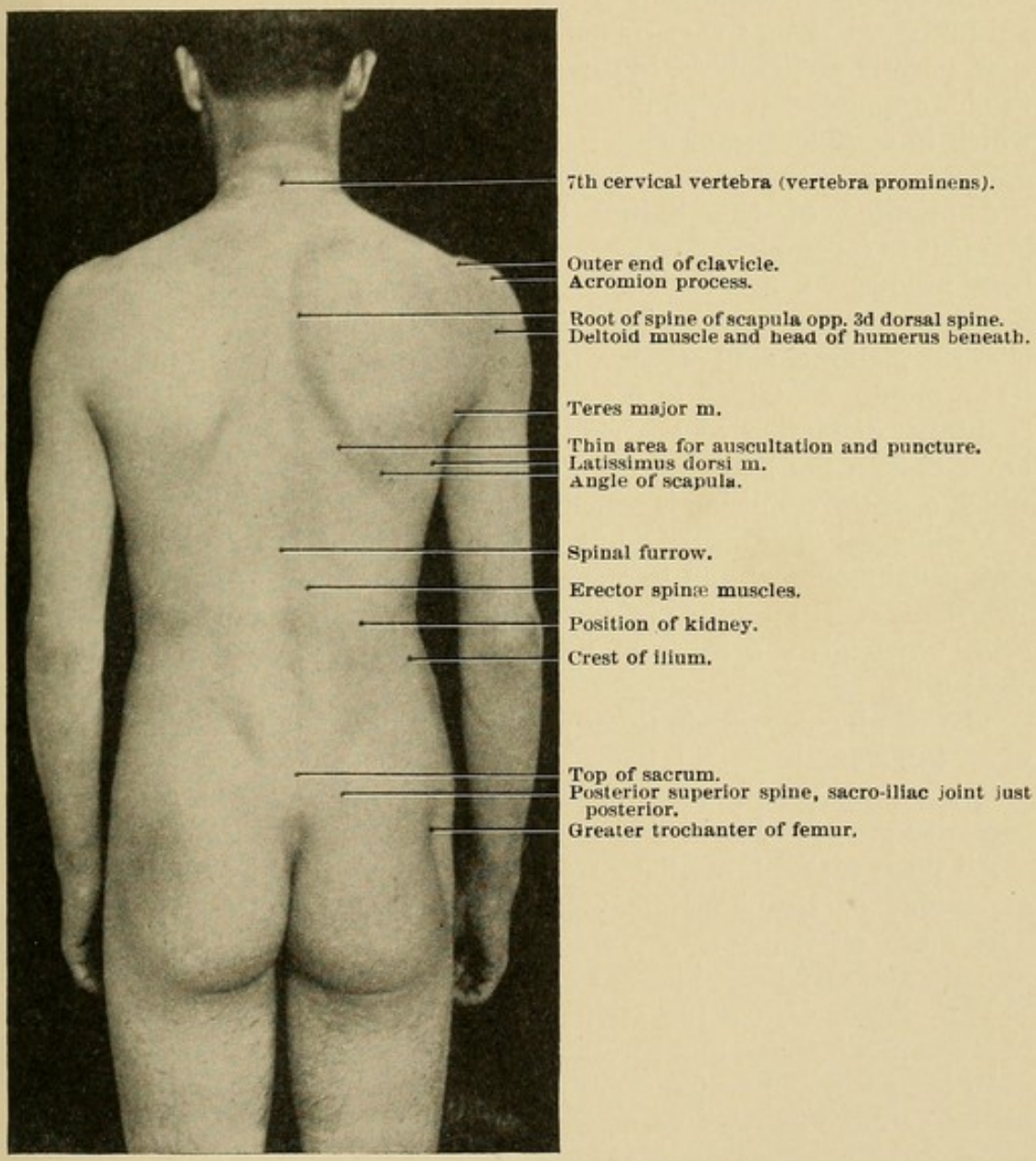
The atlas and the axis depart from type, since they are intimately associated with the movements of the head upon the spinal column. The former bone has no body or spinous process. The latter in place of a body has a tooth-like process projecting upward upon which the atlas is pivoted.

The spinal canal containing the cord and its membranes is wide in the cervical and lumbar regions where motion is free and the cord large, and is narrow in the thoracic region. Between the inner bony wall of the canal and the dura is the epidural space, containing bloodvessels and cellular tissue. The dura forms a closed sac from the foramen magnum to the coccyx, sending a fibrous investment with each nerve root leaving the cord. The dura, because of its great strength and loose attachment, may remain apparently uninjured, though the cord be crushed by fracture or dislocation.

The transverse process of the atlas can be felt slightly below and in front of the tip of the mastoid process. By palpation of the posterior pharyngeal wall can be felt the anterior tubercle of the atlas, or, if the head be rotated, its arch and the anterior surfaces of the bodies of the axis and the third cervical vertebra.

General Symptomatology of Affections of the Spinal Column.—Surgical affections of the spine are characterized by pain, tenderness, deformity, limitation of motion or fixation, and interference with the function and nutrition of the parts supplied by the nerves lying within or passing through the spinal canal.

FIG. 122



Surface markings of the back. (G. G. Davis.)

The pain may be located at the site of injury, infiltration, or inflammation, or may radiate along the course of those nerves the roots of which are involved. It is usually aggravated by motion, and it may exhibit any grade of severity.

The tenderness may be elicited by direct palpation, by jarring the whole spinal column, or by motion.

Tumor, because of the deep position of the spine, is rarely detected in its early stages except in the case of meningoceles and myeloceles. Deformity is a valuable immediate symptom after fracture and luxation, a late one in infiltration or inflammations.

Limitation of motion is one of the earliest symptoms of all inflammatory affections, and is most marked in the region involved. Fixation, with demonstrable muscular atrophy, is a late development.

The symptoms significant of root or cord trauma or inflammation are pain referred along the course of the nerves involved, muscular contraction, paresis or paralysis, hyperesthesia or tactile, thermic or total anesthesia, exaggeration or abolition of spinal reflexes, and trophic changes which in complete transverse lesions of the cord may be rapid in development.

Anomalies of the Spinal Column.—**Spina Bifida.**—Spina bifida incident to incomplete development of the lamina of one or all the vertebræ, produces a hernia-like protrusion, usually in the lumbar region, and often with a portion of the cord closely attached. When protrusion is of the pia arachnoid alone, it is called meningocele; when the cord and its nerves are contained in the sac, myelomeningocele; when the bulging is due to distention of the central canal of the cord, myelocystocele. Even though the laminæ have not united, there may be no bulging, in which case the condition is called spina bifida occulta.

Meningocele has usually but a single cavity. It escapes through a cleft usually narrow and to one side of the midline. There may be no symptoms other than the presence of a tumor, often covered with scar-like skin, which gives a sense of fluctuation and becomes tense when the child cries.

The meningomyelocele usually exhibits a broad base. Within its sac septa can sometimes be felt.

Spina bifida occulta may be characterized by no symptoms other than excessive growth of hair over the defect.

All these tumor formations are likely to be overlaid by a fatty hemangiomatous or lymphangiomatous growth in the subcutaneous tissue. There are often associated deformities, such as club foot, epispadia, hypospadia, and those incident to paralysis.

The diagnosis, usually obvious, may be difficult. The distinction between meningocele and myelocele may be impossible before operation.

In the coccygeal region there may be a tail-like extension which may contain supernumerary vertebræ, may be made up of soft fibrous tissue alone, or of an overgrowth of either skin or hair. The latter condition is significant of a cleft in the sacral canal.

In addition to the teratomata, myeloceles, and meningoceles, in the sacrolumbar region overlaid by lipoma, hemangioma, or lymphangioma, pure lipomata and lymphangiomata are observed. Moreover, these forms of tumor are found on the anterior surface of the coccyx and sacrum.

The commonest congenital malformation in the region of the coccyx appears as a midline dimple or pit incident to the inturning of a skin pouch, thus forming a dermoid sac, which is later subject to inflammation

causing a suppurating sinus, usually mistaken for fistula and distinuished from the latter by the fact that it does not communicate with the rectum, and particularly by the presence of hair in its walls and in its discharge.

The tumors and cysts placed on the anterior surface of the coccyx and sacrum lying between these bones and the rectum exhibit their presence by interference with the function of defecation, and are readily detected by digital examination. A cyst due to persistence of a postanal gut may reach a size so large as to be detected both by abdominal palpation and by inspection of the perineum.

Cervical Rib.—Cervical rib may be unilateral or bilateral. It is incident to a bony outgrowth from the transverse process of the last cervical vertebra. Though probably congenital, symptoms may not develop until about the period of puberty or thereafter. These are essentially those of pressure. They are manifested by pain, neuritis, or even palsy in the distribution of the brachial plexus, and exceptionally by the production of aneurysm. The affection is usually not recognized until pressure symptoms become pronounced. It is detected then by palpation and certainly by the *x*-rays. In many cases the condition causes no symptoms.

Absence of vertebra has been noted, but in itself occasions no symptoms. It is usually associated with other more obvious deformities.

Curvature of the Spine.—This may be with its convexity lateral (scoliosis), posterior (kyphosis), anterior (lordosis), or combined.

Lateral curvature, exceptionally congenital, usually beginning between the sixth and tenth years, and exhibiting no sex predilection, is usually due to an habitual faulty posture, or unequal length of the lower extremities. Muscular palsy, thoracic empyema, rickets, osteomalacia, and affections resulting in a limp are also common causes. The primary curve is usually left convex in the lumbar regions, with dorsal compensation in the opposite direction. Or there may be a single lateral bulge, called total scoliosis. Associated with the lateral curve there is rotation of the vertebræ producing asymmetry of the chest.

Diagnosis is based upon examination with the patient stripped to the top of the trochanters. This affection early shows inequality in the height of the shoulders, scapular prominence, elevation of one hip, asymmetry of the two sides of the chest, and often deviation of the spinous processes from the dorsal vertical furrow. The normal position of the spinous processes is indicated by running a line from the mid-occiput to the gluteal cleft. There may be considerable rotation without marked departure of the spinous processes from this position. The dorsal asymmetry of the chest is accentuated by having the patient with straight knees bend forward, attempting to touch the floor with the fingers.

Limitation of motion is often an early sign. The patient is directed to flex and extend the trunk; to bend it first to one side and then to the other, to rotate the shoulders to the right and the left as far as possible. Limitation in one direction is, in the absence of other cause, suggestive of beginning curvature.

Kyphosis, or convex posterior curvature, is usually postural when not incident to antecedent disease, such as tuberculosis or rickets. It is a common deformity of youth, is often developed by occupations requiring prolonged stooping, and is stated by specialists to be caused by adenoids or enlarged tonsils. The deformity is obvious.

Lordosis is a condition of sway-back which is usually compensatory, as in case of bilateral luxation of the hip, or spondylolisthesis, *i. e.*, forward and downward displacement of the body of the last lumbar vertebra. This malposition is usually symptomless, excepting for undue prominence of the sacrum and the iliac crests. It may be an early sign of Pott's disease.

The *neurotic spine* is characterized by pain, which may be severe and localized, particularly in the region of the last cervical vertebra, by extreme sensitiveness to pressure, limitation of motion, and general invalidism. Often there may be an associated curve. Diagnosis is made only after prolonged observations and repeated examinations show a want of consistency in the symptoms and that they are relieved or exaggerated by causes inadequate to so affect a local lesion (see p. 211).

Trauma of the Spine.—In the absence of fracture or luxation the cord is so well protected that it seems scarcely amenable to concussion. Clinically, however, cases are encountered which, following trauma, exhibit primary shock and for a brief period the symptoms of a complete transverse lesion of the cord. The complete and rapid recovery is the only proof of the absence of a demonstrable cord lesion.

The diagnosis of this rare condition can be made only by the prompt convalescence of the patient. Injuries and diseases of the cord and roots are discussed under the Nervous System.

Sprain and Contusion.—Sprains and contusions of the spine are characterized by pain which is usually severe, is aggravated by motion, may give root radiations, and is attended with a protective muscular fixation and tenderness, usually fairly well localized. There is no displacement, though a previously existing aberration in the contour of the spinous processes may lead to the suspicion that such is of recent traumatic origin.

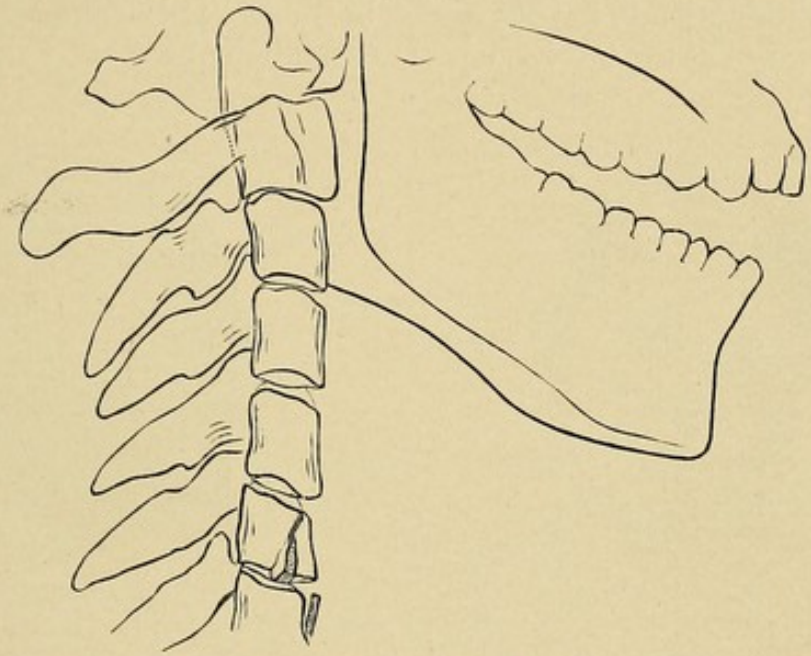
Absence of cord symptoms, the transitory nature of the suffering and disability, and the relief afforded by strapping, support and massage are indices of the absence of a more serious lesion. The symptoms are, however, precisely those of fracture without displacement; their persistence and their aggravation by treatment appropriate to sprain should suggest either bone lesion or the onset of a local tuberculosis.

Fractures and Dislocations of the Spine.—These injuries are usually combined, though either may exist without the other. They are commonest in vigorous, active men, and usually involve the fourth, fifth, or sixth cervical and the last two thoracic and first lumbar vertebræ.

In fracture the bodies of the vertebræ are the parts chiefly involved, and the movement producing the injury is generally one of forced flexion. The force applied may be comparatively slight or overwhelming. The injury may involve one or several vertebræ.

The deformity if present is usually in the form of kyphosis or obvious backward projection of the spinous processes. In the three upper vertebræ forward displacement may be detected by examinations through the pharynx. There may be lateral deviation. There is always local tenderness elicited by direct palpation, percussion, or manipulation of the spinous process of the involved vertebra; even slight movement of the spine is painful. Crepitus may be felt, but should not be searched for.

FIG. 123



Fracture of the cervical spine involving the bodies of the sixth and seventh vertebræ. A momentary displacement of one of these bones, probably the sixth, with immediate replacement, evidently accompanied the injury, because the cord was severely injured though not severed, and the radiograph shows the vertebræ to be in line. Patient a young adult. Cause of the injury was hyperflexion during an attempt to make a "tackle" on a friend during play, but not in football practice nor in a game. The anteroposterior view in this case shows no indication of the fractures. The lateral view is always the best for determining fractures of the cervical bodies, but it is seldom that a radiograph can be made to include as low down as the seventh, as in this case, and often it is impossible to show below the fifth vertebra, where fractures usually occur.

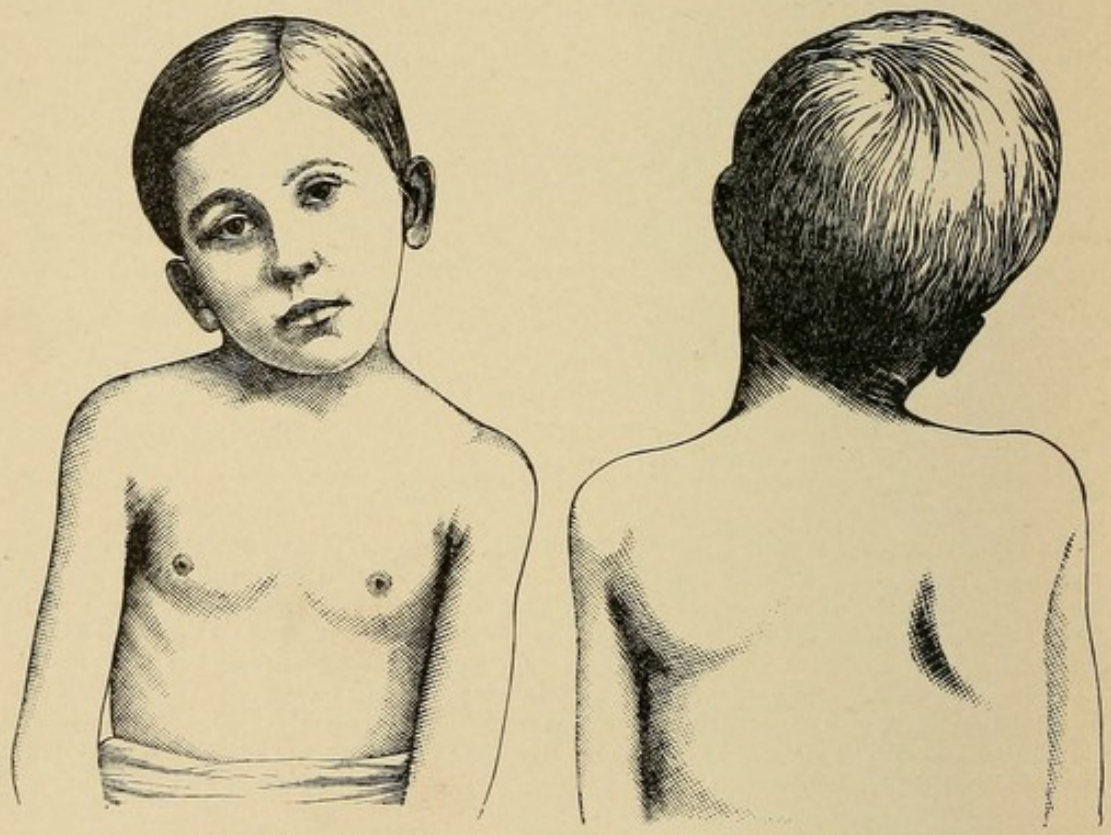
Cord injury is expressed by motor, sensory, and reflex phenomena, which, if due to the crushing force of displaced bone, are instantaneous in development and more or less permanent; if caused by hemorrhage, symptoms develop more slowly (minutes, hours); if by traumatic reaction, still more slowly (days, weeks, months).

Complete transverse lesion, usually but not always indicative of fracture dislocation, is characterized by flaccid palsy of the parts supplied by that portion of the cord lying below the seat of injury and by complete absence of tendon reflexes. Death is immediate from asphyxia when the first four segments of the cord are involved. In lesions lower down, above the line of anesthesia, there is usually a zone of hyperesthesia incident to irritation of the undestroyed roots and cord immediately adjacent. Localizing symptoms are given in the section devoted to the Nervous System (p. 190).

Lesion of the cord, either partial or completely transverse, has been observed in the absence of either fracture or demonstrable luxation, this condition being accounted for by a luxation which was immediately reduced.

Dislocation unaccompanied by fracture is noted almost solely in the cervical region involving chiefly the fourth, fifth, and sixth cervical vertebræ. The dislocation is commonly unilateral, and is due to a twisting force, the lower articular cartilage of the displaced vertebra riding forward over the cartilage below it and either resting upon its anterior border or dropping into the depression in front. This necessarily implies at least a sprain of the intervertebral articulation of the other side.

FIG. 124 FIG. 125



Left subluxation of the fifth cervical vertebra. (Von Bergmann.)

The condition is characterized by severe pain which may be most marked in the lateral articulation least involved. The pain is greatly aggravated by motion, particularly such as tends to increase the characteristic rotation and lateral flexion of the head toward the sound side. Deviation of the spinous process from the midline can sometimes be felt. Increased prominence of the body of the vertebra and the lateral process on the dislocated side is readily palpable through the posterior pharyngeal wall in the case of the upper vertebræ. The findings of the *x*-rays are conclusive. This luxation may undergo spontaneous reduction during etherization.

When the luxation is complete and bilateral there will be an anterior deformity and forward projection of the displaced vertebra, and flexion

at the seat of displacement, though this may be concealed by compensating extension of the vertebræ above.

Partial or complete dislocation of the atlas and axis are reported incident to forced flexion or rotation, usually attended with fracture, especially of the odontoid, and commonly resulting in immediate death. Because of the roomy canal in this portion of the spine the cord may be but slightly or not at all pressed upon. The head fixed in flexion, the deformity, recognized by examination of the pharyngeal wall, and the results of an *x*-ray examination would establish the diagnosis. When such injuries are suspected, movements of the head for diagnostic purposes are contra-indicated.

Fracture unaccompanied by dislocation usually of the vertebral bodies exhibits the symptoms of severe sprain with more pronounced and persistent local tenderness best elicited by percussion or manipulation of the spinous process. Deformity, if present, appears in the form of an unnatural prominence of the spinous process of either the fractured vertebra or the one above or below the seat of fracture. This deformity immediately after the injury is lessened or caused to disappear on extension; it becomes permanent from ankylosis on recovery. The *x*-rays may be diagnostic.

Though the presence or absence of lesions of the spinal cord is of major importance, the determination as to whether or not the bone has been broken by violence in the absence of such lesion is essential, since a failure to recognize fractures of the bodies of the vertebræ or of the intervertebral disks without displacement, and therefore a neglect to secure rest sufficiently prolonged for complete healing, is probably responsible for post-traumatic spondylitis (see p. 342).

When the spinous processes are fractured, usually from direct violence, preternatural mobility and crepitus may be elicited. Fractures of the laminæ are of major importance only if they be complicated by external wound or cord symptoms.

Fracture Dislocations. Forced flexion, as from a fall backward on the head and neck, is prone to cause a forward dislocation of the fourth, fifth, or sixth cervical vertebra, with an oblique fracture of the body of the vertebra below it, the plane of fracture running from above downward and forward, so that the displaced vertebra carries the fragment forward with it. This is the type of dislocation fracture commonly observed in the lower cervical and upper dorsal regions, and, because of the wide displacement favored by the fracture, the cord is generally involved.

Impact and forced flexion in the dorsolumbar region, as from a heavy fall on the buttocks or feet or the imposing of an overwhelming weight on the shoulders, causes a crushing fracture of the bodies of one or more of the dorsolumbar vertebræ, particularly the eleventh, twelfth, and first, which may or may not be complicated by dislocation. In the former event there may be no cord symptoms, or, because of a backward displacement of a bone fragment, these may be pronounced. In the latter case the symptoms are usually those of more or less complete transverse lesion.

The diagnosis of fracture dislocation is based upon the undue prominence of the spinous processes, with or without lateral deviation, local tenderness, pain both local and radiating, usually total disability, and frequently the evidence of local cord lesion. The *x*-rays may be absolutely diagnostic.

Wounds of the vertebræ are usually detected by direct examination. Gunshot wounds with modern weapons are of particular importance because of the associated cord lesion, which may be completely transverse even though the bone be not extensively shattered.

Inflammation of the Spine.—Acute Suppurative Spondylitis.—Acute osteomyelitis of the spine is an affection of youth, commonest in the lumbar region, and most likely to develop in the bodies of the vertebræ, though it may involve any portion. It may follow either slight or severe trauma; the source of infection can often be traced to a preceding boil, carbuncle, sore throat, or suppurating area.

It is characterized by the constitutional symptoms of pronounced sepsis, being usually inaugurated by chill and high fever. There is local fixation of the spine, tenderness to palpation, though the latter may not be marked, and severe pain aggravated by motion and radiating along the course of the nerves the roots of which pass close to the infected area, often associated with muscular spasm.

In the cervical region torticollis and rigidity develop early, and are soon followed by postpharyngeal swelling, which makes both swallowing and breathing difficult.

In the thoracic region a secondary pleural effusion is quickly formed and usually obscures the diagnosis. Rigid belly walls and extreme pain may also suggest peritonitis.

Diagnosis is based upon the violent onset of the septic symptoms, their persistence and aggravation, the localized tenderness and fixation of the spine, and the elimination of other causes for the condition, such as mastoiditis, or meningitis. The pleural effusion secondary to involvement of the thoracic vertebra, at first purely serous, later becomes purulent. A pleurisy has neither the stormy onset, the vertebral fixation and tenderness, the pain radiations and muscular spasm, nor the progression of symptoms after tapping. When the vertebral bodies are involved in an acute osteomyelitis, the prognosis, grave at the best, is almost absolutely bad in the absence of early intervention, death being from sepsis or meningitis.

Tuberculous Spondylitis.—Tuberculosis of the spine attacks by preference male children before puberty, being most frequent before the fifth year, though it may develop at any period of life. The seats of preference are the anterior portions of the bodies of the lower thoracic and upper lumbar vertebræ and their intervertebral cartilages. It may involve simultaneously more than one portion of the spine. From disintegration of the anterior vertebral bodies and their cartilages angulation results, forming kyphosis, which, when several vertebræ are involved, may appear as a rounded bulging. Abscess usually forms and may reach huge size.

Of the upper cervical vertebræ, the axis is the one most frequently affected, the resulting abscess, if one develops, appearing behind the pharynx and producing difficulty in swallowing and breathing. It may burrow downward into the posterior mediastinum, or open to the inner or outer side of the lower attachment of the sternomastoid muscle, or even present at the arm pit.

The abscess of dorsal caries exceptionally presents along the course of the ribs. It is more prone to follow the course of the great vessels, presenting in the groin, exceptionally on the buttock. The abscess of dorsolumbar origin follows the course of the psoas muscle, presenting beneath Poupart's ligament on the outer side of the bloodvessels or burrowing still lower in the leg. When the arches are involved in the tuberculous process the abscess customarily points backward. In its ultimate development caries not infrequently involves the cord and its nerves, producing inflammatory and pressure symptoms, exceptionally incident to narrowing of the bony canal, usually due to pachymeningitis.

Tuberculous spondylitis, obvious in its later course, is characterized in its early stages by pain, which may be persistent and of a throbbing character and exhibit severe exacerbations with radiations incident to jars or sudden motion, by rigidity of the affected part of the spine, and by the habitual assumption of such postures as tend to remove the weight of the body from the diseased area. Moreover, there are often night cries due to sudden spasmodic contraction, torticollis when the disease involves the upper cervical vertebræ, shallow, grunting respiration and irritative cough when the dorsal vertebræ are affected, and colicky pains in dorsal and dorsolumbar involvement. Particularly in the case of children there is a marked change in habits and disposition, cheerful activity being replaced by a condition of languor and querulousness. There is steady deterioration in general health, and the tuberculin reaction is positive.

The diagnosis is strongly suggested by local tenderness and fixation of a child's spine after slight trauma, or in the absence of this, these symptoms persisting and growing worse. In the case of infants it is often not suspected until distinct deformity occurs, the general irritability, failure in health, crying on being lifted or moved, and tendency to keep the spine rigid being attributed to colic or any of a number of various causes.

The examination for suspected tuberculous spondylitis is conducted by stripping the patient to the trochanters, or below. Standing with heels together, knees straight, and pelvis held by the examiner, the patient is directed to bend forward as far as possible; this motion will accentuate a beginning prominence of the spinous processes, will be limited, and will occasion pain.

With the body straight and the pelvis still held, the patient is directed to look as far back as possible, first over one shoulder, then over the other. This motion will be limited usually in both directions; the approximate region of limitation may be further determined by fixing the shoulders and directing similar motion to be made with the head.

The patient is told to pick a small object, such as a match, from the

floor; the stooping is done at the thigh, knee, and ankle, the back being kept straight, and on rising there is a tendency to use the hands on the thighs as a help.

The patient is placed in ventral decubitus, and, with the pelvis held down, the straight leg is lifted upward, this to test contraction of the psoas muscle. Along the line of the spinous processes light percussion is practised to elicit local tenderness.

When the cases of tuberculous spondylitis present themselves for examination there is usually kyphosis and unmistakable spinal rigidity and tenderness, making the diagnosis obvious. In the early stages the symptoms which are most characteristic, and which may not be elicited without careful examination, are limitation of motion in the spine and slight tenderness on local manipulation and percussion. Torticollis, thigh flexion from psoas involvement, and referred pain may be early symptoms.

In some cases of tuberculous spondylitis the onset is insidious, even the general health remaining apparently unaffected and angular deformity is the first symptom which calls for an examination.

To distinguish tuberculous spondylitis from chronic post-traumatic, or from syphilitic spondylitis, may in the beginning be quite impossible, except by means of a negative tuberculin test. The age incidence is helpful, since the tuberculous process is rare in the adult and frequent in little children. The reverse is the case in regard to the two other affections.

Typhoid Spondylitis.—Typhoid spondylitis occurs late in the course of typhoid fever, or even after convalescence seems fully established. It is marked by the sudden onset, in the lower dorsal or lumbar region, of severe pain, both local and referred, aggravated beyond endurance by the slightest movement, associated at times with muscular spasm. Constitutional symptoms are slight or wanting. Paresis of the bladder and rectum have been noted.

The diagnosis is based on the sudden or rapid development and persistence (weeks, months) of pain and rigidity following typhoid fever.

Gonorrheal Spondylitis.—Gonorrheal spondylitis, a rare complication of gonococcal infection, in its symptomatology closely simulates typhoid spine. The diagnosis is based upon the presence of gonococcal infection, the sudden onset of pain, tenderness and fixation in the spine area, and the betterment which promptly follows the removal of an infecting focus.

Chronic Traumatic Spondylitis.—This is an inflammatory condition which may be immediately sequent to spinal injury or may follow it by an interval of weeks or months. It is characterized by localized pain and tenderness about the seat of injury, the former greatly aggravated by motion often referred and crippling in intensity, by both voluntary and involuntary fixation of the back by muscular action, by the gradual (months) development of deformity, usually kyphosis, and by apparently causeless exacerbations or remissions. There is a softening process incident to inflammation, in turn probably kept up by inadequate treatment of an unsuspected fracture.

The distinction from early tuberculosis is in children impossible except there be obtained a negative tuberculin test. The early severe crippling pain in adults, who are less subject than children to Pott's disease, would suggest an osteitis of other than tuberculous origin. The absolute diagnosis even in them must be a matter of time, observation, and the results of the tuberculin test.

Spondylitis Deformans.—Spondylitis deformans, or osteitis deformans, called also rheumatoid arthritis, is usually one of the local manifestations of a general trouble. It may, however, be confined entirely to the spine, and may begin in childhood. The affection is characterized by pain, tenderness, and gradual stiffening, requiring for its full development many years. The normal curvatures undergo gradual modification, and the spine exhibits but a single dorsal curve. The pain is subject to remissions. Root pressure may occasion severe referred paroxysms or may cause sensory or motor palsy.

This affection not infrequently begins in the neck, travelling downward. The recognition of the well-developed disease offers no difficulty. In its incipiency, especially when it begins in childhood, the distinction from tuberculous spondylitis is difficult, and will in the main depend upon the results of the tuberculin test and prolonged observation.

Syphilis.—Syphilis of the bodies of the vertebræ (rare) may appear in either the hereditary or acquired form of the disease. It may so closely simulate tuberculosis in its early development as to make a diagnosis impossible, excepting it be based upon a history of syphilis and associated evidence of this and the negative evidence of the tuberculin test.

Actinomycosis.—Actinomycosis (rare) cannot be diagnosticated as such except by the finding of the ray fungus in the discharge and associated lesions elsewhere.

Tumors of the Vertebræ.—Tumors of the vertebræ are nearly always malignant and secondary. Carcinoma is the usual form and is frequently sequent to primary foci in the breast, uterus, or prostate. In metastasis from the prostate the spinal manifestations may precede the appearance of clinical signs indicating the original focus of infiltration. As a rule, the body of but one vertebra is involved; this is commonly in the lower thoracic or lumbar region.

Primary sarcoma is more frequently reported than primary carcinoma.

Myeloma, extremely rare, characterized by a softening of the bone, resembles osteomalacia rather than tumor, from which it is distinguished by the failure of medicinal and hygienic therapeutics to accomplish betterment.

Exostoses and cartilaginous overgrowths (rare) produce only pressure symptoms. They may mechanically interfere with motion. They are usually associated with similar outgrowths from other and more accessible bones.

The diagnosis of tumor of the vertebra is based upon pressure symptoms, at least in the early stage of the development of these growths. These are manifested in the form of pain located at the seat of infiltration, radiating along the course of the involved nerves, and in the case of

malignant growths becoming rapidly excruciating in type. The involved area is usually sensitive to deep palpation; ultimately deformity and at times tumor develop. Deformity in case of malignant growths is usually sudden and incident to slight trauma.

In distinguishing from tuberculous infiltration, the age incidence, the steady progression of the affection, the failure of extension to relieve the pain, the evidences of both cord and root pressure, and particularly the discovery of a primary focus are of importance. Moreover, a tuberculin test is likely to be helpful.

An eroding aortic aneurysm will cause much the same symptoms as a cancerous infiltration, but is usually distinguished by other characteristic symptoms of this condition.

The detection of benign tumors depends entirely upon their slow development and the persistence of symptoms of localized root or cord pressure or both. Pain is likely to be the dominant feature. When the growth is a bony one, the *x*-rays will be helpful.

CHAPTER XIV.

THE UPPER EXTREMITY.

THE HAND AND WRIST.

The skin on the dorsum of the hand is comparatively thin, loosely attached, and there can be seen coursing beneath it a number of large veins. The palmar skin is thick, richly supplied with sweat glands, and closely attached to the deeper tissues by an abundance of connective-tissue bands running vertically downward. The sheaths of the flexor tendons extend from the base of the third phalanx to the level of the metacarpophalangeal joints, with the exception of the flexor sheath of the little finger, which usually communicates directly with the common flexor bursa lying beneath and above the annular ligament. The sheath of the flexor longus pollicis also passes directly beneath the annular ligament and into the forearm.

The knuckles of the closed fist are formed by the distal end of the metacarpals and the first row of the phalanges.

On the palmar surface of the wrist to the radial side, and at a lower level than the styloid process, may be felt the tuberosity of the scaphoid, and immediately below this the ridge of the trapezium. To the ulnar side and about the same level may be felt the pisiform with the unciform more deeply placed and internal to it. The interphalangeal joints allow of flexion and extension. The metacarpophalangeal joints also of abduction and adduction when the fingers are extended.

The radial and ulnar styloid processes are the prominent bony points about the wrist. A line joining the tips of the styloid processes does not form a right angle to the long axis of the forearm, the radial process lying at a lower level (quarter to half an inch).

The bony projection just proximal to the base of the third metacarpal bone, made prominent by flexion of the wrist, is the os magnum.

To the outer side of the wrist in the depression bounded on the radial side by the tendons of the extensor ossis metacarpi pollicis, and extensor brevis pollicis, on the inner (ulnar) side by the extensor longus pollicis, lies the snuff box, a skin hollow made conspicuous by abduction and extension of the thumb.

In its depth the trapezium can be palpated.

Though the metacarpals and phalanges are easily palpated, fractures of these bones may escape detection.

The wrist joint allows of flexion until the long axis of the hand makes a right angle with that of the forearm, extension to a little more than

half this degree, abduction (to the radial side) of 20 degrees, adduction of 45 degrees, with combinations of these movements.

The thumb can be flexed and adducted until it touches the palmar base of the little finger and abducted to nearly a right angle with the long axis of the palm.

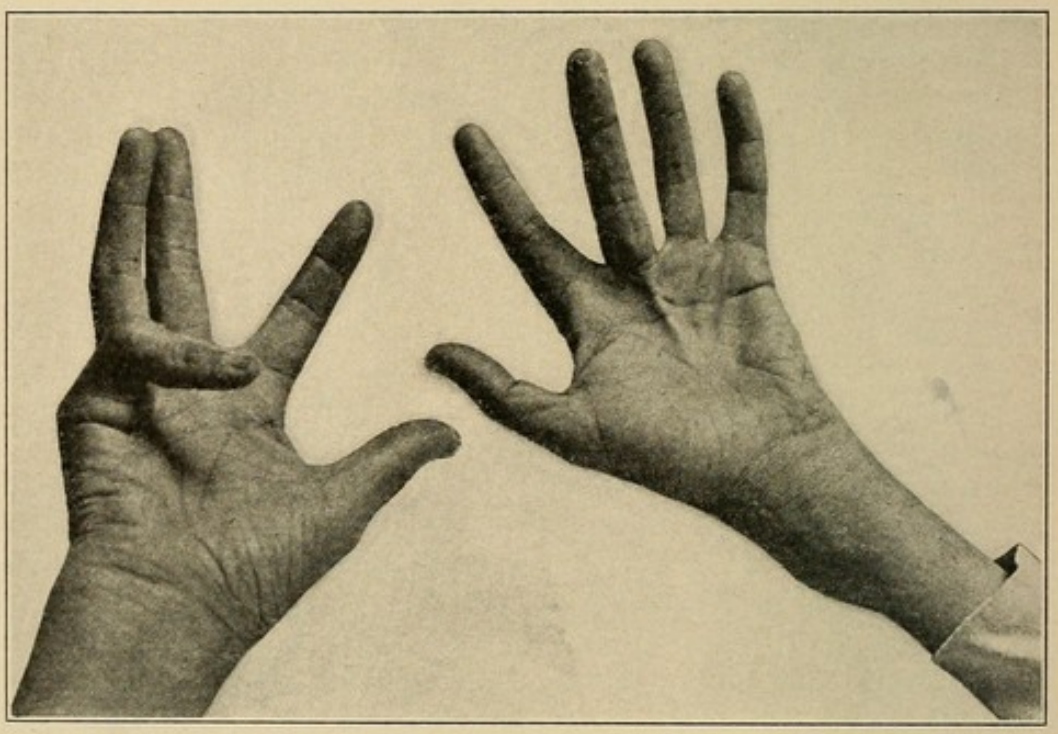
The metacarpophalangeal joints, except that of the thumb, can be flexed to a right angle, the midphalangeal joint to beyond a right angle, the distal phalangeal joints to very near a right angle.

The commonest lesion about the wrist is a sprain. Great swelling, severe pain, and pronounced or prolonged disability are presumptive evidence of more serious injury.

Congenital Deformities.—Congenitally the digits may be absent, supernumerary, or fused. The hand may be absent, wanting in its parts, or clubbed in any direction. There may be contractures, usually expressed by flexion of the little finger, and often bilateral. Exceptionally at birth the hand may exhibit the thickening of myxedema, associated with the general conformation of this lesion.

Acquired Deformities.—These are due to loss of parts from traumatism or destructive ulceration, contraction of scars incident to the healing of extensive wounds or ulcers, atrophy, hypertrophy or distortion following chronic inflammation of the bones, joints, or soft parts, or injuries or diseases of the nerves or their centres.

FIG. 126



Bilateral Dupuytren's contractures. Flexion of fingers. Fibrous bands in palm adherent to skin. Fifteen years' duration. (Carnett.)

Dupuytren's Contracture.—This occurs in men past forty, usually those who do hard work with their hands, which are therefore subjected to repeated slight trauma, and is characterized by an induration, nodulation,

thickening and shortening of the palmar fascia with intimate skin attachment.

The tendon-like bands first fix the little finger in flexion, with subsequent involvement of the other fingers, but not the thumb. This fixation and flexion is confined to the first and second joints. The condition is not attended by inflammatory symptoms. Distinction from fixation incident to muscular contracture is made by the superficial position of the bands, which are made obviously tense by efforts to extend, this tension being uninfluenced by flexion or extension of the wrist.

FIG. 127

Deformity of paralysis of the ulnar nerve (claw hand).

FIG. 128

Deformity from paralysis of the median nerve (ape hand).

The postural distortions of palsies of either cerebral apoplexy, poliomyelitis, diffuse sclerosis, or peripheral nerve lesions (trauma, pressure neuritis) are characterized by associated symptoms. (See section on Nerves.)

Wrist Drop.—Wrist drop incident to injury of the musculospiral nerve is characterized by inability to extend the hand or fingers, with possibly slight anesthesia on the dorsal surface of the thumb and index finger.

Claw hand, in its typical development usually due to injury of the ulnar nerve, is characterized by extension of the first phalanges and a flexion of the second and third, with inability to materially change this position. The fingers can be neither adducted nor abducted. In the contractures incident to late ulnar palsy the intrinsic hand muscles are wasted, useless, and give no electrical reaction, excepting those of the thenar eminence and the outer lumbricals. Ape hand due to median paralysis (rare as

an isolated lesion) is characterized by thenar atrophy and lack of power to flex the second digital phalanges. There is wasting of the thenar and hypothenar eminences.

Ischemic contracture (**Volkmann**), caused by tight bandaging, to which children are especially sensitive, and usually observed in the forearm, is characterized by rigid flexion fixation of the fingers and hand. Its onset after the application of dressings is indicated by severe pain, followed in a few hours by tender induration and paralysis of the compressed muscles. Thereafter there is a transitory swelling (days) and a rapid atrophy and contracture. Embolism, thrombosis, or any cause cutting off the blood supply of the muscles may cause this same condition.

Occupation paresis, due to overuse of muscle groups, often associated with repeated slight traumata, as from the handling of tools, is characterized by progressive paresis and atrophy, and at times by moderate pain. The diagnosis is based upon the disability and atrophy of an overused muscle group.

Occupation spasm is characterized by incoördination of an overused muscle group associated with tendency to painful tonic spasm. Writer's cramp is a familiar example.

Trigger Finger.—Trigger finger, or snapping finger, commonest in the middle finger of the right hand and in women (Weir), is evidenced by a sudden partial locking of the finger at one point, in either extension or flexion, or both, followed by a sudden slightly painful release. It may be due to a localized swelling of the tendon, associated with an annular thickening of its sheath or to neoplasm. It is often traumatic in origin.

Stunted useless fingers are often due to the destructive effects of syphilitic or tuberculous dactylitis of infancy.

Repeated trauma of a joint is followed by permanent thickening and limitation of motion (baseball finger). A similar condition is noticed in the hand and finger-joints of laborers whose occupation compels long-continued or frequently repeated forced flexion of the hand.

Deformities involving the joints of the fingers and hand due to the atrophic (common) or hypertrophic (rare) forms of arthritis deformans (see section on bones) may be trivial or extreme. The joints (multiple involvement, metacarpophalangeal and phalangeal) are enlarged, limited in motion, and at times greatly distorted; there is marked muscular atrophy and a tendency to ulnar deflection of the hand (flipper hand). There is a suggestive history, the onset is slow (exceptionally acute), and the complete development of the deformity is a matter of years.

Gouty deformity, which may be as pronounced as that from other forms of joint infection, is characterized in the beginning by acute attacks with complete remissions. Later by periarticular urate deposits (tophi).

The thick broad hands of myxedema are associated with other and more marked symptoms of this condition.

Pulmonary osteoarthropathy, in its hand development, is characterized by clubbing of the ends of the fingers.

The deformity due to the destruction of the tissue of the fingers incident to syringomyelia and the joint deformities of this condition are characterized by preservation of tactile sensation with loss of that incident to temperature and pain, and loss of function less pronounced than would seem proportionate to the extent of the lesion. This is also true of the joint affection of locomotor ataxia (rare).

Acromegaly is characterized by a bilateral overgrowth of the hands and feet involving all the tissues, and associated with gigantism elsewhere, particularly in the lower jaw.

Aside from enlargement of the epiphyses of the wrist, rickets does not produce marked deformity of the hand or fingers. Other and more characteristic signs are present elsewhere.

Traumatic Affections of the Hand and Wrist.—Sprains.—Sprain of the fingers, hand, and wrist is characterized by tenderness and swelling in or around the joint, pain, and disability.

FIG. 129[1]

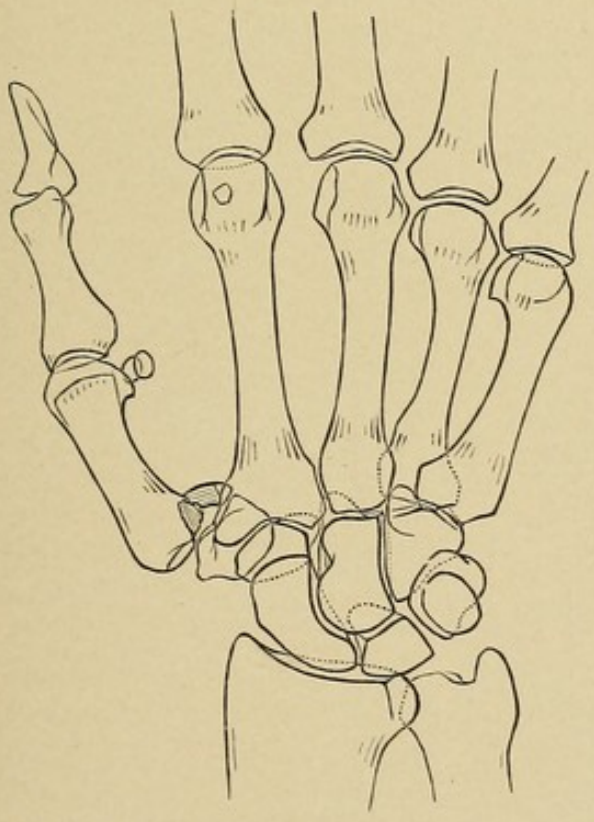


FIG. 130

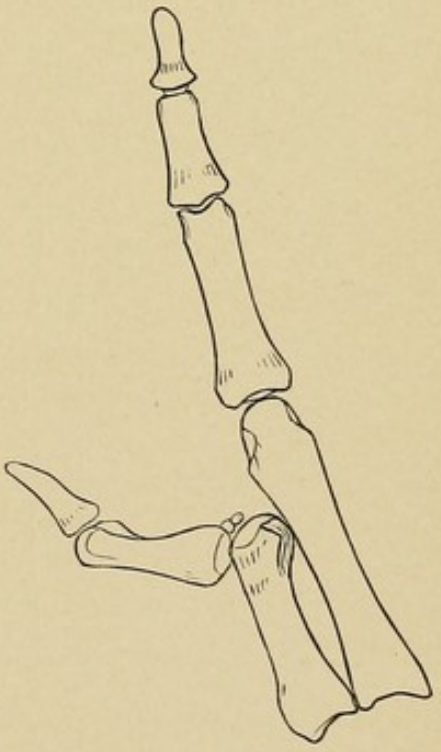


FIG. 129.—Fracture of base of metacarpal of thumb, separation of ulnar side of articular surface, and dislocation of metacarpal from trapezium, in male, aged forty-six years. (Frequent injury.) Clinical diagnosis of fracture not difficult, but proper reduction of both often difficult, especially when exact nature of injury is not recognized (when no *x*-ray is made).

FIG. 130.—Common dislocation of thumb backward at metacarpophalangeal joint, in a female, aged twenty-five years. Clinical diagnosis easy, but *x*-rays important to exclude complicating fracture or show obstacles to reduction.

[1] Figs. 129 to 138. Fractures of the hand. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. Frazier, Wood, Musser, Siter, and Carnett, from dispensaries, and private cases of Dr. Pancoast.

FIG. 131 FIG. 132

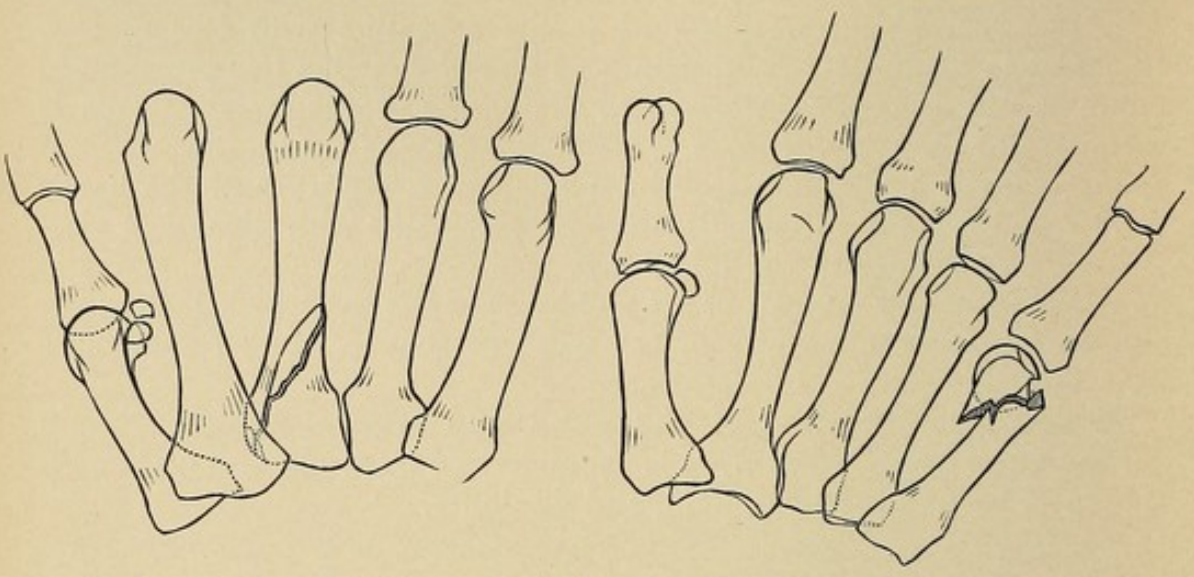
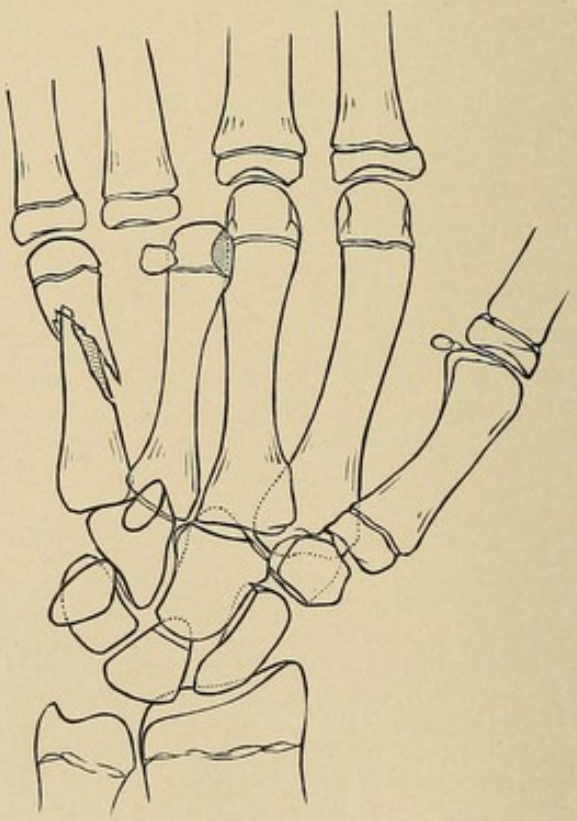


FIG. 131.—Oblique fissured fracture of middle metacarpal, in male, aged twenty-three years. Clinical diagnosis uncertain, depending mainly on pain and local tenderness.

FIG. 132.—Fracture of distal end of fifth metacarpal, in female, aged forty years. Displacement upward and to radial side.

FIG. 133



Oblique fracture of middle of shaft of fifth metacarpal; dislocation at fourth metacarpophalangeal joint, with separation of small fragment from epiphysis of fourth metacarpal. (Latter probably represents ligamentous attachment.) Boy, aged sixteen years.

FIG. 134 FIG. 135 FIG. 136

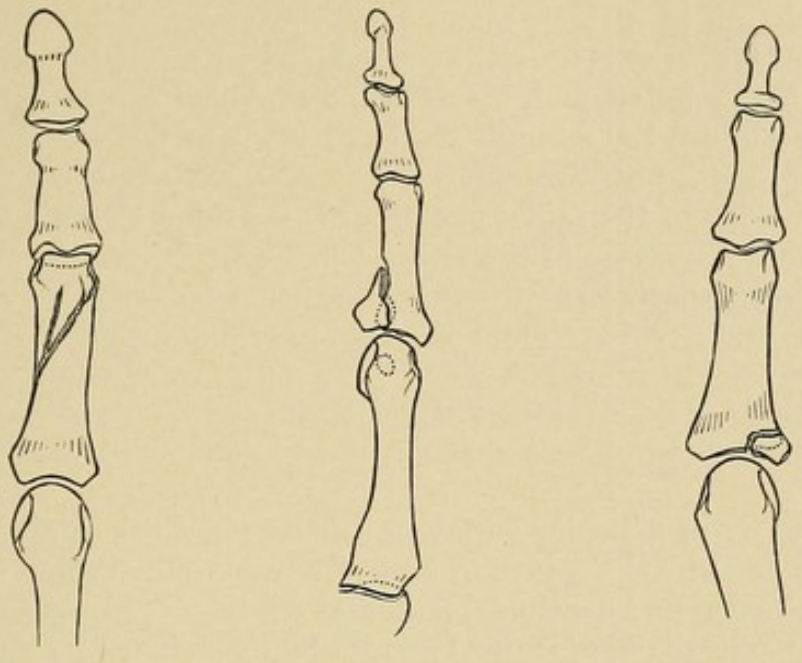


FIG. 134.—Oblique fissured fracture of proximal phalanx of fourth finger, in adult male.

FIG. 135.—Fracture of base of proximal phalanx of fifth finger, with separation of half the articular surface, in adult female. Clinical diagnosis of such fractures often either difficult or not made, but recognition important on account of danger of subsequent disability if not properly treated.

FIG. 136.—Fracture of base of proximal phalanx of index finger, with separation of very small fragment from articular surface, in adult male. Clinical diagnosis difficult, but recognition just as important as in the preceding case, and for the same reason.

FIG. 137 FIG. 138

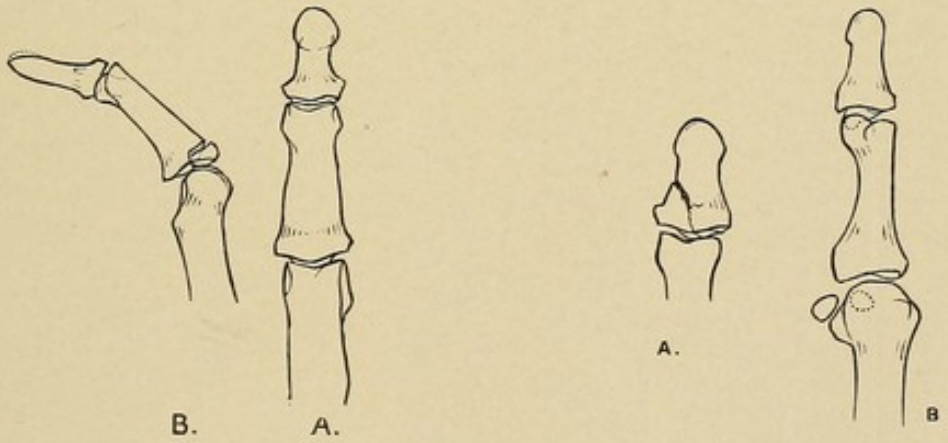


FIG. 137.—Fracture of proximal end of middle phalanx of third finger, with separation of fragment of posterior portion of articular surface, in adult male. Baseball injury. Fracture shown in lateral view only (*B*), as is often the case in such injuries. (Two views should always be taken.) Clinical diagnosis difficult.

FIG. 138.—Incomplete fracture of distal phalanx of thumb, in adult female. Only injury sustained in fall one story down elevator shaft. Clinical diagnosis of fracture not made. Shows in antero-posterior view (*A*) only. *B*, lateral view, and the one usually made in radiographing hand.

Sprain of the last finger-joints is at times complicated by a tearing away of the attachment of either the extensor or flexor tendon, making it impossible to extend in one case (hammer finger), or to flex in the other (bayonet finger), the last digit.

The loss of power is characteristic. Before swelling has developed the small fragment of bone may be felt. The *x*-rays are diagnostic.

Sprain of the wrist is usually accompanied by tenosynovitis, this often being the major lesion, and, if severe and attended by great swelling and pain, may require the administration of ether or the use of the *x*-rays to exclude fracture or luxation.

Tenosynovitis of the radial extensors is regarded as highly characteristic of fissured fracture of the radius.

All sprains characterized by persistence of disability, pain, local tenderness, and swelling should suggest the probability of a complicating fracture, for the diagnosis of which the *x*-rays are needful.

Fractures of the Bones of the Fingers, Hand, and Wrist.—Fracture of the digits, usually due to direct violence, if complete, exhibits characteristic features.

Chipping off of articular surfaces, usually regarded as simple sprain, has been shown by the *x*-rays to be fairly common. Pronounced intra-articular effusion and continued pain and tenderness would suggest such an injury. The diagnosis must be made by the *x*-rays.

FIG. 139[1]

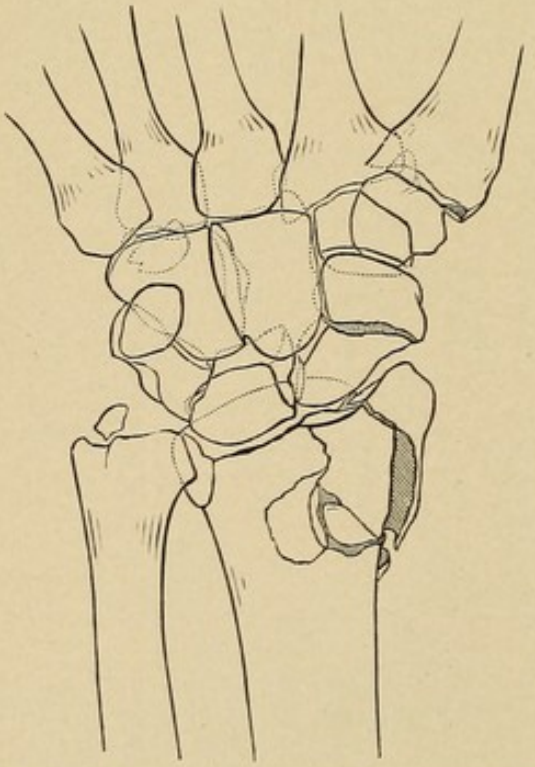
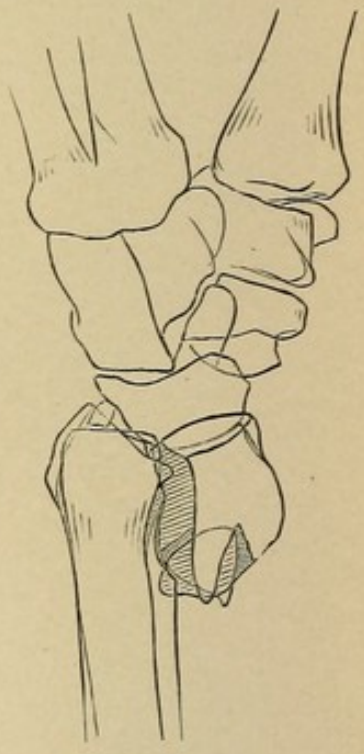


FIG. 140



FIGS. 139 and 140.—Fracture of lower end of radius of unusual type, in which the outer (radial) and palmar portion of the articular surface is split off. (In "Barton" type dorsal portion is separated.) Complicated by separation of styloid of ulna and fracture of scaphoid. Male, aged forty years. Fig. 139, anteroposterior view; Fig. 140, lateral view, showing displacement of lower radial fragment toward palmar aspect and upward. Exact clinical diagnosis difficult.

[1] Figs. 139 to 143. Complicated injuries in the region of the wrist. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from service of Dr. Siter, and from dispensaries.

FIG. 141

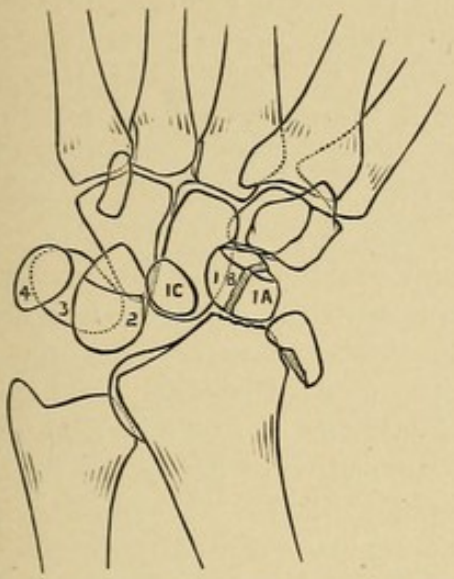


FIG. 142

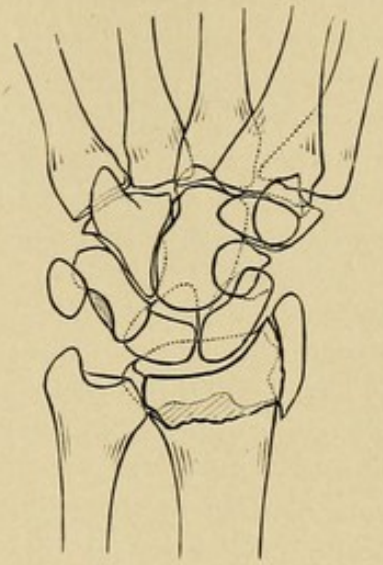
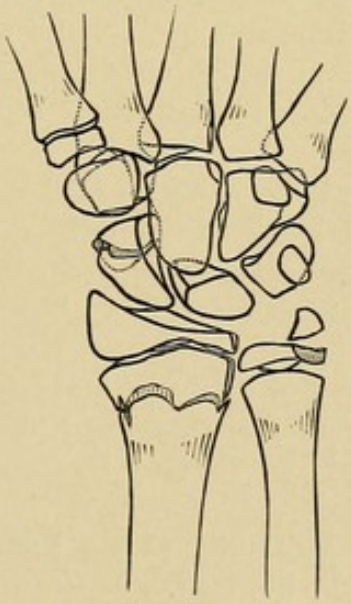


FIG. 141.—Complicated injury in wrist of sailor, aged twenty-two years, resulting from a fall into hold of vessel, comprising the following: Fracture of styloid of radius, displaced upward; scaphoid split into three pieces, 1 *A*, 1 *B*, 1 *C;* relative or actual subluxation of carpus and hand laterally to radial side; lateral (ulnar) dislocation of cuneiform, pisiform, and semilunar. Exact clinical diagnosis of injury practically impossible.

FIG. 142.—Impacted and comminuted Colles' fracture, with separation of tip of styloid of ulna, complicated by fracture of scaphoid and dislocation of pisiform, in adult female. Referred to hospital with clinical diagnosis of sprain of wrist, but possible fracture. Clinical diagnosis of none of the separate injuries easy, however.

FIG. 143



Colles' fracture (above but extending into epiphyseal line), with separation of entire styloid of ulna, complicated by fracture of scaphoid, in a boy, aged fifteen years. (Latter fracture not determined clinically.)

The tearing away of a fragment of bone from the base of the third phalanx by its tendinous attachment leaves a joint fixed in either extension or flexion (bayonet finger, hammer finger).

Fractures of the metacarpal bones, transverse if from direct violence, oblique, spiral, or fissured if from force applied to the knuckles, may be

obvious. They are, however, often attended by but slight displacement, and can be recognized only by extreme and persistent localized tenderness and swelling and later the formation of callus. The tenderness is elicited either by pressure at the seat of injury, or, the fingers being flexed, by suddenly pushing against the knuckle of the affected bone toward the wrist.

Even the *x*-rays may fail to show the fracture unless both anteroposterior and lateral exposures are made.

An oblique fracture involving the articular surface of the metacarpal bone of the thumb, usually caused by a blow with the clenched fist, the impact falling upon the first phalanx of the thumb, is rarely recognized as such, since the effusion into the joint, the general swelling, and the extreme tenderness make the elicitation of crepitus or mobility difficult or impossible. The deformity is strongly suggestive of backward luxation of the metacarpus upon the trapezium. Since this injury is characterized in its ultimate development by considerable deformity, persistent disability, and much pain, its early diagnosis is important.

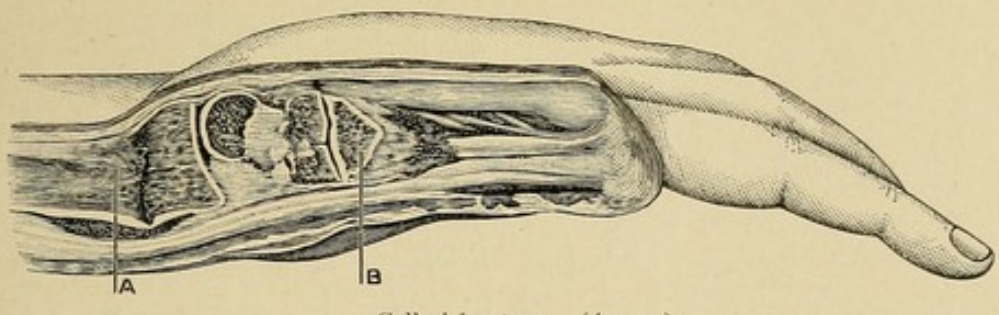
This can be made best by the *x*-rays, though a deformity consisting of backward luxation of the first metacarpus, which is readily reduced but as easily recurs, is highly suggestive. Later a bony swelling on the outer side of the joint attended by limitation of motion, pain, and tenderness will sufficiently characterize the nature of the affection.

Fractures of the carpal bones, usually due to indirect violence, as from striking a blow with the fist or a fall upon the hand, are attended by marked and rapid effusion into the joint, pain, and extreme local tenderness on deep palpation. These fractures are usually unrecognized, and are the common underlying lesions of persistent disability and gradually increasing deformity following injury which was supposed to have been sprain and was so treated.

The scaphoid is the bone commonly broken. Codman notes as characteristic symptoms, localized tenderness in the anatomical snuff box when the hand is adducted, swelling on the radial side of the back of the wrist, and pronounced disability. These symptoms do not disappear, as in the case of sprain, but either persist or recur and are associated with limited motions of the wrist and hand and painful spasm on efforts to increase this motion, particularly if these be made in the direction of extension. Carpal fracture may be complicated by other fracture or by luxation.

Fractures of the Lower Extremity of the Radius.—Colles' fracture, the one usually encountered in the region of the wrist, is commonest in the middle aged as the result of a fall on the palm. The break is placed from one-half to one and one-half inches above the joint surface of the radius, and is generally slightly oblique. It may be impacted or slightly or extensively comminuted. The lower fragment is generally displaced backward and may be rotated in the same direction. There is at times a complicating luxation of the head of the ulna, this portion of the bone being displaced beneath the tendon of the extensor carpi ulnaris. The ulnar styloid is sometimes broken.

FIG. 144



Colles' fracture. (Anger.)

The diagnosis is based upon obvious deformity (silver fork) and, in the absence of impaction, unnatural mobility and crepitus. When the fracture is impacted, the deformity is characterized by radial deflection of the hand and angular deformity which can be both seen and felt. The upper end of the lower fragment projects on the dorsal surface of the wrist above the articular line, the lower end of the upper fragment forming a similar projection on the palmar surface of the wrist.

The radius is shortened, as shown by the elevation of its styloid to the level of that of the ulnar or even above this, and by measurements from the external humeral condyle to the radial styloid in the two arms. There is pain, swelling, and limitation of all motions.

A fall upon the back of the flexed hand may produce a Colles' fracture, but with the deformity reversed, *i. e.*, the lower fragment rides forward,

FIG. 145[1]

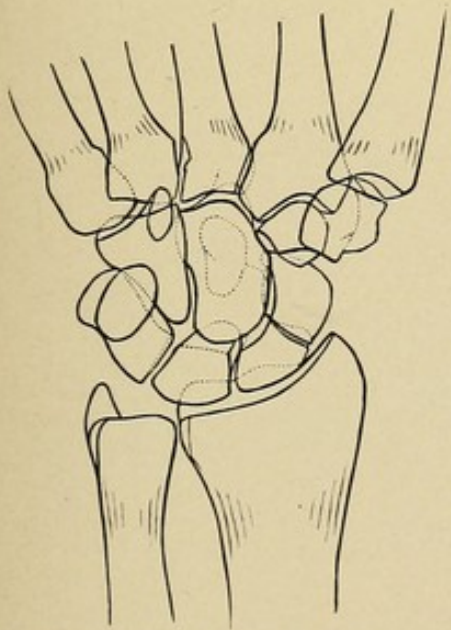


FIG. 146

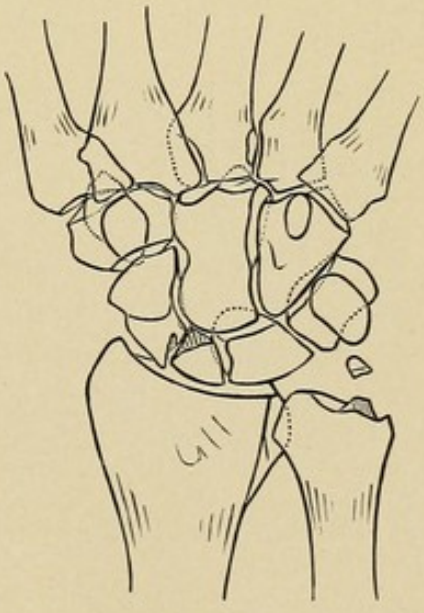
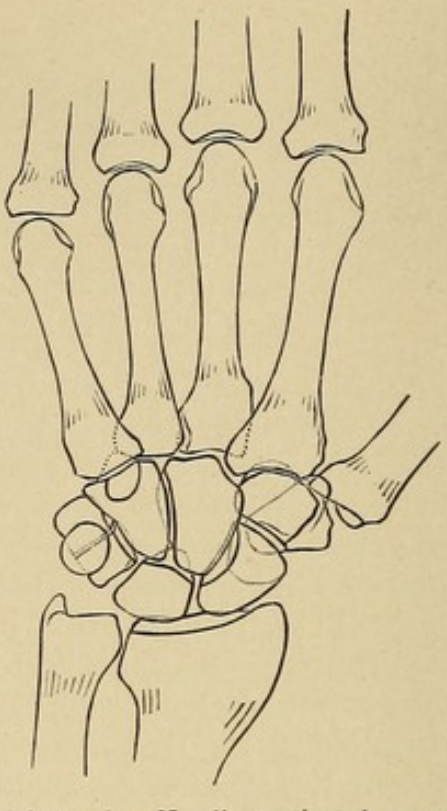


FIG. 145.—Old ununited (by bony union) fracture of scaphoid, in a male, aged nineteen years. Neither diagnosticated nor treated. *x*-ray examination made to discover cause of disability.

FIG. 146.—Recent fracture of scaphoid, with separation of tip of styloid of ulna, in a male, aged twenty-six years. Clinical diagnosis difficult.

[1] Figs. 145 to 149. Uncomplicated fractures of the carpal bones. Outline drawings of radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from dispensaries, and private cases of Dr. Pancoast.

FIG. 147



Fracture of cuneiform, in adult female. Not diagnosticated or treated. Radiograph made three weeks after injury to determine cause of disability. Clinical diagnosis very difficult, however.

FIG. 148

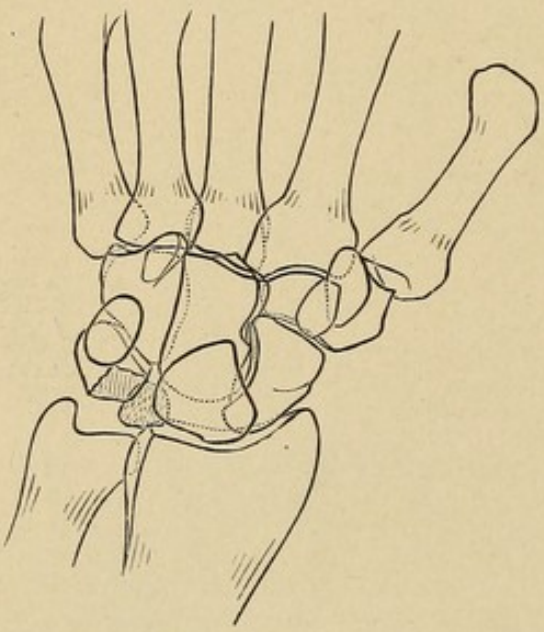
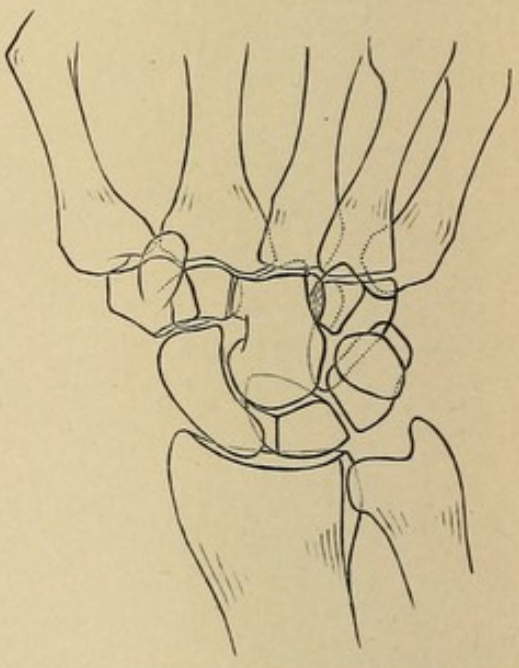


FIG. 149



FIGS. 148 and 149.—Fracture of cuneiform and complete anteroposterior dislocation of semilunar in left wrist of male, aged twenty years. (Clinical diagnosis, Colles' fracture.) Fig. 148, anteroposterior view of injured wrist; Fig. 149, same view of normal right wrist. Lateral view (omitted here) shows rotation of semilunar on lateral axis about 90 degrees, so that articular surface for the os magnum faces directly toward the palmar aspect of the wrist. Pressure on median nerve. Exact diagnosis not only not made clinically, but would be extremely difficult or impossible in any case. Lateral view essential for *x*-ray diagnosis.

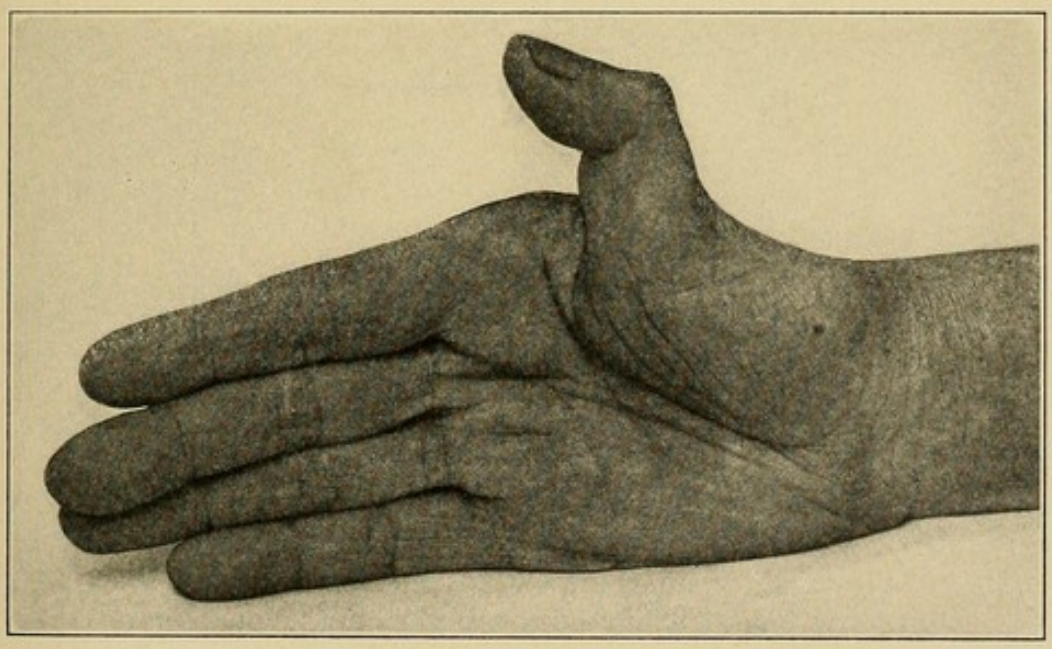
the upper backward (gardener's spade deformity). When Colles' fracture is complicated by avulsion fracture of the ulnar styloid, due to the pull of the internal lateral ligament, and this is usual when there is marked deformity, mobility, crepitus, and local tenderness make the diagnosis obvious.

Fracture of the ulnar styloid may result from violent twisting of the wrist in the absence of radial fracture. The superficial position of the bony prominence makes the demonstration of characteristic symptoms easy.

Fissured fractures of the lower extremity of the radius running into the joint, or fracture of the epiphyseal line or near it, may be without displacement, preternatural mobility, or demonstrable crepitus.

A diagnosis of fissured fracture of the radius is suggested by bone tenderness on deep pressure and by effusion into the synovial sheaths of the extensor longus pollicis and radiocarpal extensor (Codman), characterized by the rapid development of a tender fluctuating swelling on the back of the wrist-joint, obscuring these tendons and projecting for a short distance upward over the dorsal aspect of the radius along their course. The positive assurance of the presence of such a lesion can be secured only by the x-rays.

FIG. 150



Recurrent backward dislocation of (proximal phalanx of) thumb. Proximal phalanx hyperextended, with its head resting on the dorsal aspect of the metacarpal. Distal phalanx flexed. (Carnett.)

Luxations of the Hand and Wrist.—Luxations of the phalanges are attended by the characteristic symptoms of gross and obvious deformity, fixation, and complete disability. If partial, these displacements may escape attention because of swelling and tenderness.

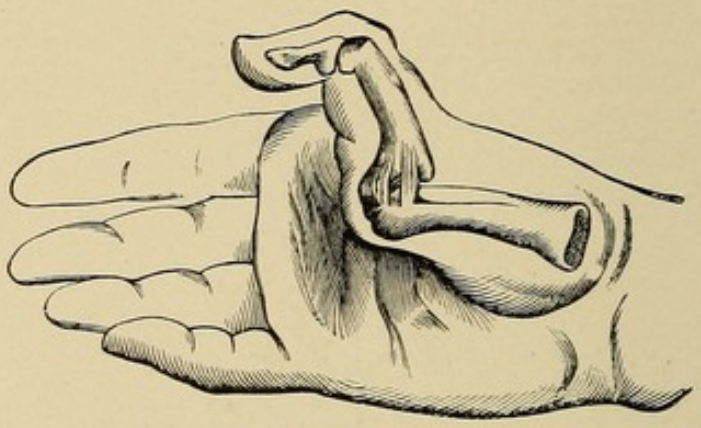
Radiocarpal luxation (rare) forward or backward exhibits the deformity of Colles' fracture, except that the radial styloid maintains its proper relation to the ulnar and there is shortening of corresponding measure-

ments on the healthy and injured side as taken between the radial styloid and a bony point of the hand. This luxation may be complicated by Colles' fracture.

Radio-ulnar luxation from violent twisting of the wrist is characterized by prominence and mobility of the ulnar head. In some people this joint is naturally prominent and exceedingly movable.

Luxation of the individual carpal bones affects usually the os magnum and the semilunar. The os magnum dislocated backward, often carrying the semilunar with it, sometimes with this bone completely reversed, forms a projection at the back of the wrist at the base of the third metacarpal bone, easily recognized unless obscured by swelling and great tenderness.

FIG. 151



Metacarpophalangeal dislocation.

The semilunar bone, if displaced forward, in addition to the pain and disability, makes the upper surface of the os magnum unduly prominent on the dorsum of the wrist. The deformity and disability are similar to those of Colles' fracture. The radial and ulnar styloid exhibit their normal relation to each other, and examination shows that the deformity is placed below the articular line and not above it. Swelling and tenderness may make the diagnosis of this injury impossible without an examination under ether or the use of the *x*-rays.

Subluxation of the wrist, noted in young working people whose occupation requires constant use of the flexors of the arm, is characterized by a widening of the wrist, at times a forward bending of the lower extremity of the radius and dorsal prominence of the ulna. There is weakness, limited extension, and pain on use. This condition is due to irritation of the growing epiphysis.

Acute Inflammatory Affections of the Soft Parts of the Hand and Wrist.—The acute dermatitis of rhus poisoning may occasion some diagnostic difficulty in the absence of a history of exposure. The free vesiculation, irregular distribution, and moderate constitutional symptoms are characteristic as contrasted to erysipelas, which, when it attacks the hand complicates an obviously infected wound.

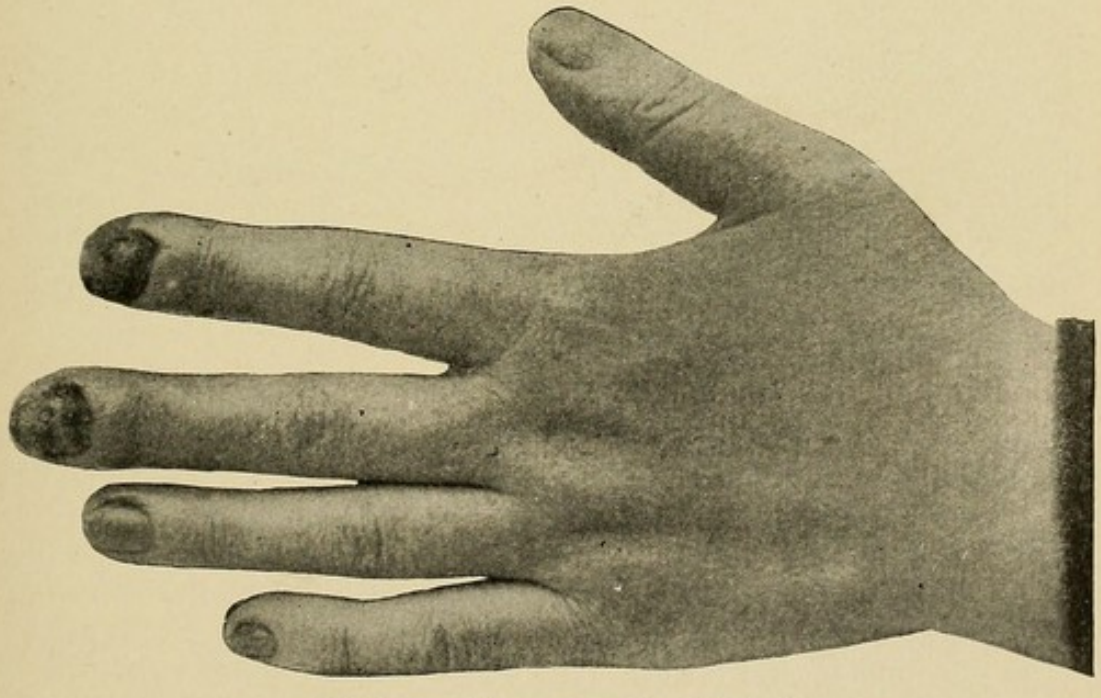
Cellulitis.—Cellulitis (common), secondary to wounds which may be slight, is characterized by pronounced edematous swelling extending up

the arm, most marked on the back of the hand. It is often preceded by the red tender edematous streaks of lymphangitis, is accompanied by the constitutional symptoms of sepsis, and may be complicated or followed by suppurative inflammation of the epicondyloid or axillary glands. In exceptionally virulent infections the constitutional symptoms may precede by some hours the local swelling.

Furuncle.—Furuncle, or boil, usually on the dorsal aspect of the hand, wrist, or fingers, begins with a folliculitis, which is stimulated to further development by slight traumatism, usually that incident to the rubbing of a cuff or glove. It is distinguished from a poisoned wound by its history of onset, its slower course, and fairly sharp limitation.

Paronychia.—Paronychia usually begins with heat, redness, and throbbing pain, generally at the base of the nail, where there shortly forms a yellow bleb, from which, on puncture, one or two drops of pus are discharged. This inflammation may almost painlessly involve the entire nail base or may burrow wide of this beneath the epidermis (subcuticular), forming a pustule. Often it is the starting point of felon.

FIG. 152



Diffuse syphilitic paronychia. (Taylor.)

Cellulitis of the Finger.—Here the pain is severe, throbbing, constant. The finger is swollen and excessively tender, there is accompanying lymphangitis and moderate fever. The cellular tissue of the finger is the portion first involved in the inflammation (subcutaneous); if the condition be unrelieved, the tendinous sheaths become infected; finally the bones (distal phalanx) and joints (midphalangeal). The swelling usually terminates, at least in its hyperacute form, before reaching the middle third of the palm.

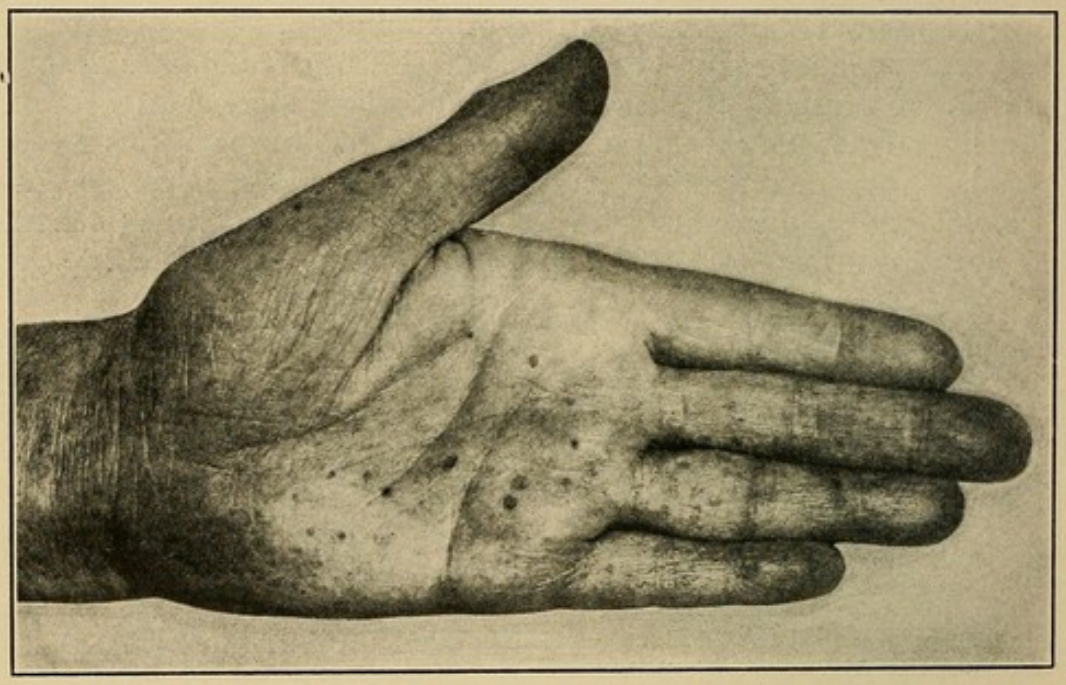
If the tendon sheaths of the thumb or little finger are affected, the

infection more rapidly and surely reaches the wrist-joint and forearm beneath the deep flexors.

The common cause of tendon sheath infection is environing cellulitis, particularly when the cause of this also produced a predisposing congestion of the tendinous sheaths, as in the case of those infected fingers which so frequently follow rowing or handling tools after a period of rest.

The distinction between subcutaneous cellulitis and involvement of tendon sheaths, bone, or joint should be made by free incision and direct examination.

FIG. 153



Keratitis palmaris (arsenical). Shot-like nodules of epithelium embedded in the thick skin. (Hartzell.)

Palmar Abscess.—Palmar abscess, usually secondary to digital cellulitis, also caused by wound, sprain, or contusion, with blood effusion into and beneath the palmar fascia, is characterized by severe pain, fever, prostration, and swelling of the entire hand, which becomes like a pus-soaked sponge. Because of the dense tissues lying in the palm, the swelling and edema are usually more pronounced on the dorsal aspect.

The infection travels up the wrist and into the cellular structures of the forearm. It may involve the wrist-joint in a suppurative arthritis, and commonly causes sloughing of the tendons.

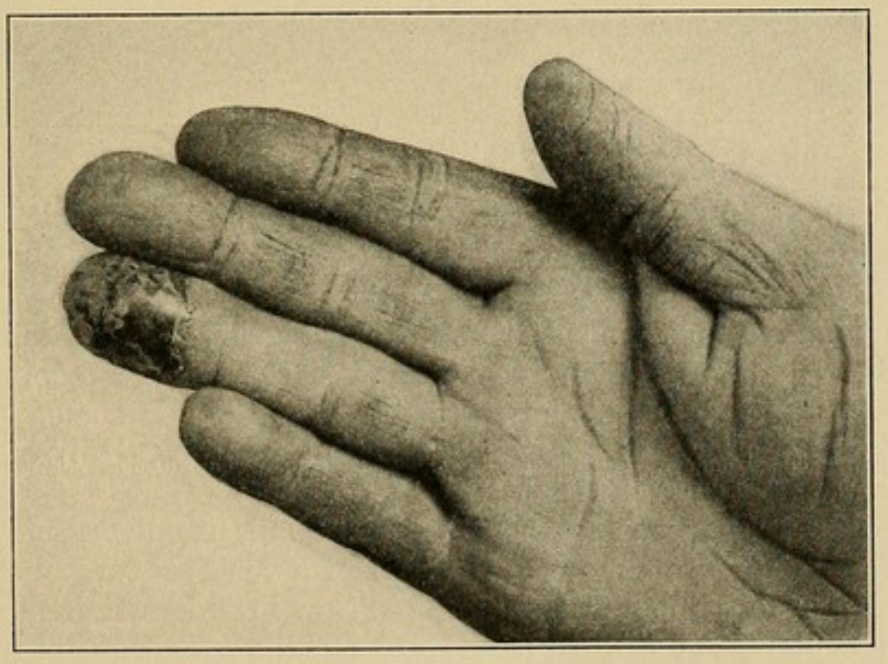
Chronic Inflammation of the Soft Parts of the Hand.—Erysipeloid.—Erysipeloid is an affection common to those who handle fish, oysters. and raw meat, characterized by a slowly spreading (weeks), dusky red inflammation of the skin of the hand, usually the fingers, exhibiting raised borders and all the features of an erysipelas, with the exception of the progression and the constitutional symptoms of the latter. Of the inflammatory skin lesions, psoriasis, keratitis palmaris, and dermatitis repens all from their obstinate persistence should be recognized on sight.

Dermatitis vegetans (rare), without obvious cause, is characterized by its slow course and persistence in the absence of antiseptic treatment.

Fig. 154

Dermatitis vegetans. (Hartzell.)

Fig. 155



Dermatitis repens. Slowly spreading (months), superficial, exfoliating dermatitis. (Hartzell.)

Traumatic Ulcers.—Traumatic ulcers, superficial, irregular in shape, indolent, but slightly indurated, exhibiting areas of healing and breaking down, and not painful, are such as are found on hands subject to repeated slight trauma without opportunity for cleanliness and protection. These lesions are observed on the hands of guides, masons, bricklayers, wood-choppers, etc.

Syphilitic Ulcers.—Syphilitic ulcers may appear in the form of chancre, secondary or tertiary lesions.

Chancre, often beginning in a hang-nail or an unobserved scratch or abrasion, appears as a chronic, slowly spreading, often painful, persistent ulcer, on any part of the fingers or hand, but commonly at the base of the nail. Often there is in the latter case an associated swelling of

FIG. 156

Palmar syphilide (late lesion). (Hartzell.)

the entire phalanx. In appearance these ulcers do not resemble chancres seen on the genitalia; the surrounding induration is not sharply circumscribed.

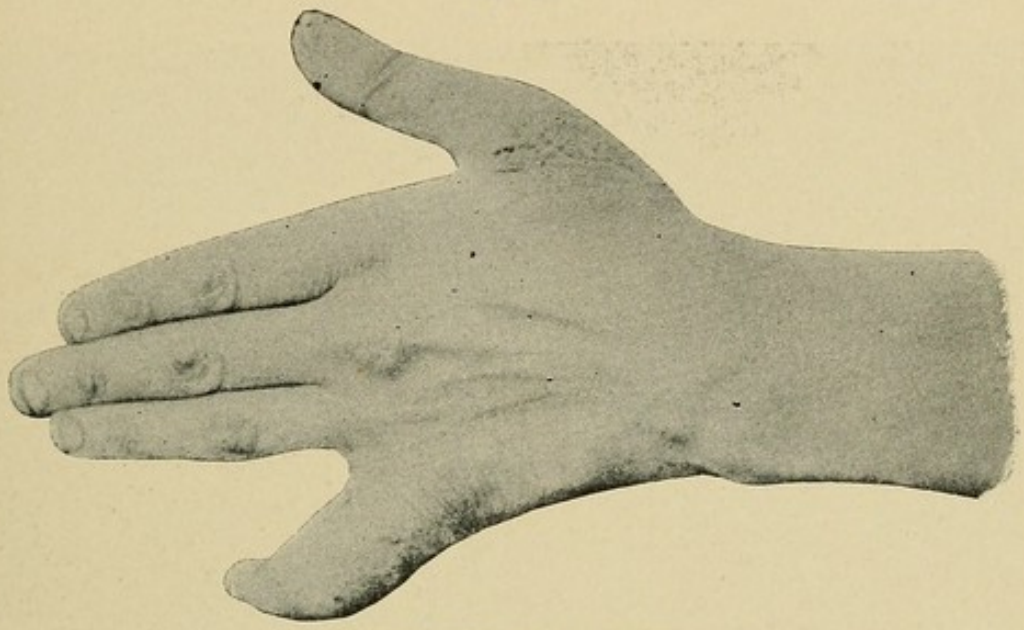
The diagnosis must be based upon their persistence, the difficulty of explaining their presence on any other basis, the associated epitrochlear and axillary enlargement, and the finding of the spirochete. Usually it is not made until the secondary eruption develops. Physicians are peculiarly subject to such lesions.

Chancre over the knuckles or back of the hand, usually secondary to a tooth wound, conforms more to the type of a venereal sore in that it is rounded or oval, indolent, persistent, and slow in progression.

The inoculation of virulent sepsis and syphilis may occur at the same time, the cellulitis, lymphangitis, and lymphadenitis of the former

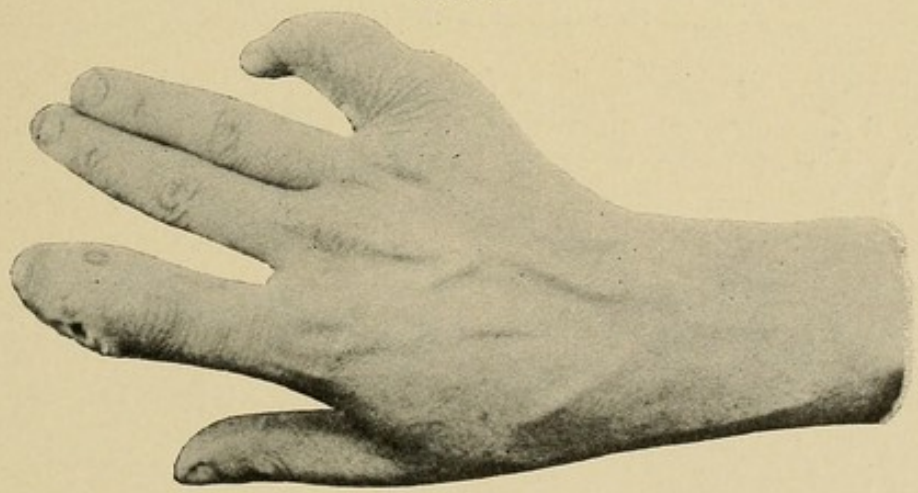
completely masking the latter for weeks or months. Moreover, chronic sepsis exhibits at times skin manifestations not unlike those of secondary syphilis. A diagnosis under such circumstances must be made by the therapeutic test, by the development of typical lesions, and possibly by finding the spirochete. This mixed infection is exceedingly rare, is seen mainly in doctors infected during operation, and in them is frequently imaginary.

FIG. 157



Dactylitis syphilitica. (Taylor.)

FIG. 158



Dactylitis syphilitica. (Taylor.)

Secondary lesions of syphilis, usually non-ulcerating, commonly appear in the form of papular exfoliating palmar lesions. Associated symptoms make the diagnosis.

Tertiary lesions are characterized by nodulations which exceptionally ulcerate and slowly extend in a circinate form.

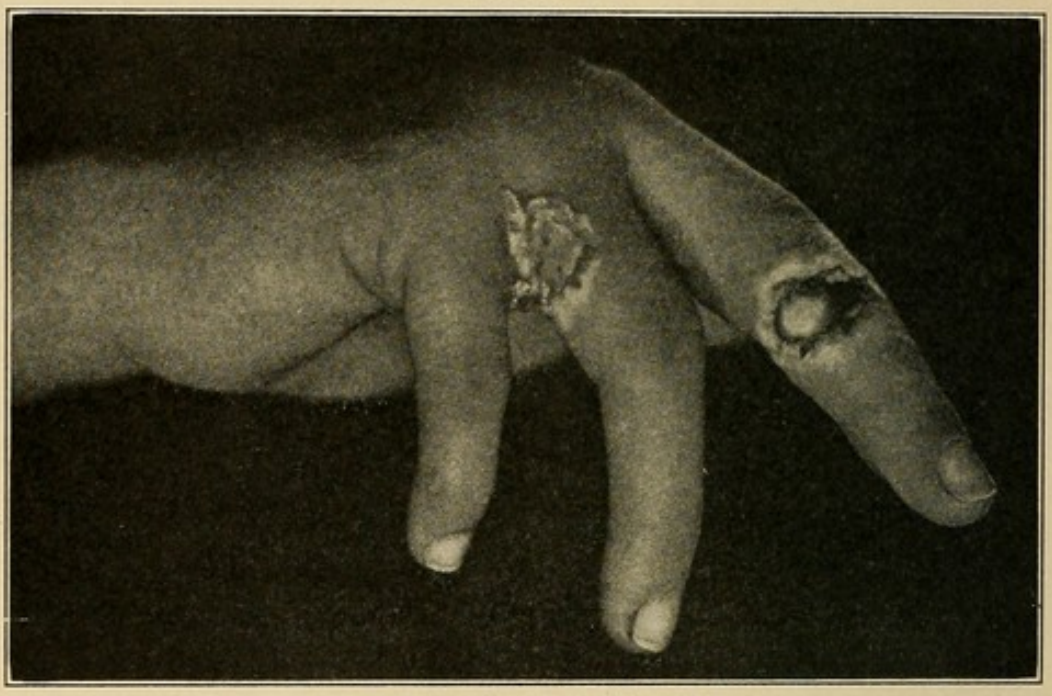
The diagnosis is based upon the indolence of the lesions, their circinate borders, and associated symptoms.

Circumscribed gumma involving the soft parts of the hand is rare. It corresponds in type to gummata in general.

Ulcerating sinuses incident to the breaking down of a gummatous lesion of the phalanges of infants are common manifestations of hereditary syphilis.

Deep trichophytosis may form a superficially ulcerating lesion, the diagnosis of which can be established only by the microscope.

FIG. 159



Deep trichophytosis. (Hartzell.)

Tuberculosis.—Tuberculosis of the soft parts of the hand and fingers is rare, if the chronic ulcerations and papillary outgrowth observed in the hands of those working in the dissecting room be excepted. These lesions appear either in the form of small clusters of warts, ulcerating or pustulating at the base, or as nodular, indolent ulcerations. The diagnosis is based upon the finding of the tubercle bacillus.

Lupus may assume any of its forms, *i. e.*, hyperemic, verrucous, nodular, or superficially or deeply ulcerating. In the last type it is ultimately attended by deforming and crippling contracture. It begins in youth on the dorsal aspect, is extremely indolent (years), and is resistant to cleansing and protecting treatment.

Tuberculous Tenosynovitis.—A chronic painless tenosynovitis is the commonest tuberculous lesion involving the soft parts of the hand. Indolent, fusiform, soft swellings form along the course of the tendons, sometimes the flexors of the fingers; usually the involvement is of the common flexor sheath. The palm is gradually (years) distended by a soft painless tumor which also appears on the wrist. The communication of the swellings beneath the annular ligament is shown by fluctuation. Usually, because of the rice-like bodies with which the synovial sac is filled, there is, in addition to fluctuation, a chain-like grating on

manipulation. There is muscular atrophy and limitation of flexion, or, when the tendons themselves are fibrillated and destroyed, complete loss of motion. Involvement of the sheath of the extensors is manifested by a globular swelling on the back of the wrist-joint. In the fungating form of tuberculous tenosynovitis, softening and sinus formation occur. The seat of the swelling, its indolence, fluctuation, extent, and chain-like grating when this is present suggest the diagnosis of a condition which is not accounted for on any other than a tuberculous basis.

Gonorrheal tenosynovitis is more acute in onset and subsidence. Lipoma of the palm may cause an enlargement exactly simulating tenosynovitis of the flexor sheath. It gives no crepitation and does not cause muscular atrophy or fixation to the same degree. The diagnosis is usually made by operation.

Epitheliomatous Ulcers.—Epitheliomatous ulcers, found on the dorsal surface of the hands and fingers, usually begin in warts or cicatrices, and are characterized by the persistence of ulceration and slow extension. Later, the indurated, destructive, often fungating ulcer with glandular involvement is unmistakable. The chancre is more rapid in evolution (weeks), the gumma begins as a dermal or subdermal induration which softens and breaks down (weeks or months).

Early diagnosis can be made only by microscopic examination of the excised lesion.

Trophic Ulcers.—Trophic ulcers, incident to nerve lesion, are accompanied by the changes in circulation and nutrition characteristic of the underlying lesion. These ulcers are persistent, painless, and progressive.

Digital cellulitis, dependent upon syringomyelia, is highly destructive. There is usually fever, but aside from this the constitutional symptoms are slight.

The diagnosis in the case of syringomyelia is based upon the preservation of tactile sensation and the loss of sensation for temperature and pain.

Gangrenous Affections of the Hand.—**Acute traumatic gangrene** following extensive injury exhibits the forms and symptoms of the affection as observed in other parts of the body (p. 99).

Carbolic Acid Gangrene.—Carbolic acid gangrene, which may follow the continued application of a weak solution (1 to 100), is characterized by a numb, white area, becoming completely anesthetic, cold, black, and gangrenous.

Diabetic Gangrene.—Diabetic gangrene, characterized by the rapid or slowly progressive sloughing of tissues out of proportion to the original trauma or infection, is suggested by this very fact and corroborated by urinary examination.

Arteriosclerotic, or senile, gangrene, an affection of old age, which may occur in younger people, exhibits the prodromal symptoms of tingling pain, loss of heat, and impaired strength and motility, followed by vesiculation of the skin and dry gangrene.

Symmetrical gangrene, or Raynaud's disease, is characterized by extreme pallor, coldness of the part, attended by blunting of sensation,

succeeded in turn by duskiness, bleb formation, anesthesia, and complete or partial local death. It is usually bilateral and involves more than one finger of each side.

Embolic Gangrene.—Embolic gangrene, characterized by sudden onset, without previous pronounced symptoms, in the presence of a valvular heart lesion, is marked by the sudden circulatory failure, followed by typical symptoms of death of the part. The seat of arterial obstruction can usually be determined by palpation of the brachial artery.

Inflammatory Affections of the Bones and Joints of the Hand and Wrist.—Acute inflammatory affections of the bones and joints of the hand and wrist, in their suppurative form, are nearly always secondary to cellulitis and suppurative tenosynovitis.

Acute post-traumatic, non-suppurative inflammation of the bones and joints, characterized by persistent pain and tenderness on deep pressure, swelling, usually obscured by exudate into the surrounding soft parts, and fixation of the joint in the position which allows of greatest distention of its capsule (slight flexion), is usually suggestive of fracture, for the detection of which the *x*-rays are needful.

Acute Gouty Periarthritis.—Acute periarthritis of gout closely simulates infection, but is characterized by an absence of history of trauma, sudden onset, swelling, heat and redness, and the absence of either lymphangitis or pronounced constitutional symptoms of septic absorption. Tophi, when present, are diagnostic.

Gonorrheal Arthritis.—Gonorrheal arthritis is characterized by acute inflammatory symptoms, joint fixation, severe pain, usually marked periarticular heat, redness, and swelling. The finger-joints and that of the wrist are especially subject to this involvement. It is usually complicated by tenosynovitis.

The diagnosis is based upon the sudden onset of joint inflammation, for which no other cause than gonorrheal infection can be found.

Acute Rheumatoid Arthritis.—This is distinguished from rheumatic arthritis only by the persistence of the joint lesions (polyarticular and bilateral), usually periarticular, with ultimate pronounced limitation of motion, distortion, and deformity, best marked in the midphalangeal and metacarpophalangeal joints. The affection develops in the young with fever. It is usually called rheumatic. The functional prognosis is bad.

Chronic inflammation of the bones and joints of the hand and wrist may be due to repeated slight trauma, infection of unknown origin (rheumatoid arthritis), tuberculosis, syphilis, or syringomyelia.

Chronic Traumatic Arthritis.—Chronic inflammation incident to repeated slight trauma, exhibited most frequently in the wrist-joint, but possible in any of the articulations of the hand, is characterized by a gradual thickening and enlargement both of bone and periarticular tissue, producing deformity and disability. It is observed in young people who are compelled to use their hands constantly without opportunity for rest, or in those who are subjected to slight injury, and who

have no opportunity for complete recovery from the same. In its early course it resembles tuberculous involvement, nor can it be distinguished from this except in its progress, there being no tendency toward softening nor abscess formation.

Tuberculous Arthritis.—Tuberculous arthritis often follows slight traumatism. It is observed in the wrist of the adult; in the metacarpophalangeal articulations in children.

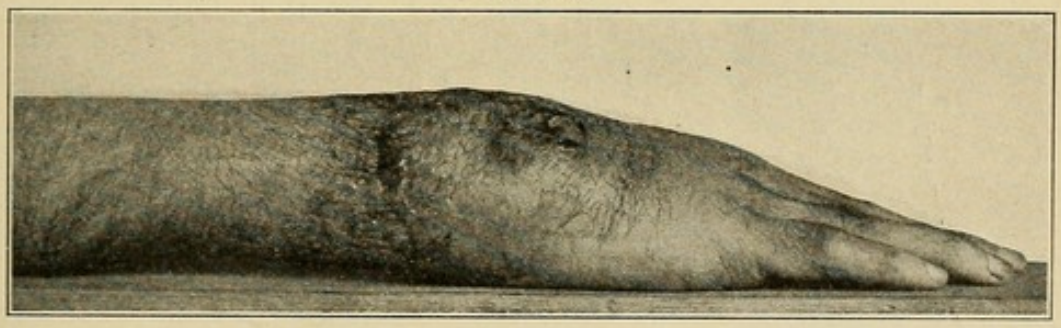
In the early stages of tuberculous arthritis of the wrist, pain, aggravated by use, partial fixation, muscular atrophy, and often a point of tenderness on deep pressure, are the symptoms. The wrist, hand, and fingers are held slightly flexed.

A distinction from the continued disability, tenderness, and swelling, following fissured fracture, can be made only by the *x*-rays, and by the fact that tuberculosis follows slight rather than severe trauma.

Tuberculous arthritis is distinguished from arthritis produced by overuse only by the history and the result of brief rest in the latter case.

Since, preceding a general joint invasion, the tuberculous process is often limited to the radial epiphysis, the base of the metacarpus or the carpus, an early diagnosis of such localization, suggested by local tenderness, made possible often by the *x*-rays, is highly desirable. The slow (months) progression of the tuberculous process, forming a spindle-shaped swelling accentuated by muscular atrophy, involving the tendons and their sheaths and fixing them, and ultimately softening and discharging through fistulæ which lead to carious bone, is characteristic.

FIG. 160

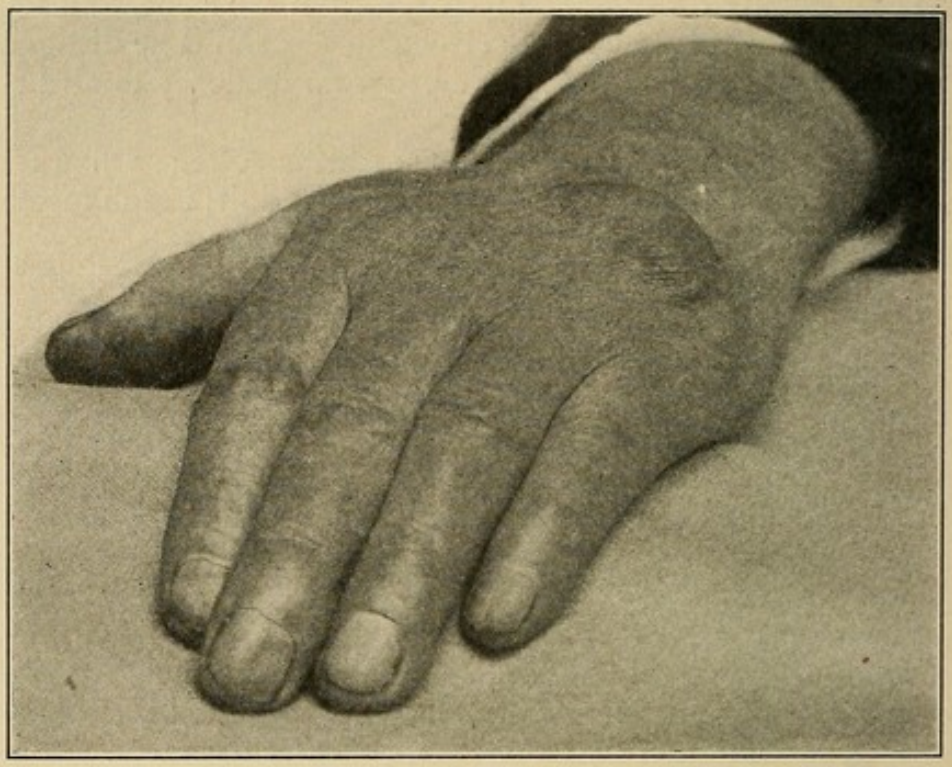


Tuberculosis of wrist and carpal joints, with suppurating sinus on dorsum of hand. Eighteen months' duration. Doughy infiltration of soft tissues. Grating of articular surfaces on manipulation. Motion limited in all directions. Similar lesion in knee-joint. (Carnett.)

Tuberculosis of the metacarpals and phalanges, called spina ventosa, and usually an affection of childhood, is characterized by a painless, cylindrical swelling, at first of the bone, later involving the joint. It is followed (weeks or months) by redness and edema of the overlying skin, softening, and discharge of a curdy pus from sinuses which lead to dead bone. It results in pronounced deformity of the fingers and bony ankylosis. Recovery may take place without suppuration.

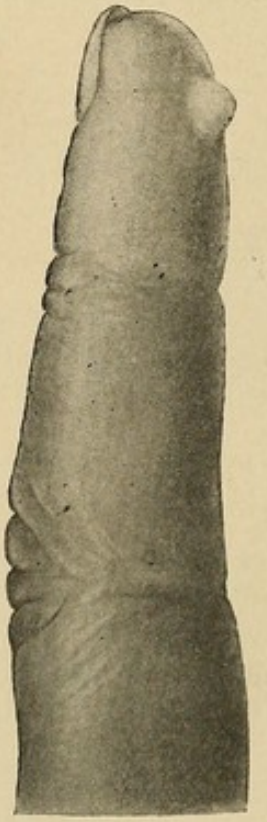
Syphilitic Inflammation.—Syphilitic inflammation of the bones and joints of the hand presents a picture so like that of a tuberculous involvement that the differential diagnosis from the appearance alone is impossible. Associated symptoms and signs of syphilis and the

FIG. 161



Angioma, probably with lipomatous and fibromatous admixture. Dense, hard in place, unattached to the underlying skin, and movable on the bone below. Varying in size in accordance with the amount of local venous congestion.

FIG. 162



Traumatic epithelial cyst, usually beneath the skin, which is not adherent. Vary from size of pea to that of walnut; contents similar to that in sebaceous cyst; may follow trauma by many years. (Berger.)

therapeutic test furnish the means of differentiation. This test is futile when fistulæ have formed.

As in the case of tuberculosis, ankylosis or marked atrophy or distortion of the finger may result in the absence of suppuration.

Tumors of the Hand and Wrist.—**Multiple Angiomata.**—Multiple angiomata, either capillary or venous, are not infrequently seen on the back of the hand. Lipoma, fibroma, and sebaceous cysts are rare.

Epithelial Cysts.—Epithelial cysts, observed on the palmar surface of the finger, exceptionally the palm, form small, hard, rounded, non-inflammatory skin tumors, slow in growth.

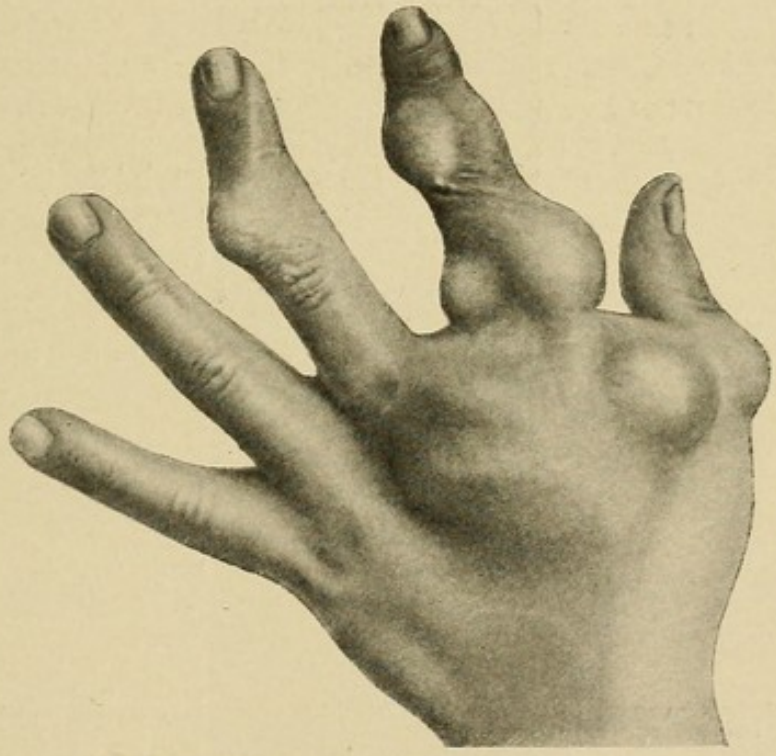
The diagnosis is based upon excision and microscopic examination. Neuroma and neurofibroma of traumatic origin, forming about small encysted foreign bodies, are occasionally found. The diagnosis must be by the microscope.

Ganglion.—Ganglion forms a rounded elastic tumor, the prominence and

tension of which can be markedly altered by flexion and extension of the joint near which it occurs. Its appearance often follows slight traumatism or overuse, and its usual position is on the back of the wrist, to the ulnar side of the extensor carpi radialis, where it causes little discomfort aside from the deformity. When placed in front of the wrist, the pressure on nerves may cause distressing pain and disability. Exceptionally, these tense, rounded tumors, are found on the palmar surface of the metacarpophalangeal joints.

The diagnosis is based upon the position of the tumor, its non-inflammatory character, its slight mobility, its pronounced change in tension dependent upon joint position, and finally, upon excision. The contents are usually jelly-like and, though the cysts are adherent to the sheath of the tendons, they usually originate from the capsule of the joint itself.

FIG. 163



Multiple enchondroma of the left hand. (v. Bruns.)

Multiple Enchondromata.—Multiple enchondromata form hard, painless tumors which are fixed to the bone and grow slowly (years). Sarcomatous degeneration is characterized by rapidity of growth and early metastases.

Sarcoma.—Sarcoma of the melanotic variety may start in a nevus, particularly about the ungual region. It is usually of the spindle-cell variety, occurs in young people, and is characterized by rapid growth and the obliteration of the surrounding bone.

Fibrosarcoma.—Fibrosarcoma forms a tumor, usually on the palmar surface of the fingers, attached to the flexor sheaths and attended by no symptom other than the inconvenience caused by this growth. It may remain (years) long standing and local, closely simulating a fibrous

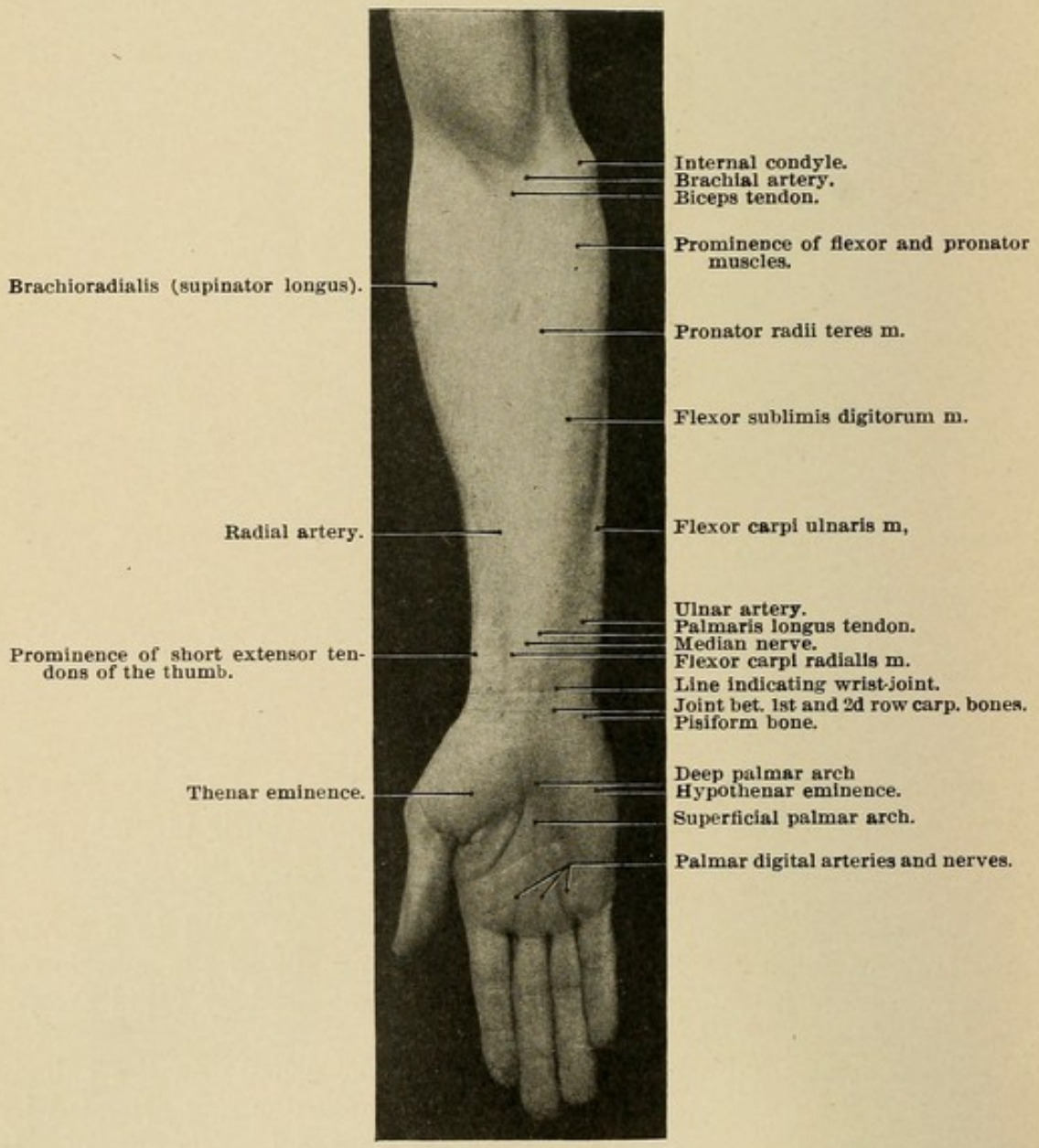
thickening. Rapid growth of such an apparent thickening should suggest possible malignancy. The diagnosis should be based upon excision and microscopic examination.

Epithelioma.—Epithelioma, originating in an ulcer, cicatrix, or wart, is marked by a persistent, slowly (weeks or months) spreading, destructive ulcer. The diagnosis is made by microscopic examination. It is most malignant when it originates in congenital warts (Volkmann).

THE FOREARM.

Malformations are obvious. The forearm may be absent or the bones may only partially develop. The radius is more frequently involved than the ulna.

FIG. 164

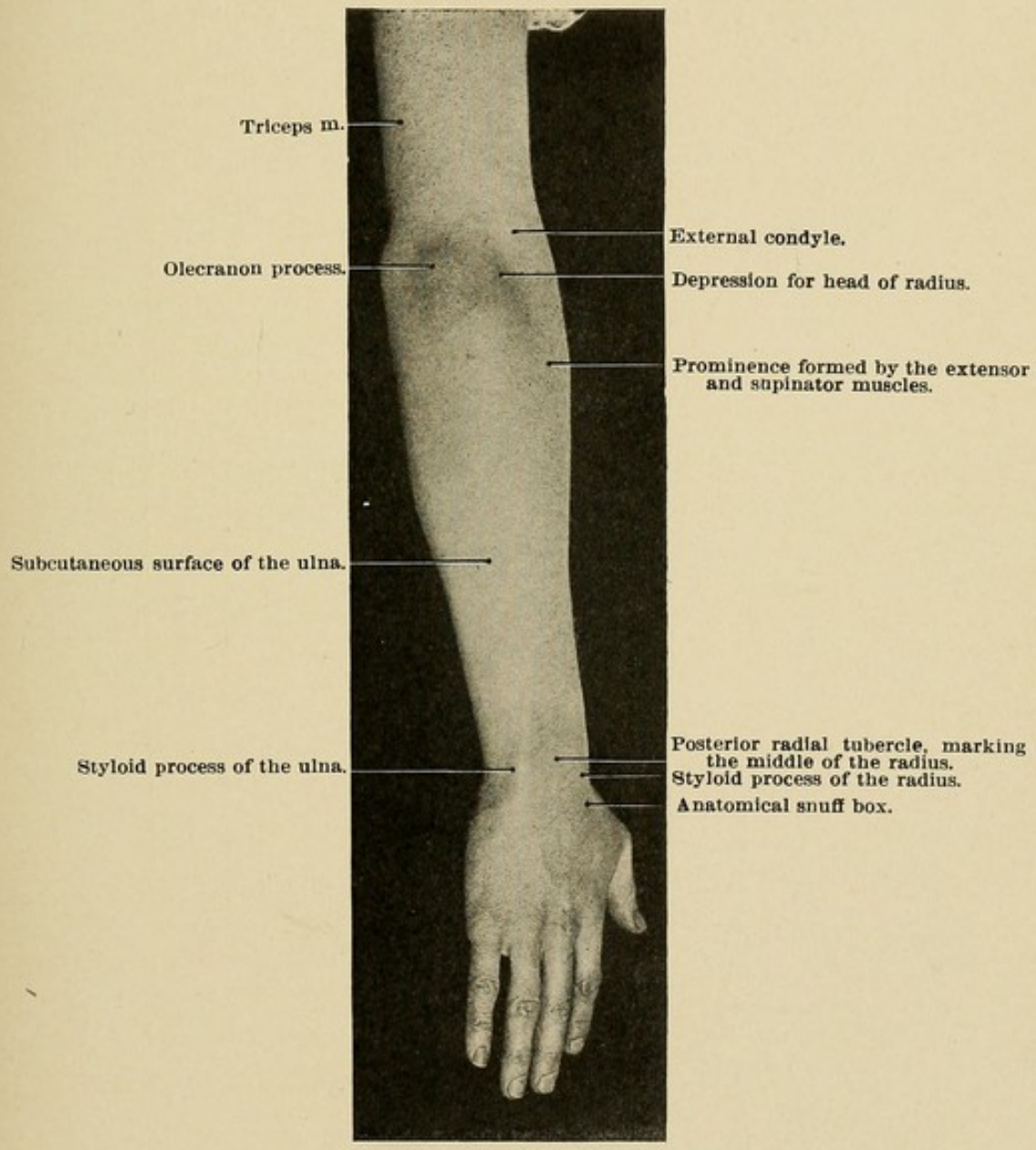


Surface anatomy of the forearm. (G. G. Davis.)

Traumatism.—The effects of traumatism may be manifested by contusion, subcutaneous rupture of muscle or tendons, wounds, fracture, or luxation.

Subcutaneous rupture of tendons or muscles, usually the result of muscular action, is characterized by sudden, sharp pain, disability in so far as the muscle or tendon affected is concerned, localized tenderness and

FIG. 165



Surface anatomy of the forearm. (G. G. Davis.)

swelling, and, if the rupture be extensive and superficial in the case of the muscle, or complete in the case of the tendon, the almost immediate formation of a soft tumor, deep pressure into which shows a break in continuity, increased by muscular contraction.

Acute Tenosynovitis.—Acute tenosynovitis is a common expression of overuse occurring frequently in masons, carpenters, oarsmen, or

washerwomen, who take up their work after a period of rest. It is characterized by tenderness and crepitation along the course of the tendons, particularly the radiocarpal and the thumb extensors. There is pain on motion and often slight redness of the overlying skin. Crepitation is best detected by grasping the forearm just above the wrist and causing the patient to repeatedly flex and extend the hand and thumb.

FIG. 166[1]

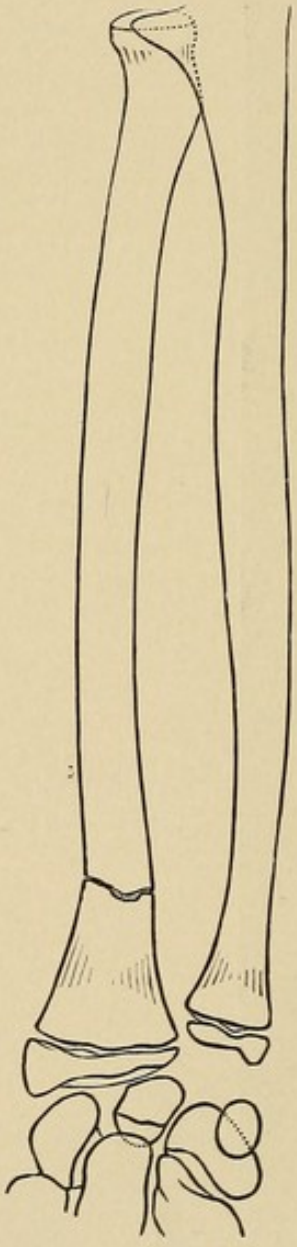
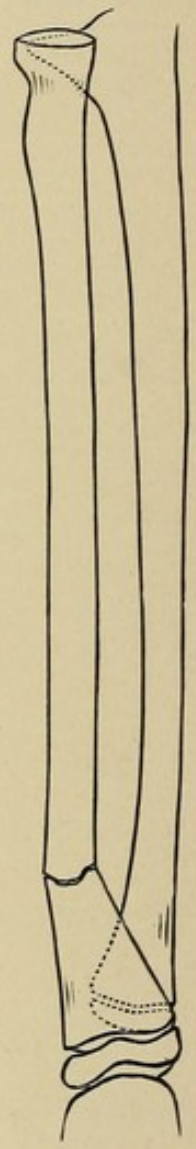


FIG. 167



FIGS. 166 and 167.—Fracture of radius near lower end, in a girl, aged ten years, resulting from fall on hand while roller skating. Anteroposterior view, Fig. 166, shows no deformity; lateral, Fig. 167, shows angular deformity toward palmar aspect, degree of which was not determinable clinically. (Important in female.) Clinical diagnosis of fracture easy.)

[1] Figs. 166 to 192. Fractures of the lower ends of the bones of the forearm. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. Wood, Carnett, and Siter, from dispensaries, and private cases of Dr. Pancoast.

FIG. 168

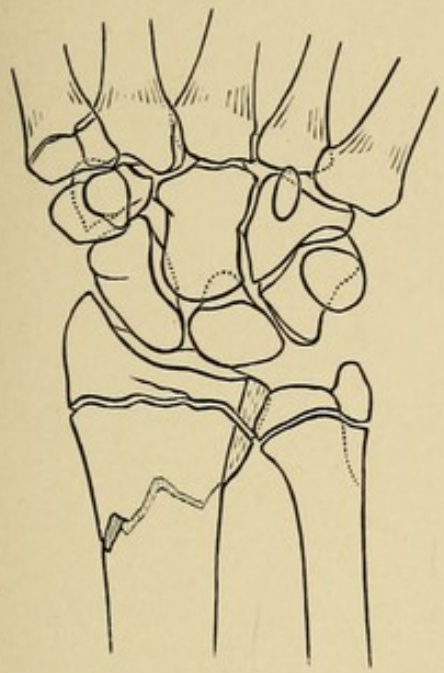


FIG. 169

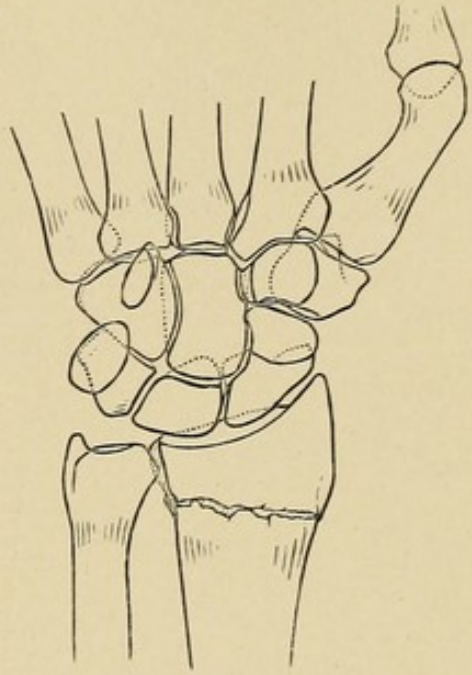


FIG. 168.—Fracture of radius, lower end, just above epiphyseal line, in a boy, aged seventeen years, resulting from fall on hand while roller skating. Anteroposterior view. (No displacement shown in either view.) This type corresponds to the Colles fracture in the adult, being usually a little higher than level of latter. Epiphyseal separations and fractures just above the line (of Colles) are less frequent. Clinical diagnosis not difficult, although fracture was more or less impacted.

FIG. 169.—Typical example of impacted Colles' fracture, in adult male. No displacement in either direction; mobility and crepitus absent. Clinical diagnosis depends upon history of injury, pain, local tenderness, and swelling. Anteroposterior view.

FIG. 170

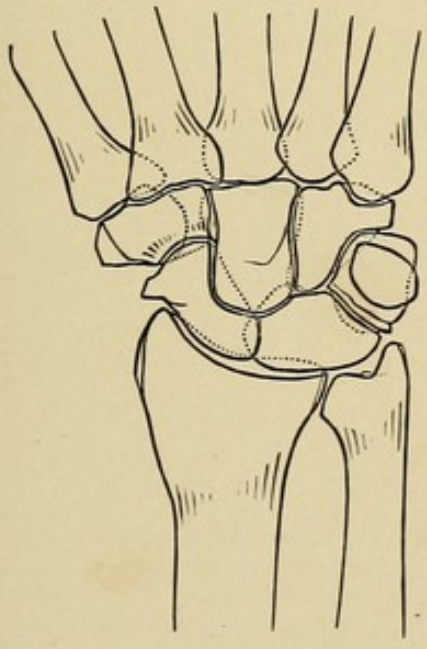
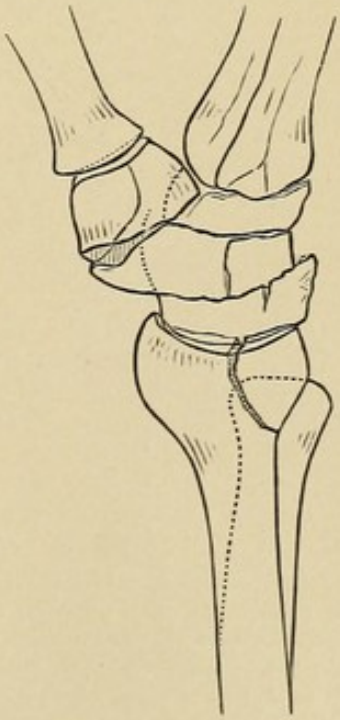
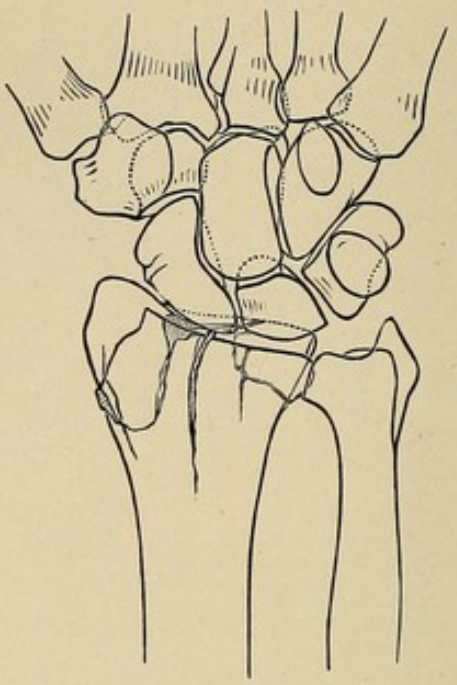


FIG. 171



FIGS. 170 and 171.—Typical example of so-called "Barton" fracture—splitting off of posterior portion of articular surface. Adult male, with chronic atrophic arthritis of wrist. (Note close approximation of carpal bones due to loss of cartilage.) Fracture shows in lateral view only, as is often the case (Fig. 171). No deformity, but diagnosis of fracture not difficult clinically.

FIG. 172



Unusual type of fracture, in adult male. Radiograph two weeks after injury. Resembles "Barton" type more than "Colles." Considerable comminution at articular surface. Clinical diagnosis of fracture not difficult, but *x*-ray important in proper reduction. Anteroposterior view.

FIG. 173

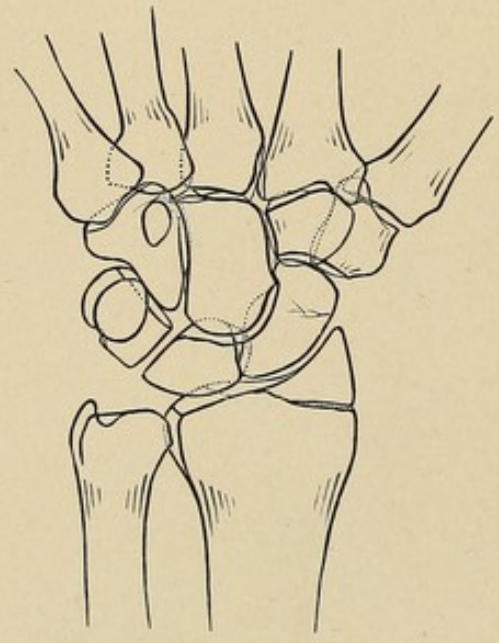


FIG. 174

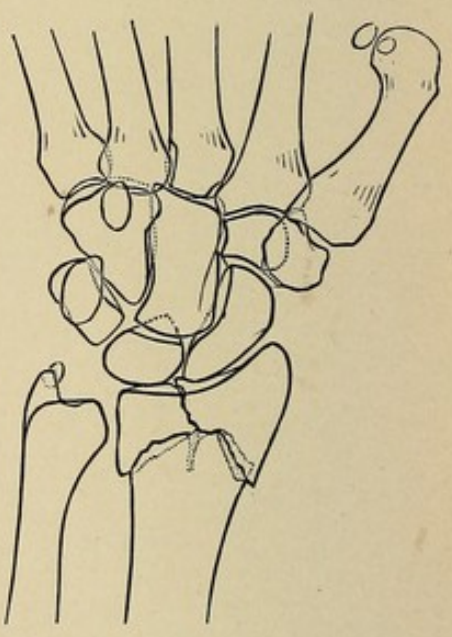


FIG. 173.—Typical example of the common "automobile fracture," in an adult male. (Direct violence from back kick of crank.) A fissured fracture through the base of styloid process of radius. Clinical diagnosis often difficult, depending mainly on history, pain, and local tenderness. Frequently overlooked. Anteroposterior view.

FIG. 174.—Colles' fracture, with comminution into joint, in an adult female. Also separation of tip of styloid of ulna, which *x*-rays have shown occurs in at least half these fractures, especially in falls backward on hand, as when slipping on ice. Anteroposterior view after reduction; good apposition.

FIG. 175

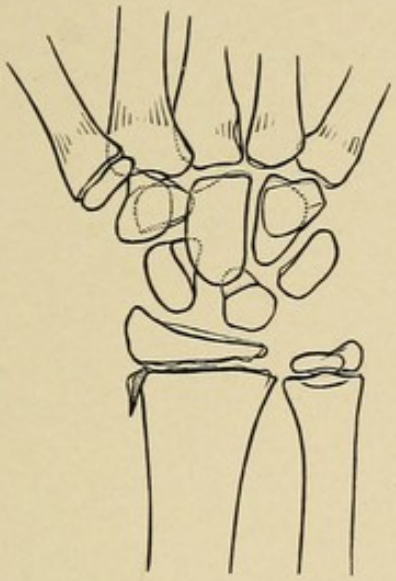


FIG. 176

FIGS. 175 and 176.—Epiphyseal separation lower end radius, in a boy, aged eleven years. Small fragment of diaphysis separated from posterior and outer edge with epiphysis. Anteroposterior view, Fig. 175, indicates no deformity laterally, but lateral view, Fig. 176, shows dorsal displacement of radial epiphysis, needing correction. Clinical diagnosis not difficult, especially when such displacement exists. (Without latter, *x*-rays always negative unless fracture accompanies epiphyseal injury.)

FIG. 177

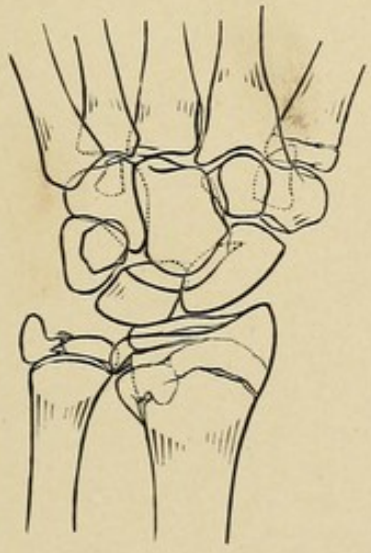


FIG. 178

FIGS. 177 and 178.—Epiphyseal separation radius, with more extensive fracture of diaphysis than preceding, in a girl, aged thirteen years. Line of fracture starts posteriorly about level of Colles', then runs downward and forward into epiphyseal line, whence break continues as separation of epiphysis. Anteroposterior view, Fig. 177, indicates no lateral displacement, but also no certain evidence of radial injury. It does show a fracture through ulnar epiphysis at base of styloid. Lateral view, Fig. 178, shows dorsal displacement of epiphysis and fragment of diaphysis of radius. No difficulty about clinical diagnosis.

Fig. 179

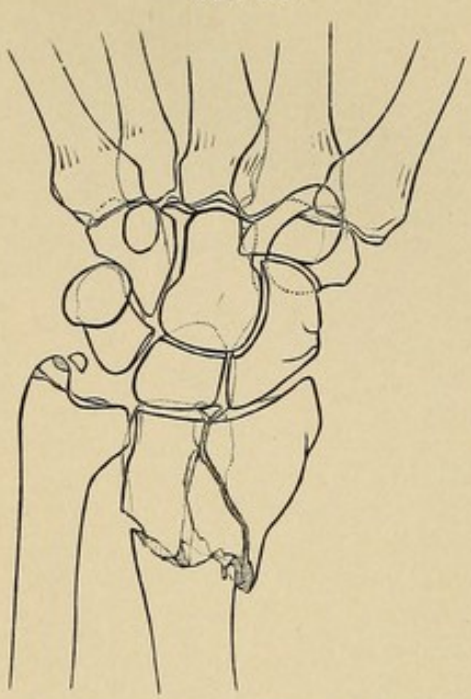


Fig. 180

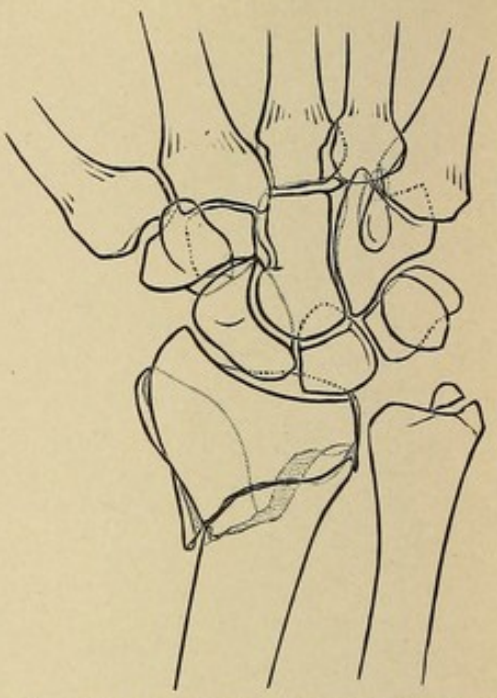
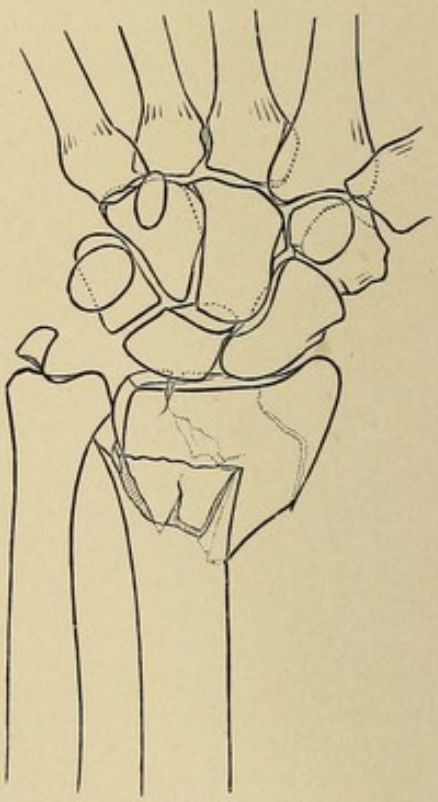


Fig. 179.—Colles' fracture at higher level than usual, and lower fragment comminuted into joint, accompanied by separation of both base and tip of styloid of ulna, in an adult female. Anteroposterior view after reduction. Clinical diagnosis of fracture not difficult, but *x*-rays important in reduction.

Fig. 180.—Comminuted Colles' fracture, rather high level and oblique in direction, with separation of styloid of ulna, in an adult male. Joint not involved. Anteroposterior view after reduction. Clinical diagnosis not difficult. *X*-rays made to determine apposition of fragments.

Fig. 181

Fig. 182



Figs. 181 and 182.—Comminuted Colles' fracture and separation of styloid of ulna, in an adult male. Anteroposterior view, Fig. 182, shows lateral displacement to radial side. (Note altered relation in levels of styloids of two bones.) Lateral view, Fig. 181, shows dorsal and upward displacement of lower fragment. No difficulty in clinical diagnosis of fracture, but *x*-rays important to show deformities requiring correction.

FIG. 183

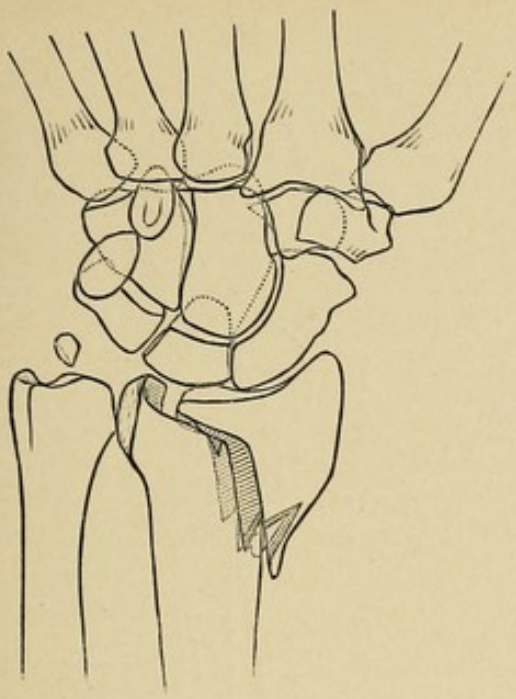


FIG. 184

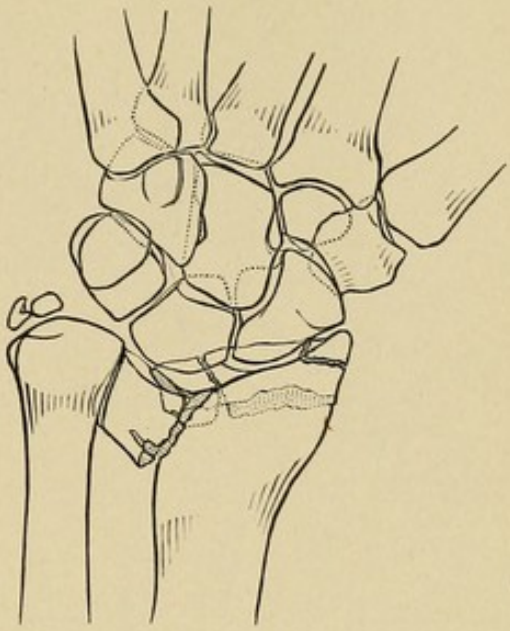


FIG. 183.—Fracture of lower end of radius, differing from preceding Colles' types in direction of line. Accompanied by wide separation of styloid of ulna. Male, aged twenty-six years. Anteroposterior view, shows marked displacement to radial side, and shortening.

FIG. 184.—Comminuted Colles' fracture, with separation of styloid of ulna in two fragments, in a male, aged thirty-three years. Fragments of comminuted lower main fragment driven apart by entering wedge of shaft, with widening of joint. Anteroposterior view. Clinical diagnosis of fracture easy, but *x*-ray very important to determine nature of injury and deformity.

FIG. 185

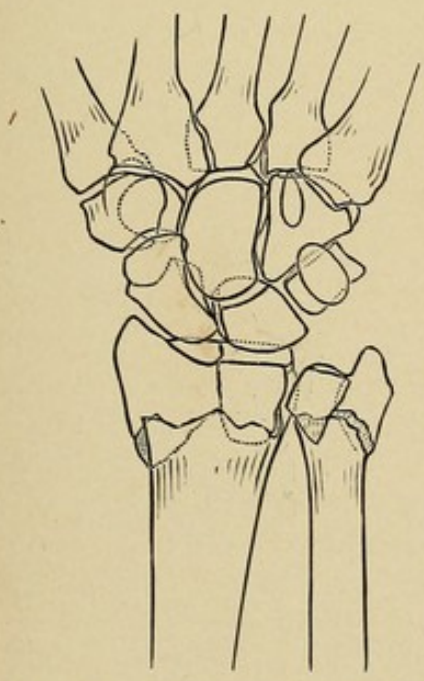


FIG. 186

FIG. 187

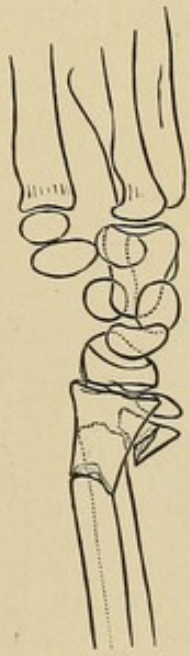
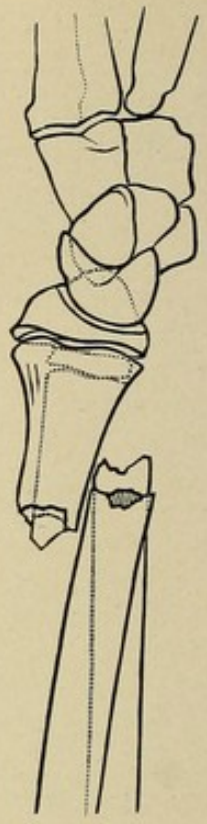


FIG. 185.—Comminuted Colles' fracture (into joint) with fracture through *neck* of ulna, in adult female. Anteroposterior view shows good apposition after reduction. (Lateral shows persistence of dorsal displacement lower radial fragment.) Clinical diagnosis easy, object of *x*-rays to determine result of reduction.

FIGS. 186 and 187.—Fracture radius (above level of Colles') and neck of ulna, in a boy, aged seven years. (More common level for radial fractures in children than lower down as in adults.) Anteroposterior view, Fig. 186 (before reduction), shows radial fragments in good position apparently, but head of ulna displaced upward and to ulnar side. Lateral view, Fig. 187, shows angular deformity in radius (toward palmar aspect) and bad displacement of ulnar head backward and upward. Clinical diagnosis of fracture not difficult, but *x*-rays important to reveal deformities.

FIG. 188

FIG. 189



FIGS. 188 and 189.—Fracture of both bones of forearm in lower portions of shafts, in a boy, aged fourteen years. (Transverse and same level.) Very common type of fracture in children. Tip of styloid of ulna separated in addition. Anteroposterior view, Fig. 188, indicates slight lateral displacement both lower fragments to ulnar side. Lateral view, Fig. 189, shows complete dorsal displacement both lower fragments, with over-riding. Clinical diagnosis of fracture easy, but importance of *x*-rays obvious.

FIG. 190

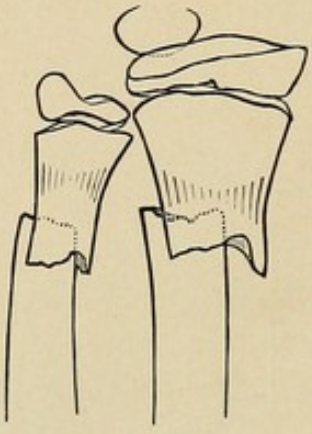
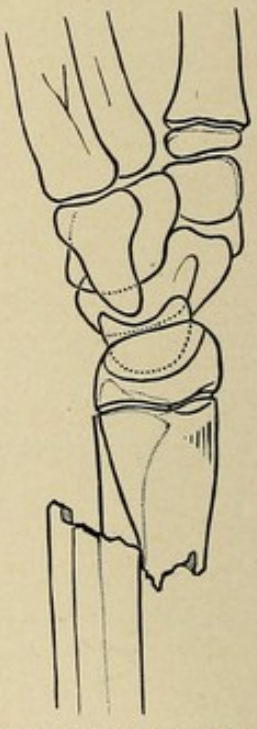
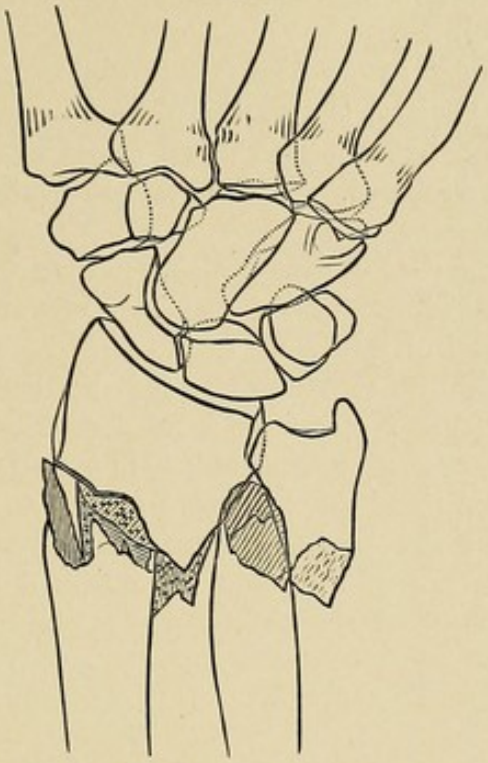


FIG. 191



FIGS. 190 and 191.—Fracture both bones lower portions of shafts, in a boy, aged fourteen years. (Transverse and same level; radius compound.) Anteroposterior view, Fig. 190, shows lateral displacement of both lower fragments to radial side. Lateral view, Fig. 191, shows displacement of both toward palmar aspect, complete in radius. (Exactly opposite displacements from preceding case.)

FIG. 192



Old fracture of both bones, similar in type to the two preceding cases, in a male, aged twenty-four years. Radius united in bad position; ulna ununited, lower fragment completely displaced laterally to ulnar side. Anteroposterior view. (Lateral view shows dorsal displacement of both lower fragments.)

Fissured fracture of the lower extremity of the radius is attended by a tenosynovitis similarly placed but not giving crepitation because of a more abundant effusion.

Wounds of the Forearm.—Wounds of the forearm call for determination of cutaneous sensibility and power of free motion in the hand and wrist.

Injury of the median nerve just above the wrist, usually associated with division of the flexor sublimis and palmaris longus, causes a sensory palsy of the palmar surface of the thumb, index and middle fingers, and radial side of the ring finger. Wounds higher up paralyze flexion at the second joints of all the fingers and the terminal joints of the index and middle fingers. If the wound be near the elbow, the power of pronation is lost.

Injury of the ulnar nerve paralyzes flexion of the ring and middle fingers, adduction of the thumb, and abduction of all the fingers; also flexion of the first joint and extension of the other joints. There is anesthesia of the ulnar side of the hand, of the little finger, and the ulnar border of the ring finger.

Injury of the posterior interosseous nerve is characterized by paralysis of the extensor muscles, resulting in wrist drop, more or less complete in proportion to the height of the injury.

Fractures of the Forearm.—Colles' fracture, the commonest injury, is discussed under affections of the hand and wrist. Fractures of the head and neck of the radius, of the olecranon, and of the coracoid

process are considered in the section dealing with surgical affections of the region of the elbow.

Fracture of both bones of the forearm, in children often of the incomplete or green-stick variety, is usually placed below the middle, and is due to a fall upon the hand. The usual cause of complete fracture of both bones is direct violence. The break in both bones is at or near the same level.

The symptoms in the case of green-stick fracture are obvious deformity, sharply localized tenderness and pain; in children there is sometimes surprisingly slight disability.

The complete fracture is characterized by crepitus, preternatural mobility and deformity. Non-union is an occasional sequel.

Fracture of the ulna, if occurring alone, is usually due to direct force. A break in the upper third of the bone is not an uncommon complication of luxation of the radius. Because of its subcutaneous position throughout, fracture of the ulna is readily detected by palpation.

Fractures of the shaft of the radius are usually in the middle third,

FIG. 193[1]

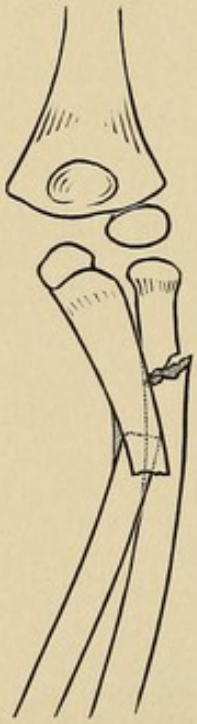
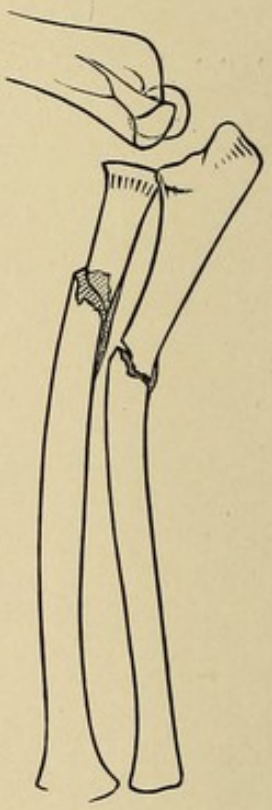


FIG. 194



FIGS. 193 and 194.—Fracture of both bones in upper third of shafts, in a child, aged five years, result of fall on hand. Radiographs three weeks after injury show union well advanced, with considerable angular deformity in ulna laterally to radial side. Injury neither diagnosticated nor treated as a fracture, although typical signs must have been present. Fig. 193, anteroposterior view at elbow; Fig. 194, lateral.

[1] Figs. 193 to 211.—Fractures of the shafts of both bones of the forearm. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. White, Wood, and Frazier, from dispensaries, and private cases of Dr. Pancoast.

Fig. 195

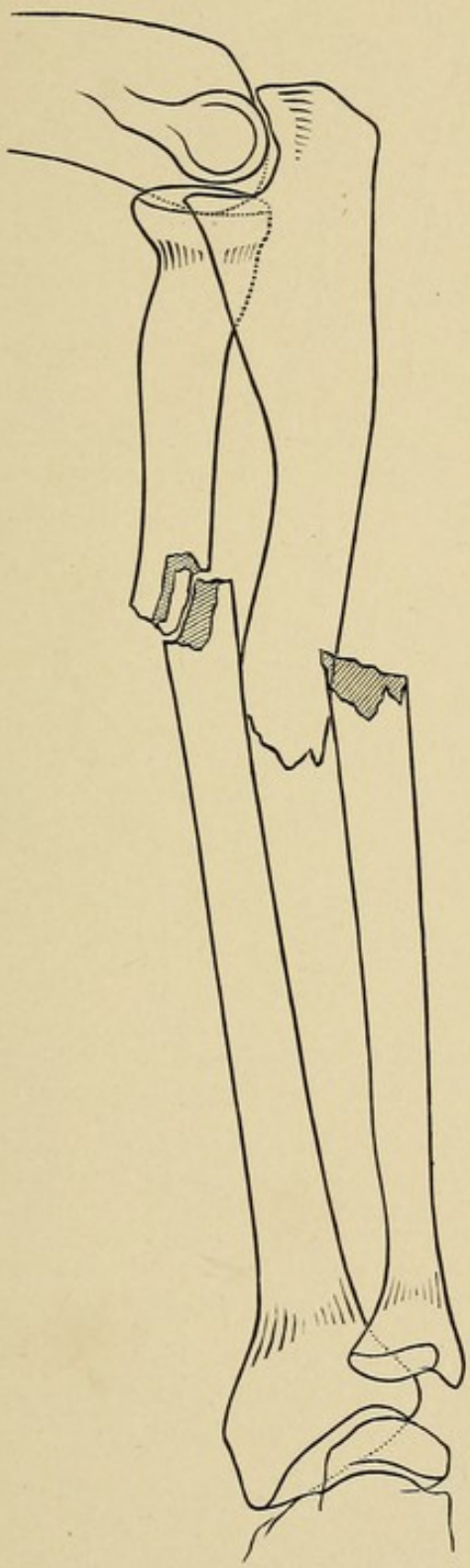


Fig. 196

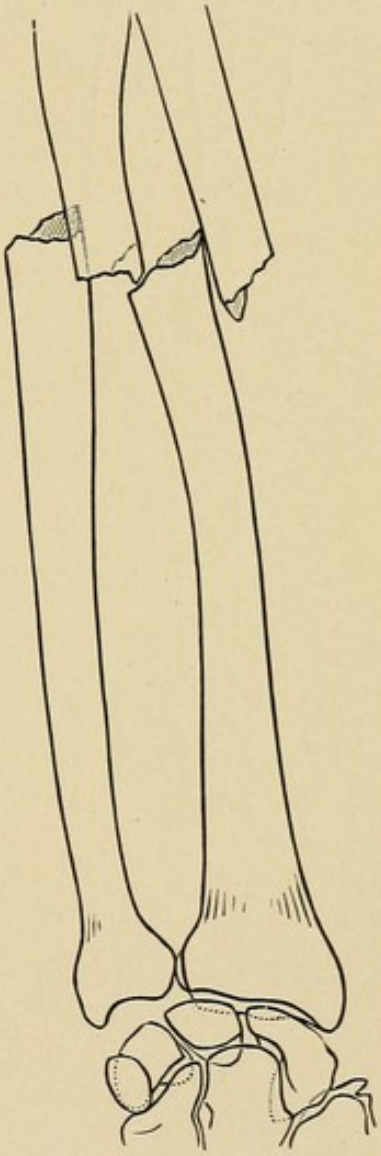


Fig. 195.—Fracture of both bones near junction of upper and middle thirds of shafts, in male, aged twenty years, result of fall from horizontal bar in gymnasium. Lateral view (at elbow, pronation) before reduction, shows angular deformity and complete lateral and forward displacement of upper ulnar fragment with over-riding. Clinical diagnosis not difficult.

Fig. 196.—Fracture of both bones at junction of upper and middle thirds of shafts, in female, aged thirty-seven years, transverse, same level. Anteroposterior view before reduction shows complete lateral displacement with over-riding.

Fig. 197

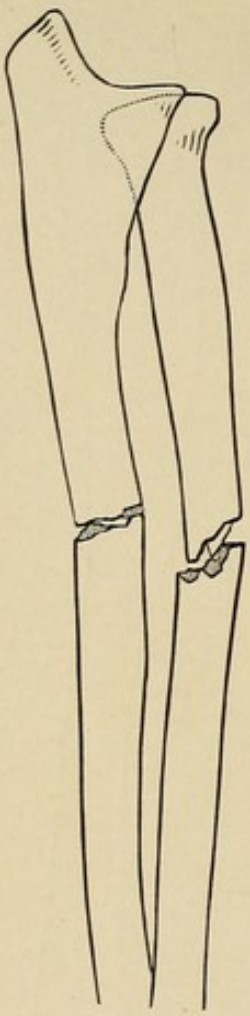


Fig. 198

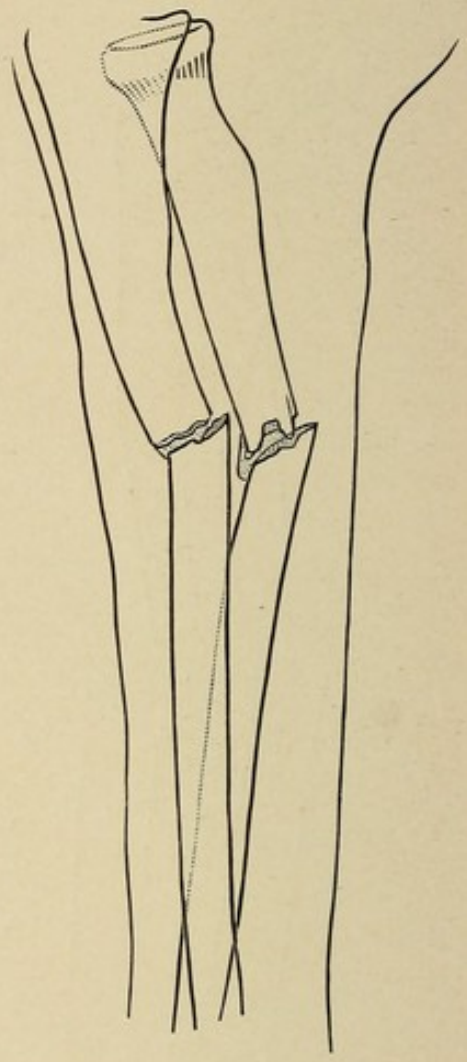


Fig. 197.—Lateral view of case shown in Fig. 196, after fluoroscopic reduction. (Fore and aft also shows perfect reduction.)

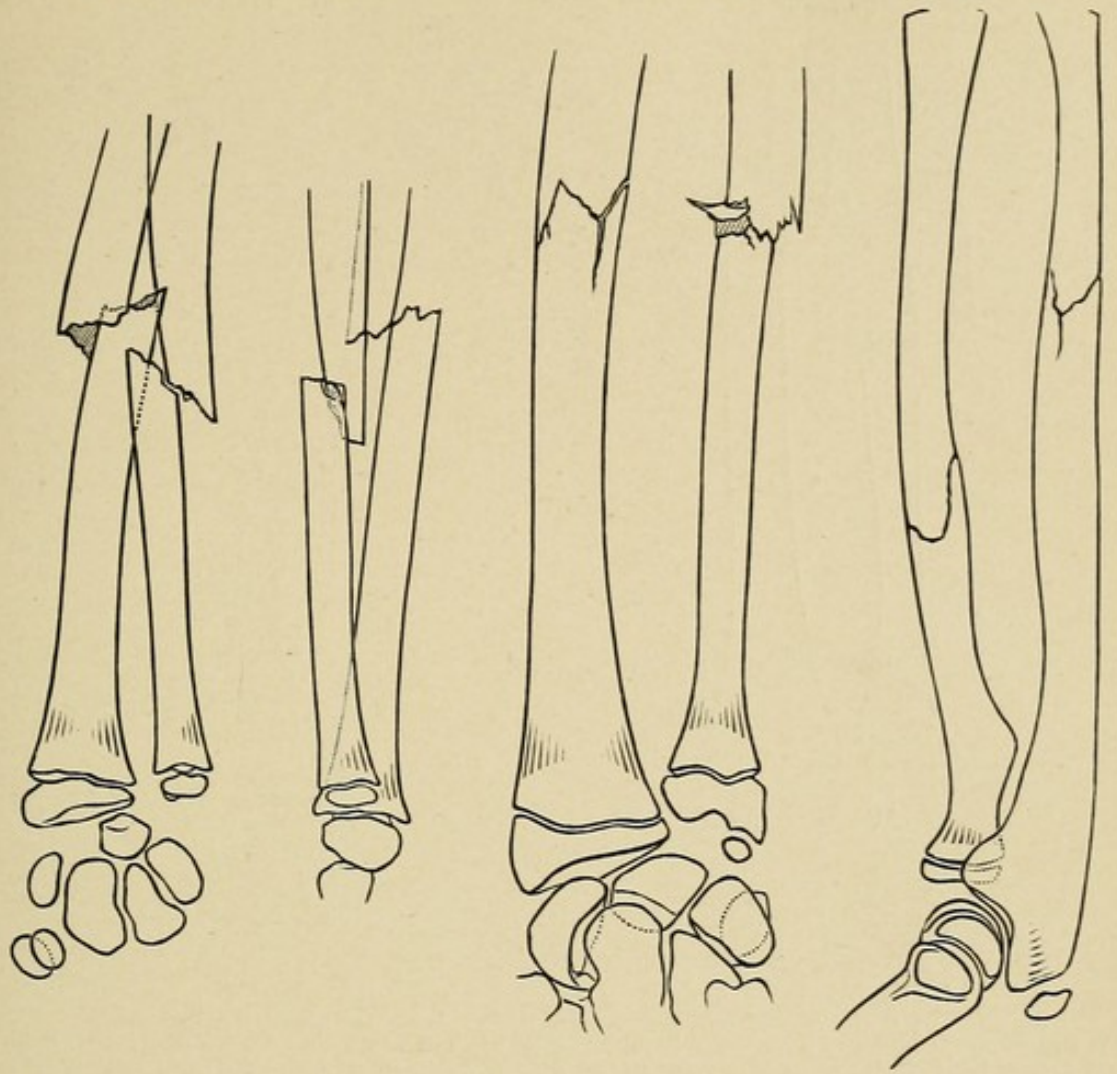
Fig. 198.—Same view of same case six weeks later, showing delayed but moderately firm union with marked angular deformity, for which the dressing, an anterior rectangular splint, may have been wholly or in part responsible. An illustration of the advisability of *x*-ray examinations during treatment of some fractures to determine proper maintenance of reduction.

and result from direct or indirect violence. The fracture is usually transverse or slightly oblique. It may be spiral. Its detection is based upon the classical symptoms, the local swelling and tenderness, and the failure of the radial head to rotate when the hand is alternately pronated and supinated.

Inflammatory Affections of the Forearm.—*Lymphangitis of the forearm,* expressed in the form of a rose-colored, slightly raised band passing upward to the elbow along the course of the lymphatics, is symptomatic of infection of the hand.

Cellulitis.—Cellulitis is secondary to trauma or is an upward extension of palmar abscess. The pus is found not only in the superficial and subaponeurotic tissue, but when it travels along the tendon sheaths accumulates beneath the deep flexors.

FIG. 199 FIG. 200 FIG. 201 FIG. 202



FIGS. 199 and 200.—Fracture of both bones about middle of shafts, in a young boy. Clinical diagnosis of fracture not difficult, but examination made ten days after injury to determine position of fragments. Fig. 199, anteroposterior view, shows central displacement with complete obliteration of interosseous space. Lateral view, Fig. 200, indicates palmar and dorsal displacement of lower fragments in addition. Examination made barely in time to anticipate callus formation.

FIG. 201.—Fracture of both bones at junction of middle and upper thirds, in a boy, aged thirteen years; ulna slightly comminuted and radius "subperiosteal" and nearly "green-stick." Detachment of styloid process of ulna. Injury resulted from a fall. Clinical diagnosis not difficult, although radial fracture might escape notice. Anteroposterior view.

FIG. 202.—Fracture in a girl, aged ten years; radius at junction of upper and middle thirds and "subperiosteal;" ulna lower and middle thirds and "green-stick." Anteroposterior view. Clinical diagnosis somewhat difficult, especially of ulnar fracture.

Osteomyelitis.—Osteomyelitis (rare) is attended with the characteristic intense pain, total disability, and pronounced local and general symptoms of pus formation and septic absorption.

Syphilis.—The chronic ulcerative lesions of syphilis are not infrequently found on the skin of the forearm, and chancre has been observed here sufficiently often to make it a diagnostic possibility in the presence of a superficial indolent ulceration without obvious cause, which in the course of two or three weeks reaches the size of a half-dollar, and which

Fig. 203

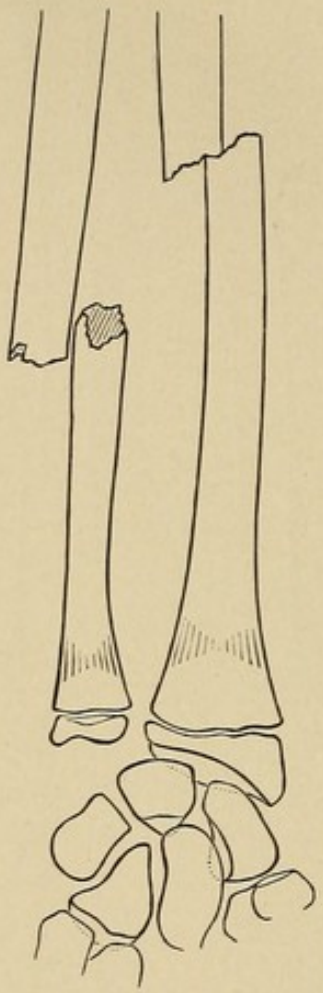


Fig. 204

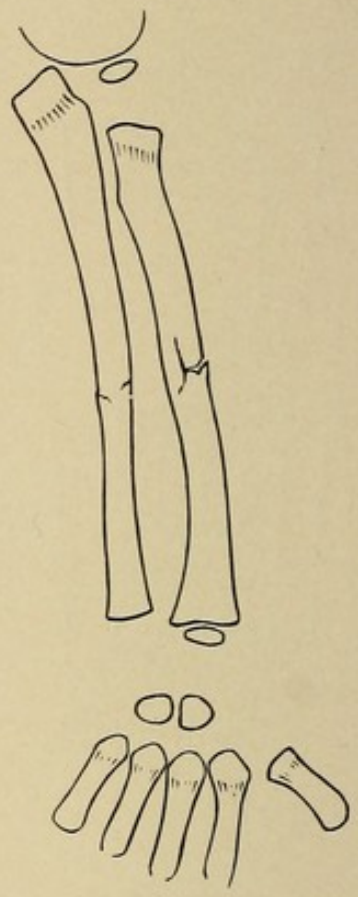


Fig. 203.—Fracture of both bones in middle third of shafts, in a boy, aged fifteen years; radius at higher level. Anteroposterior view, before reduction, shows complete lateral displacement of ulna and almost complete of radius, to radial side. Clinical diagnosis not difficult. (Lateral view shows no deformity.)

Fig. 204.—Typical example of "green-stick" fracture of both bones, at middle of shafts, in a child, aged three years. Clinical diagnosis difficult. Anteroposterior view; no deformity.

is attended with characteristic glandular enlargement. The early diagnosis is based upon the findings of the spirochete.

Tuberculous and syphilitic involvement of the muscles and bones of the forearm do not depart from type. Gumma of the ulna is fairly frequent, appearing as a palpable, moderately sensitive node. The diagnosis is based upon the history and the result of treatment.

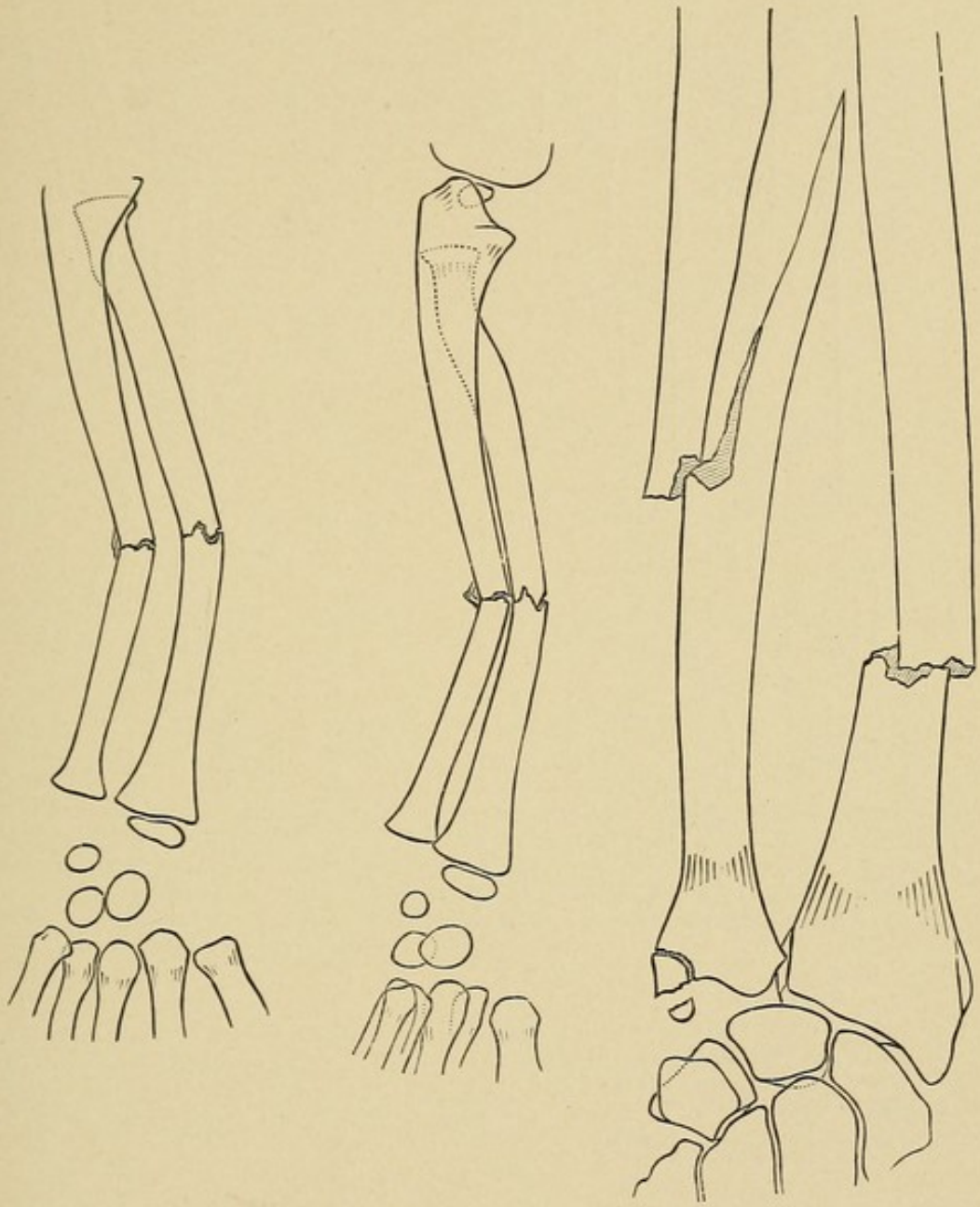
Tumors of the Forearm.—*Lipoma* may be either subcutaneous or subaponeurotic. In the latter case it may extensively infiltrate the cellular spaces between the muscles. The slow growth (years) and soft, almost fluctuating, consistency are characteristic.

Neurofibromata and angiomata are fairly common on the forearm, and enchondromata have been observed.

Sarcoma has its seats of predilection near the ends of the bones. It may be spindle-cell or giant-cell or mixed.

The diagnosis in the early stage cannot be made from syphilis or tuberculosis. It will be suggested by absence of syphilitic history or of

FIG. 205 FIG. 206 FIG. 207



FIGS. 205 and 206.—"Subperiosteal" fracture of both bones near junction of lower and middle third of shafts, transverse and same level, in a boy, aged four years. Result of a fall down stairs. Anteroposterior view, Fig. 205, shows lateral angular deformity, and Fig. 206, lateral view, indicates a decided bend toward the palmar aspect. Examination before reduction. Clinical diagnosis not difficult, especially in view of deformity.

FIG. 207.—Fracture of both bones, in adult male, radius transverse, lower and middle thirds; ulna longitudinal, through middle third of shaft. (Compound.) In addition a fracture of base and of tip of styloid process of ulna. Satisfactory reduction impossible without operation. Anteroposterior view.

tuberculous heredity or lesions elsewhere. In the absence of a syphilitic history, a fixed, persistent bone pain, associated with tumor which does not involve the nearest joint, is sufficient cause for exploratory operation. Even before the development of a palpable tumor the *x*-rays may show the seat of lesion if not its nature.

FIG. 208

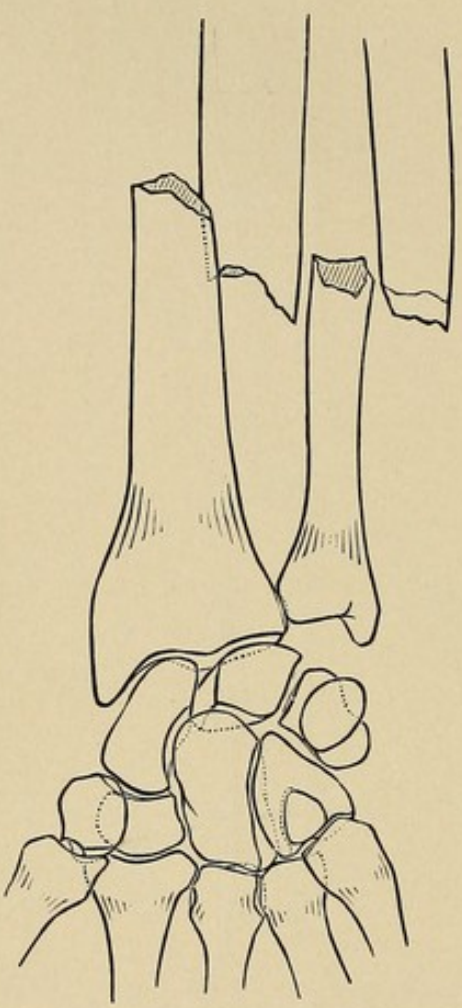
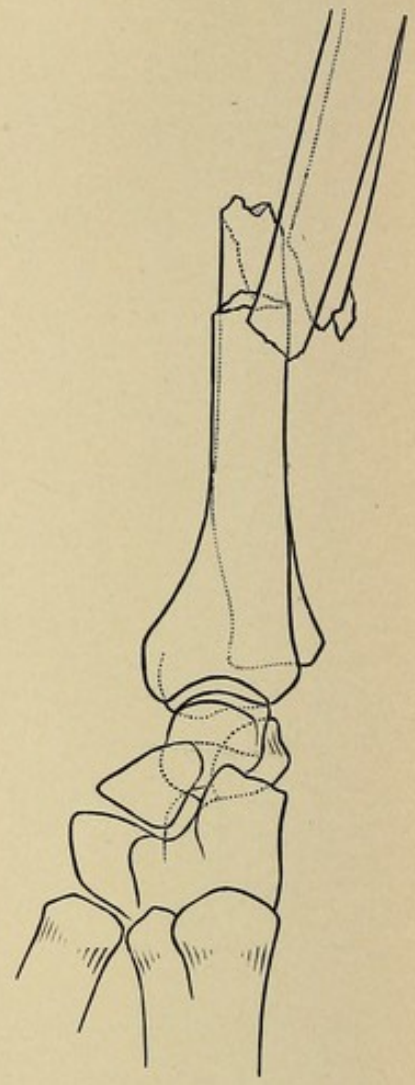


FIG. 209



FIGS. 208 and 209.—Fracture of both bones in lower and middle fourths of shafts, same level, in a male, aged thirty-five years. Anteroposterior view, Fig. 208, shows complete lateral displacement of both lower fragments to radial side, with over-riding. Lateral view, Fig. 209, shows displacement of upper ends of lower fragments to palmar aspect. Clinical diagnosis not difficult, but *x*-rays of great assistance in reduction.

THE ELBOW.

The two epicondyles can easily be palpated, even when there is great swelling; the inner in its direction indicates the facing of the articular surface of the upper extremity of the humerus. Because of an obliquity of the joint, there is an outward bend (carrying angle) at the elbow, perceptible only when the arm is extended, and more marked in women than in men.

The olecranon forms the bony projection at the back of the elbow. To either side of it the joint capsule approaches the surface and here and above the head of the radius joint tenderness and effusion are earliest detected by palpation. A finger's breadth below the external epicondyle the head of the radius may be felt.

FIG. 210

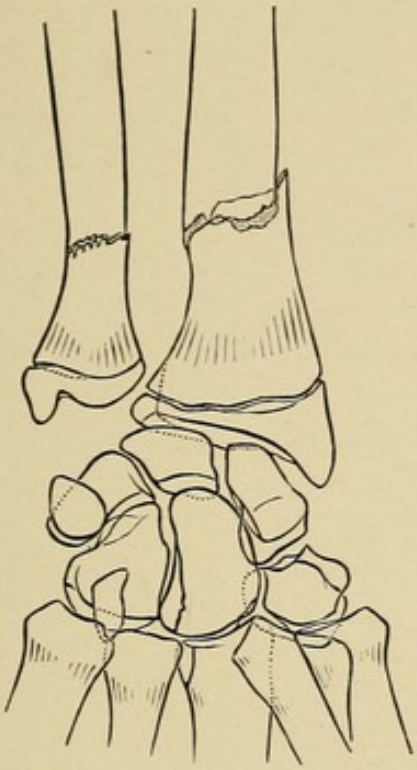


FIG. 211

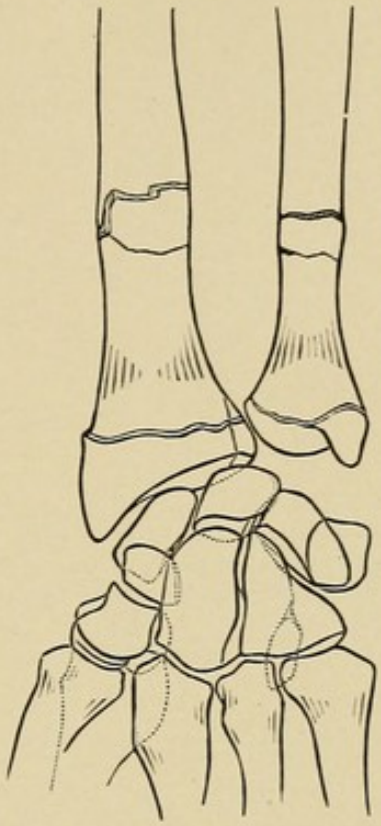
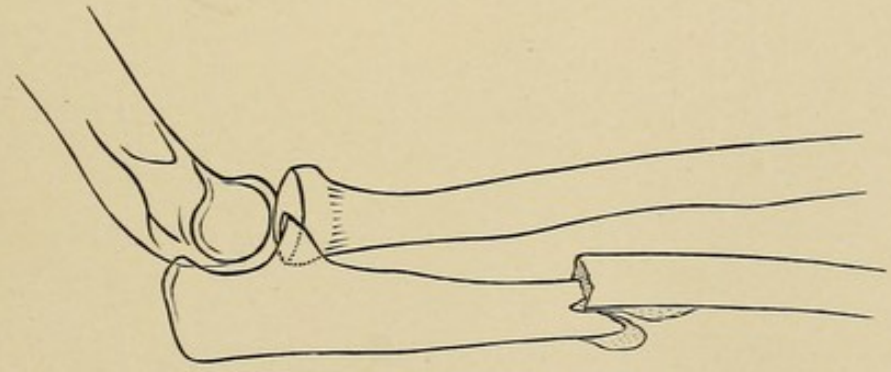


FIG. 210.—Fracture of both bones near lower end of shafts, "subperiosteal," transverse, same level, in a boy, aged fifteen years. Caused by direct violence—struck by automobile crank. Clinical diagnosis not difficult. Anteroposterior view.

FIG. 211.—Secondary fracture of both bones in same case as Fig. 210, occurring fifteen weeks later, as a result of indirect violence. The lines of fracture are immediately above those of the first injury. (Plate reversed in drawing.)

With the forearm extended, the tip of the olecranon and the epicondyles are supposed to lie very nearly in a plane with which the long axis of the humerus makes a right angle.

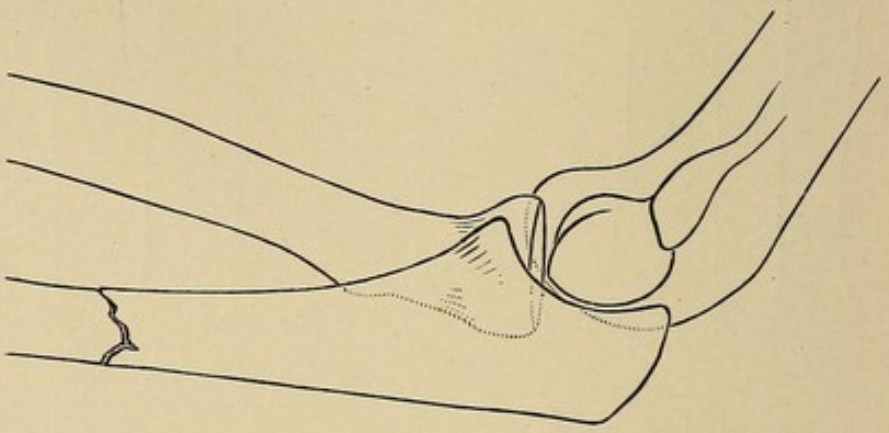
FIG. 212[1]



Old fracture of shaft of ulna, upper and middle thirds, in an adult female, ununited. Lateral view at elbow; anteroposterior of forearm.

[1] Figs. 212 to 219. Fractures of the shaft of the ulna. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from service of Dr. Martin, from dispensaries, and private cases of Dr. Pancoast.

FIG. 213



"Subperiosteal" fracture of upper and middle thirds of shaft of ulna, in an adult male, resulting from direct violence—a blow on back of extended elbow during a game of football. Not diagnosticated clinically; cardinal signs of fracture absent, and attention drawn mainly to the more severe subjective manifestations of sprain of elbow. Lateral view at elbow.

FIG. 214

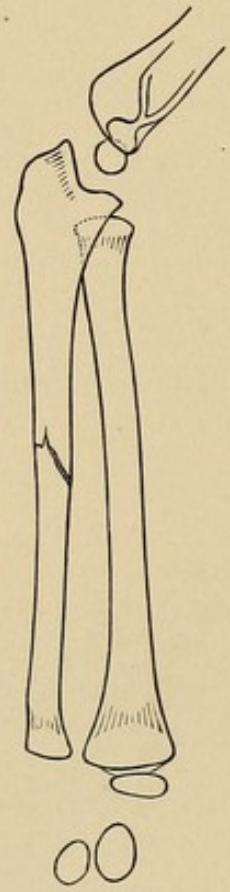
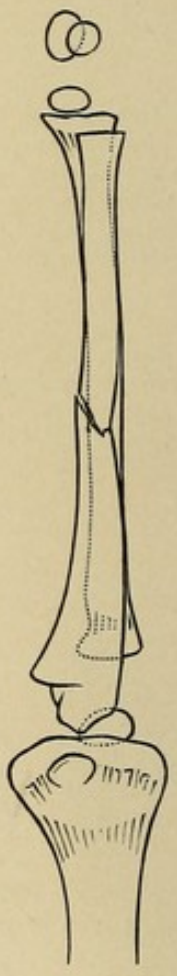


FIG. 215



FIGS. 214 and 215.—"Green-stick" fracture of middle of shaft of ulna, in a child, aged three and one-half years. Not diagnosticated clinically, but examined because of local tenderness. Fig. 214, anteroposterior, and Fig. 215, lateral view.

Fig. 216

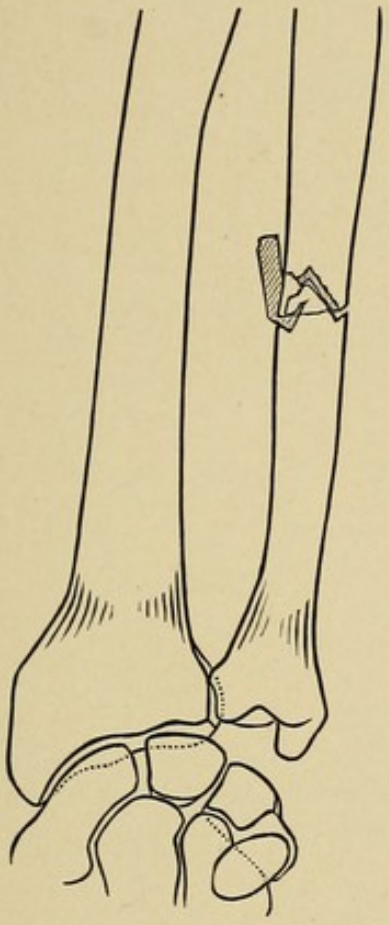
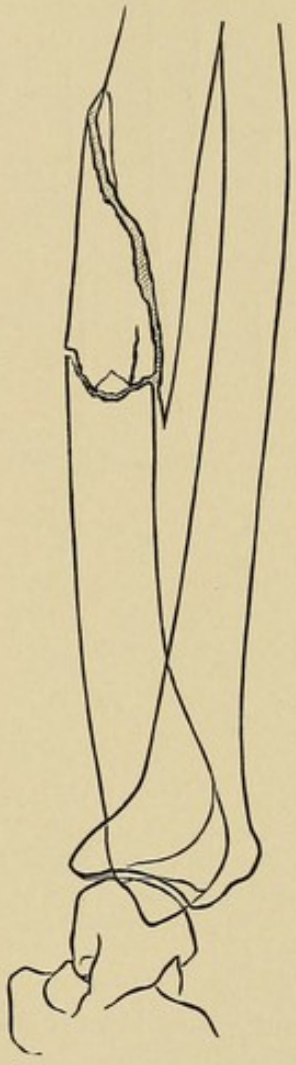


Fig 217



Figs. 216 and 217.—Compound comminuted fracture of middle third of shaft of ulna, in a male, aged twenty-nine years. Fig. 216, anteroposterior view, shows only a part of the fracture, while the lateral view, Fig. 217, shows a much more extensive break. Clinical diagnosis of injury not difficult, but *x*-rays essential to determine proper reduction.

Flexion and extension are the only normal movements expressed at the humero-ulnar joint. The humeroradio-ulnar articulation permits rotation of the forearm.

Normal flexion can be carried to the degree which permits the fingers to palpate the acromial process on the same side. Normal extension brings the anterior surface of the arm and forearm in the same plane with a slight outward angle (carrying angle) at the elbow. Rotation of the forearm can be carried through a half circle, the palm being made to face directly upward or downward without movement at the shoulder.

After trauma, great swelling, pronounced disability, and intra-articular effusion are presumptive evidence of fracture or luxation.

Inflammation of the joint causes limitation of motion in all directions and muscular spasm and atrophy.

Deformities of the Elbow.—Congenital luxations have been noted either of both bones or of the radius alone. Cubitus valgus and varus

FIG. 218

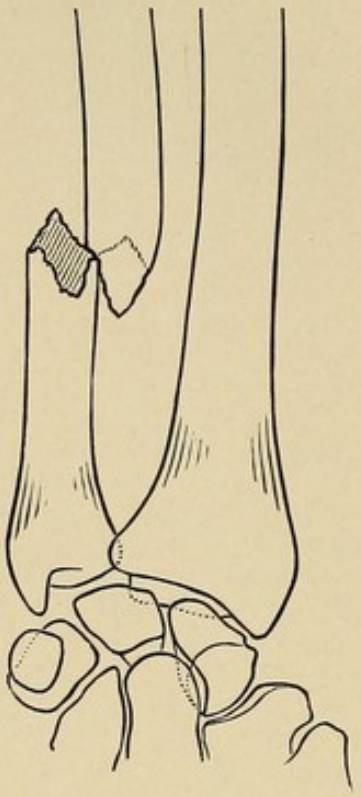


FIG. 219

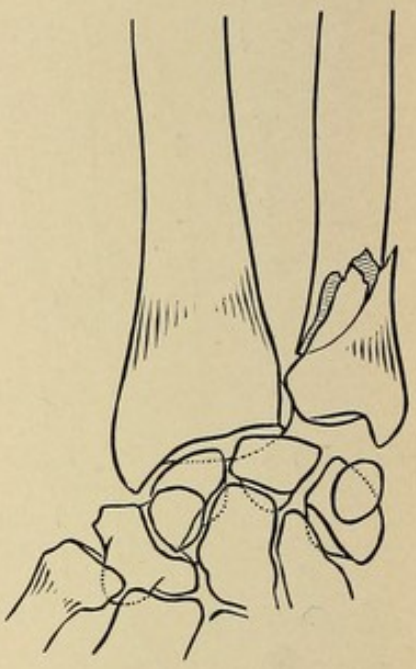


FIG. 218.—Fracture at junction of lower and middle fourths of shaft of ulna—in an adult male. Anteroposterior view, showing complete lateral displacement. (Lateral view indicates none.) Clinical diagnosis of fracture and deformity easy.

FIG. 219.—Oblique fracture at lower end of shaft, or neck, of ulna, in a male, aged fifty-nine years. Anteroposterior view.

are descriptive of lateral deviations of the forearm upon the arm, valgus involving abduction (radial side) and varus adduction (ulnar side).

A similar acquired deformity may be due to a condyloid fracture with upward displacement; or it may be an expression of rickets. A slight degree of valgus is normal.

Contractures of the elbow-joint may be cicatricial or myogenic, usually of the flexors. Aside from those incident to central or peripheral nerve lesions, the commonest cause of muscular contracture is syphilitic myositis of the biceps.

Distortions of the elbow-joint are due to chronic osteoarthritis, which may be secondary to trauma, infection, autotoxemia, or arteriosclerosis, or may be of neuropathic origin (tabes, syringomyelia).

Ankylosis of the elbow-joint is secondary to traumatism or arthritis in any of its varieties. Pyogenic and gonococcal arthritis are the forms most likely to be followed by complete ankylosis.

Limitation of motion may be partial or complete, may involve the motions of flexion and extension, or may be limited to the upper radio-ulnar articulation, interfering with pronation and supination.

Traumatism of the Elbow.—Wounds.—Wounds in the region of the elbow may involve the soft parts alone or may enter the joint. In the first case examination must be made to exclude the anesthesia and loss

of motion which characterize lesions of the median, musculospiral, and ulnar nerves.

Wounds involving the joint may be obvious, or, in case of puncture, may be difficult of immediate detection. If such wounds are infected there is a prompt synovial effusion characterized by a fluctuating swelling most marked posteriorly to either side of the olecranon and triceps tendon and in the interval between the external condyle and the head of the radius; accompanied by great tenderness, severe pain aggravated by all motions of the joint, and fixation in a position of slight flexion. The constitutional symptoms of septic absorption develop promptly and the overlying skin becomes edematous, hot, and red.

A moderate aseptic effusion may accompany a wound of the joint capsule, but not reaching the joint itself. The distinction between this

FIG. 220[1]

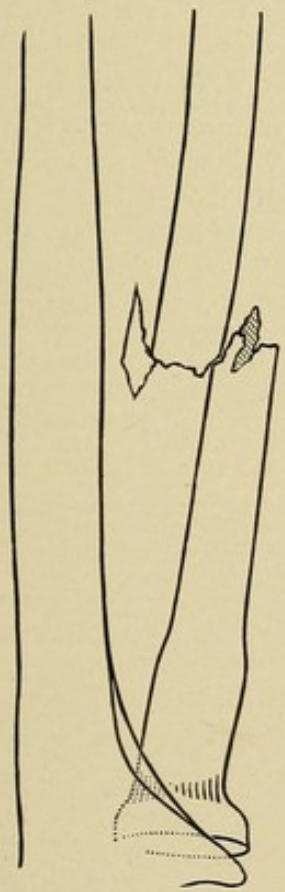


FIG. 221

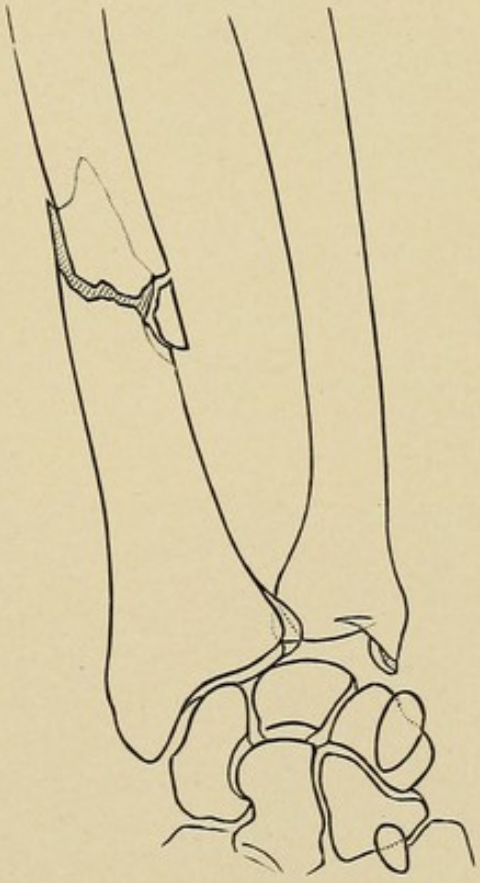


FIG. 220.—Fracture at junction of upper and middle thirds, and above insertion of pronator radii teres, in a male, aged twenty-three years. Anteroposterior view, showing typical lateral displacement, persisting after attempted reduction. Clinical diagnosis not difficult, but *x*-rays essential for proper reduction. (Fluoroscope often a valuable aid in *reduction* of this particular fracture.) No anteroposterior deformity shown in lateral view.

FIG. 221.—Fracture at junction of middle and lower thirds of shaft, in a male, aged twenty-five years. Anteroposterior view shows slight comminution and perfect reduction. Clinical diagnosis not difficult. There is in addition a fracture of the tip of the styloid process of the ulna, which frequently accompanies forearm fractures, but is usually not recognized.

[1] Figs. 220 to 223. Fractures of the shaft of the radius. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from service of Dr. Martin and from dispensaries.

Fig. 222

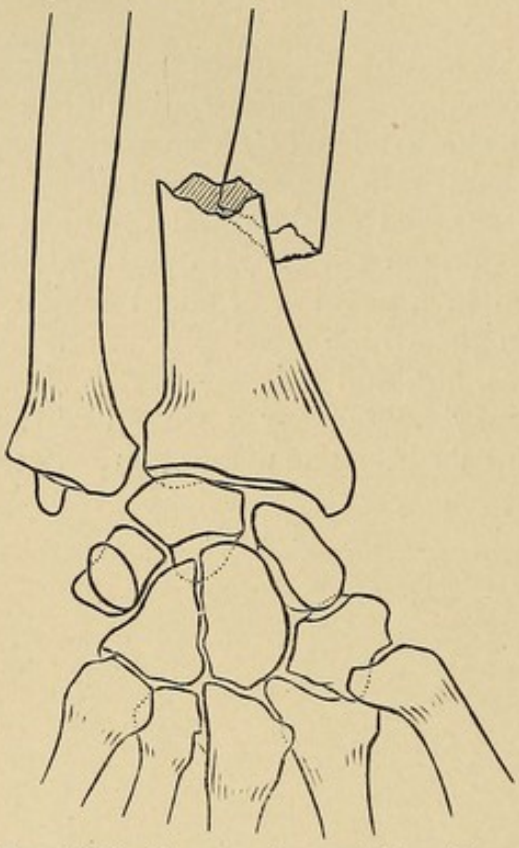
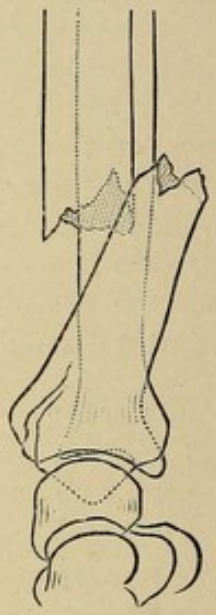


Fig. 223



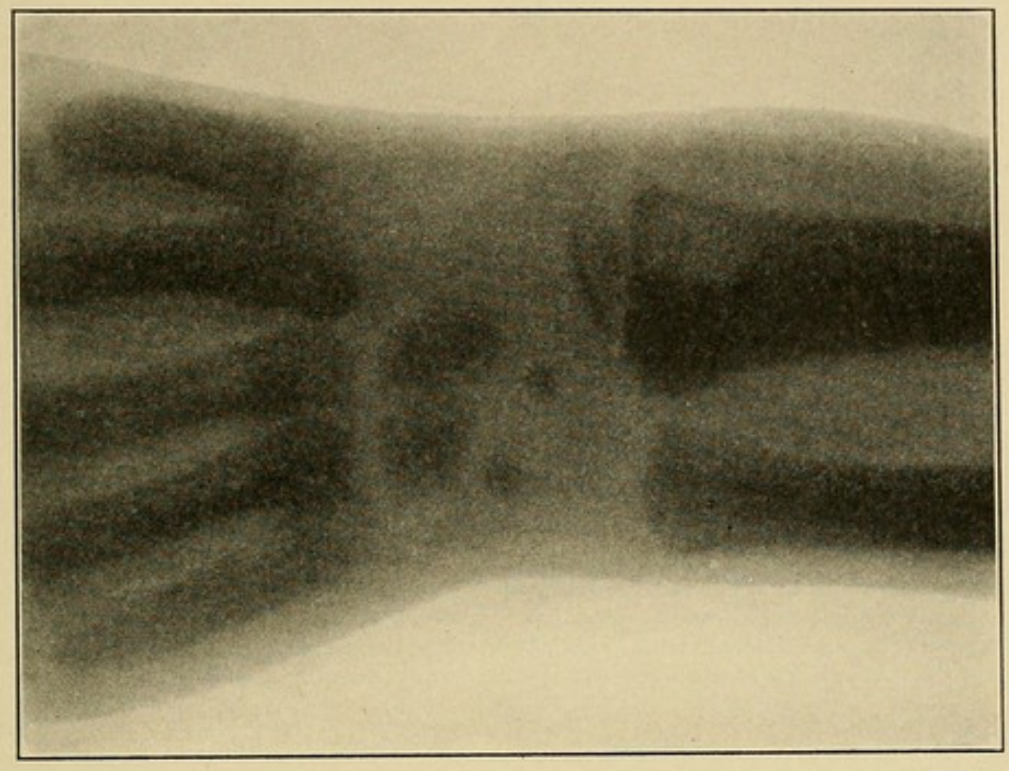
Figs. 222 and 223.—Fracture about middle and lower fourths of shaft, in a male, aged twenty-six years. Result of direct violence—struck on palmar aspect by automobile crank. Antero-posterior view, Fig. 222, shows lateral displacement to ulnar side. Lateral view, Fig. 223, shows complete palmar displacement of lower fragment with over-riding. Clinical diagnosis of fracture not difficult.

Fig. 224

Syphilitic rupia. Tertiary (years) lesions. Duration, months. No subjective symptoms. Patient feeling well.

effusion and acute pyogenic infection of the joint may be made early by aspiration and microscopic and cultural investigation of the contents of the joint.

FIG. 225



Tuberculous abscess in lower end of radius. Localized pain, tenderness, and swelling, but no redness. Secondary inflammatory effusion in wrist-joint. Tuberculous lesion in upper epiphysis of femur and in knee-joint. (Carnett.)

Sprain of the Elbow.—This is the commonest form of injury about the joint, involving chiefly the internal lateral ligament, characterized by a history of wrench or twist such as is incident to hurling a ball, followed immediately or shortly by disability, pain, tenderness, and swelling, most marked over the seat of subcutaneous injury. In one or two days following the trauma the skin may exhibit discoloration.

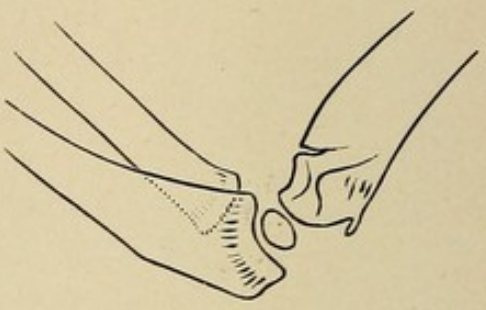
There may be bleeding into the joint, causing a traumatic synovitis with immediate effusion, characterized by swelling and fluctuation on either side of the triceps and beneath the external condyle, and fixation of the joint in slight flexion. The presence of a joint effusion is so suggestive of fracture that, when this is present, the *x*-rays should always be used.

Persistent pain, tenderness, and disability following sprain, unless this be frequently repeated, or no opportunity for recovery has been given, are signs which should suggest an associated bone lesion.

Fractures about the Elbow.—Fracture in the region of the elbow commonly involves the lower end of the humerus, at times the olecranon, exceptionally the head or neck of the radius, and, almost as a surgical curiosity, except as a complication of backward luxation, the coronoid process of the ulna.

FIG. 226[1]

FIG. 227



FIGS. 226 and 227.—Incomplete supracondyloid fracture, in a child, aged four years. Antero-posterior view, Fig. 226, shows a fissure extending completely across, a short distance above the epiphyseal line. The epiphysis for the external condyle is the only one in which ossification has begun, and the possibility of detecting an epiphyseal separation of this condyle by the radiograph would depend upon an evident alteration in the position and relations of this centre as compared with that of the opposite elbow. If reduced, the injury could not be diagnosticated by the *x*-rays unless there was an accompanying break in the bone adjacent. An epiphyseal separation of the internal condyle could not be determined radiographically at this age. The lateral view, Fig. 227, shows the same fissure extending but about half-way through from before backward. The identity of the small process at the lower posterior aspect of the diaphysis is uncertain.

FIG. 228

FIG. 229

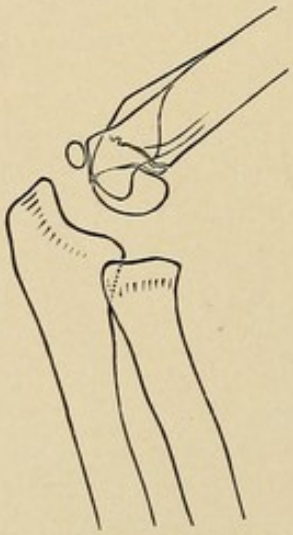
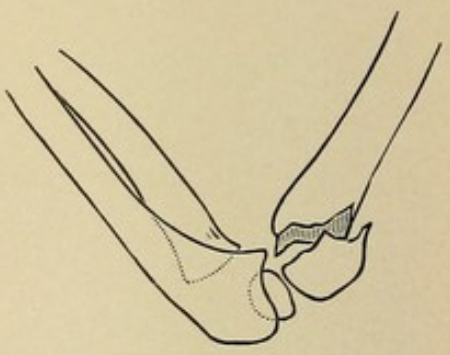


FIG. 230



FIGS. 228 and 229.—Incomplete supracondyloid fracture, in a child, aged six years. Antero-posterior view, Fig. 228, shows a fissure extending part way across, but it is barely perceptible in the lateral view, Fig. 229. Note the increase in size of the centre of ossification in the epiphysis for the external condyle and beginning ossification in that for the internal. (See Figs. 226 and 227.)

FIG. 230.—Complete supracondyloid fracture, in a child, aged eight years. The typical deformity of this fracture is shown in the lateral view here represented, and which is the one necessary. The fore-and-aft view may not show even the fracture in some instances. The posterior displacement is of a moderate degree. Clinical diagnosis of fracture not difficult, but in presence of great amount of swelling might be mistaken for dislocation. Radiograph especially valuable for determining displacement.

[1] Figs. 226 to 234. Supracondyloid fractures of the humerus. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from services of Drs. Martin, Carnett, and Wood, from dispensaries, and private cases of Dr. Pancoast.

FIG. 231

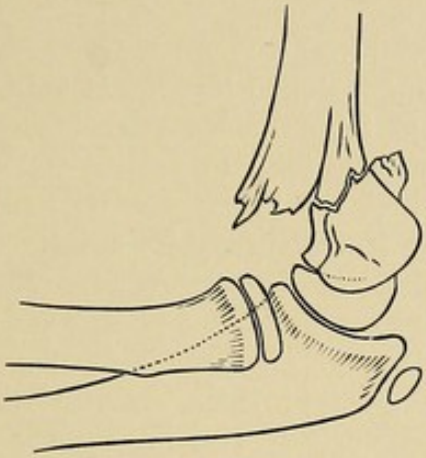
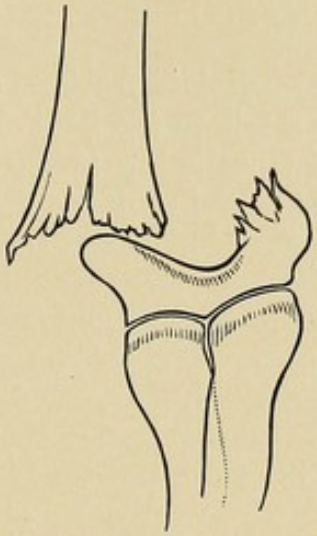


FIG. 232



FIGS. 231 and 232.—Supracondyloid fracture, in a child, aged nine years. Lateral view. Fig. 231 shows the typical posterior deformity, but the anteroposterior view, Fig. 232, indicates in addition a very unusual lateral displacement to the radial side. The smooth appearance of the upper edge of the lower fragment gives somewhat the impression of an epiphyseal separation, but is due to the articular surface showing above in place of broken surface because of the peculiar angle at which the part was exposed on account of the dressing on an internal rectangular splint. This is a proof of the necessity of examining in both directions, even under such difficulties as mentioned. Note beginning ossification of epiphysis for olecranon in Fig. 231.

FIG. 233

FIG. 234

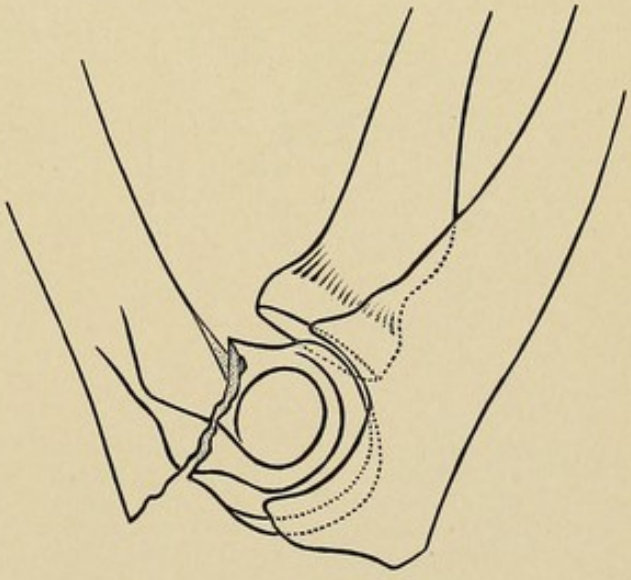


FIG. 233.—Supracondyloid fracture in a child, aged eight years. Lateral view before reduction shows an extreme degree of posterior displacement of lower fragment, as compared with Fig. 230.

FIG. 234.—Supracondyloid fracture, in a male, aged sixty years, old and ununited. Clinical diagnosis of injury somewhat difficult at this time, but *x*-rays show its exact nature, amount of callus and the deformity. This fracture is not nearly so common in adults as in children.

Fractures of the lower end of the humerus may be supracondyloid, intercondyloid, condyloid, epicondyloid, or epiphyseal. All these fractures, except the sypracondyloid and epicondyloid, involve the elbow-joint, and are accompanied by almost immediate and pronounced swelling due at first to blood effusion into and around the joint, later to

traumatic inflammatory reaction. The rapid and extensive swelling is in itself presumptive evidence of the presence of fracture as opposed to sprain.

Supracondyloid fracture, common in children under ten years of age, follows a fall on the bent elbow or the outstretched hand. It is usually oblique from below upward and from in front backward. Hence the lower end of the upper fragment projects anteriorly and occasionally injures the bloodvessels or nerves. When the injury is due to a fall upon the bent elbow (adults) the line of fracture may be oblique from in front downward and backward. Hence, the lower end of the upper fragment projects backward, the lower fragment lying forward and usually inward.

Rapid extra-articular swelling, the preservation of the normal relation of the tip of the olecranon, the head of the radius, and the internal and

FIG. 235[1]

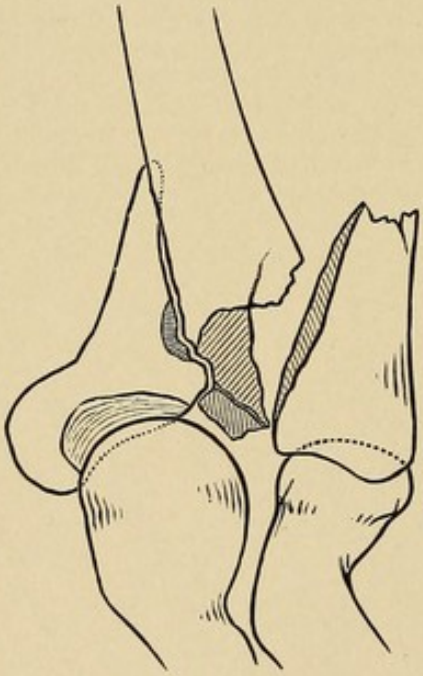


FIG. 236

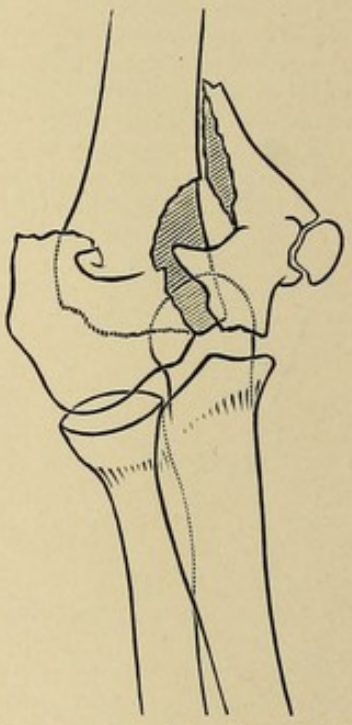


FIG. 235.—Fracture of both condyles, in male, aged fifty-four years, resulting from a fall out of a window. Wide separation of fragments. Clinical diagnosis not difficult, except as obscured by great swelling. Exact nature of injury more readily determined by radiograph, which also shows exact deformity. Anteroposterior view represented, and is the more important one, although difficult to obtain on account of flexion of forearm. (Latter accounts for distortion of bones of forearm.)

FIG. 236.—Fracture of both condyles, in a girl, aged thirteen years, with lateral separation and upward displacement of fragments. The smooth upper surfaces of the fragments suggests a separation of the lower epiphysis (the two condylar epiphyseal centres being fused at this age), but the portion of the shaft attached to the internal condylar fragment indicates that the epiphysis has united on the inner side at least. The patient's age being that at which this epiphysis begins to unite, the injury is probably both a fracture and an epiphyseal separation above the condyles, and a fracture between them. The centre for the internal epicondyle has not yet united. Clinical diagnosis of injury not difficult, but radiographs essential to determine displacement. Proper reduction was impossible without operation.

[1] Figs. 235 and 236. Fractures at the lower end of the humerus—*both condyles.* Outline drawings from radiographs by Dr. H. K. Pancoast in collection of the University Hospital *x*-ray Laboratory; patients referred from services of Drs. White and Martin.

external condyle, estimated by comparison with the uninjured side, crepitus and preternatural mobility above the condyles elicited by grasping the elbow and rocking it from side to side, limited flexion and exaggerated extension, deformity obvious on both palpation and inspection, and shortening as measured from the acromion to the external epicondyle, make the diagnosis easy.

Condyloid fracture may be of either the internal or the external condyle.

Fractures of the external condyle, especially frequent in children, involve the capitellum, sometimes the trochlea. They are characterized by swelling, pain, and tenderness, which reach their maximum intensity

FIG. 237[1]

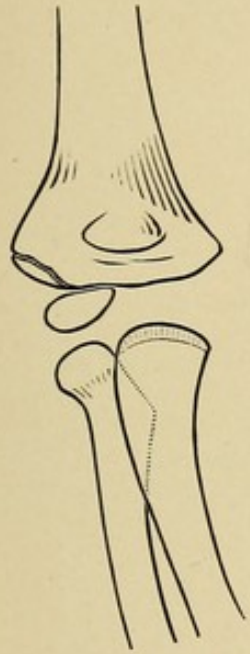


FIG. 238

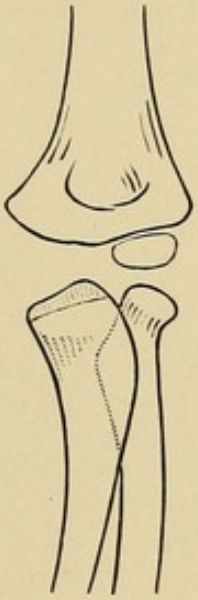
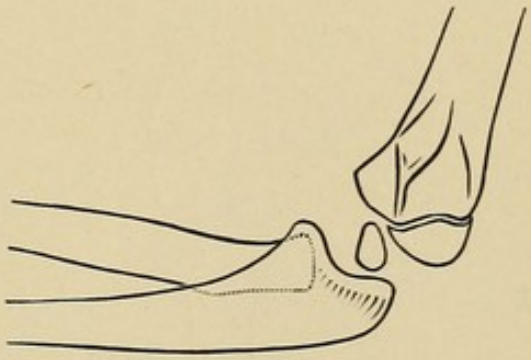


FIG. 237.—Fracture of the external condyle in a child, aged four years, the line of fracture appearing as a fissure immediately above the epiphyseal line, and extending into it. Shows in anteroposterior view only. Clinical diagnosis difficult—depending mainly upon pain on motion and local tenderness. (No displacement, and crepitus and preternatural mobility absent.)

FIG. 238.—Normal elbow of the same case as Fig. 237, and same view (anteroposterior).

FIG. 239

FIG. 240

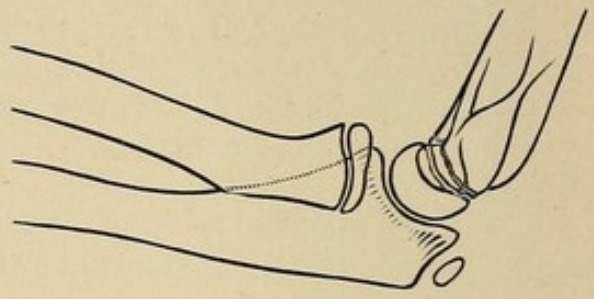


FIGS. 239 and 240.—Fracture external condyle, in a boy, aged five years, at a higher level than the preceding, and with slight downward and outward displacement, latter shown in anteroposterior view, Fig. 239. (Lateral view, Fig. 240.) Clinical diagnosis not so difficult as in preceding case, deformity and crepitus being determinable.

[1] Figs. 237 to 247. Fractures of the lower end of the humerus—*external condyle*. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from service of Dr. Frazier, from dispensaries, and private cases of Dr. Pancoast.

FIG. 241

FIG. 242



FIGS. 241 and 242.—Fracture of the external condyle in a boy, aged ten years, the line of fracture appearing as a fissure just above the epiphyseal line, and tending almost to an incomplete fracture of the internal condyle as well (or there may have been a separation of the unossified epiphysis) without displacement. Both this case and Fig. 237 might be regarded as epiphyseal separations. In the absence of displacement the clinical diagnosis is difficult, crepitus being absent or ill-defined. Fig. 241, anteroposterior, and Fig. 242, lateral view.

FIG. 243

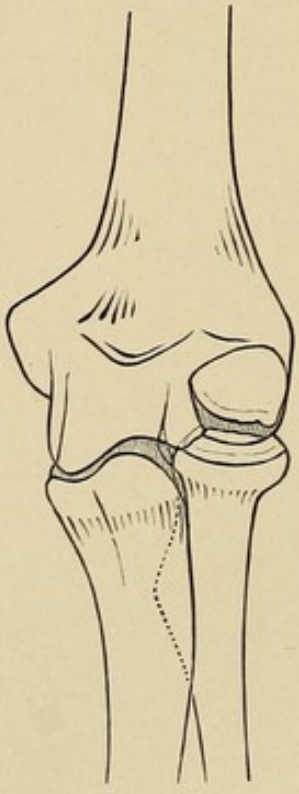
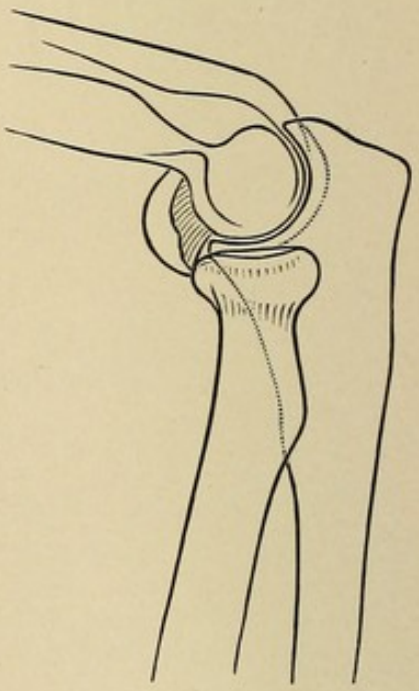


FIG. 244



FIGS. 243 and 244.—Peculiar fracture of external condyle—separation of anterior portion of articular surface of capitellum, in a female, aged forty-five years. Upward and forward displacement of fragment. Clinical diagnosis difficult, deformity not in evidence, preternatural mobility impossible to determine, and crepitus hard to locate. Exact diagnosis essential to prevent future disability, and readily shown by radiographs. Fig. 243, anteroposterior view, and Fig. 244, lateral view.

FIG. 245

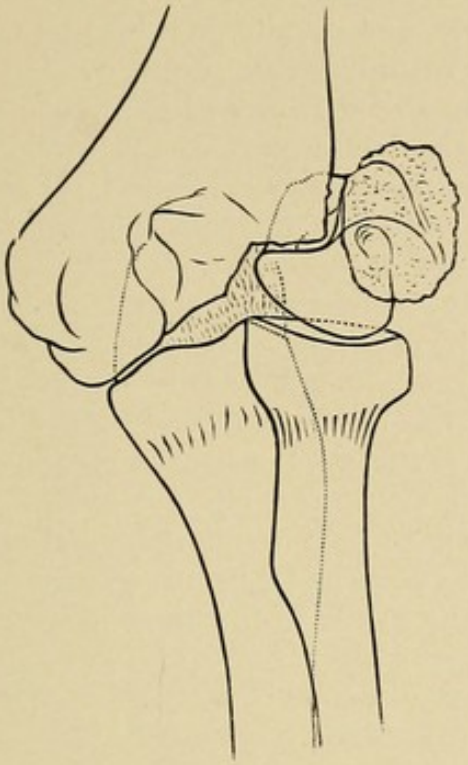
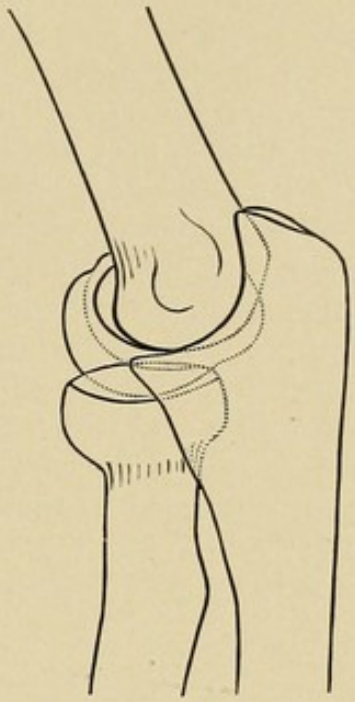
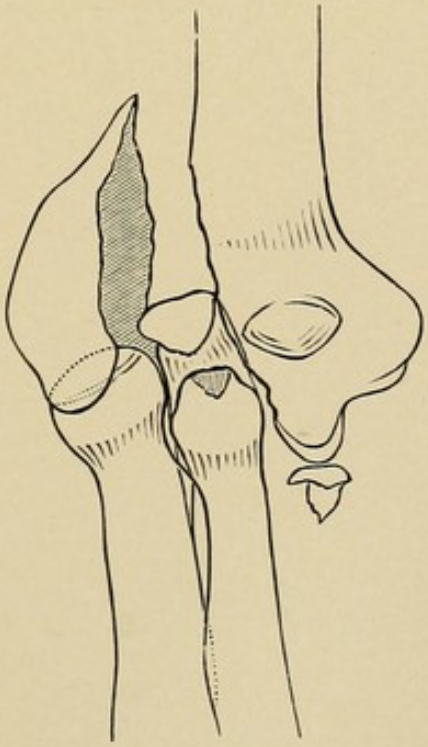


FIG. 246



FIGS. 245 and 246.—Old fracture of external condyle, in a male, aged twenty-one years, with more or less union of fragment in peculiar position, the broken surface having rotated outward, and the articular surface inward nearly 90 degrees on anteroposterior axis. Very poor surgical result from *x*-ray standpoint, but fairly good functionally. Radiographs made because of a recent injury. (Negative.) Fracture and displacement both shown in anteroposterior view, Fig. 245, but neither in lateral view, Fig. 246.

FIG. 247



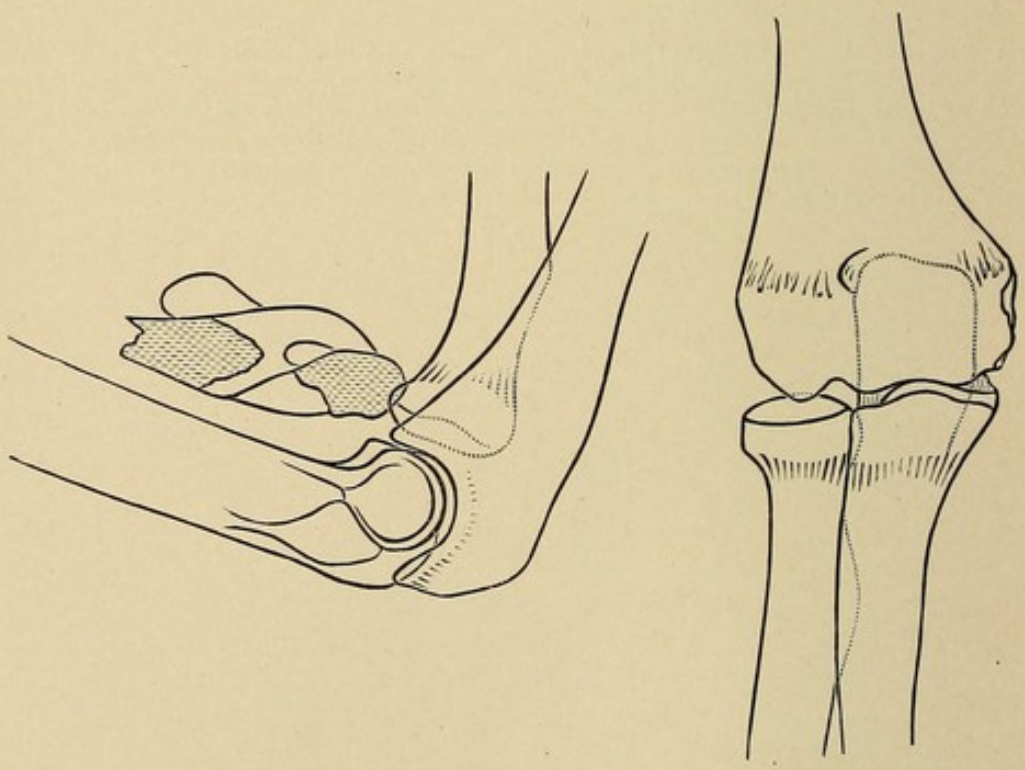
Fracture of external condyle and tip of coronoid process of ulna, with lateral outward displacement of condylar fragment and corresponding dislocation of both bones of forearm. Male, aged twenty-seven years. Clinical diagnosis not difficult unless obscured by great amount of swelling. Anteroposterior radiograph shows exact nature of injury and the displacement more readily, however.

over the external condyle; outward displacement of the head of the radius which moves with the condyle, and usually crepitus and mobility detected by direct palpation and manipulation of the condyle while traction is exerted upon the forearm and it is rocked laterally.

Fracture of the internal condyle involves a part or the whole of the trochlea, often a part of the capitellum. It is evidenced by swelling, pain, and tenderness, particularly marked in the region of the internal condyle, and crepitus elicited by direct palpation. Traction, flexion, extension, and lateral rocking may demonstrate crepitus and preternatural mobility if it cannot be felt by grasping the condyle and attempting to move it in various directions. There is usually a partial backward and inward displacement of the ulna which carries the internal condyle with it and which is easily reduced but as easily recurs.

Fracture of the internal epicondyle, usually, but not always, extra-articular, is marked by sharply localized pain, tenderness, and swelling, and the detection of preternatural mobility and crepitus by direct palpation. It is sometimes complicated by injury of the ulnar nerve.

FIG. 248[1] FIG. 249



FIGS. 248 and 249.—Old (thirteen months) ununited fracture of the internal condyle, in a male, aged twenty-one years. The lateral view, Fig. 248, shows the fragment completely separated and displaced anteriorly, while the anteroposterior picture, Fig. 249, is remarkable in giving the impression of a perfectly normal elbow, with not the slightest suggestion of a fracture, even though details are clear.

[1] Figs. 248 to 252. Fractures of the lower end of the humerus—*internal condyle and epicondyles.* Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from dispensaries.

FIG. 250

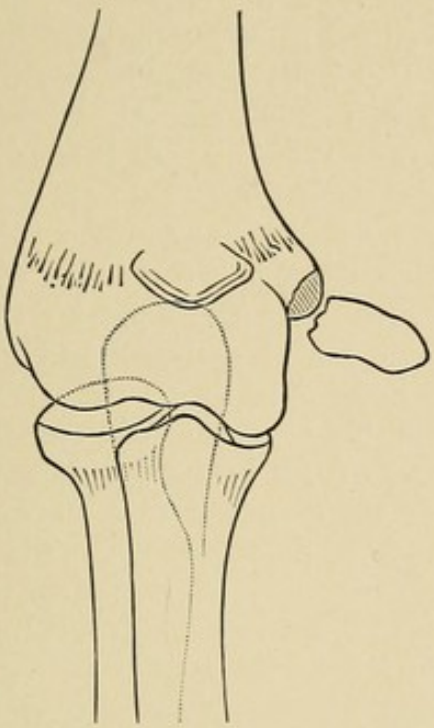
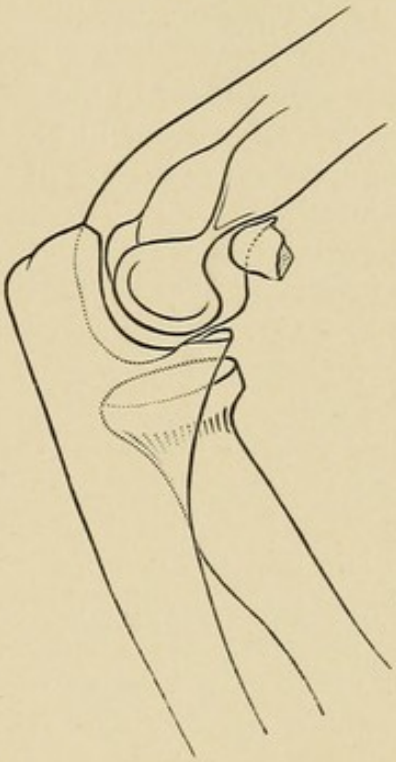
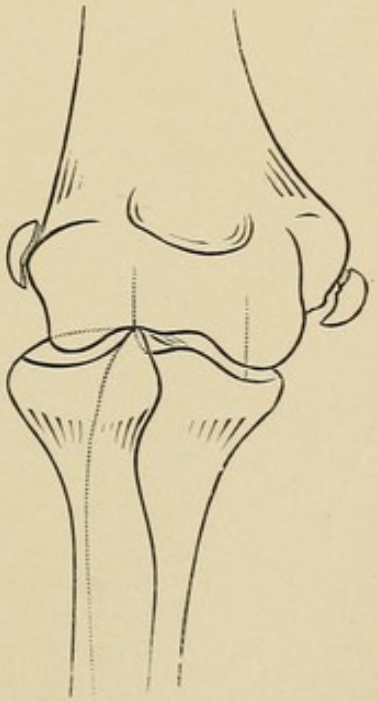


FIG. 251



FIGS. 250 and 251.—Fracture of the internal epicondyle, in a male, aged eighteen years (being about age of union, may be epiphyseal separation), resulting from either direct violence or muscular action during a wrestling match. Complete separation (muscular attachments). Fig. 250, anteroposterior, and Fig. 251, lateral view.

FIG. 252



Fracture of both epicondyles, in a male, aged twenty-four years. Very slight displacement. Clinical diagnosis not difficult. Anteroposterior view. (Lateral view practically negative.)

Supracondyloid and intercondyloid fractures are characterized by a line or lines of break passing into the joint in addition to the supracondyloid fracture. They are usually due to falls upon the elbow, and are incident to the direct splitting force transmitted from the olecranon. Such fracture may appear in the form of a T or a Y, or may be greatly comminuted. They occur in the adult as well as in children.

The apparent reduction of the deformity is simple, but it is as readily reproduced.

Intercondyloid fracture is attended by rapid and pronounced swelling within and around the joint, which is held in a position of slight flexion. On grasping and attempting to move the condyles with the finger and thumb of each hand, preternatural mobility and crepitus can be elicited, the condyles moving independently of each other. If the ulna is driven between the condyles, the olecranon will be displaced upward and backward. The distinction from luxation is based upon preternatural mobility as opposed to fixation, the ease of apparent reduction, and the prompt reappearance of deformity when the reducing force is removed. Also by bone crepitus, obvious displacement of the condyles, and a marked increase of the intercondyloid measurement. Extensive comminution with great displacement of fragments is common, nor can this be accurately diagnosticated except by the *x*-ray.

FIG. 253[1] FIG. 254

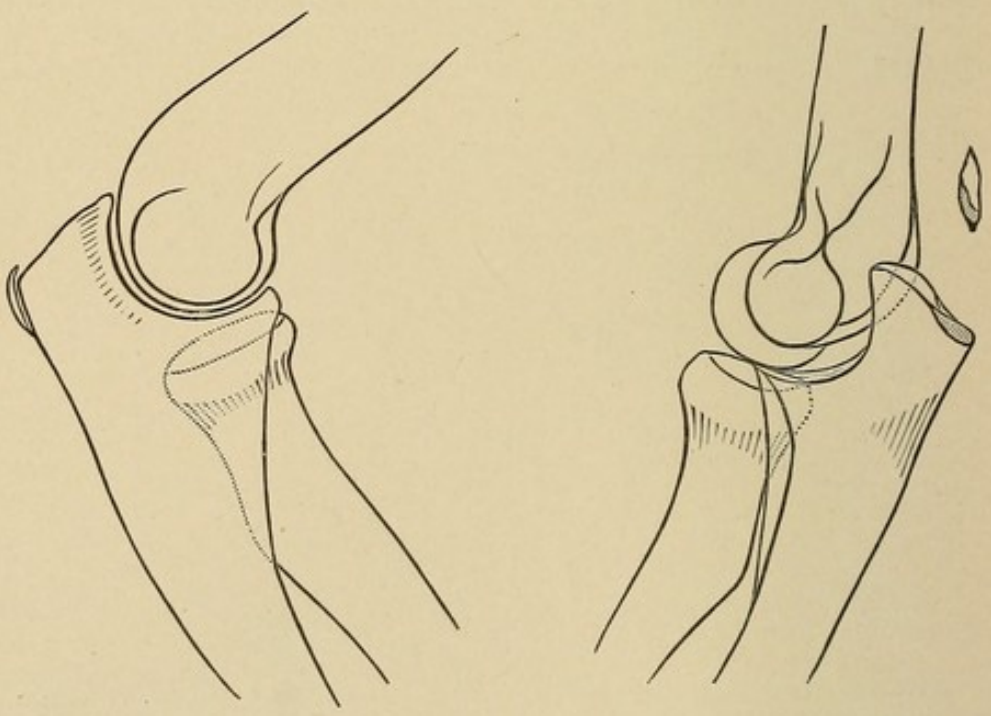


FIG. 253.—Fracture of extreme tip of olecranon, in an adult male, result of direct violence (struck by automobile crank). Triceps insertion not involved, therefore no displacement. Small fragment covered by bursa, and diagnosis difficult on account of swelling.

FIG. 254.—Peculiar fracture of olecranon comparable to a rupture of the triceps tendon. Separation from posterior surface of scale-like fragment representing attachment of the tendon. Wide separation from retraction of latter. Adult male.

[1] Figs. 253 to 262. Fractures of the olecranon and coronoid processes. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. Martin, Frazier, and Siter, and from dispensaries, and private cases of Dr. Pancoast.

FIG. 255

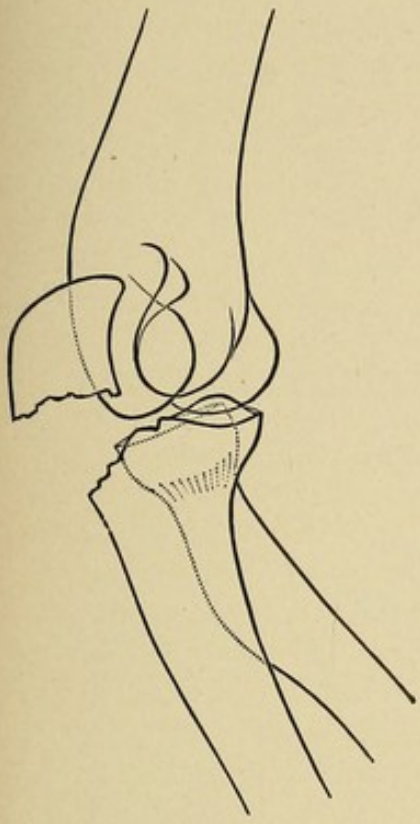


FIG. 256

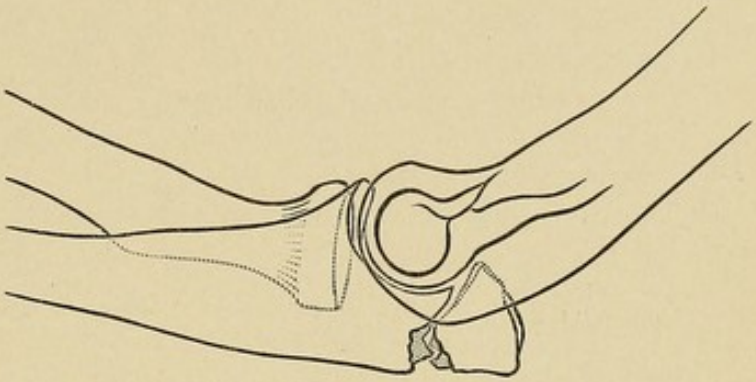


FIG. 255.—Typical fracture of olecranon, with usual degree of separation from action of triceps, in a male, aged twenty-seven years. Clinical diagnosis not difficult. *X*-rays show no complicating fracture.

FIG. 256.—Old "subligamentous" fracture of olecranon, in adult female, diagnosticated and treated as rupture of triceps tendon. First radiograph, two years after injury, indicates fibrous but no bony union. Caused by direct violence—fall from trolley car.

FIG. 257

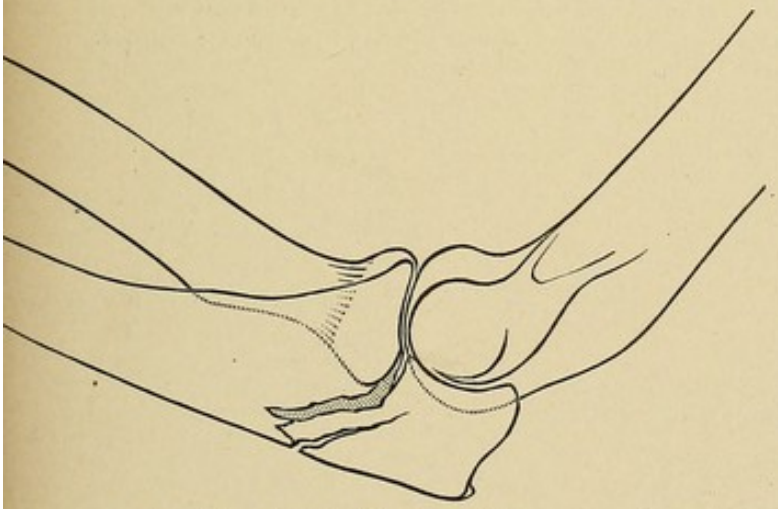
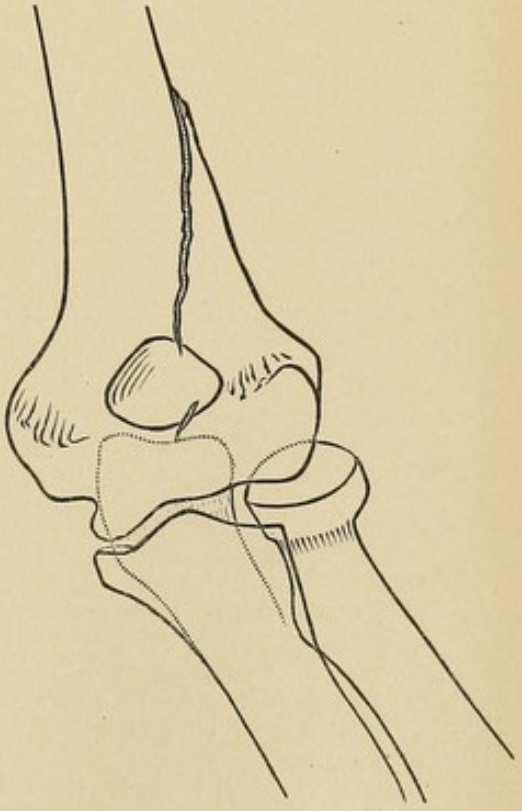
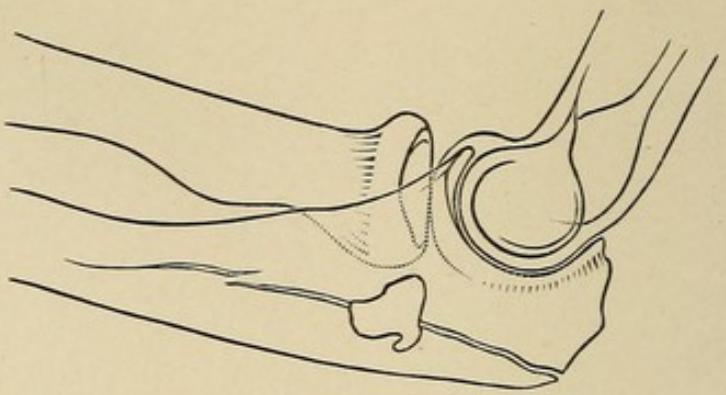


FIG. 258



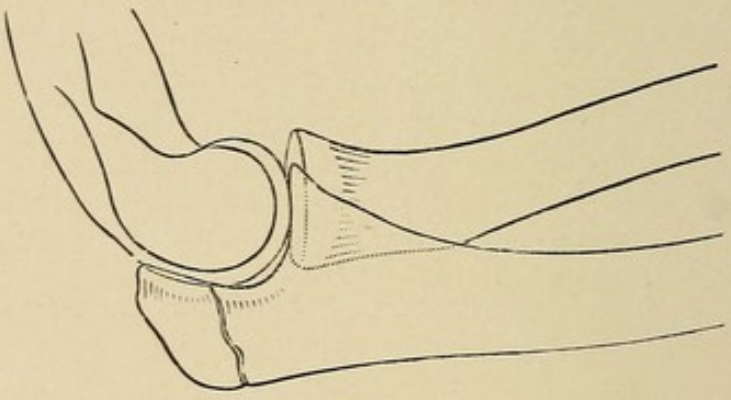
FIGS. 257 and 258.—Fracture of olecranon and incomplete fracture of external condyle of humerus, in male, aged forty-nine years, due to direct violence—fall on elbow. Lateral view, Fig. 257, shows only fracture of olecranon, without separation, and slightly below usual level. Anteroposterior view, Fig. 258, shows only the fracture of the external condyle. Both views necessary for complete diagnosis. Clinical diagnosis of condylar fracture difficult. (Absence of deformity, mobility, and crepitus.) Also, more conspicuous olecranon fracture apt to detract attention from latter.

FIG. 259



Incomplete longitudinal fissured fracture of olecranon and upper portion of shaft of ulna, in a male, aged twenty-five years, result of gunshot injury.

FIG. 260



Normal elbow of a boy, aged sixteen years, showing the epiphyseal line just before union of epiphysis of olecranon with shaft, occurring at this age. This line is often mistaken for fracture, and a year or two later such an appearance would imply the latter.

FIG. 261

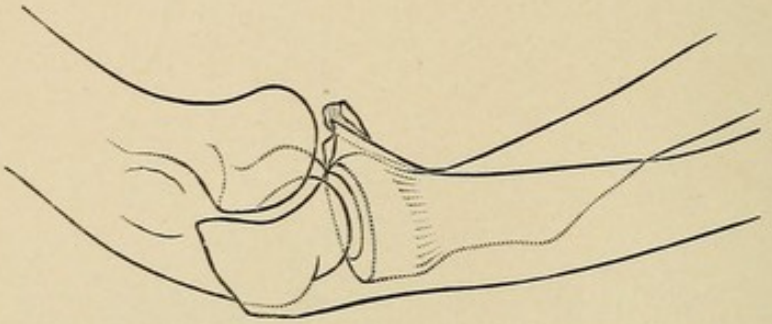


FIG. 262

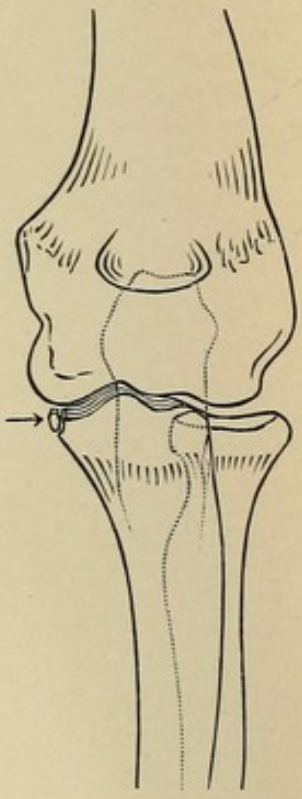


FIG. 261.—Fracture of tip of coronoid process of ulna, in a male, aged thirty-six years, resulting from a fall on the elbow. (Unusual.) Clinical diagnosis difficult, pain on movement, limitation of motion, and local tenderness, but absence of cardinal signs.

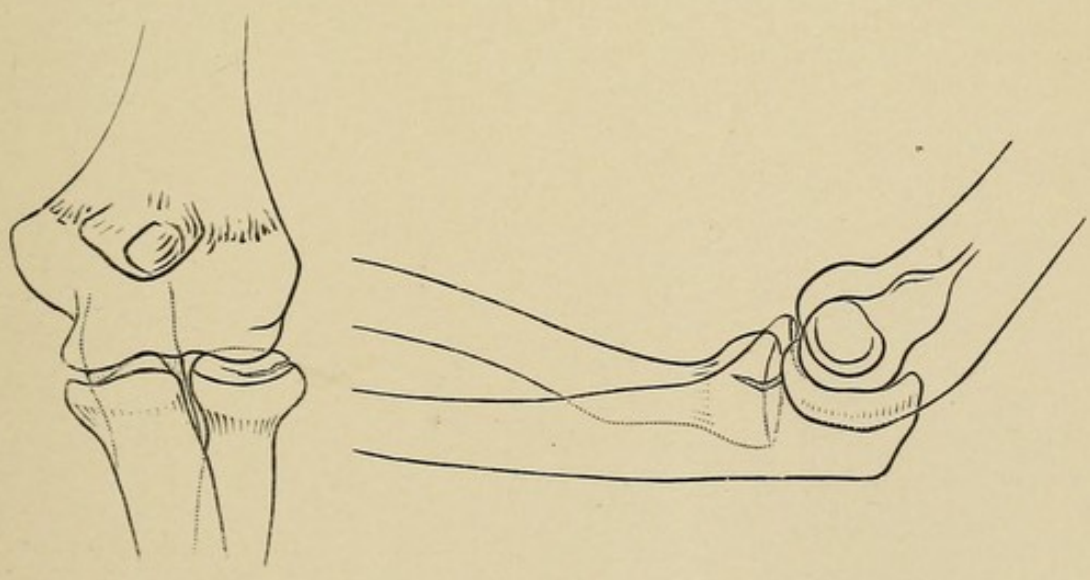
FIG. 262.—Example of a "sprain fracture" at elbow, separation of inner edge of coronoid process representing the attachment of a portion of the internal lateral ligament. Equivalent to a severe sprain. Pain and local tenderness led to the suspicion of a fracture of the internal condyle. (Male, aged twenty-nine years.)

Fractures of the olecranon, due to falls on the elbow or muscular action, may be extra-articular in the form of a tearing off of the bone attachment of the triceps tendon; usually they are intra-articular and are attended by an abundant joint effusion. They are manifested by pain and tenderness, most marked at the seat of injury, inability to extend the arm, or to extend it forcibly, pain experienced in attempting this motion, separation of fragments and preternatural mobility detected by direct palpation. When the bones are held in place by the investing fibrous tissue, persistent localized tenderness, swelling, pain and loss of power on attempting extension may be the only symptoms. The *x*-rays may be needful for diagnosis; also, in young people, an interpreter familiar with epiphyseal development.

Fracture of the coronoid process of the ulna, a common complication of backward dislocation, rare as an isolated lesion, is attended by immediate joint effusion and persistent tenderness and pain located in the bend of the elbow to the inner side of the biceps tendon. The diagnosis must be made by the *x*-rays.

Fractures of the head and neck of the radius due to a fall upon the hand, probably with the arm straight, are characterized by an effusion into the entire joint, tenderness most marked over the head or neck of the radius, and, if the fracture be complete and involve the neck, failure of the head to follow the shaft in the motions of pronation and supina-

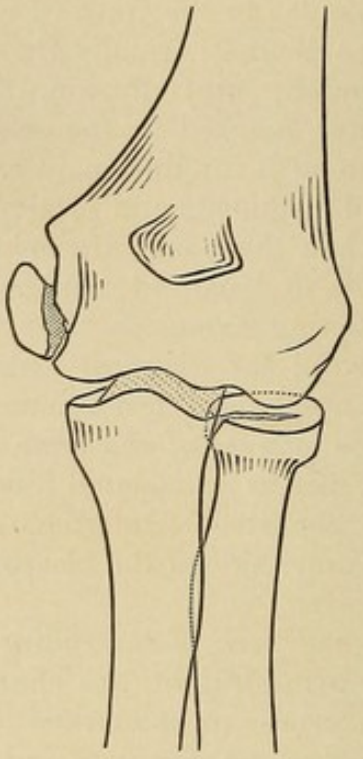
FIG. 263[1] FIG. 264



FIGS. 263 and 264.—Incomplete longitudinal fissured fracture of head of radius in a female, aged twenty-five years, resulting from indirect violence. (Fall down stairs, striking on hand.) Antero-posterior view (Fig. 263) is most likely to show such a break. Clinical diagnosis difficult, and this type of fracture not detected in majority of cases. Only signs, pain on motion, local tenderness, and ill-defined "click" on rotation. Orbicular ligament prevents displacement. Lateral view (Fig. 264) frequently does not show this type on account of overlying olecranon.

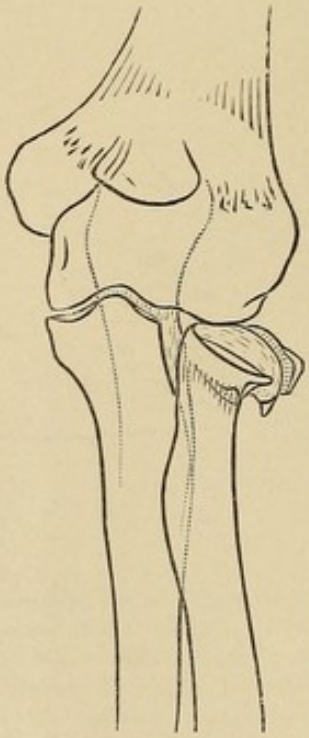
[1] Figs. 263 to 271. Fractures of the head and neck of radius. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from service of Dr. Martin, and from dispensaries, and private cases of Dr. Pancoast.

FIG. 265



Incomplete longitudinal fracture (fissured) of head of radius, and either a fracture or epiphyseal separation of internal epicondyle of humerus, in a boy, aged seventeen years. (Very near age of union of this epiphysis.) Diagnosis of latter injury not difficult clinically. Neither fracture could be detected in the lateral view.

FIG. 266



Old (six months) comminuted and impacted fracture of head and neck of radius, united with permanent displacement of fragments. Female, aged thirty-two years, referred for determination of cause of partial ankylosis of joint. Clinical diagnosis of such a type of fracture should not have been difficult at time of injury.

FIG. 267

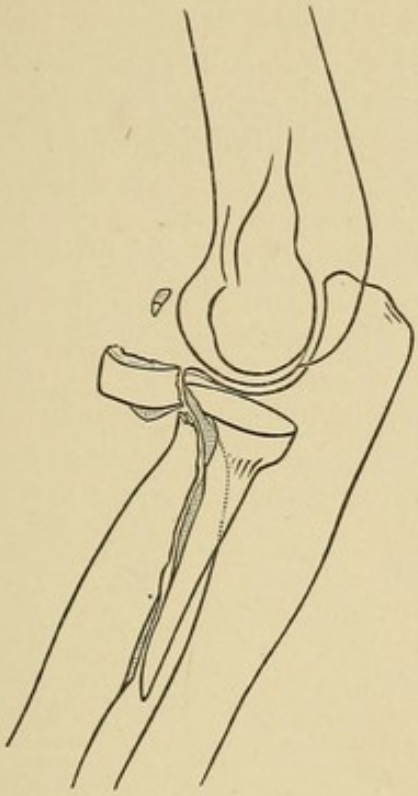
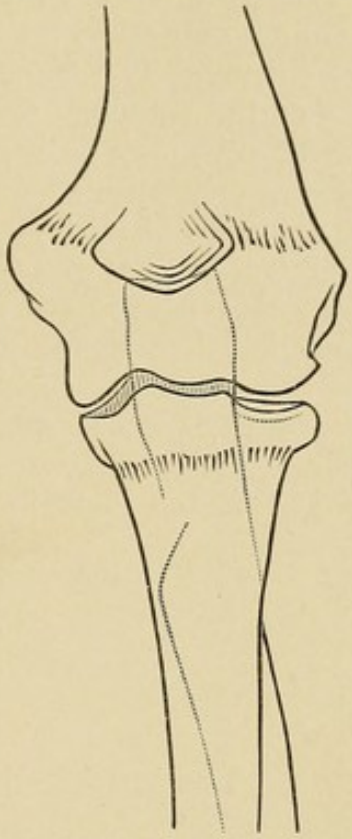


FIG. 268



FIGS. 267 and 268.—Old (five weeks) comminuted fracture of head, neck, and upper portion of shaft of radius in an adult male. The lateral view, Fig. 267, shows a longitudinal split through the head, neck, and shaft, and a large fragment of the head completely separated and displaced outside of the orbicular ligament. Reduction of latter by manipulation impossible. Anteroposterior view, Fig. 268, important and remarkable for the reason that it presents the appearance of a perfectly normal elbow. Case not properly diagnosticated at time of injury, although an exact clinical diagnosis would be very difficult without the radiograph.

FIG. 269

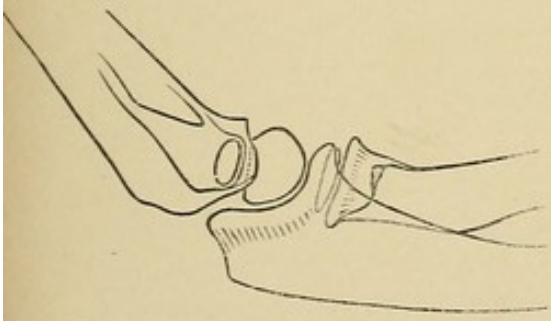


FIG. 270

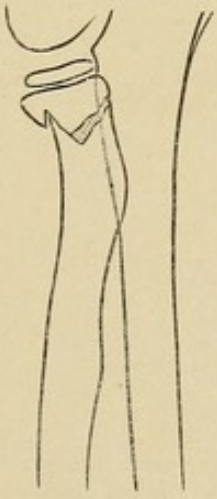
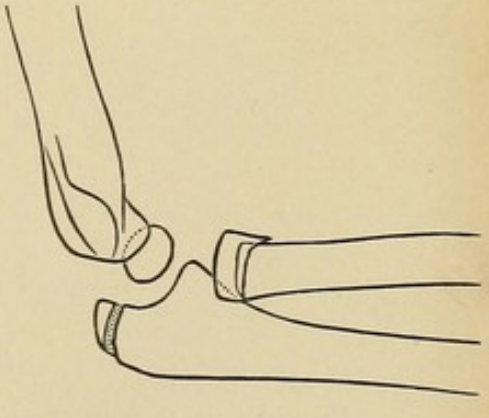


FIG. 271



FIGS. 269 and 270.—Impacted fracture of neck of radius, in a boy, aged nine years, resulting from a fall on the hand. Clinical diagnosis difficult because of absence of crepitus and deformity, and the fact that the head rotated with the shaft. Pain on rotation and local tenderness most prominent signs. Fracture of neck and epiphyseal separation of head are more common in children than fracture of the head.

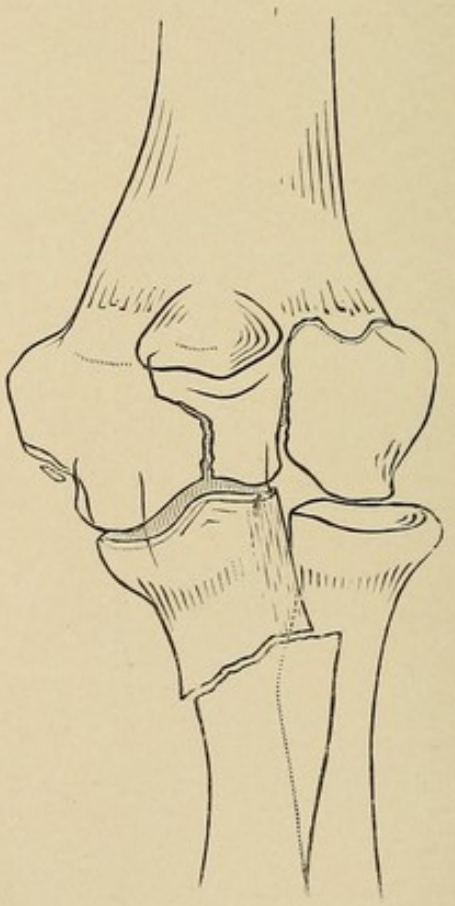
FIG. 271.—Impacted fracture of neck of radius and fracture of bony portion of olecranon, in a child, aged five years. Latter "subligamentous," and clinical diagnosis not difficult, as was the case with radial fracture. These two fractures not uncommonly occur together in children. Child too young for appearance of ossification in olecranon epiphysis, and likewise in that of head of radius. Lateral view.

tion. Shortly after the injury these motions will be so painful that they cannot be performed actively nor tolerated passively. Crepitus may be elicited. The diagnosis in fissured or impacted fractures, and in most of the complete ones must be made by the *x*-rays, or, in the absence of this, may be based upon persistent disability and localized tenderness.

The diagnosis of all injuries about the elbow-joint should be revised by careful *x*-ray pictures interpreted, in the case of children, by one familiar with epiphyseal development and ossifying centres. The prognosis in all these injuries must be guarded in so far as complete functional and cosmetic restoration are concerned.

Dislocations of the Elbow.—Dislocations of the elbow, usually of both bones backward, common in young people, are usually due to falls, the weight of the body being suddenly arrested by the outstretched

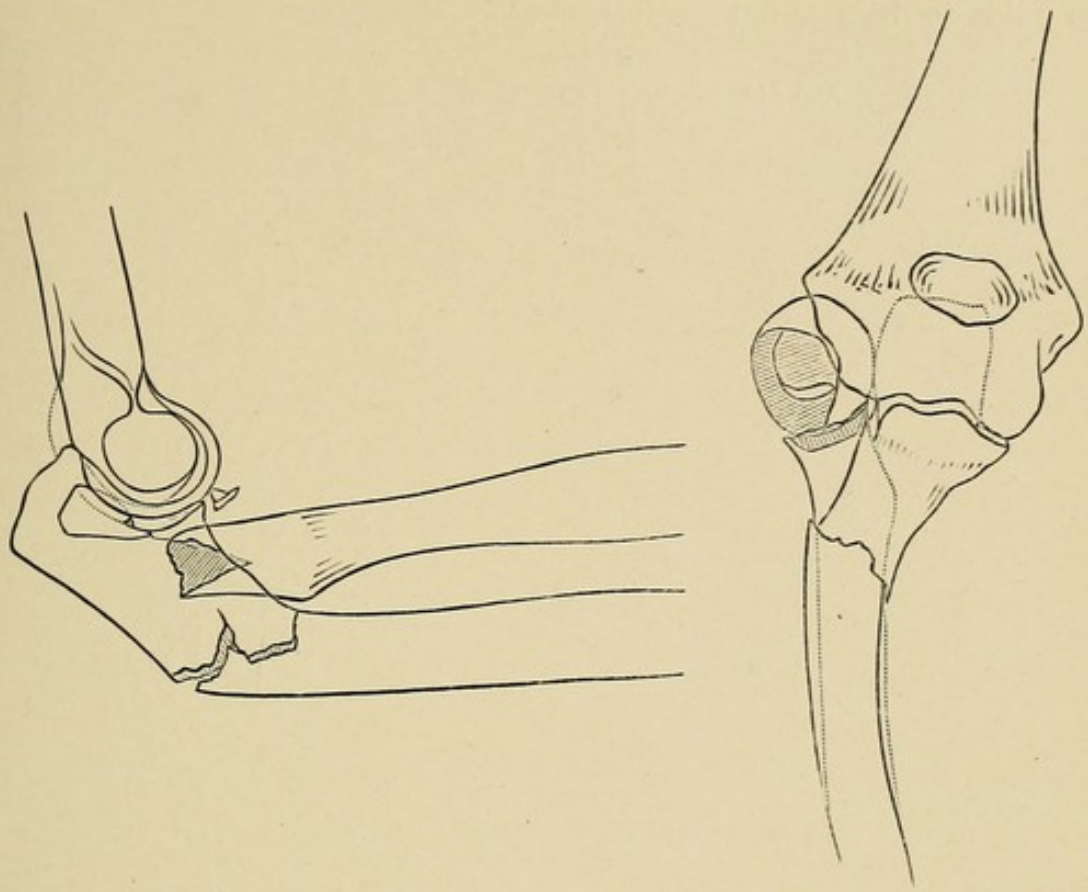
FIG. 272[1]



Unusual form of injury in a man, aged fifty-seven years, result of a fall either on hand or elbow, probably the former. Definite clinical diagnosis could not be made. Evidently the force exerted through radius caused more or less impacted fracture of external condyle. Force on ulnar side probably largely expended in a transverse fracture of ulna below base of coronoid. In addition, an incomplete fracture of internal condyle. (Both condyles complete would constitute "V" type.)

[1] Figs. 272 to 284. Dislocations, unusual fractures, and complex injuries at the elbow. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from service of Dr. Martin and from dispensaries, and private cases of Dr. Pancoast.

Fig. 273 Fig. 274



Figs. 273 and 274.—Oblique fracture, slightly comminuted, at junction of head and neck of radius, and a fracture through the ulna at base of coronoid process. Adult female. Exact cause not known. Fig. 273, lateral view, shows the fragment of the head of the radius completely detached, but almost entirely obscured by the olecranon. Fig. 274, anteroposterior view, shows the head displaced upward and backward behind the external condyle and turned with the articular surface facing anteriorly. Exact clinical diagnosis extremely difficult, especially in regard to the radial fracture. Radiograph indicates reduction of the head impossible.

hand with the elbow-joint in full extension. The ligaments are usually torn from their attachment to the humerus, the internal lateral often carrying its epicondyle with it. Fracture of the coronoid process is also noted.

The diagnosis is based upon the relative position of the external and internal condyle of the humerus to the olecranon process and head of the radius. In the normal joint with the arm extended, the tip of the olecranon lies very slightly above a line drawn transversely across the back of the elbow from one condyle to the other. In backward luxation the tip of the olecranon lies well above this line. There is an elastic resistance to flexion beyond an obtuse angle; when carried as far as possible the olecranon projects backward as compared with the same bony process of the sound side. Behind the external condyle the head of the radius can be felt in its abnormal position. The smooth, rounded, articular extremity of the humerus can be felt in front, and below the bend of the elbow. Compared measurements of the injured and the healthy arm show shortening as measured from the condyle

to the styloid process; absence of shortening as measured from the acromion to the external condyle.

FIG. 275

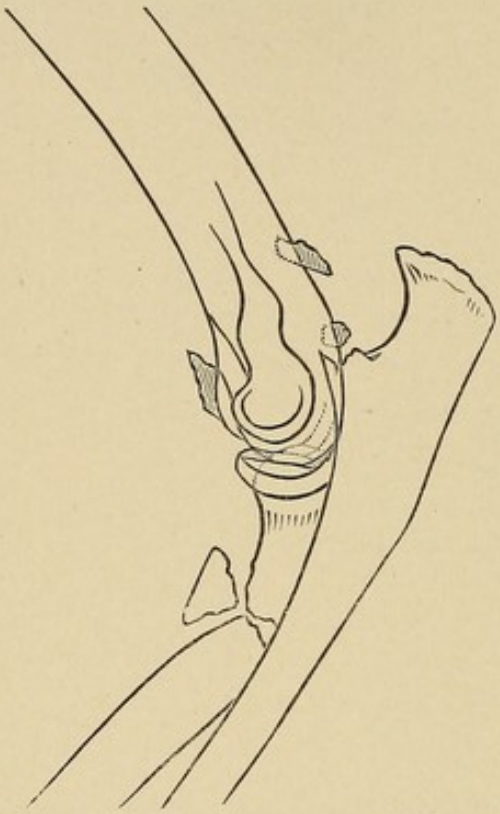
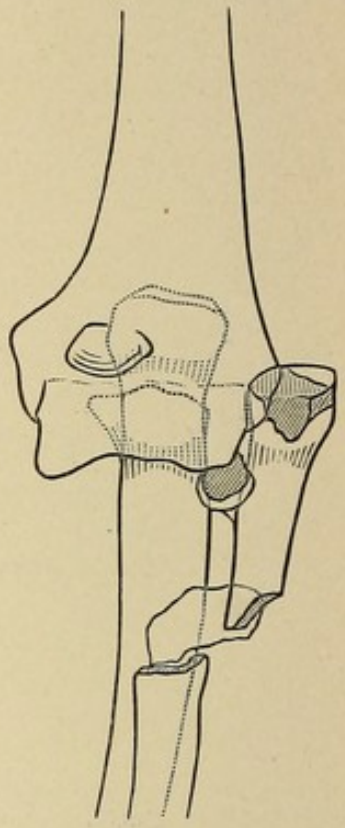
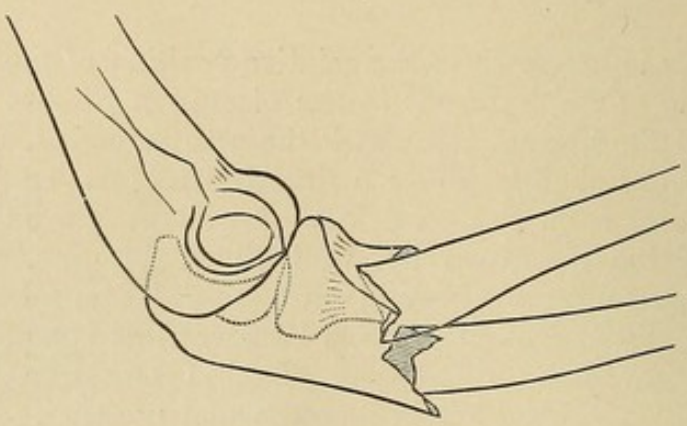


FIG. 276



FIGS. 275 and 276.—Complicated elbow injury in a woman, aged fifty-nine years. Had been diagnosticated and treated by her physician as a *sprain*. The radiographs made several weeks later show the following: (*a*) Unreduced posterior dislocation of both bones; (*b*) comminuted fracture of the head of the radius; (*c*) comminuted fracture of the shaft at about the biceps insertion; (*d*) fracture of she tip of the coronoid process of the ulna (Fig. 275). Clinically, the serious nature of the injury should have been evident, and a diagnosis of the dislocation and the lower radial fracture should have been made readily, although complete diagnosis would have been practically impossible without an *x*-ray examination. Fig. 275, lateral view; Fig. 276, anteroposterior view.

FIG. 277



Fracture of the neck of the radius and of the ulna below the base of the coronoid process, in an adult female, resulting from a fall on the arm and elbow. (Lateral view.) Exact diagnosis was uncertain clinically, but was readily determined radiographically, and reduction much simplified.

FIG. 278

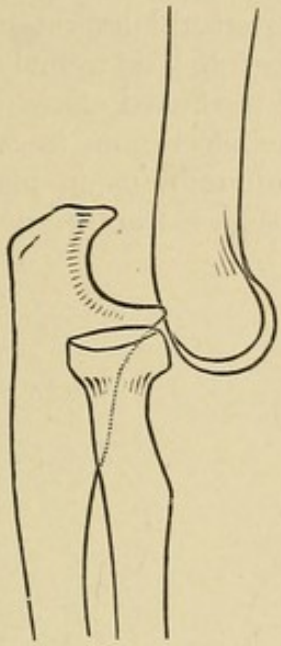
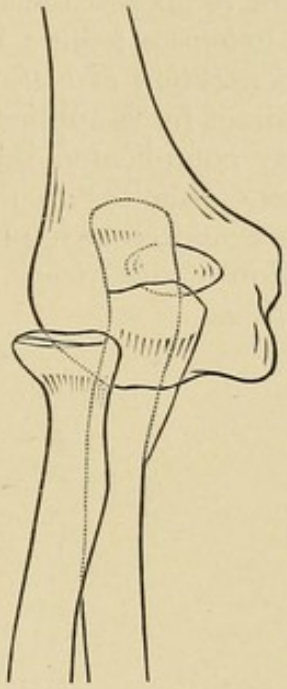


FIG. 279



FIGS. 278 and 279.—Unreduced dislocation elbow, both bones posterior, in an adult female. Clinical diagnosis not difficult, but injury in this case not recognized by physician. Caused by fall from car. In Fig. 279, anteroposterior view, the appearance of lateral displacement to radial side is one always observed in the radiograph in this direction.

FIG. 280

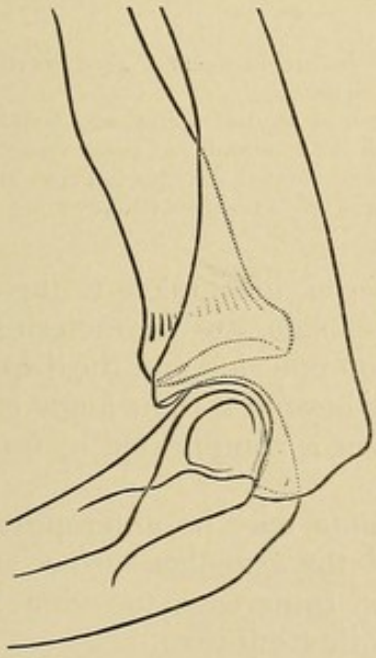
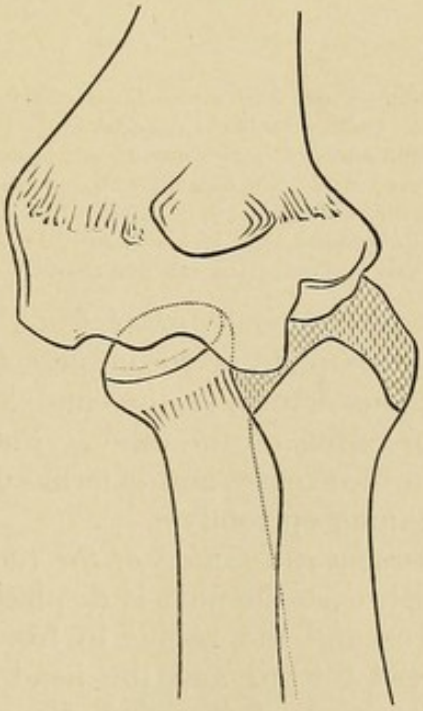


FIG. 281



FIGS. 280 and 281.—Unreduced dislocation of elbow, lateral, both bones to ulnar side, in male, aged twenty-three years. Clinical diagnosis of the dislocation not difficult, but radiograph essential in excluding a possible complicating fracture, for which both views are necessary, although the luxation is shown in the fore-and-aft one only.

In supracondyloid fracture the angular projection of the lower end of the upper fragment is felt in front but is above the bend of the elbow; there is no resistance aside from that incident to pain to either flexion or extension; there is usually preternatural lateral mobility.

Forward luxation of both bones of the forearm is extremely rare. It is due to direct force applied to the back of the flexed elbow, and is not infrequently complicated by fracture of the olecranon, in which case the fragment attached to the triceps tendon remains in place. This dislocation would seem impossible without such a fracture or a rupture of the tendon of the triceps.

FIG. 282 FIG. 283 FIG. 284

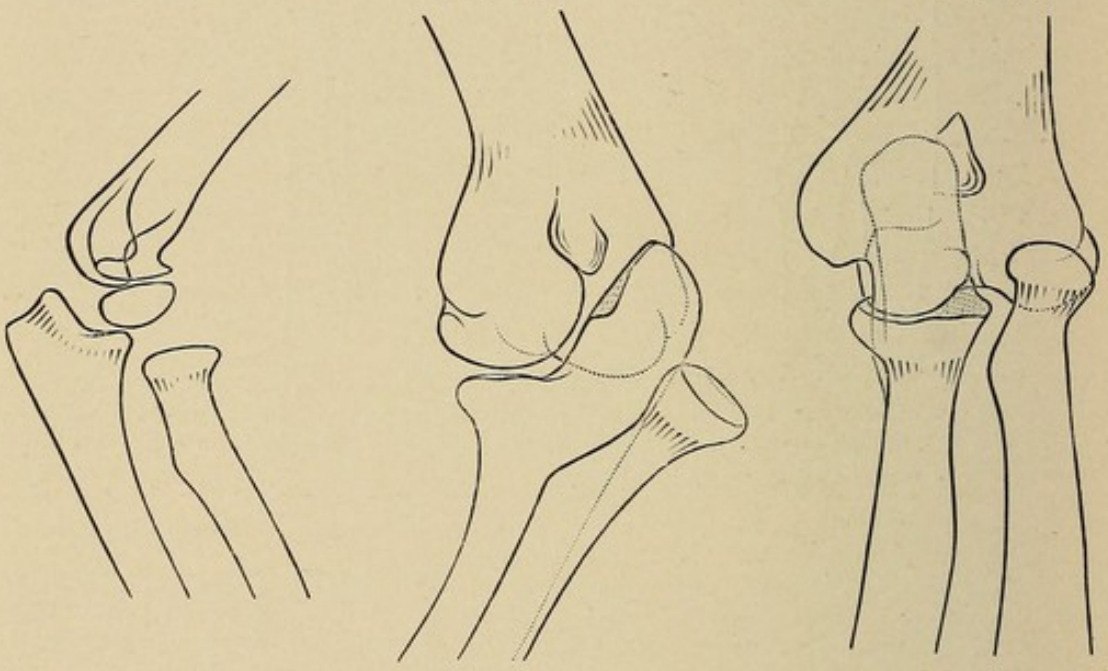


FIG. 282.—Unreduced anterior dislocation of head of radius, in a child, aged seven years. (Recent.) Ossification has not begun in the epiphysis for the head.

FIGS. 283 and 284.—Old, unreduced, posterior dislocation of head of radius, in a female, aged twenty-one years. Not diagnosticated or treated, although the condition was easily recognized at the time the radiographs were made. Fig. 283, nearly lateral view, shows ulna in place, but head of radius displaced back of olecranon. Fore-and-aft view, Fig. 284, shows it above and behind the articular surface of the external condyle.

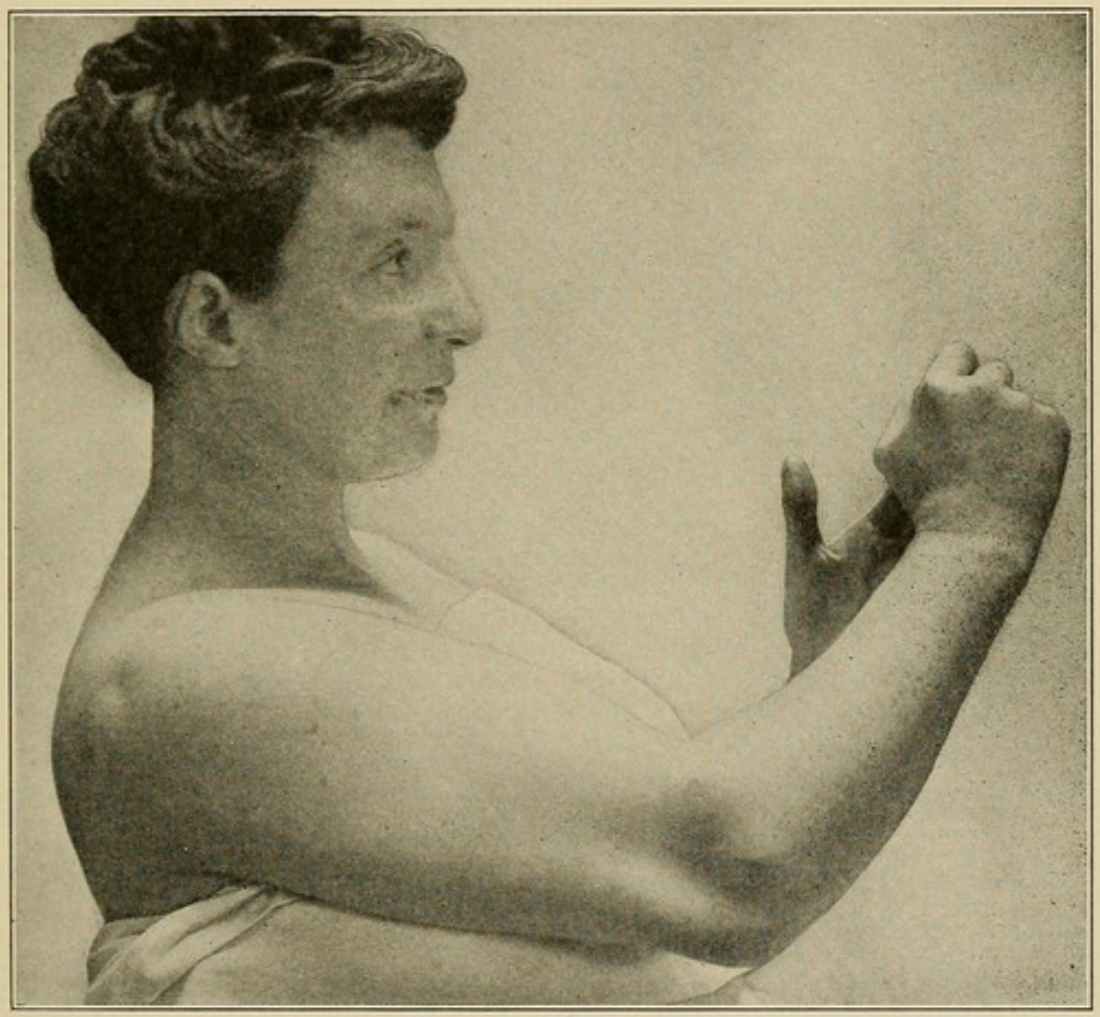
Lateral luxations of both bones of the forearm, incomplete to the inner side or complete or incomplete to the outer side, are characterized by an obvious deformity, the condyle bulging on one side and the displaced ulna or radius on the other. Flexion to or beyond a right angle is possible in these cases and external displacement is complicated by fracture of the inner epicondyle.

Divergent dislocation of the radius and ulna may be anteroposterior, in which case the ulna is displaced behind the articular surface of the humerus and the radius in front of it; or transverse, the ulna being displaced inward and the head of the radius outward.

Dislocation of the ulna alone (rare) is characterized by extension of the arm with limitation of flexion but free rotation. Palpation shows the head of the radius in place, the olecranon displaced posteriorly, the trochlear surface of the humerus forming a projection in front.

Dislocation of the radius is likely to be forward, and may be complicated by fracture of the ulnar shaft. It may occur from a fall on the hand. Flexion is limited to a right angle; on extending the arm, the head of the radius is found lying in front of its normal position in the bend at the elbow; there is a depression in its normal position below the condyle. Outward luxation of the radius (rare) is readily recognized by the displaced bone. It has been frequently complicated by fracture involving the inner articular surface.

FIG. 285



Backward luxation of ulna and radius. Treated originally for sprain. Exhibiting limited flexion and extension. Shortening of forearm (from external condyle to styloid process of radius), backward projection of the olecranon, prominence of the biceps tendon. Accentuation of the depression behind the external condyle. Backward and outward displacement of the head of the radius.

Subluxation of the radius is supposed to be due to a partial displacement of the head of the bone from the orbicular ligament. It is observed only in young children who have been lifted or pulled by the hand or wrist. There is often, but not always, sudden pain. The affection is marked by disability, the arm hanging at the side with slight flexion at the elbow and pronation of the forearm. The only point of tenderness is over the head of the radius. Supination is limited. The diagnosis is made

by the readiness with which the condition is cured by traction and forcible supination.

Inflammation of the Elbow.—The skin overlying the region of the elbow, is subject to the inflammatory affections observed in other parts of the body. On the back of the elbow the lesions of psoriasis and those of secondary and tertiary syphilis are likely to be well marked. In the latter case the eruption is characterized by its indolence, often its symmetry, by its circinate borders, its history, and its prompt yielding to specific treatment.

Acute Circumscribed Inflammation.—Acute circumscribed inflammation, involving the soft tissues about the elbow-joint, may appear as a boil or carbuncle, as a bursitis or an adenitis.

Acute Bursitis.—The bursa commonly involved is that lying between the olecranon and the skin. The affection is usually traumatic, often accompanied by a wound. It is marked by heat, redness, swelling, fluctuation, and often fine crepitation from blood effusion. If pus forms, the local inflammatory symptoms are rapidly progressive and are associated with general symptoms of septic absorption. The diagnosis is based on the seat of the inflammation which is distinctly subdermal, fluctuation from the first, and absence of joint involvement.

Chronic bursitis, which may be traumatic or a local expression of toxemia or infection, is characterized by the rapid or slow formation of a usually fluctuating tumor in the position of the olecranon bursa.

Acute adenitis, secondary to infection of the ulnar side of the hand or forearm, develops in front of the internal condyle or just above it, forming a tender, primarily hard tumor, over which the skin is freely movable. This may subside or suppuration may occur, in which case the skin becomes reddened, edematous, and adherent, and softening takes place in a few days. There is often associated axillary enlargement, and constitutional symptoms of septic absorption are usually present.

Inflammation of the Elbow-joint.—The elbow follows the knee in the frequency with which it is subject to inflammation. When distended by exudate, the elbow-joint is fixed in a position of slight flexion (130 degrees). The swelling due to the joint effusion is most easily perceived at either side of the olecranon process and triceps tendon, and between the external condyle and the head of the radius.

Acute Arthritis of the Elbow.—This is usually traumatic, rheumatic, or gonorrheal.

In its acute suppurative form it is due to direct infection by wound or extension from surrounding parts, as from osteomyelitis, epiphysitis, or periarticular suppuration; or is a local expression of a general infection (pyemia, typhoid, pneumonia).

Acute traumatic arthritis, if incident to contusion or sprain, causing a blood effusion into the joint, is characterized by pain, disability, distention of the joint capsule, and moderate periarticular swelling, with prompt (days) and complete subsidence. Persistent pain, tenderness, disability, and swelling suggest a bone lesion or a beginning tuberculosis.

A form of recurring traumatic arthritis is that incident to a loose body in the joint, which may be present without symptoms or may cause sudden painful locking, limiting extension, and followed by effusion into the joint. The diagnosis is made by the suddenness of the attacks of painful locking, their recurrence, inexplicable except on the basis of a movable mechanical obstruction and, at times, by the detection of the foreign body on palpation.

Acute rheumatic arthritis of the serous type is suggested by high fever, acid sweats, involvement of other joints, and the absence of demonstrable systemic or local infectious cause.

Acute gonococcal arthritis is usually of the serofibrinous and periarticular form, is exceedingly painful, obstinately persistent, and results in joint destruction and ankylosis. The diagnosis is suggested by the demonstration of a gonococcal focus elsewhere, and is made at times by bacteriological examination of the joint contents.

Acute suppurative arthritis is characterized by the rapid onset and progression of local symptoms and the prompt development of profound sepsis. Early diagnosis, when this is not obvious from the preceding history, should be made by joint aspiration.

Chronic Arthritis of the Elbow.—This may be post-traumatic, syphilitic, incident to other forms of chronic infection or toxemia or neuropathic. It is usually tuberculous.

Post-traumatic chronic arthritis gives a history of either severe or frequently repeated slight traumatism. It is characterized by bony deformity with consequent mechanical impediment to free mobility, together with pronounced periarticular thickening, and pain on use.

Tuberculous Arthritis.—Tuberculous arthritis is characterized, first, by pain, limitation of motion and muscular atrophy, which may persist for weeks or months preceding appreciable swelling. There is often at this period a point of greatest tenderness to pressure. The focus of infection is usually in the ulnar or humeral epiphyses, exceptionally that of the radius. In its later development, the pallid, fusiform swelling, destruction of whole or part of the joint, softening, and sinus formation are sufficiently characteristic.

The diagnosis should be suggested by a pain in the elbow without adequate cause, persistent and growing worse; by limitation of motion; and by muscular atrophy. The seat of infection should be determined by the *x*-rays.

Associated tuberculous lesions elsewhere or the tuberculin test may aid in the diagnosis.

Syphilitic Arthritis.—Syphilitic arthritis of the elbow, aside from that form characterized by slight intra-articular effusion in the early secondary stage, so closely resembles tuberculous infection that the diagnosis must be based upon the history, associated symptoms, the therapeutic test, and the negative evidence afforded by the tuberculin test.

Osteochondritis of hereditary lues may cause epiphyseal disjunction and flail-joint.

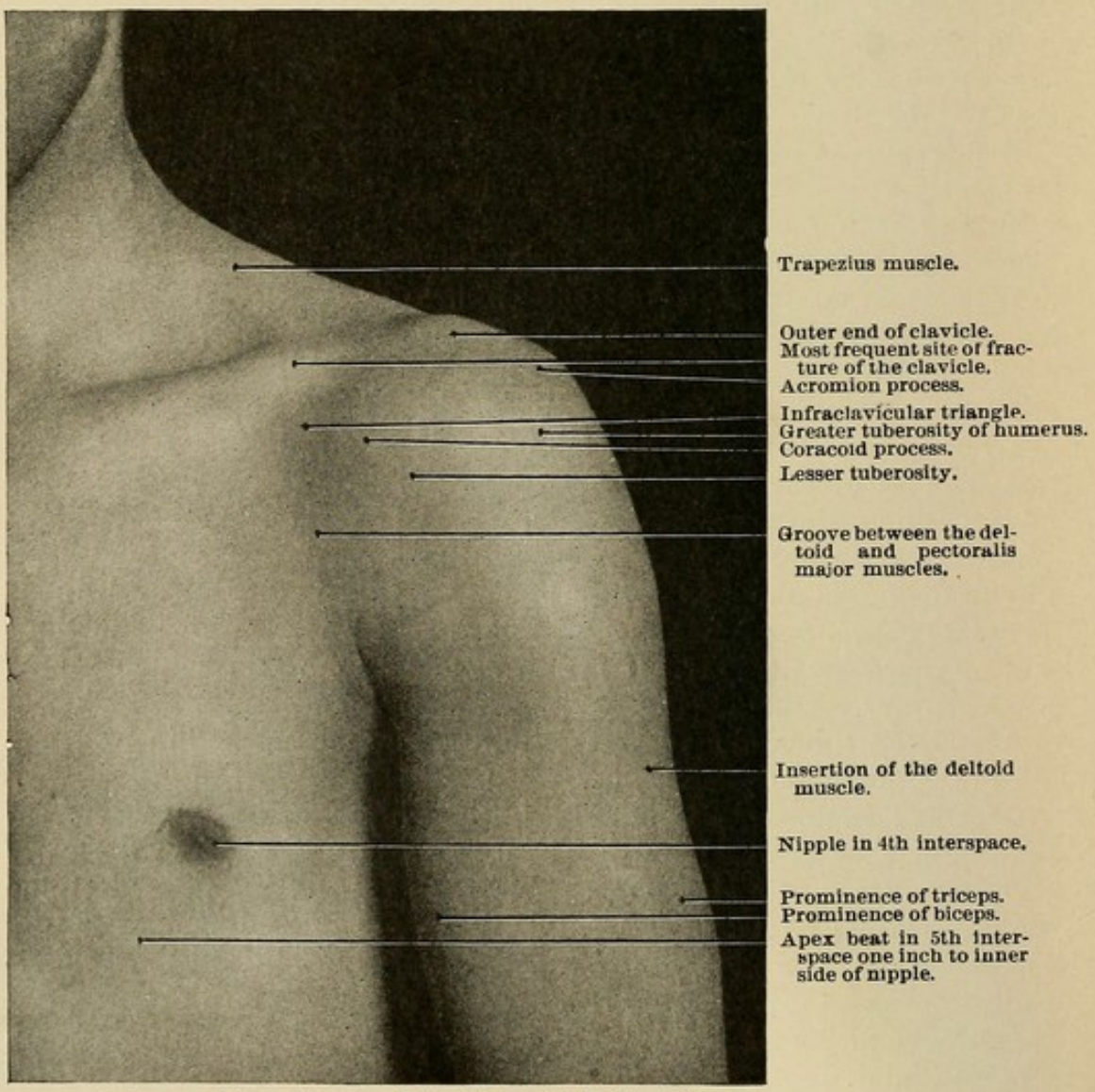
Neuropathic Arthritis.—Neuropathic arthritis of the elbow is symptomatic of syringomyelia or tabes; it is characterized early by hydrops, later by gross bony deformity and rough crepitation without subjective symptoms, the disability being purely mechanical. The diagnosis is based upon the absence of pain, the surprisingly slight disability, and associated symptoms of the major malady.

The benign and malignant tumors about the elbow do not depart from type. Those of the bone are characterized early by pain which is persistent and localized, later by rapid growth. They should be diagnosticated by excision and microscopic examination.

THE ARM AND SHOULDER.

The shoulder owes its rotundity to the deltoid muscle supported beneath by the acromion process and the greater tuberosity of the humerus. The latter, projecting beyond the anterior third of the

FIG. 286



Surface markings of arm and shoulder. (G. G. Davis)

acromial margin, underlies the most prominent (point) part of the shoulder, and, if widely displaced, as in luxation, allows the deltoid to fall inward, making the acromion unduly sharp and prominent.

The greater tuberosity and, by outward rotation, the lesser tuberosity and the bicipital groove between them can be felt in thin subjects when there is no local swelling.

Since the sheath of the long head of the biceps communicates directly with the joint, effusions into the latter, if abundant, may be detected by swelling in the bicipital groove.

The coracoid process can be felt in the groove between the great pectoral and the deltoid muscle by deep pressure a finger's breadth below the junction of the middle and outer third of the clavicle.

The clavicle is palpable throughout its course; its outer articulation is often congenitally placed on the upper instead of the anterior surface of the acromial process, thus giving the impression of displacement.

Examination of the shoulder should first be visual, the patient being stripped to the waist for comparison of the two sides. Then functional, the patient attempting to move the two arms together in the directions indicated. Palpation and passive motion are next practised. Finally, in case of doubt, the *x*-rays should be used.

The normal shoulder-joint should allow the heel of the hand to be placed on the acromion process of the opposite side, with the inner surface of the arm pressed closely against the chest; the palm to be carried around the opposite side until it rests on the midposterior portion of the neck, with the arm at a right angle to the long axis of the body; both hands to be carried backward until the knuckles of each touch the scapular angle of the other side; both arms to be carried outward without moving either scapula until they form a right angle with the long axis of the body; both arms carried upward until the midbicipital region of each touches the ear of its corresponding side. Normal rotation is through about a quarter of a circle.

The usual effect of trauma is bruise or sprain, the prognosis of which must be guarded. Pronounced periarticular swelling, following trauma, is presumptive evidence of more serious injury.

Obvious tumors of the deltoid region are usually not from the joint. They are generally fatty, bursal, or sarcomatous. Joint inflammations limit motion in all directions, but not equally so. Tuberculous inflammation involves the humerus and scapula more frequently than it does the joint.

Sprengel calls attention to a congenital deformity usually affecting the scapula of the left side, which is abnormally elevated and rotated. Because of the rotation the supraclavicular space is practically obliterated. Disability is most marked when efforts are made to elevate the arm. There is often a fibrous or bony attachment of the scapula to the cervical vertebræ.

Deformities of congenital origin, such as absence of the entire upper extremity, or shoulder, insertion of the hand, the arm and forearm being absent, are obvious.

The same may be said of acquired deformities, such as the curved and stunted humerus of rickets, or the atrophied, flail-like, useless joint of infantile palsy, probably incident to birth trauma or acute poliomyelitis.

Kirmesson notes that in cases of infantile palsy the upper fibers of the trapezius remain sound and hence are able to raise the front of the shoulder. An early diagnosis may enable much to be done for the prevention of ultimate crippling.

Limitation of motion, or ankylosis of the shoulder, may follow muscular contracture or any of the forms of arthritis or periarthritis. Even when the shoulder-joint is completely ankylosed, there may be comparatively free movement. In conducting an examination, the scapula should be grasped with one hand, while the arm is moved in various directions by the other. In case of complete joint fixation, the shoulder blade will be found to participate in all the movements of the humerus. When the joint is excessively tender, a correct estimation of the limitation of motion calls for the administration of an anesthetic.

Traumatism of the Arm and Shoulder.—Wounds and, indeed, all severe traumatisms call for an examination of the sensory and motor power of the hand and arm, in order to determine the presence or absence of nerve lesion, and the search for the radial pulse as an assurance against occlusion of the main artery.

Rupture of the muscles, commonly of the biceps, is characterized by sharp pain, sudden loss of power, and the formation of a soft tumor, pressure on which shows a break in continuity aggravated by contraction. Rupture of the tendon of the biceps is characterized by the same symptoms. When the long head of the biceps is ruptured, on account of its deep position the break in continuity may not be discovered. The disability and sharp pain incident to muscular action, often the sensation of something having given way, and the partial luxation inward and forward of the head of the humerus are characteristic.

Stretching or contusion of the nerves of the upper arm is characterized by anesthesia, loss of power, often by persistent and harassing neuritis, and by muscular atrophy.

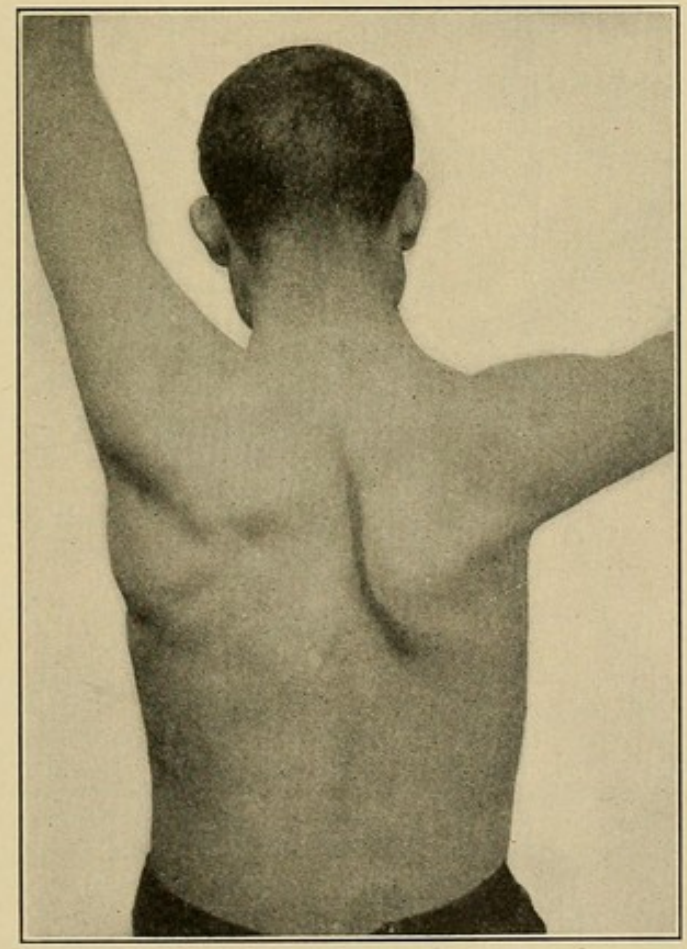
Contusion and Sprain of the Shoulder.—Contusion is due to direct force, usually a fall on the point of the shoulder. Sprain is usually caused by violent wrenching of the humerus upward or backward, or twisting inward. These injuries are characterized by severe pain, pronounced disability, tenderness at the point of direct bruise or capsular tear, and, in the case of sprain, late ecchymosis, often extensive, commonly appearing on the inner side of the arm. The ruptured capsule may tear away a fragment of bone with it.

The distinction from luxation is made by finding the head of the humerus in its normal position; from fracture by the absence of char-

acteristic symptoms of this affection. The motions of abduction and outward rotation are usually most painful and are sharply limited. There may be blood effusion into the joint, which, if extensive, may be palpated. The reactive inflammation often becomes chronic in the middle-aged and elderly, causing deltoid atrophy, weeks or months of harassing pain, periarthritic thickening and contracture, and partial or complete fixation of the joint.

Injuries of the shoulder-joint depart from the rule that persistent disability and tenderness following trauma justify the assumption that there has been a lesion of the bone. Even though clear *x*-ray pictures fail to show such lesion, the ultimate prognosis of contusion or sprain of the shoulder must be guarded. This disability is often attributable to a chronic post-traumatic inflammation of the subdeltoid bursa, resulting in adhesion of its walls and obliteration of its cavity.

FIG. 287



Paralysis of the serratus magnus (long thoracic nerve). Arm cannot be carried beyond a right angle with the long axis of the body. Posterior border of the scapula prominent.

Fractures.—Fractures of the shaft of the humerus (frequent), transverse, oblique, or spiral, in the latter case at times comminuted, are usually due to direct force, are simple, complete, and exhibit all the characteristic features of the injury. A complicating lesion to the musculospiral nerve at the time, or later as the result of callus formation,

is frequently noted. Muscular interposition, preventing crepitus and later causing non-union, is occasionally observed in these fractures.

Fractures of the upper extremity of the humerus may involve the head of the bone or may pass through the anatomical neck. In either case the injury is intracapsular. They may pass through the tuber-

FIG. 288[1] FIG. 289

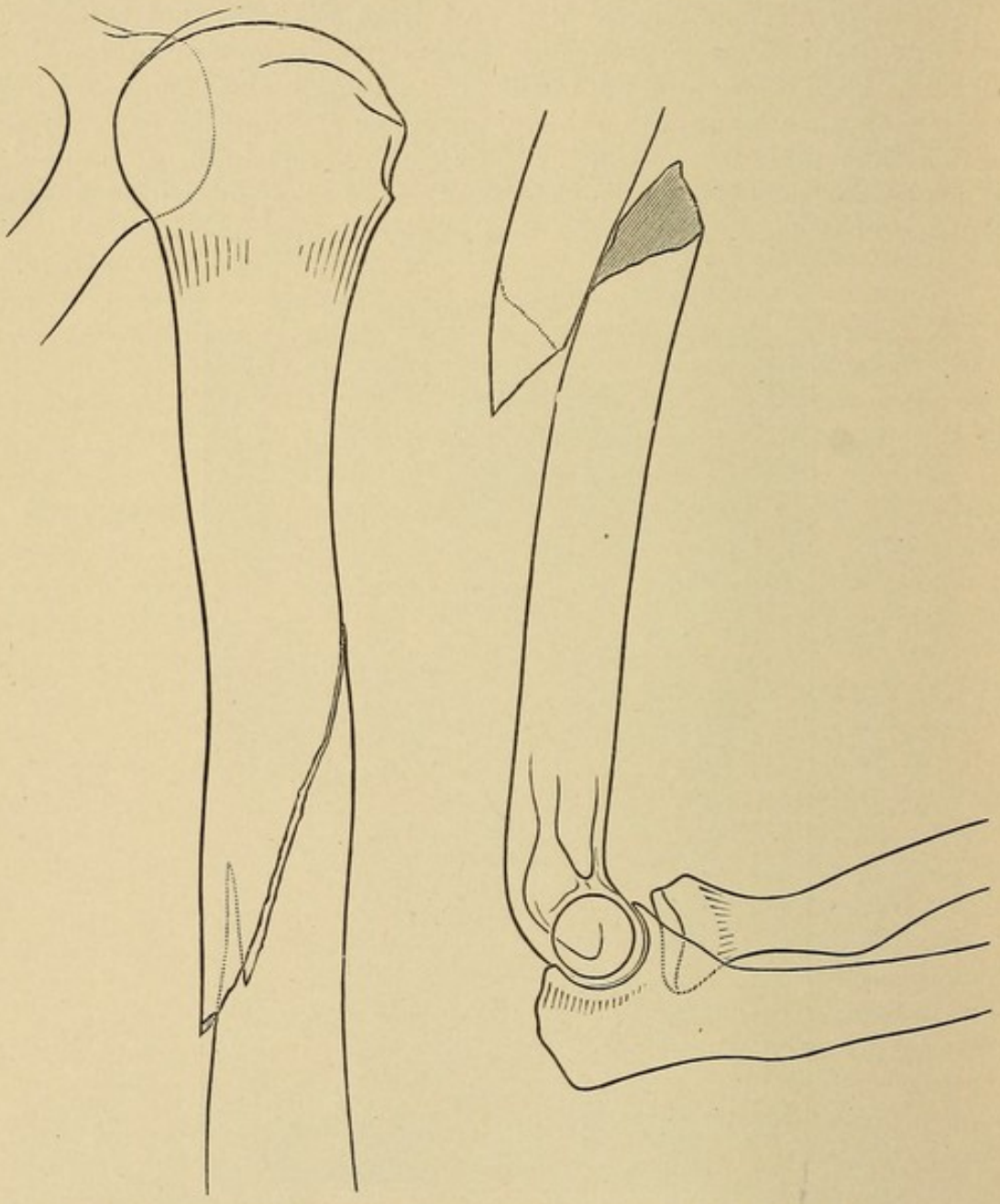


FIG. 288.—Oblique fracture through middle portion of shaft, in an adult male.

FIG. 289.—Fracture at middle of shaft, in an adult female. Anterolateral view shows line slightly oblique, marked displacement, and complete over-riding with considerable shortening, the lower fragment being anterior. Clinical diagnosis of fracture easy, but *x*-rays important for determining displacement.

[1] Figs. 288 to 295. Fractures of the shaft of the humerus. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from services of Drs. White and Siter, and private cases of Dr. Pancoast.

Fig. 290

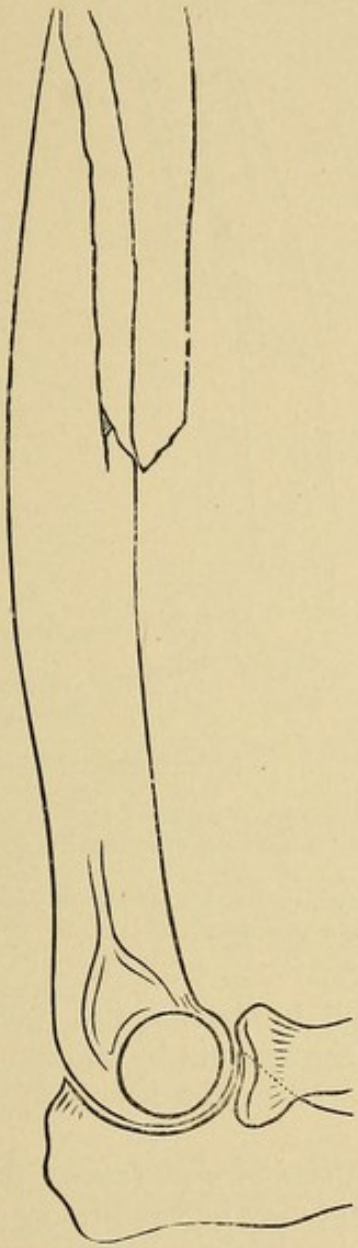


Fig. 291

Fig. 290.—Longitudinal fracture involving middle third of shaft, in an adult male. Occurred while throwing a baseball. (Unusual but not uncommon cause of such fractures.) An important feature is the fact that the anteroposterior view (usually the only one that can be made because of the form of dressing), while showing the fracture, gave the impression of perfect apposition. The lateral view here represented (taken with dressing removed) reveals a complete separation. Under such circumstances union would either not take place or would be much delayed. Clinical diagnosis of fracture not difficult, but *x*-rays very important for determination of deformity.

Fig. 291.—Transverse fracture about junction of lower and middle thirds of shaft, in a boy, aged nine years. Anteroposterior view indicates apparent good approximation. (Compare with Fig. 292.)

osities or beneath them (surgical neck), may involve the greater or lesser tuberosity, or may appear as comminuted breaks representing combinations of these forms. They are observed most frequently in old age or youth.

Fracture of the head of the humerus, usually fissured and without displacement, is characterized by disability, pain, and tenderness, best

Fig. 292

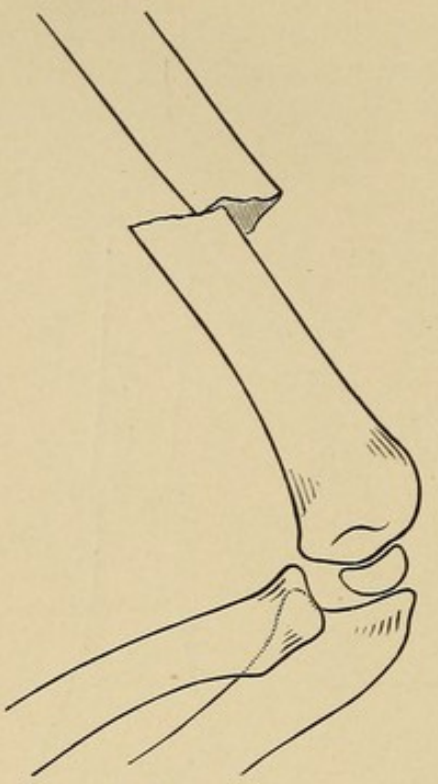


Fig. 293

Fig. 292.—Lateral view of same case as Fig. 291, shows almost complete forward displacement of lower fragment. Clinical diagnosis of fracture easy, but importance of careful *x*-ray examination is apparent.

Fig. 293.—Comminuted fracture in lower third of shaft, in a girl, aged eleven years, resulting from a fall. Lateral view after reduction shows good approximation.

elicited by deep axillary palpation and by jarring the head of the humerus against the articular surface of the scapula by sudden pressure against the abducted and flexed elbow. It can be positively diagnosticated only by the *x*-rays.

This is also true of *fracture of the anatomical neck* (above the tuberosities). The small intracapsular fragment may be completely reversed. The joint is unduly lax, the disability is absolute, and crepitus may be elicited by abduction, traction, and rotation of the humerus, the fingers of the examining hand being pressed deep in the axilla. In case of impaction, crepitus will be absent and all the other symptoms will be less marked.

Fracture through the tuberosities, epiphyseal in young people (before the age of twenty), often impacted in older ones, results from direct violence.

Epiphyseal fracture without deformity and impacted fracture are impossible to diagnosticate without the *x*-rays. Deformity, if it exists, is usually due to a forward and upward displacement of the upper end of the lower fragment, which may be felt beneath the coracoid process. The presence of the head in its normal position, its failure to rotate with the shoulder, the preservation of the shoulder rotundity, preternatural mobility, and soft or grating crepitus, exclude luxation; more-

FIG. 294 FIG. 295

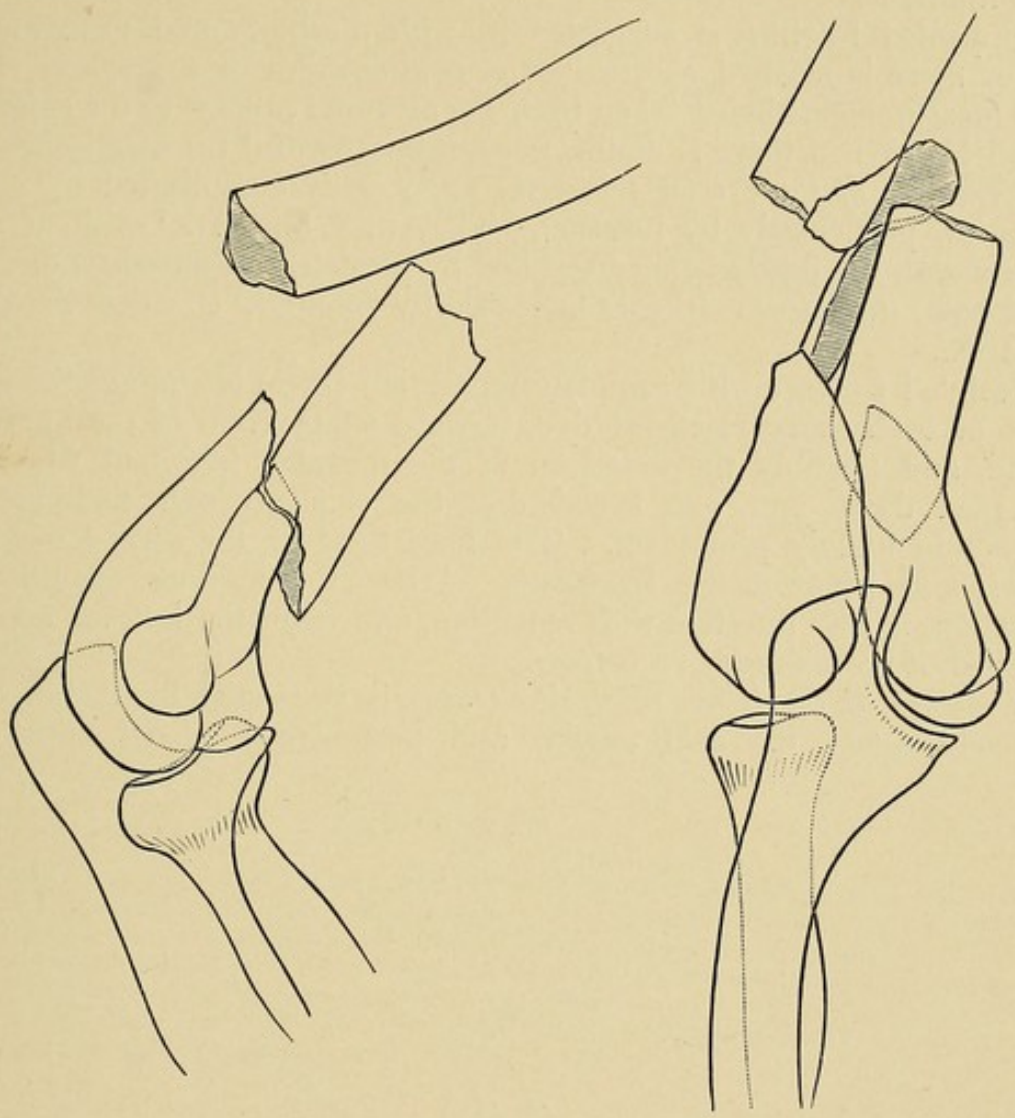


FIG. 294.—Multiple fracture in lower third of humerus, and compound, in a sailor, aged twenty-two years, resulting from a fall from a great height. The lateral view here represented was the only one possible at the first examination, and indicates two separate fractures of the shaft, with complete separation between upper and middle fragments (see Fig. 295).

FIG. 295.—Same case as Fig. 294, anterolateral view obtained after a change in form of dressing following a partial reduction. Indicates an additional longitudinal fracture of the lower fragment, splitting the condyles apart. This view fails, however, to show the break between the middle and lower fragments which is distinctly evident in the direct lateral view.

over, the fracture occurs at a time of life when dislocation is rare. From fractures of the surgical neck the diagnosis can be made only by the *x*-rays.

Fracture of the surgical neck (beneath the tuberosities) is the one most frequently found in the upper extremity of the humerus. It is especially common in elderly people because of senile atrophy. The upper end of the lower fragment projects upward and forward. Characteristic fracture symptoms are usually present.

Distinction from luxation is made by the finding of the head of the

bone in its normal position and its failure to rotate with the shaft of the humerus.

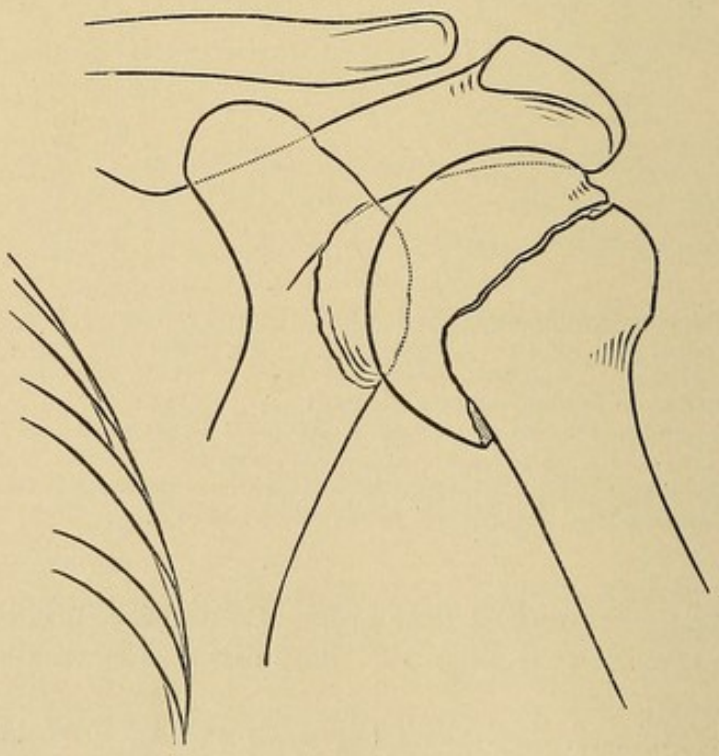
Impacted fracture is suggested if, with disability and pronounced pain, there is marked shortening as contrasted with the sound side, the measurements being taken from the acromial process to the external condyle. When there is doubt, the *x*-ray is needful for diagnosis.

Fractures of the greater tuberosity are usually complicated by other injuries, particularly by luxation. They may be partial without displacement, the injury being suggested by persistent localized tenderness and pain, the latter markedly increased by voluntary efforts at external rotation.

Isolated fracture with complete separation (rare) is characterized by free or even exaggerated rotation, forward subluxation of the humeral head, and possibly the detection of the movable fragment which is dragged down and out, broadening the shoulder and making the acromion unduly prominent. The long head of the biceps may be interposed between the fragments. When the fracture complicates luxation, it may interfere with reduction, and when the latter is accomplished, it permits easy recurrence.

Fracture of the lesser tuberosity (rare) is suggested by inability to actively rotate the arm inward and persistent localized pain and

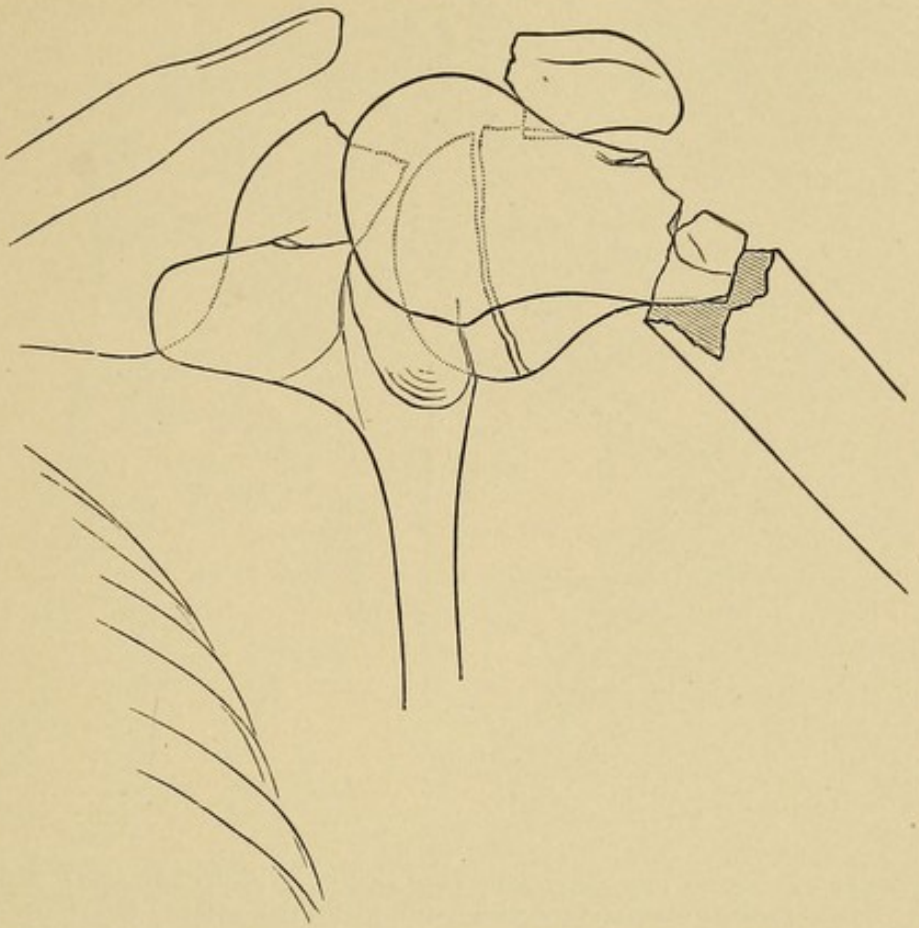
FIG. 296[1]



Fracture of the anatomical neck, caused by direct violence. Patient an adult male.

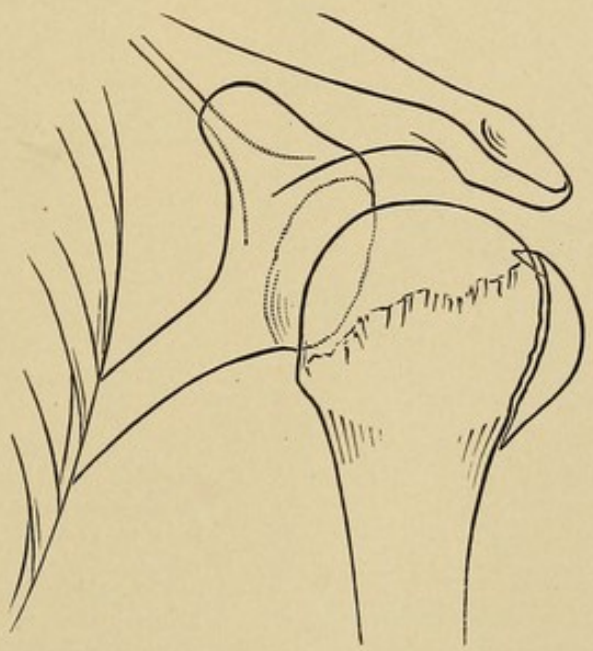
[1] Figs. 296 to 308. Fractures of the upper portion of the humerus. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; cases referred by or from services of Drs. White, Frazier, Carnett, Young, and Spellissy, from dispensaries, and private cases of Dr. Pancoast.

FIG. 297



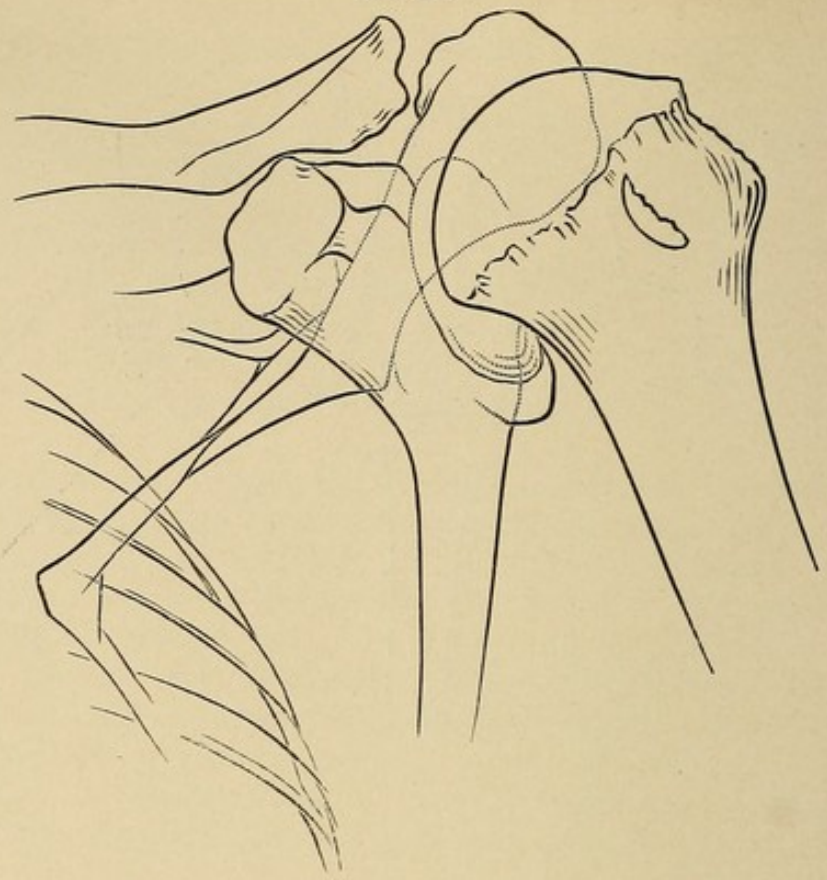
A complicated injury of the shoulder comprising the following distinct fractures: (*a*) Fracture through the surgical neck; (*b*) a longitudinal fracture extending downward through the head to the line of the previous one, and splitting the upper portion of the bone lengthwise into two parts; (*c*) a fracture of the portion of the anatomical neck represented in one of these fragments; and (*d*) a fracture of the acromion process with wide separation of the fragment from its clavicular attachments. Such injuries are the result of unusually severe violence, and in this instance the patient, a male, aged twenty-four years, was struck by a train.

FIG. 298



Fracture of the greater tuberosity of the humerus, without separation of the fragment. Patient a female, aged fifty-seven years.

FIG. 299



Fracture of the greater tuberosity, with wide separation and displacement inward of the fragment. This fracture complicated a dislocation which was reduced before the radiograph was made. The *x*-rays show it to be not an uncommon complication of shoulder dislocations. Patient a male, aged eighty-six years.

FIG. 300

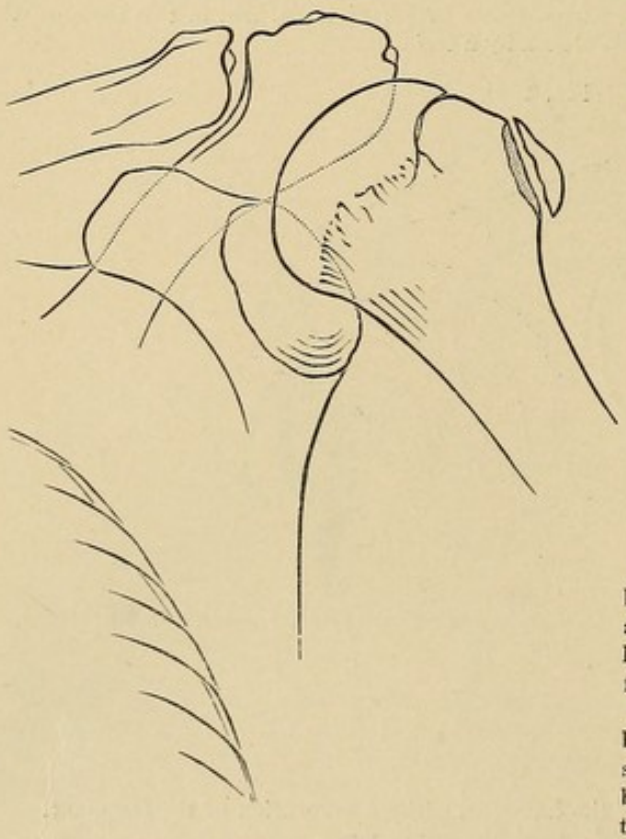


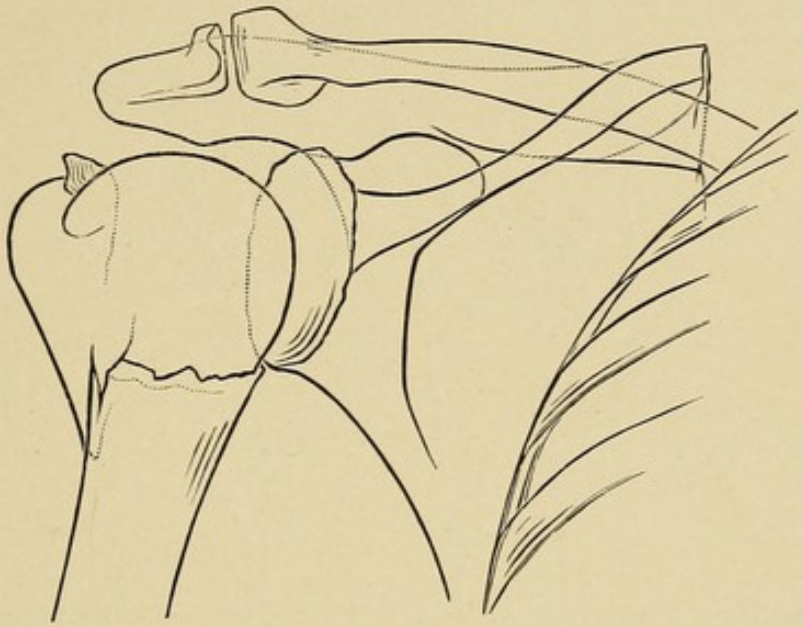
FIG. 301

FIG. 300.—Fracture of the greater tuberosity and incomplete fracture of the anatomical neck resulting from direct violence by a blow of a fist. Patient an adult female.

FIG. 301.—Fracture of the greater tuberosity and incomplete fracture of the surgical neck resulting from direct violence by striking the shoulder during a fall on the ice. Patient a female, aged thirty-six years.

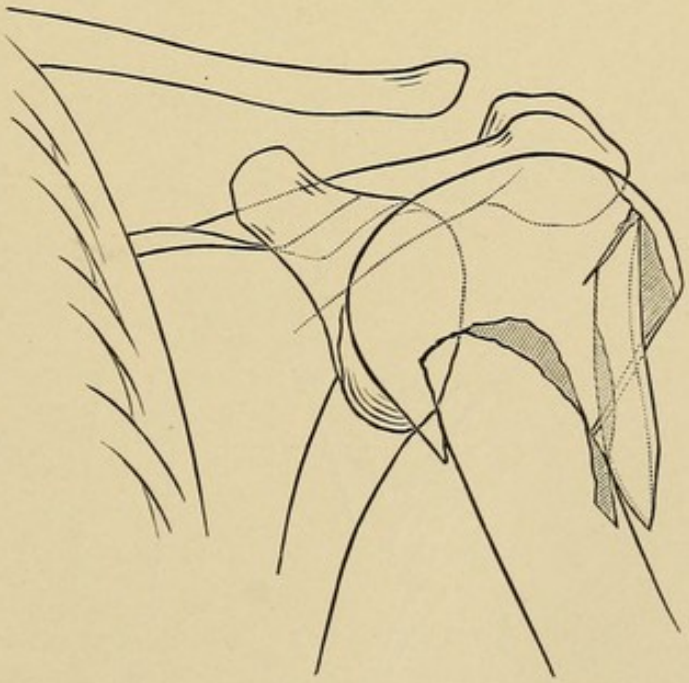
tenderness. Crepitus and mobility may be elicited. The *x*-rays may be needful for diagnosis, especially when it is a complication of displacement.

FIG. 302



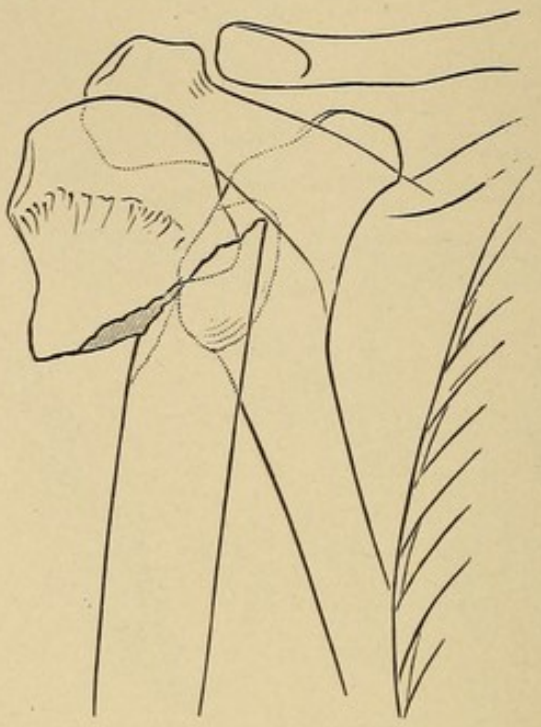
Old fracture of the greater tuberosity and the surgical neck. This injury was the result of an automobile accident. No diagnosis of fracture was made at the time, and the patient was treated for a contusion of the shoulder. The radiograph here represented was made when she consulted a surgeon later for an ankylosis of the joint. Although union was complete and the fragments were in fairly good apposition, there was firm fixation of the joint. Patient an adult female.

FIG. 303



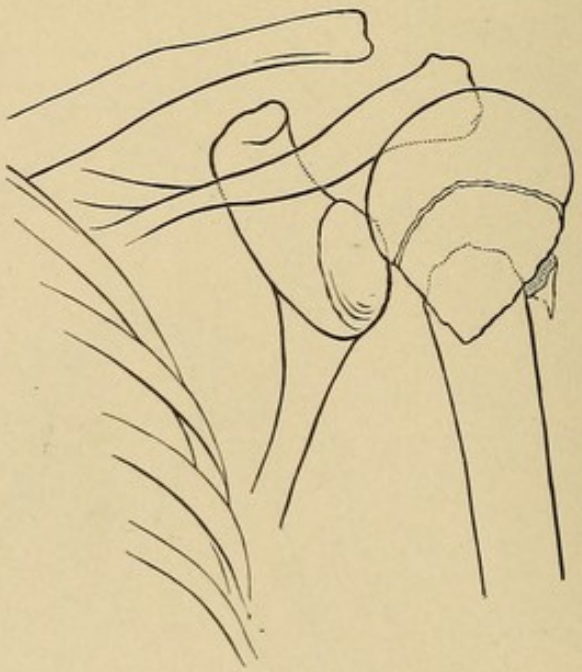
Impacted fracture of the surgical neck with comminution of the upper fragment of the head, which is apparently split apart by the entering wedge of the shaft. Patient a male, aged forty-one years.

FIG. 304



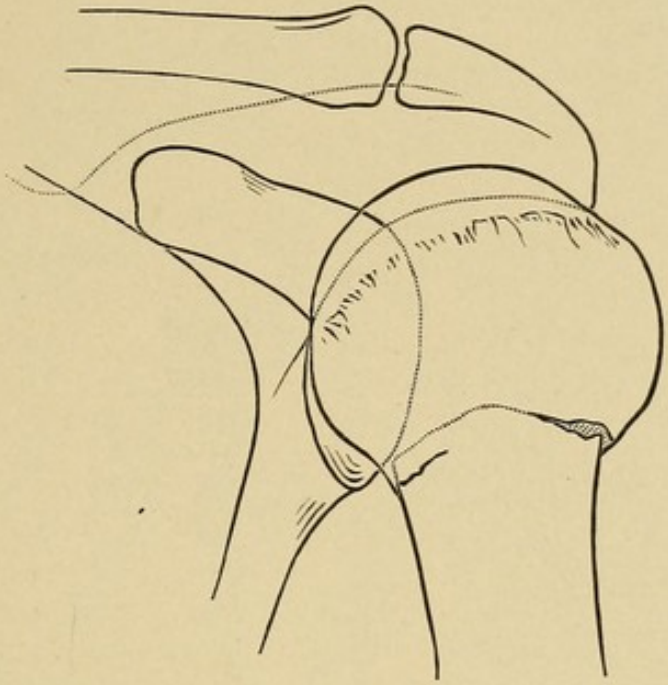
Fracture of the surgical neck, which, with the accompanying typical deformity, presents an appearance conforming with the usual graphic description of this injury. The upper fragment is rotated outward, while the lower one is displaced upward and inward. The nature of this fracture and the direction of the line readily explain why the displacement shown had resisted repeated attempts at correction. Patient a female, aged fifty-six years.

FIG. 305



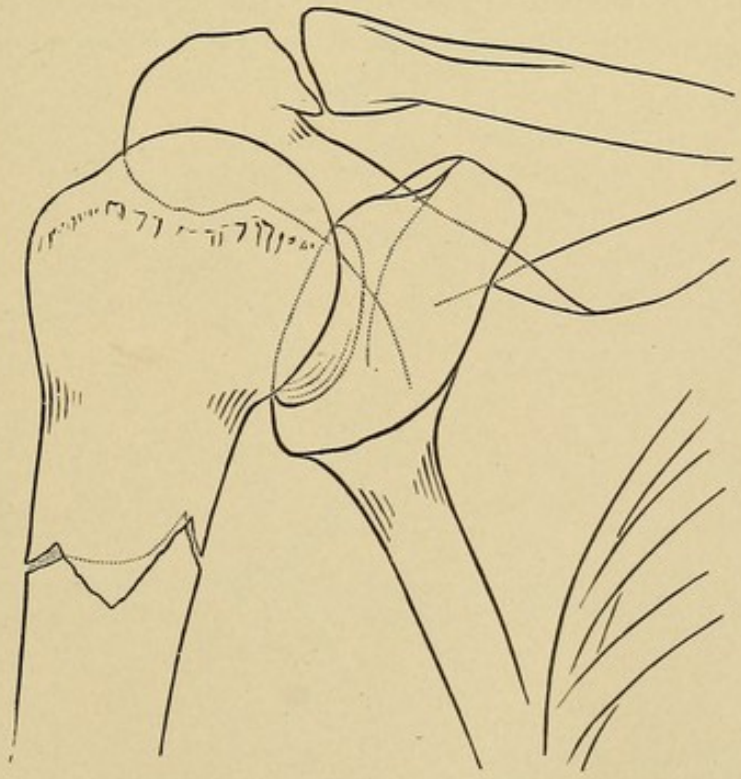
Fracture of the surgical neck in a child, aged ten years. In children the injury in this part of the bone may be either an epiphyseal separation or a fracture of the surgical neck below the line, depending largely upon the nature and the direction of the force.

FIG. 306



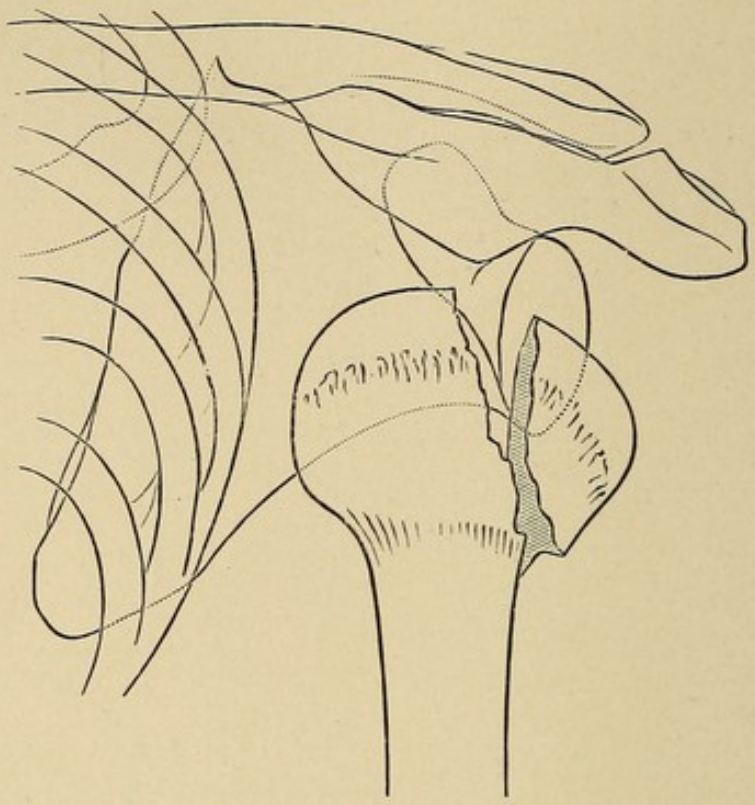
Fracture of the surgical neck, probably complete, but in some respects resembling an incomplete fracture. The injury was due to direct violence. There were no cardinal symptoms of fracture in this case, pain aggravated by rotation and local tenderness being the only physical signs directly referable to a break. Patient an adult male.

FIG. 307



Fracture of the shaft just below the surgical neck. Although complete, the only signs directly referable to the fracture in this case were pain and local tenderness, and an exact diagnosis was dependent solely upon the *x*-ray examination. Patient an adult male.

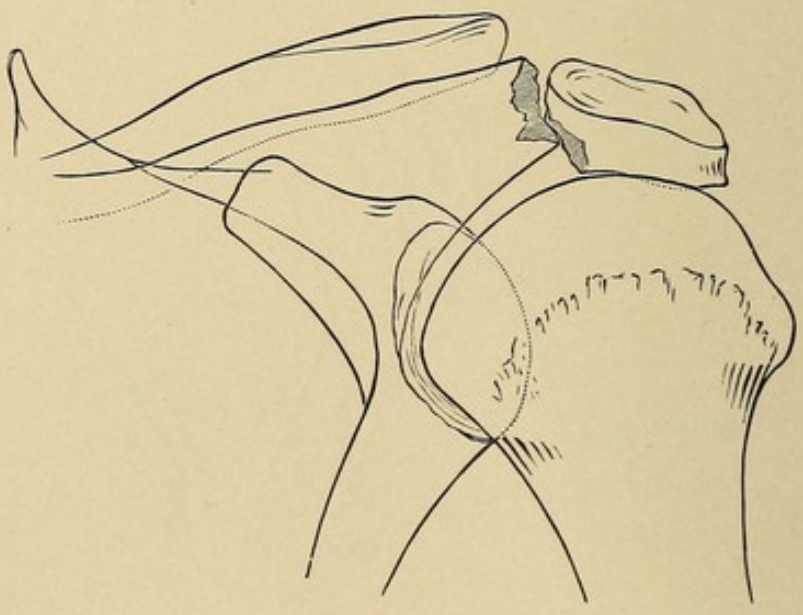
FIG. 308



Subcoracoid dislocation of the shoulder, complicated by fracture of the tuberosities of the humerus, in an adult female. Clinical diagnosis of dislocation not difficult, but of fracture uncertain in respect to exact seat.

Fracture of the Scapula.—Fracture of the scapula is rare. These fractures may be articular, a portion of the joint surface being chipped

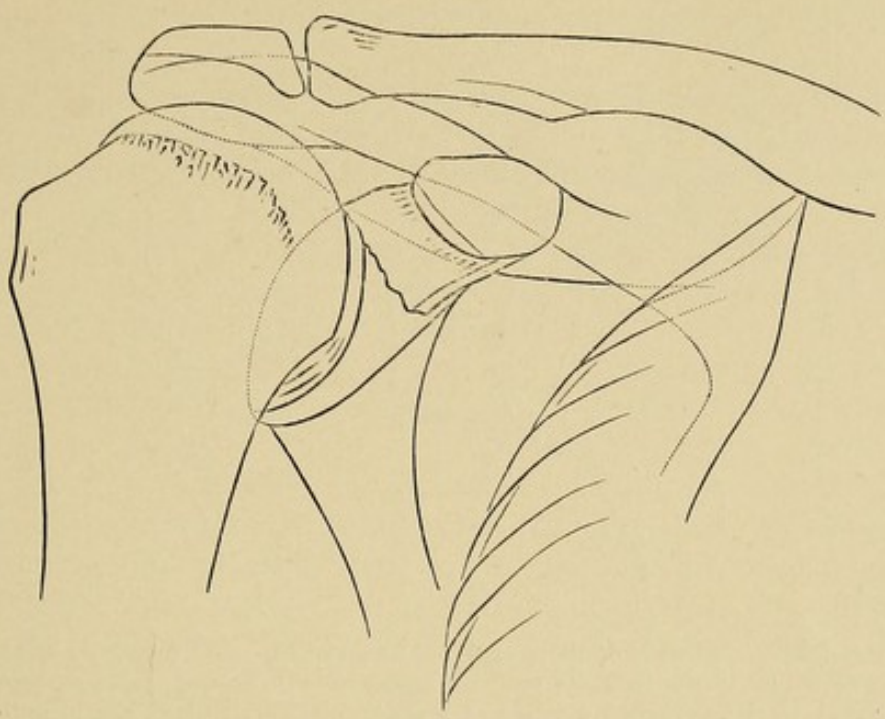
FIG. 309[1]



Fracture of the acromion process. Patient an adult male.

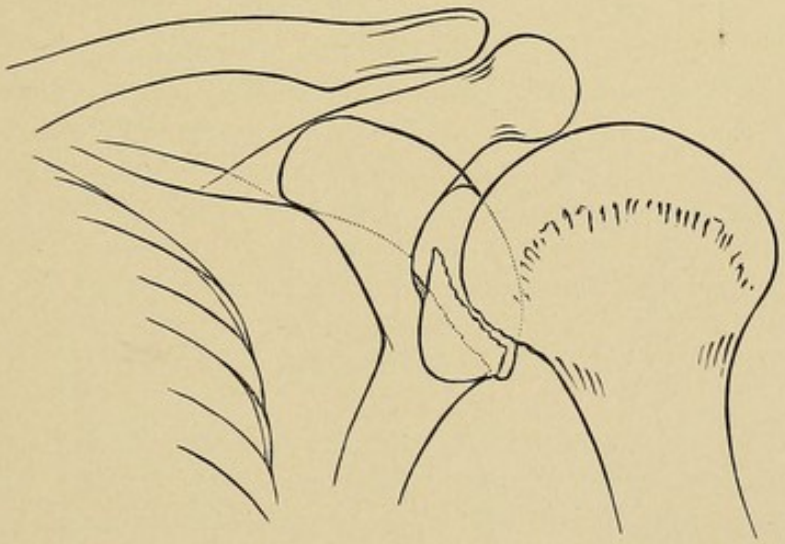
[1] Figs. 309 to 313. Fractures of the scapula. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. Frazier, Fussell, and White, from dispensaries, and private cases of Dr. Pancoast.

FIG. 310



Fracture of the coracoid process. The cardinal symptoms of fracture were absent in this case, the moderate degree of downward and outward displacement preventing crepitus. The condition was strongly suspected clinically, but an exact diagnosis could not be made. This fracture is not only difficult to diagnosticate clinically, but is very easily overlooked radiographically as well. Patient a male, aged fifty-seven years.

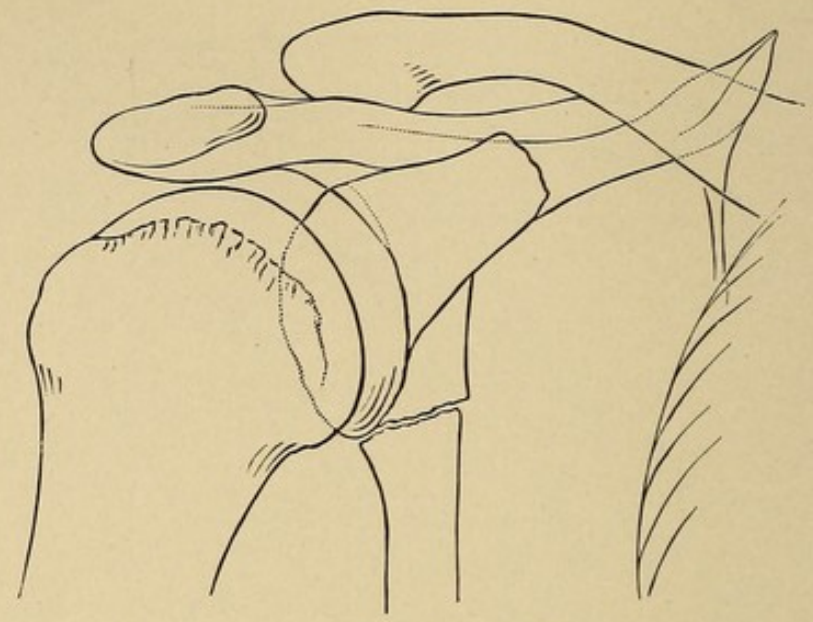
FIG. 311



Old fracture of the lower portion of the lip of the glenoid cavity, with probably more or less union of the somewhat displaced fragment, resulting in partial ankylosis of the shoulder-joint. Patient a female, aged sixty-two years.

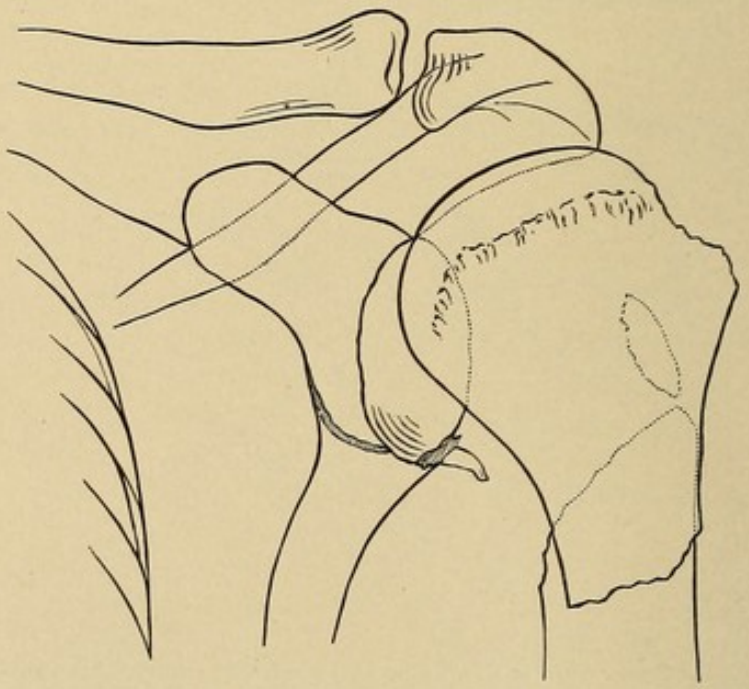
off usually as a complication of luxation, or the whole joint surface being avulsed (anatomical neck). They may pass through the surgical neck, the lesser fragment then including the coracoid process, through the acromion process, the coracoid process, the spine, or any part of the body of the bone.

FIG. 312



Fracture of the surgical neck of the scapula. The line of fracture can be seen only through the thick outer border of the bone, its probable course upward toward the suprascapular notch being concealed by the thickened portions of bone forming the root of the coracoid and the spine, and possibly also by some overlapping of the separated fragment. Patient a male, aged forty years.

FIG. 313



A complicated injury of the shoulder comprising four distinct fractures: (*a*) The surgical neck of the scapula; (*b*) the lower portion of the lip of the glenoid cavity; (*c*) the shaft of the humerus just below the surgical neck; (*d*) the greater tuberosity of the humerus, the fragment of which is considerably displaced downward and inward. Patient an adult male.

Fractures of the articular surface, usually limited to small parts, or stellate, exceptionally involving the entire articular surface, are diagnosticated by tenderness, disability, crepitus, and the *x*-rays. The last

form presents features much like those of fracture of the surgical neck, except that the coracoid process does not move with the humerus and lesser fragment.

Fracture of the surgical neck, usually from direct violence, is characterized by dropping and abduction of the arm, flat shoulder with prominent acromion, free passive movement, and absolute disability. There is lengthening as measured from the acromion to the external condyle. Deep axillary palpation may detect the fragment, and usually gives crepitus if the humerus is pushed up and rotated. The coracoid process follows the motions of the humerus.

The easy, grating reduction of deformity, by pushing up the humerus, and its prompt recurrence on removal of pressure, distinguish this lesion from luxation.

Fractures of the acromion process are in youth epiphyseal, and are complicated at times by dislocation of the outer end of the clavicle. These fractures are characterized by marked disability and tenderness, crepitus, and slight mobility, best elicited by alternately pulling and pushing the abducted humerus and direct manipulation. Usually there is no deformity.

The *x*-rays may be deceptive since the acromial epiphysis may remain permanently separated from the scapular spine by a cartilaginous plate.

Fractures of the coracoid process (rare) result from direct trauma or muscular action. They are characterized by disability, localized tenderness, swelling, and crepitus; if the ligamentous attachments are torn away, downward displacement. Localized tenderness, mobility, and crepitus may be detected by deep, direct palpation.

The diagnosis of this affection is theoretical rather than practical, except with the aid of the *x*-rays.

Fractures of the spine, body, or angles of the scapula, due to direct force, are characterized by pain, swelling, and usually but little deformity. The detection of mobility and crepitus is diagnostic, and, if the fracture be complete, is easily accomplished by grasping and manipulating the bone. The traumatic inflammation of the subscapular bursa may give crepitus, pain, and disability, which should not be mistaken for fracture.

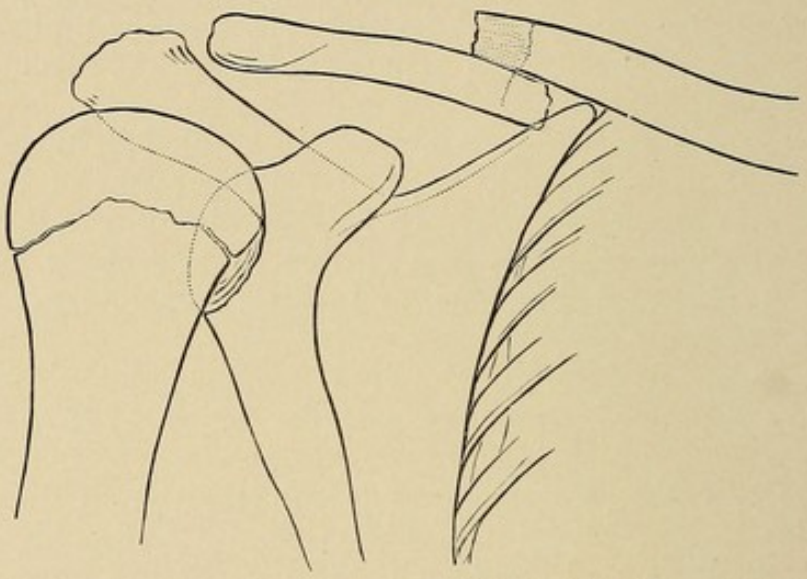
Fractures of the Clavicle.—*Fractures of the outer third of the clavicle*, if within the limits of the coracoclavicular or acromioclavicular ligaments, are attended with localized pain and tenderness, and disability, but with displacement so slight as to escape detection on examination, though the bone throughout its whole extent is subcutaneous. If the break be between these ligamentous attachments, the displacement is usually obvious. It is distinguished from luxation by the angularity of the projecting fragment and crepitus.

Fractures of the middle third, usually at the junction of the middle and outer third, may be transverse or oblique. They occur most frequently in children as the result of a fall on the hand or shoulder, and are often incomplete. The complete fracture is characterized by deformity

which can be seen and felt, mobility and crepitus, detected by grasping and manipulating the fragments or by raising, depressing, and abducting the shoulder while the seat of injury is palpated. There is late (days) ecchymosis over the seat of injury. In the case of children there may be surprisingly little loss of function.

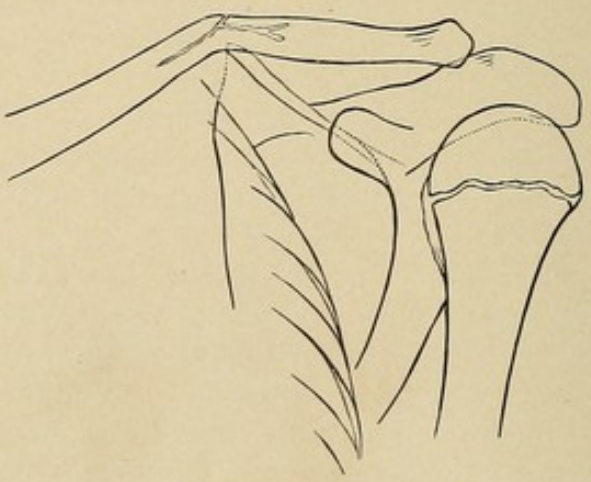
The incomplete fracture, occurring usually in children, will be characterized by sharply localized tenderness, deformity, late ecchymosis (days), and usually pronounced disability, the arm hanging unused at

FIG. 314[1]



Example of the most common type of fracture of the clavicle, at about the junction of the middle and outer thirds, showing also the typical deformity—dropping of the outer fragment with the shoulder, relative or actual upward displacement of the outer end of the inner portion, and overriding with shortening. Patient, a male, aged thirteen years.

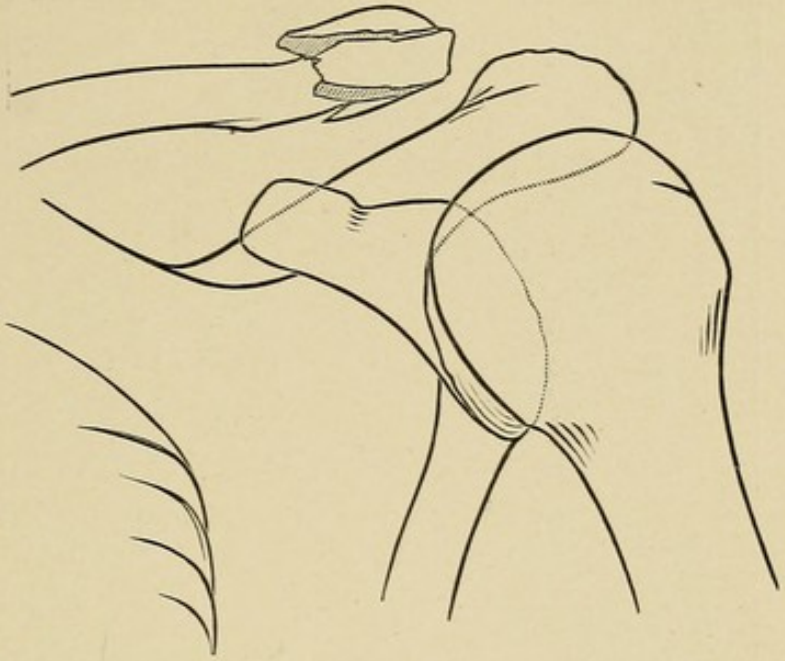
FIG. 315



A typical example of the so-called "green-stick," or incomplete, fracture occurring at one of its most frequent seats—the junction of the outer and middle thirds of the clavicle. Patient a boy, aged eight years.

[1] Figs. 314 to 316. Fractures of the clavicle. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from dispensary service.

FIG. 316



Comminuted fracture of the acromial end of the clavicle. The injury resulted from the patient, an adult male, "taking a header" from a bicycle and striking on the shoulder.

the side. At times there is no disability, the fracture not being suspected until ecchymosis and, later (a week), callus formation suggest the nature of the lesion.

Luxations of the Shoulder-joint.—Dislocation of the head of the humerus from the glenoid cavity, the commonest of all luxations, is observed chiefly in vigorous adult males.

It is rare in children, the traumatic bone lesions in them appearing as fractured clavicle or epiphyseal separation of the humerus. In the elderly, fractures of the surgical neck of the humerus can be expected.

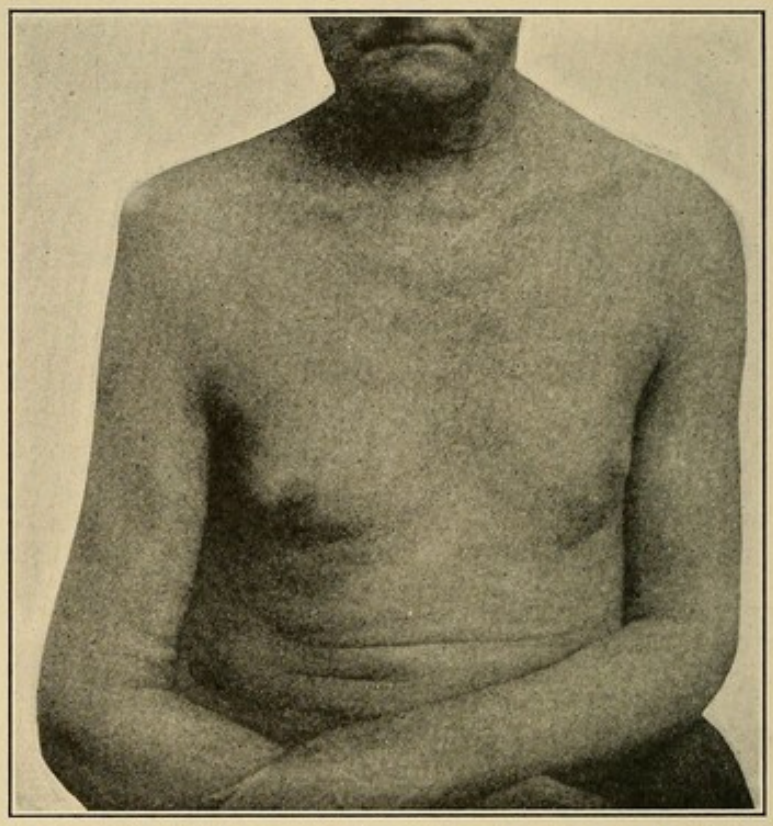
The usual cause of luxation is direct or indirect violence; exceptionally it has been due to muscular action, as from throwing efforts.

The forward dislocations are the subcoracoid and subclavicular. The downward displacement is subglenoid; the backward, subacromial or subspinous.

Common complications are tearing away of muscular attachments, particularly those of the subscapularis and the supra- and infraspinatus, and fracture of the articular process of the scapula or shaft or tuberosities of the humerus. The commonest complicating fractures are those of the surgical neck and the great tuberosity of the humerus.

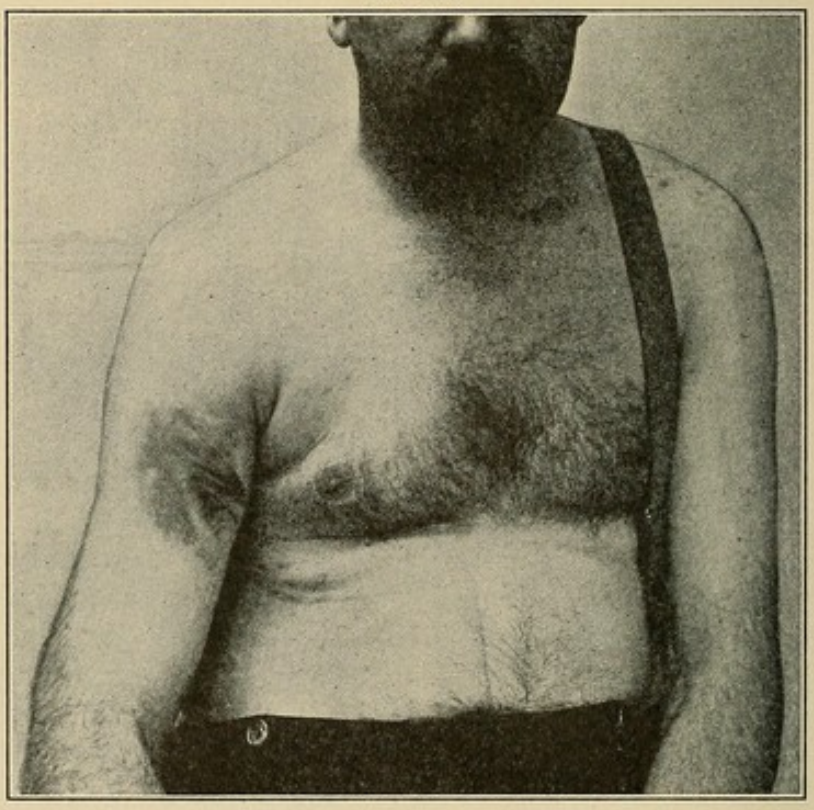
The symptoms of luxation are pain, complete disability, elastic fixation of the arm, usually in slight abduction, angularity due to the prominence of the acromion and the flattening of the deltoid bulge beneath it. There is a depression felt beneath the anterior portion of the acromion border where the greater tuberosity should normally form a bulging projection (the point of the shoulder). The displaced head of the bone is felt in its abnormal position. The elbow stands out from the side and efforts to bring it in contact with the chest wall demon-

FIG. 317



Subcoracoid luxation of right humerus. Several months old. Angled shoulder. Increased width measured from top of shoulder to lower border of anterior axillary fold. Arm carried slightly from side. A plane surface can be made to touch the external condyle and the outer acromial border. Forearm flexed.

FIG. 318



Recent subcoracoid luxation of humerus. The characteristic features shown at Fig. 317 somewhat obscured by swelling.

strate an elastic resistance, nor, even in the subclavicular displacement, can the hand of the injured side be carried to the sound shoulder and the elbow be brought in contact with the chest wall. This last test fails when the capsule and muscular attachments of the humerus have been extensively torn, and in enormously fat people.

In all cases there is an increase in the circumference of the shoulder and a departure from normal in the direction of the long axis of the humerus as contrasted with that of the sound side. With the arm rotated inward and pressed as close to the side as is possible, a plane surface can be made to touch the external epicondyle and the anterior portion of the outer margin of the acromion. This is impossible unless the greater tuberosity is displaced.

The subglenoid luxation is characterized by the ease with which the head of the bone can be felt by axillary palpation and by pronounced abduction which exceptionally may carry and hold the elbow out so far that the arm makes almost a right angle with the long axis of the body. In this form of luxation there is sometimes lengthening as measured from the acromion process to the external condyle. The subcoracoid and subclavicular displacements are characterized by finding the head of the bone in the position indicated by the name. In both the elbow is carried outward and backward.

The backward luxations, subacromial or subspinous, are rare and characterized by prominence of the acromial process, often of the coracoid, and the presence of the rounded tumor made by the head of the humerus, either beneath the posterior border of the acromion, where there is normally a depression, or the spine of the scapula. Unless there be extensive muscular rupture, the arm is fixed in a position of adduction and internal rotation.

The diagnosis of complicating fractures, if these involve the shaft of the bone, is dependent upon finding the glenoid cavity empty, the head of the bone in its abnormal position, and preternatural mobility and crepitus elicited by direct palpation and adduction, abduction, and rotation of the humerus. If the surgical neck be broken, the head and tuberosities will not participate in passive movements of the shaft.

Fracture of the glenoid cavity is suggested by crepitus on deep palpation and by difficulty of retention after reduction is accomplished.

Fracture of the tuberosity and of the surgical neck of the scapula are likely to escape detection in the presence of the rapid and extensive swelling which follows dislocation, without the help of the *x*-rays.

Although the symptoms of dislocation of the shoulder-joint are fairly marked, determination of the presence or absence of this lesion may be difficult in fat, muscular subjects, since the examination is always painful. In case of doubt, examination should be conducted under full anesthesia, and, as is the case with all injuries about joints, the *x*-rays should be used.

The examination of a case of shoulder luxation should not be concluded until the surgeon has assured himself of the integrity of the neighboring vessels and nerves.

If the circumflex nerve, winding around the surgical neck of the humerus and supplying the joint, the deltoid, and, by a cutaneous branch, the skin over the lower third of this muscle, be permanently injured, deltoid atrophy will follow. Anger states that such injury may be suspected if immediately following trauma there is anesthesia in the skin area supplied by this nerve.

The axillary artery may be torn without immediate colossal hemorrhage. Such complication should be at least considered if on first examination the radial or brachial pulse cannot be felt.

Luxation of the Clavicle.—Either the outer or the inner extremity of the clavicle may be displaced, either by direct or indirect force. Displacement of the outer end is characterized by extreme pain and pronounced disability. Undue mobility and displacement are readily detected. Congenital eccentricity of conformation may lead to error in the case of the acromioclavicular joint.

FIG. 319

Seborrheic eczema of the axilla. (Hartzell.)

Inflammatory Affections of the Arm and Shoulder.—Acute inflammation of the soft parts of the arm and shoulder conform to type in etiology and symptoms.

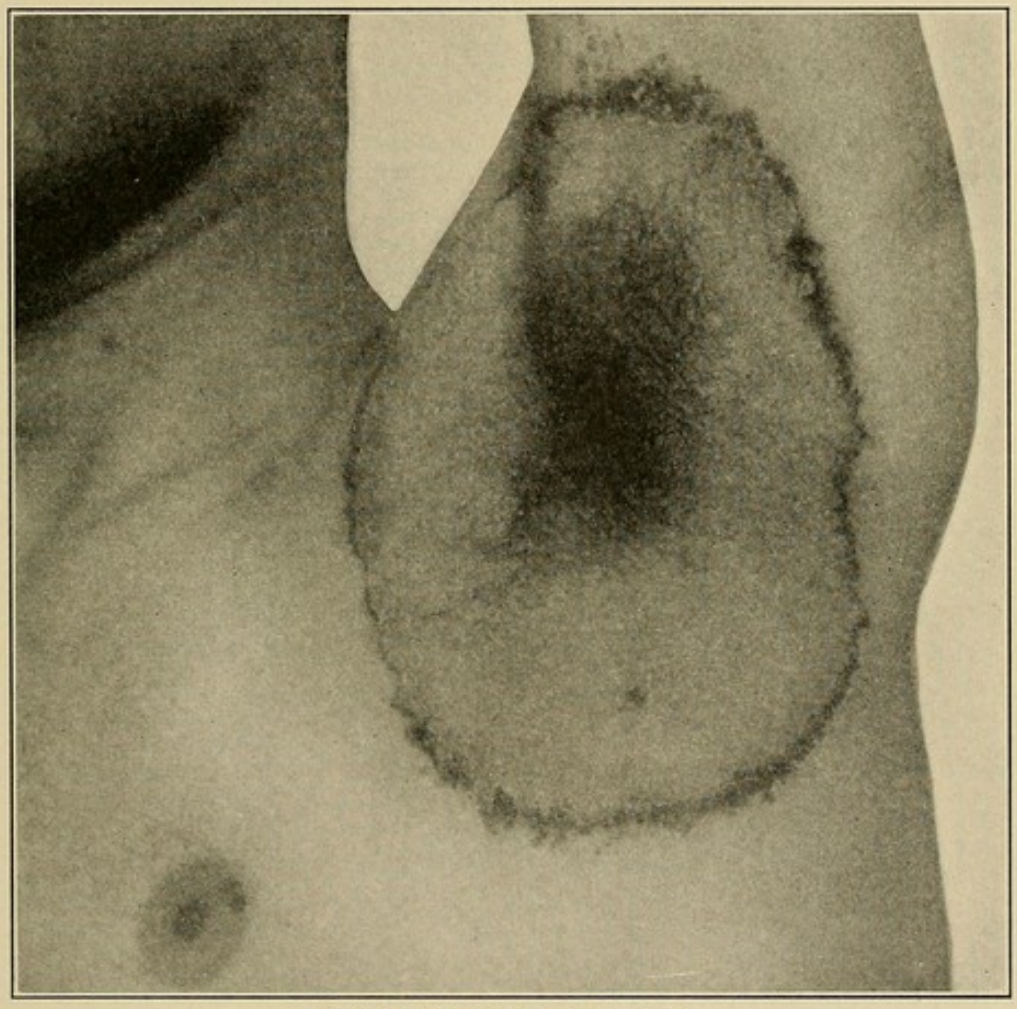
Seborrheic eczema and tinea are fairly common in the axilla.

This region is a common seat of follicular abscesses which develop successively in fresh crops, usually beginning as red, tender, shot-like skin nodules which shortly suppurate. They are extremely painful and, because of their position, cause disability. These abscesses may originate either in the sebaceous or the sudoriferous glands. In the latter case they are placed more deeply and are of larger size.

At times these subcutaneous abscesses are the starting points of diffuse cellulitis and are accompanied by symptoms of profound septic absorption. They are occasionally complicated by suppurating axillary glands.

Abscesses beneath the deep fascia are usually of lymphatic origin, incident to infection of any of the areas draining into these glands; they may be secondary to osteomyelitis of any of the bones adjoining the axillary space or may be caused by a perforating pleurisy. They may reach huge proportions, burrowing widely beneath the pectorals

FIG. 320



Tinea of the axilla. (Hartzell.)

and the clavicle. These burrowing abscesses cause profound systemic poisoning. The diagnosis is based on the diffuse swelling, fluctuation, surface edema, and constitutional symptoms of sepsis.

Acute axillary adenitis, characterized by tender swollen axillary nodules, secondary to wounds of the hand, arm, shoulder, or side of the chest, usually undergoes resolution on proper drainage of the original focus of infection.

Acute Suppurative Inflammation of the Subdeltoidean Bursa.—This is evidenced by obvious swelling, most pronounced in its beginning just below the margin of the anterior third of the acromion, associated

with extreme tenderness at this point, followed shortly by a swelling which completely obscures the point of the shoulder, edema of the skin, and marked limitation of the motions of the humerus in the outward and forward direction. It is usually a manifestation of systemic infection; very exceptionally it follows traumatism.

The diagnosis is based upon the position of swelling. Intra-articular effusions never form a projecting tumor at the point of the shoulder. On deep axillary palpation the joint is not tender, and only those motions are painful which directly affect the inflamed bursa. The constitutional symptoms are those of septic absorption. The *x*-rays indicate the position of the inflammation.

Acute Osteomyelitis of the Humerus.—This is less common than is the case with the tibia or femur and usually attacks the upper extremity of the bone. Although the focus is situated at or near the epiphysis, the line of diaphyseal junction being extra-articular, the joint is usually spared, the abscess appearing externally.

Diagnosis is based upon severe pain, localized tenderness on deep pressure, rapid edematous swelling of the soft parts, disability and constitutional signs of acute sepsis. Freedom of passive motion and absence of tenderness on direct palpation exclude arthritis of the shoulder. In young people, epiphyseal separation and subsequently marked impairment of bone growth are common sequelæ.

Multiple foci of infection throughout the shaft of the bone cause tenderness to deep pressure and marked edematous swelling of the entire arm, together with the symptoms of profound sepsis. They are followed by necrosis and the formation of sequestra.

As in the other bones, the inflammation may subside without producing gross necrosis, or may continue indefinitely, in the chronic form producing great thickening of the bone accompanied by harassing pain and localized tenderness.

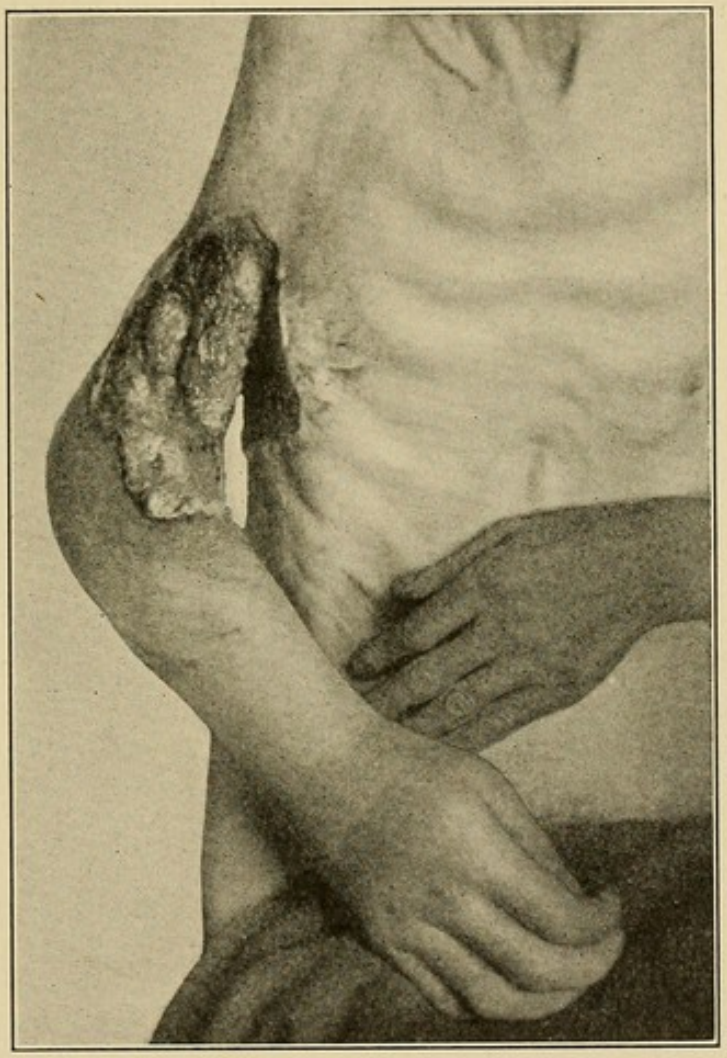
Acute serous and serofibrinous arthritis may be secondary to trauma or periarticular inflammation (osteomyelitis, the infection not reaching the joint), but is usually a local expression of constitutional infection (gonorrheal, rheumatic, typhoidal, pneumonic, influenzal, exanthematous). It is characterized by severe pain, rapid in onset, and crippling in intensity, greatly aggravated by passive movement in any direction but particularly by that of abduction, limitation of the motions of the shoulder in all directions and tenderness on pressure best marked at first where the joint can be most nearly approached by the examining finger (axilla, bicipital groove). There is little appreciable swelling even on careful palpation. Indeed, an obvious swelling of the shoulder, except as the result of acute suppuration or of a long-standing disease, practically excludes the shoulder-joint as the seat of disease.

Acute Suppurative Arthritis of the Shoulder.—This is secondary to an infected wound, osteomyelitis, or, rarely, general infection (pyemia, pneumonia, smallpox). It is characterized by intense pain, rapid and diffuse edematous swelling, total disability with joint fixation, and constitutional symptoms of profound sepsis.

The early diagnosis should be made by aspiration and examination of the fluid.

Chronic Inflammation of the Arm and Shoulder.—**Syphilitic Myositis.**—Syphilitic myositis of the biceps may develop in the secondary or the tertiary period of the disease. In the former case it is rapid in onset (days), is characterized by pain and stiffness on motion, by slight tenderness and, possibly, diffuse swelling. It is usually considered rheumatic.

FIG. 321



Epithelioma in cicatrix. Extensive burn of arm and chest. Complete healing with adhesion between arm and chest. Epitheliomatous ulceration of cicatrix twelve months' duration. Sloughing, bleeding ulcer with everted indurated edges. Edema of hand from venous and lymphatic obstruction. (Carnett.)

In the tertiary form contracture of the muscle is the dominant symptom; the forearm becomes gradually flexed on the arm, nor can it be extended. The biceps, painful and tender at first, later, swollen, undergoes gradual atrophy. The triceps muscle is sometimes affected in the same way, the contracture then limiting flexion.

This muscular contracture is in itself almost diagnostic of syphilis. It yields rapidly to constitutional treatment unless this has been post-

poned until muscular degeneration and permanent cicatricial contracture have taken place.

Gumma and tuberculous abscess, noted in both the biceps and triceps muscle, can be distinguished from neoplasm in their early course only by operation.

Inflammatory hyperplasia of the axillary glands, characterized by nodular, usually non-sensitive swellings, may follow infection or traumatism of any of the areas drained into these glands. From the arm and hand, the lymph is received by that group which lies along the vessels; from the breast, thorax, and upper abdomen, by the group lying along the lower axillary border of the great pectoral muscle. The subscapular and subclavicular group drain the shoulder and back. These groups, however, freely intercommunicate. The pectoral and vascular groups are the ones chiefly involved in chronic inflammation of the breast or hand.

Tuberculous adenitis, usually secondary to tuberculosis elsewhere, or associated with it, particularly with involvement of the glands of the neck, pursues the same course as that characteristic of tuberculous glands in general.

Neuritis.—Neuritis, usually post-traumatic, at times ascending from a peripheral lesion, is characterized by extreme tenderness along the course of the nerve, loss of function, and muscular degeneration. Harassing pain referred along the course of the brachial plexus, particularly in its ulnar distribution, relieved by posture and unattended by the characteristic features of neuritis is sometimes attributable to drooping shoulder and relaxed ligaments (Goldthwait).

Bursitis.—There is at times developed an adventitious bursa on the inner surface of the serratus magnus muscle placed at either the upper or lower angle of the scapula. This, when chronically inflamed, may give rise, on motion, to an annoying grating without any other symptoms. Or it may be associated with considerable pain.

The diagnosis is based upon the seat of pain and grating and the dependence of these symptoms upon scapular movements.

Acromial Bursitis.—Acromial bursitis due to repeated slight trauma, as from carrying weights on the shoulder, is characterized by a soft, smooth, fluctuating, dome-shaped tumor placed between the skin and the summit of the acromion process. The free mobility of the overlying skin and absence of lobulation, distinguish this bursitis from lipoma. As the result of trauma, this chronic bursitis may become acutely suppurative.

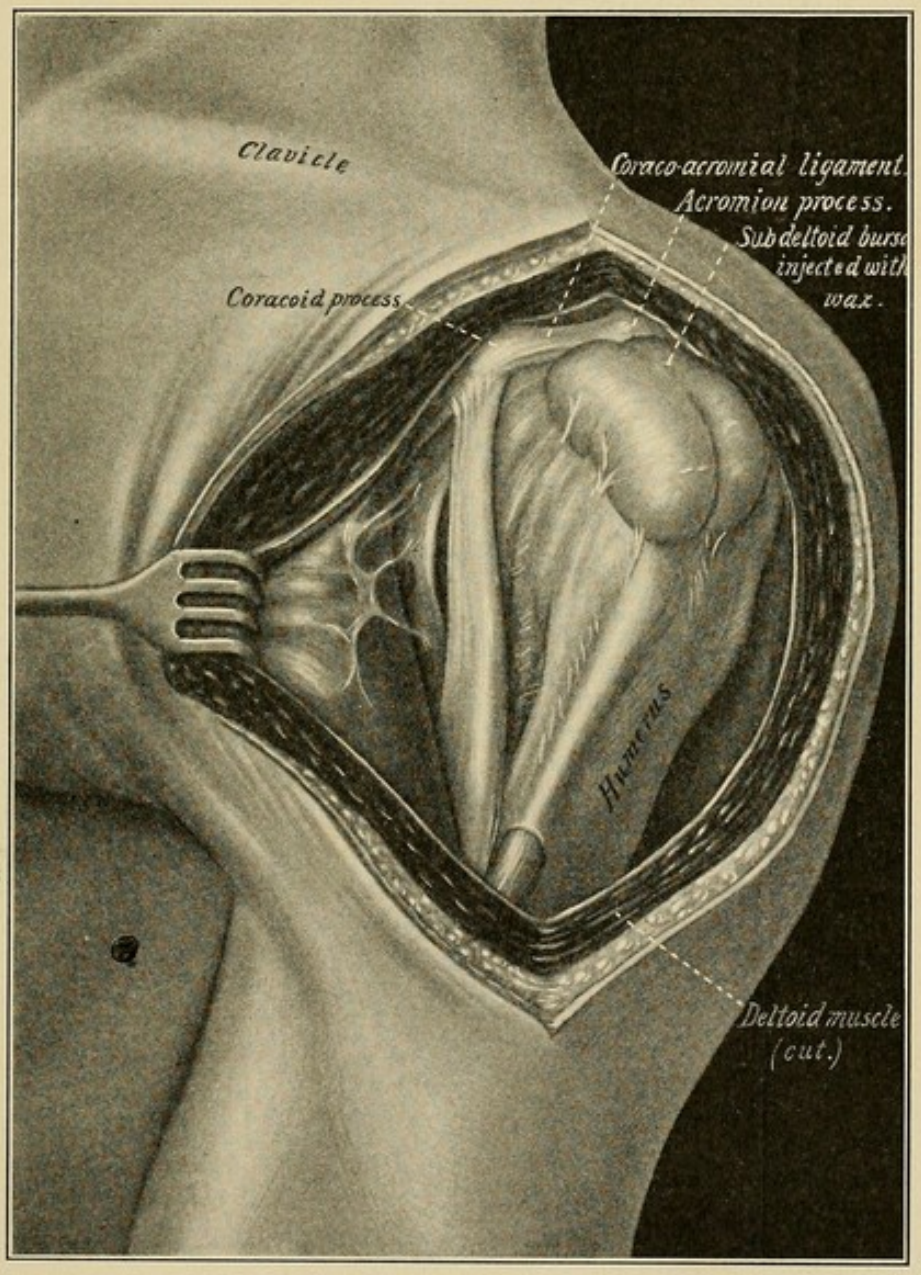
Subdeltoidean Bursitis—The subdeltoid bursa lies between the under surface of the deltoid muscle and the acromial process (subacromial portion) and the upper surface of the supraspinatus tendon and the greater tuberosity of the humerus.

The inflammation is usually fibrinous and adhesive in type, is post-traumatic, and is characterized by tenderness elicited by deep pressure against the greater tuberosity, just below the anterior third of the outer acromial border. There is pain, constant or recurrent and harassing,

radiating along the outer surface of the arm, greatly aggravated by voluntary or passive movements of the humerus, either outward or forward, ultimately muscular atrophy and a subluxated, stiff joint.

Exceptionally this chronic bursitis, when subject to repeated slight trauma, forms either a large hygroma or a hard, palpable tumor with cheese-like contents.

FIG. 322

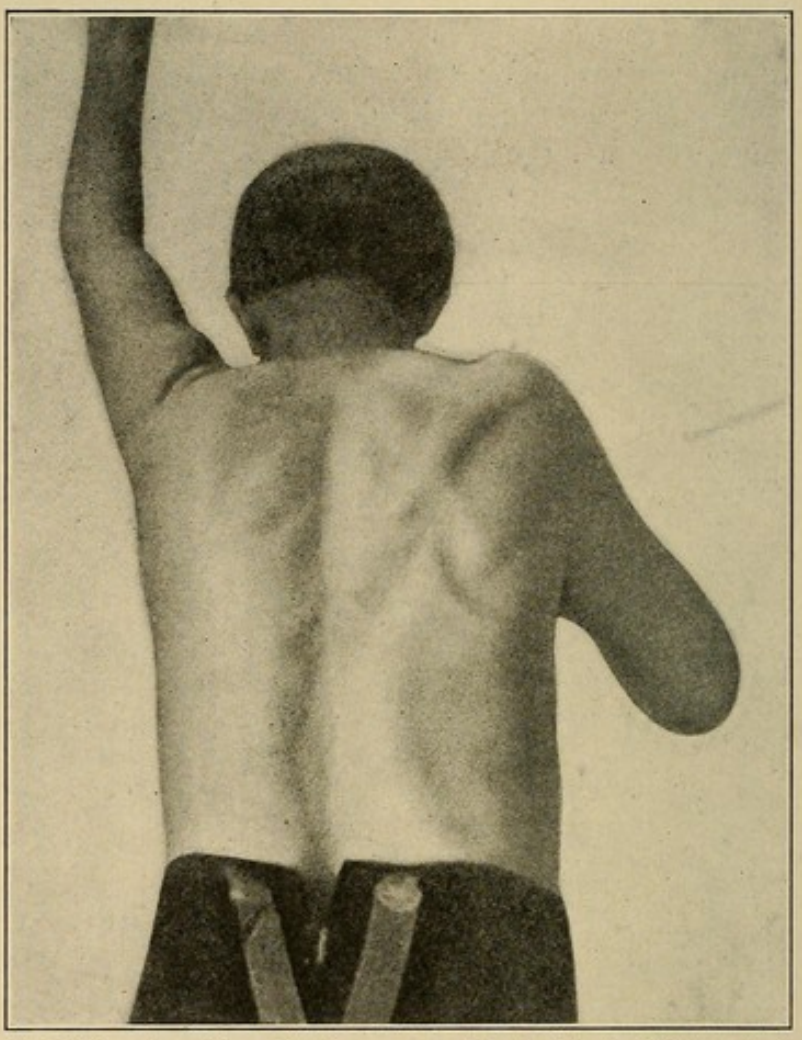


Dissection of an injected subdeltoidean bursa. (Baer.)

The diagnosis can be suspected from the position of the tumor, its sensitiveness, the distribution of the pain area, the character of the disability, and the *x*-ray picture. It can be made surely only by incision and microscopic examination of the removed bursa.

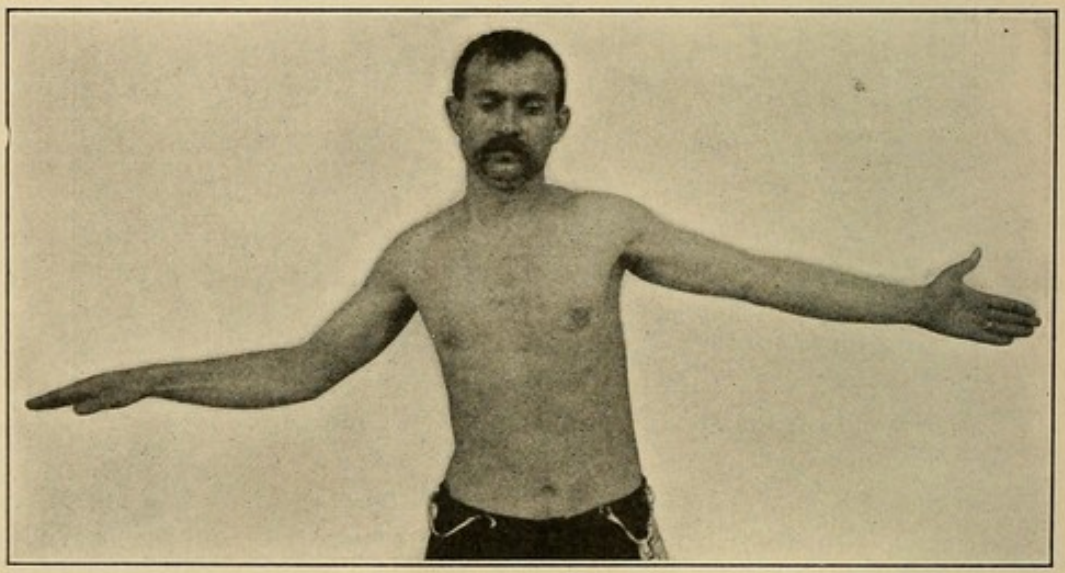
Tuberculous subdeltoidean bursitis is characterized by the almost painless formation of a soft tumor in the position of the bursa, which

FIG. 323



Chronic subdeltoidean bursitis. Both arms are abducted to their full extent. (Baer.)

FIG. 324



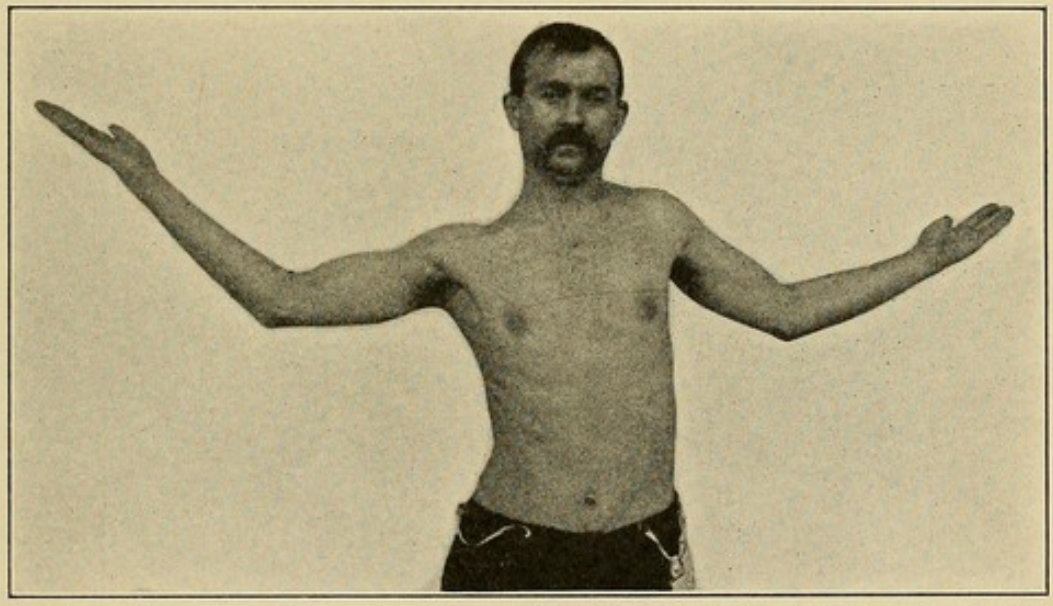
Chronic traumatic subacromial bursitis. Duration, months. Pain and disability marked. Complete abduction still possible, but accomplished with much difficulty. When the arm is carried from the side as far as shown in the illustration, it is by a swinging motion of the shoulder rotated outward, after which it can be carried above the head. On bringing the arm down to the side, the motion is reversed. In many cases the complete abduction is impossible.

on manipulation gives the crepitation or chain-like grating incident to the villous growth from its inner surface or the rice-like bodies it usually contains. In the absence of crepitation the affection simulates fatty tumor, but is much more rapid in growth.

From sarcoma, it should be distinguished by operation, since a malignant tumor so placed as to suggest chronic bursitis cannot be distinguished from this affection.

Subcoracoid Bursitis.—The coracobrachial bursa lies between the tip of the coracoid process and the joint capsule overlying the lesser humeral tuberosity. Inflammation of the bursa is characterized by pain particularly marked in rotation and by limitation of the same motion. There may be a constant or recurring pain often referred down the arm, and pronounced disability

FIG. 325



Chronic traumatic subacromial bursitis. The arm has been rotated outward and is being carried up

Chronic Inflammation of the Bones and Joints of the Arm and Shoulder.—**Chronic Osteomyelitis of the Humerus.**—This may be sequent to an acute attack which subsides without producing gross necrosis. The inflammation continues indefinitely, producing great thickening of the bone, accompanied by harassing pain and localized tenderness. There may be a central sequestrum without pus.

Tuberculosis of the Humerus.—Tuberculosis of the humerus rarely affects the shaft of the bone. Its presence is suggested by pain and localized tenderness.

Tuberculosis of the upper epiphysis is less prone to involve the joint than is the affection when it attacks the lower epiphysis. Deep-seated pain, persistent tenderness, and disinclination to use the part, these symptoms gradually (weeks or months) growing worse and finally supplemented by tumor, softening, and the formation of sinuses leading to dead bone, are characteristic features.

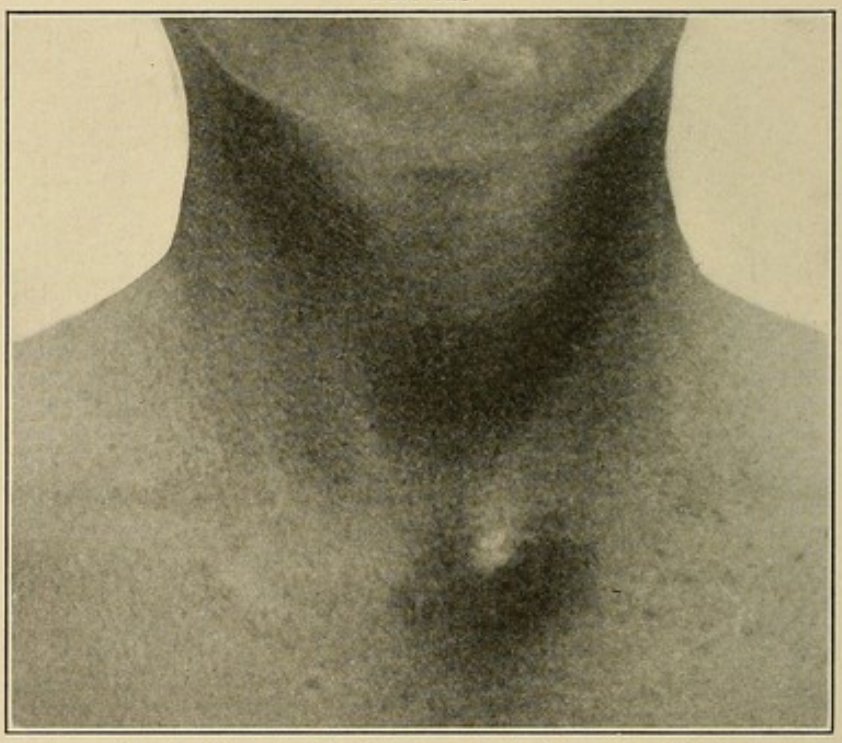
The diagnosis in the early stages of the affection will be suggested by a tuberculous family history and the presence elsewhere of lesions of the disease. It should be made by the *x*-rays before visible or palpable tumor formation; by incision as soon as a bone swelling can be detected.

Gummatous Osteitis.—Gummatous osteitis of the humerus, characterized by local tenderness, often extreme pain and tumor formation, can be distinguished in its early stage from tuberculosis or malignant growth only by a suggestive history, associated with other more characteristic lesions and the prompt effect of specific treatment.

Both syphilitic and tuberculous osteitis attack the scapula. Each affection develops according to type.

The inner extremity of the clavicle is a favorite seat for gumma.

FIG. 326



Gumma of the sternal end of the clavicle. Tertiary period (years). Painless indurated growth from bone with central softening. Duration, one week.

Chronic Arthritis of the Shoulder.—Chronic arthritis of the shoulder is usually traumatic, often toxic or infectious (rheumatoid arthritis, arthritis deformans), exceptionally neuropathic (syringomyelia and tabes).

Traumatic chronic arthritis may follow severe injury, being then incident to bone and capsular lesions which even after recovery leave the joint so mechanically altered that ordinary use represents a constantly recurring trauma; or it may be the result of long-continued overuse, as in the case of laborers. It is an affection of old age, characterized by deformities typical of rheumatoid arthritis or osteoarthritis. Pain, weakness, muscular atrophy, subluxation, and limitation of

motion, together with grating crepitus, are present. Complete ankylosis is rare.

Tuberculous Arthritis of the Shoulder.—This is rare as compared to the frequency of the inflammation in other large joints. It exhibits a predilection for that form of the affection characterized as dry caries, the bone being softened and abraded, often without the formation of a sinus discharging externally.

The affection is characterized by pain, intermittent at first, limitation of joint movement with muscular atrophy, and tenderness on palpation of the head of the bone in the axilla or in the bicipital groove to the inner side of the greater tuberosity. As the head of the humerus disappears by absorption, the acromion projects sharply. Periarticular swelling may be slight or may be pronounced.

The early diagnosis of joint involvement is suggested by limitation of motion in all directions, tenderness elicited by direct palpation and by upward jars of the elbow, muscular atrophy, and the skiagram. These symptoms will distinguish a caries sicca from malignant growth, which is always in the beginning extra-articular.

The fungous form of arthritis of the shoulder corresponds to type as seen in other joints. The bursæ are very commonly involved.

Neuropathic Arthritis of the Shoulder.—Neuropathic arthritis of the shoulder, secondary to syringomyelia or tabes, is characterized often by extraordinary bone deformity, absence of pain, and function limited only by the obstruction to movement offered by the bony outgrowths.

Neurosis of the Shoulder-joint.—Neurosis of the shoulder-joint, when it occurs in an hysterical female skilled in the ways of doctors, is the most difficult of all the affections of this region to diagnosticate.

Tumors of the Arm and Shoulder.—The tumors of the skin and subcutaneous fascia of the arm are those common to these tissues. Lipoma is, perhaps, the commonest tumor. In fat people, painful fibrolipomata are at times observed.

Indurations of bony hardness are observed both in the brachialis anticus and the deltoid, incident to repeated trauma. They are tender on pressure, but occasion little pain or disability aside from the mechanical one, nor do they exhibit any tendency toward growth.

Sarcoma of the muscles cannot be distinguished as such from tuberculous abscess or gumma at a time when this is profitable, except by excision.

Fibroma.—Fibroma has a peculiar predilection for the nerve trunks of the arm. It is characterized by a hard, fusiform, painful, and tender tumor in the course of the nerve, laterally mobile, but not in the long axis of the nerve, and causing sensory, sometimes motor, disturbance in regions supplied by the involved nerve. It is distinguished from myxoma or sarcoma of the nerve trunks (malignant neuroma) by its slow growth. Its position on the nerve is characteristic. It should be diagnosticated by the microscope before it is unmistakably malignant.

Lipoma.—Lipoma is the commonest tumor about the shoulder. It is slow in growth, subdermal, soft distinctly lobulated, and adherent to the skin. Its lobulation and skin attachments distinguish it from a supra-acromial chronic bursitis. Even when placed beneath the fascia, diagnosis is difficult only in its early course when, by pressure on nerves, the lipoma may produce pains radiating down the arms and distinct muscular weakness. Diagnosis then can be made only by incision.

Lipoma is common in the axilla, at times associated with angioma.

An aberrant mammary gland may occur in the axilla, closely simulating fatty tumor.

Osteoma.—Exostoses as the after result of traumatism, or as a local manifestation of a general process, are observed on the humerus; they are characterized by indolence, painlessness, bony hardness, and slow growth (years). The same may be said of chondromata and cysts. The latter, when they reach moderate size, are attended by the crackling sensation characteristic of the well-developed myeloid sarcoma. Nor can the differential diagnosis be made except by microscopic examination.

Sarcoma.—Sarcoma is the usual tumor of the deltoid and of the muscles surrounding the shoulder-joint. In its full development the diagnosis is unmistakable; in its early stage, its nature is suspected on the basis of probability and because of rapid growth. Diagnosis is made by excision and microscopic examination.

Sarcoma originating from any of the structures of the axilla, particularly the lymph glands and the nerve sheaths, exhibits its ordinary characteristics, *i. e.*, the rapid growth of a round, sharply outlined, solid tumor. The early diagnosis from inflammatory hyperplasia of a lymphatic gland or tuberculous adenitis is based on the causelessness of the sarcoma, rapidity of growth and, later, on the size of the tumor. It should be made by early excision.

Cavernous Angioma.—Cavernous angioma may sometimes suggest aneurysm, but is differentiated from this affection by the obvious skin involvement, by the absence of typical expansile pulsation and bruit, and by the slight effect produced upon it by pressure upon the subclavian artery.

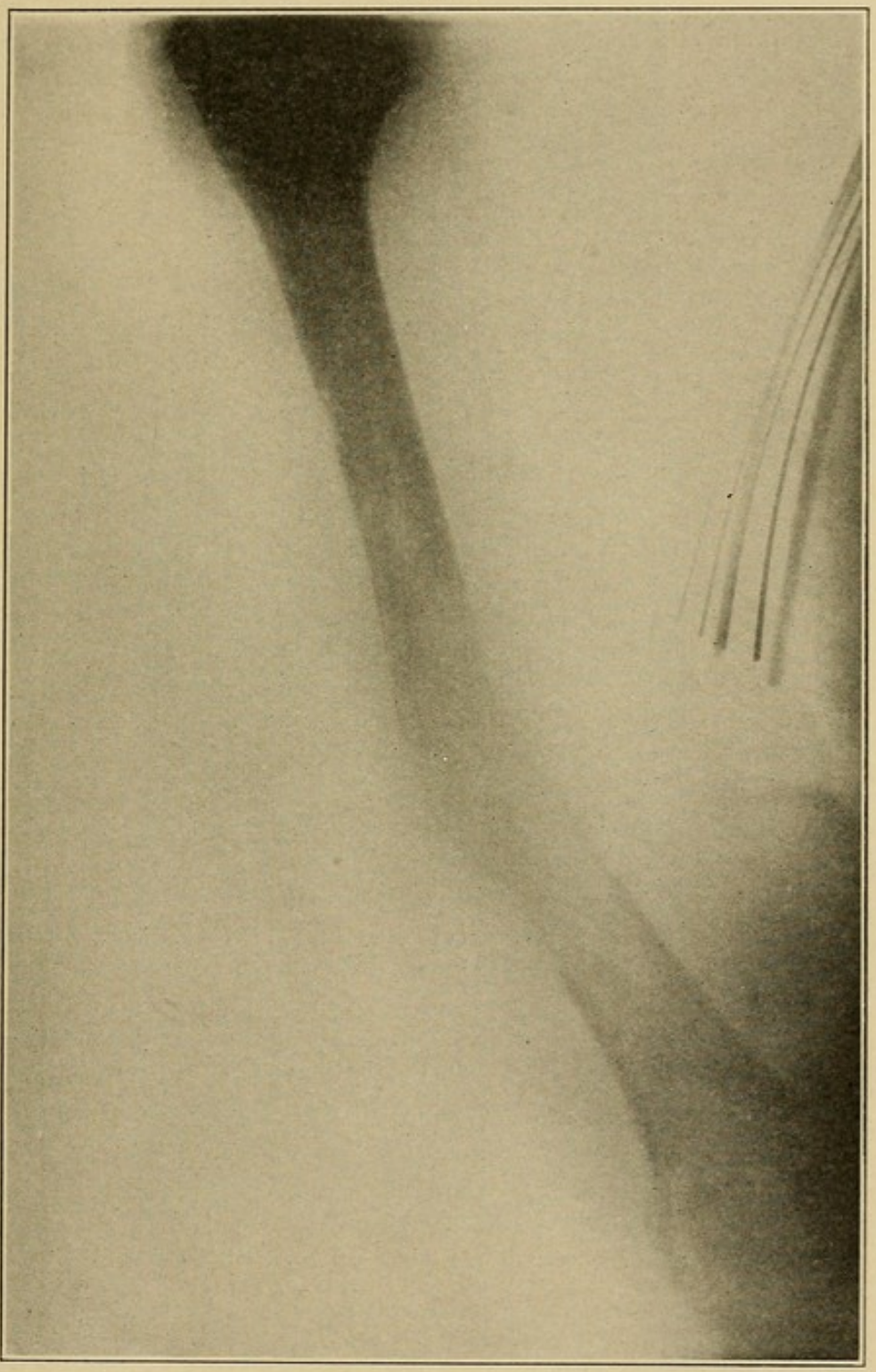
Lymphangioma.—Lymphangioma forms a cystic tumor in the axilla of infants which in its development passes up beneath the pectoralis minor and clavicle, and presents in the neck, forming a bilocular growth. Its characteristics are those of the same tumor as observed in the neck. Bleeding into such a cyst is the usual cause of non-traumatic hematoma.

Carcinoma.—Carcinomatous glands of the axilla are secondary to cancer of the area from which the lymph is drained, usually the breast. In their early stage they cannot be distinguished from glands enlarged by inflammatory hyperplasia.

Tumors of the humerus are commonest about the upper epiphysis. They are usually sarcomatous. In the early stage they are character-

ized by persistent bone pain and localized tenderness; later by swelling, which, if allowed to develop, becomes entirely characteristic. If the growth is rapid, there is fever and toxic anemia.

FIG. 327

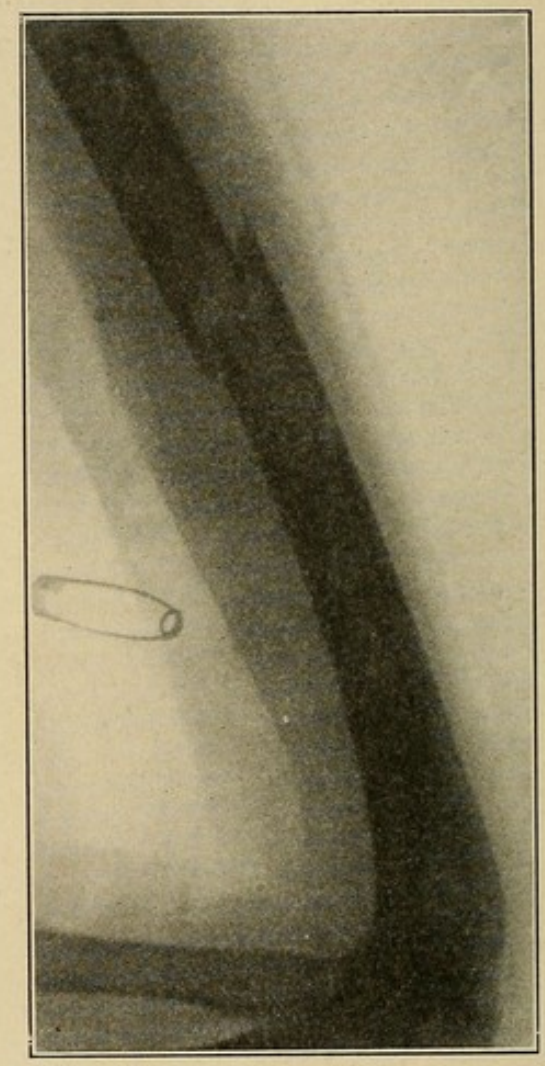


Metastatic carcinoma of humerus. Pathological fracture. Operation for cancer of breast two years previously. Metastasis present in liver. (Carnett.)

There are no characteristic features which early distinguish these tumors from tuberculous or syphilitic osteitis or osteomyelitis. The

diagnosis must be made by incision guided by *x*-ray pictures and microscopic examination. In the later stage of these growths, rapid

FIG. 328



Metastatic carcinoma of humerus. Primary in breast. Multiple foci in humerus. First symptom observed was fracture on turning patient in bed. (Carnett.)

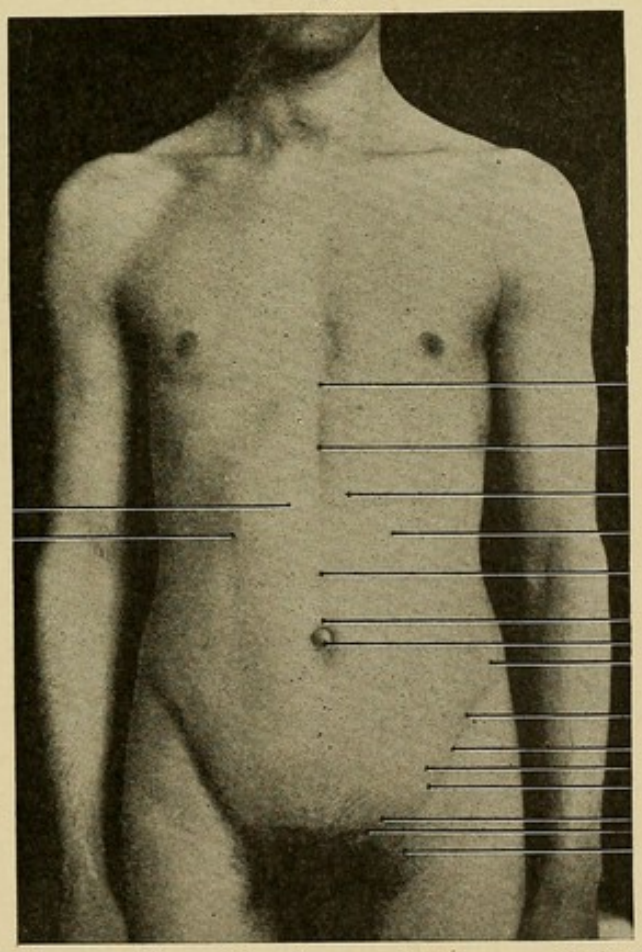
increase of size, the destruction of bone substance, surface vascularity and discoloration, metastases, and cachexia enable the diagnosis to be formulated.

CHAPTER XV.

THE THORAX.

CONGENITAL malformations, such as those due to absence or deficient development of the pectoral muscles, of the sternum, or the ribs, are obvious to inspection and palpation. A funnel-like depression of the lower part of the sternum is frequently seen and occasions no symptoms. The asymmetry due to rickets is expressed in the form of pigeon-breast, the beading of the ribs, so characteristic in infancy, later disappearing.

FIG. 329



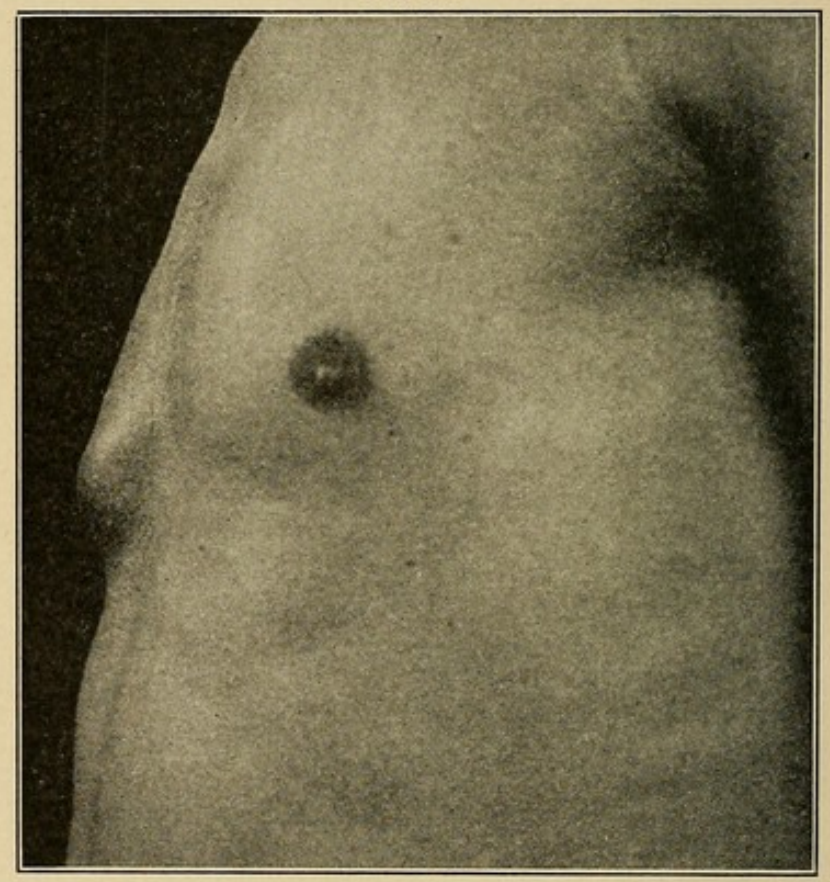
Surface markings of the thorax and abdomen. (G. G. Davis.)

Aneurysm or intrathoracic tumor may cause a local bulging even though it be not directly in contact with the chest wall. The widened intercostal spaces and bulging ribs of recent pleural exudates, the deformity of the later stages, and the thoracic growth perversions of Pott's disease or spinal curvature are well-recognized features of the underlying lesions.

Acute Cellulitis.—Acute cellulitis incident to trauma, follicular abscess, osteomyelitis, and periadenitis, secondary to peripheral infection, occurring at times without demonstrable cause, are characterized by the constitutional symptoms of profound sepsis. There is often diffuse tenderness and inspiratory pain which closely simulates that due to pleurisy. Endocarditis and septic bronchopneumonia are common complications.

The diagnosis of this fortunately rare condition is based on the local seat of tenderness, the profound constitutional symptoms, with the absence, at least in the early stage, of local signs of pleural involvement. Later, skin edema and fluctuation are characteristic of suppuration and indicate its seat.

FIG. 330



Cold abscess of the chest wall (tuberculous osteitis). Painless, obscurely fluctuating, made tense by coughing effort. Overlying skin normal and non-adherent.

Cold Abscess.—Cold abscess of the chest wall may be of sternal, costal, vertebral, pleural, or mediastinal origin. There is formed a fluctuating tumor which may exhibit impulse on coughing and which may pulsate.

The chest wall abscess of chronic vertebral osteomyelitis travels forward between the ribs; the symptoms of Pott's disease are usually well marked.

The abscess of sternal origin points over the bone or close to it; the same is true of the cold abscess of the anterior mediastinum. One originating in the posterior mediastinum may point along the ribs

or above the clavicle. If of costal origin (tuberculous, post-typhoidal), the abscess commonly points near its seat of origin, though it may burrow widely. If from the pleura, the associated signs of an empyema are readily elicited.

In some instances cold abscesses either in the intercostal space or in the dorsal region have no connection with bone, the original focus of infection probably having healed.

The diagnosis of cold abscess, which may be of large size when first seen, would be suggested by distinct fluctuation. The resemblance to lipoma may be so close as to require operation for differential diagnosis.

The tumor incident to bone erosion and surface projection of an aortic aneurysm may present the characteristics of cold abscess.

Traumatism of the Chest.—Concussion.—Concussion of the chest, by which is meant the effect produced by a jarring blow not sufficiently violent to produce demonstrable lesions of the thoracic viscera, is evidenced by the symptoms of shock and may be immediately fatal. It is not infrequently attended by dyspnea so pronounced as to occasion cyanosis, the short, irregular, hurried, painful breathing being characteristic. This condition can be recognized as one independent of gross internal lesion only by a consideration of the relatively slight trauma, at times by a knowledge of the patient's hypersensitiveness to physical impressions, and usually by the rapid (minutes, hours) improvement of the symptoms.

Spasmodic stricture of the esophagus is an occasional sequel of chest concussion.

Contusion of the Chest.—Contusion of the chest is of importance when complicated by fracture or displacement of the bones, lesions of the contained viscera, or rupture of the diaphragm. Fracture and luxation are readily recognized.

Visceral lesions will be characterized by shock, and bleeding evidenced by constitutional symptoms of hemorrhage.

Diaphragmatic rupture will be shown by profound and persistent dyspnea, displacement of the heart, and tympany and gurgling over the seat of the displaced stomach. Rupture of the lung will be suggested by hemothorax or coughing up of blood, emphysema appearing first at the base of the neck if interstitial, or in the thoracic wall if incident to lung wound by complicating fracture.

Wounds of the Chest.—Wounds of the chest are of importance in accordance with the extent to which the contained viscera are involved. Injury of the internal mammary or the intercostal artery may be followed by hemothorax and the constitutional signs of progressive hemorrhage. There is nearly always an associated external bleeding from the wound.

Wound of the lung is characterized by shock, harassing cough which usually brings up frothy blood, dyspnea, often severe pain which may be referred to the abdomen, hemothorax, and pneumothorax. If the wound be a puncture or inflicted by a small caliber weapon all these symptoms may be absent.

Pneumothorax developing in the presence of a parietal wound mechanically closed against the entrance of air is a convincing sign.

Diagnosis as to the seat of continued bleeding, if this be of neither intercostal nor internal mammary origin, must be made by opening the chest, after due consideration of the mechanics of the vulnerating force.

Complicating abdominal wounds are common, implying necessarily injury to the diaphragm.

Unless the distinction between a wound which does and one which does not involve the lung be fairly obvious, it cannot be made except by operation.

The hemothorax of chest wound may be absorbed very slowly. Often it suppurates, the symptoms of acute empyema then developing.

Hernia of the lung follows as a late sequel of wounding and at times of contusion. It is characterized by the appearance of a resonant crepitant projecting tumor responding to the influence of intrathoracic tension.

Wound of the Heart.—Wound of the heart, if not immediately fatal, is characterized by profound shock, irregular, feeble, rapid heart action, and marked dyspnea. In framing a diagnosis, the probable depth and direction of the wound, as suggested by the vulnerating agent and its points of entrance and of exit, are of major importance.

Blood effusion into the pericardial sac and hemothorax are corroborative symptoms if they are present. If the wound be of sufficient size to allow direct exploration, a positive diagnosis can be framed. Otherwise, it must depend upon exploration, which would be called for in any event by progressive bleeding.

A wound of such nature and direction as to probably involve the heart should be regarded as such so far as absolute physical quietude of the patient is concerned, since there may be neither shock, hemorrhage, nor other characteristic symptoms immediately following heart lesion. Pericardial blood effusion following a wound immediately or shortly (hours) or developing suddenly later (days) is almost pathognomonic evidence of heart lesion.

Fracture of the Sternum.—Fracture of the sternum, usually transverse, near the point of junction of the manubrium and body, at times a true diastasis, may be caused by direct blow, in which case the injury may be comminuted, by muscular action, or by forced flexion or extension. If there be displacement, the lower usually over-rides the upper fragment and the diagnosis is readily made. In the absence of displacement, persistent tenderness and late ecchymoses following an adequate cause other than direct violence are significant. This injury is a not infrequent complication of vertebral fracture dislocation in the cervicodorsal region.

Fracture or dislocation of the ensiform process (rare) is characterized by obvious displacement, preternatural mobility, and in a few recorded cases by recurring attacks of pain and vomiting.

Fracture of the Ribs.—Fracture of the ribs, from direct or indirect force or muscular action, usually involving the fifth or eighth, often a number of ribs, attended, as a rule, by little deformity and situated, even when due to indirect force, near the point of application of this force, is characterized by pain, well localized, and greatly aggravated by coughing or deep breathing, tenderness, at times crepitus, and undue mobility.

Crepitus with undue mobility may be elicited by direct palpation of each rib; at other times by placing the thumb of each hand on the extremities of the suspected rib and making alternate or synchronous pressure against the side of the chest with the flat of the hand, while the patient breathes deeply or coughs.

The diagnosis must often be based, in the absence of the *x*-rays, on the persistent pain and the extreme local tenderness to deep palpation.

Fractures by muscular contraction usually involve the lower ribs, and may occur as the result of movements calling for no undue strain upon the bones, such, for instance, as coughing or sneezing, or even turning in bed. Such fractures of the ribs have not the same significance as do those from inadequate cause affecting the bones of the extremities (bone tumor), and may be so wanting in symptoms that the appearance of callus may first call attention to their existence.

Fracture of the ribs may be complicated by wound of the pleura or lung, as evidenced by cough, pleuritic friction sounds, emphysema, exceptionally pneumothorax. The superficial emphysema is manifested as a rapidly spreading swelling which crepitates on palpation and may extend over the entire body.

Hemorrhage from an intercostal artery with bleeding into the pleura is a rare complication of fracture of the rib.

Fracture of the Costal Cartilages.—Fracture of the costal cartilages, commonly involving those of the seventh and eighth ribs, is usually characterized by pronounced lateral displacement, at times by overriding, and is then easily recognized. Persistent local tenderness and pain, especially marked in movements calling the abdominal muscles into play are the characteristic symptoms in the absence of displacement.

Inflammations of the Chest.—The Skin.—The skin of the thorax may be the seat of any of the inflammatory or neoplastic lesions to which this structure is subject. Acne and seborrheic eruptions are especially frequent, and over its lower lateral surface the first manifestation of syphilitic roseola is often seen. Boils and carbuncles, less common than on the back of the neck, are fairly frequent on the lateral chest wall.

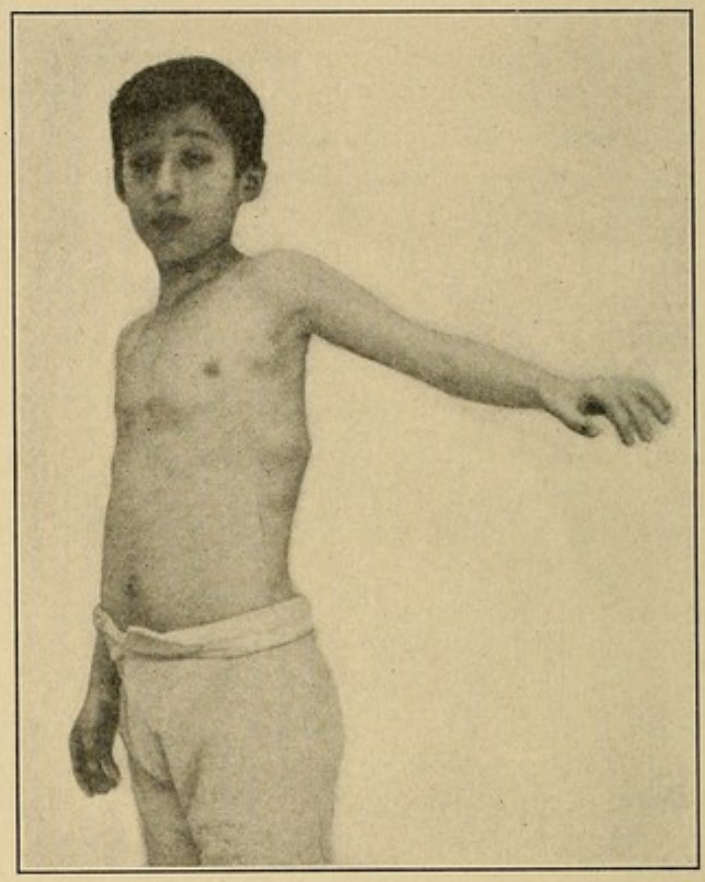
Osteomyelitis.—*Acute osteomyelitis of the ribs and sternum* (rare) is manifested by hyperacute, constitutional symptoms of infection, severe pain, local tenderness, and the rapid development of edema and abscess. The diagnosis should be confirmed by operation.

Chronic osteomyelitis, usually tuberculous, syphilitic, or typhoidal, at times an evidence of an attenuated or well-resisted pyogenic infection, is characterized by the gradual (weeks) development of a moderate bone swelling, fusiform if a rib be involved, which is usually neither markedly painful nor tender. Softening and sinus formation are fairly prompt. The first evidence of such an infection may be a fluctuating tumor due to cold abscess extending toward the surface.

Typhoidal bone infection is superficial and limited in extent. It occurs during or after convalescence, exhibits a special predilection for the ribs, and is placed on the outer surface of the bone near the osteo-

cartilaginous junction. The diagnosis is based upon the development of one or more fusiform, slightly tender rib swellings after typhoid fever.

FIG. 331



Multiple osteoperiostitis ten months after typhoid fever; semifluctuating, non-sensitive painless tumors attached to ribs covered by healthy skin. *X*-ray negative. Rapid (weeks) formation.

Tuberculous osteomyelitis, which may be either central or peripheral in origin, may form a cold abscess which may burrow wide of its original seat. The tracing of the resultant sinuses may be difficult in the absence of palpable bone tumor. It is facilitated by iodoform injection and *x*-ray pictures. The tuberculous nature of the infection is determined by the tuberculin test and examination of the discharge.

Such a cold abscess may persist after healing of the bone lesion.

Gumma.—Gumma of the ribs and sternum, fairly common seats, is manifested by an indolent infiltration which increases in size more rapidly than that of tuberculosis and exhibits softening at an earlier period (weeks). Nor is there the same tendency toward extensive sinus formation, the opening usually being direct. The diagnosis is based on associated symptoms and signs of syphilis and on the effect of appropriate constitutional treatment.

Inflammation of the mediastinum in its acute form is generally due to an extension of cellulitis from the neck. Septic phlebitis of the jugular veins, perforation of the esophagus or trachea by foreign bodies or as a complication of malignant disease, suppurating bronchial glands or

infections of the pleura, lung, pericardium, ribs, or spine are among the causes.

It is characterized by tenderness elicited by tapping the sternum or pressing deeply upon it, dyspnea, irregular feeble heart action, and symptoms of profound septic intoxication.

The anterior mediastinum is commonly involved. Abscess, if it extends peripherally, appears to the side of the sternum or in the epigastric region.

Posterior mediastinitis is commonly accompanied by signs of irritation of the spinal nerve roots. The external pointing of the abscess is in the intercostal spaces or at the root of the neck.

Pericarditis.—Inflammation of the pericardium is accompanied by effusion. This may be serous, formative, or purulent. The presence of effusion in quantity is indicated by heart hurry, often irregularity and intermission of beats, distant sounds and pronounced increase in the area of cardiac dulness, readily demonstrable in the absence of pleural effusion. The area is usually pear-shaped, with the base downward. If the effusion be large there will be distinct bulging in the cardiac region, especially marked in children.

Hydropericardium may occur as one of the features of a general dropsy, and is then associated with bilateral pleural effusion. After scarlet fever the pericardium may be the only seat of transudate (Musser). Pericardial effusion commonly occurs in pneumonia, rheumatism, or tuberculosis. It may complicate typhoid fever, scarlet fever, or pyogenic infection in any of its forms.

The *x*-rays may be helpful in diagnosis, but should be supplemented, in septic cases with local symptoms, by exploratory incision.

Adherent pericardium may follow an acute pericarditis or may develop insidiously in the course of tuberculosis. It is characterized by systolic retraction of the interspaces most marked at the position of the apex beat and synchronous with systolic shock, outward displacement of the apex, increased area of impulse, diastolic shock, collapse of the cervical veins during diastole, weakening of the pulse during inspiration and upward extension of the area of cardiac dulness not modified by full inspiration. There are often signs of an associated pleurisy. These findings are associated with the subjective symptoms of either dilatation or hypertrophy (Musser).

Pleural Effusions.—Pleural effusions, with the exception of those transudates due to venous stasis or blood dyscrasia, which are usually bilateral and accompanied by ascites, are generally secondary to abnormal conditions of the organs invested by the pleura or of the inner portion of the walls of the thorax.

A serous pleural effusion is a common accompaniment of subphrenic and perinephric abscess, and is a symptom which may divert attention from a spinal osteomyelitis.

The effusion may be serous, fibrinous, or suppurative; may be acute in onset and course and characterized by well-marked symptoms, or may be chronic from the first.

The serous effusion becomes of surgical importance only when it markedly interferes with either respiration or circulation, or both.

Pain, non-productive, harassing cough, hurried breathing, moderate fever, dyspnea on slight exertion are the characteristic symptoms, and are corroborated by percussion dulness or flatness, absence of breath sounds and vocal fremitus, and displacement of the heart. There is always, if the effusion be of considerable size, diminished excursion of the chest wall, and enlargement of the affected side. Such a condition, developing in the absence of acute inflammatory affection of the lungs, chest walls, or lower surface of the diaphragm, and not incident to an acute systemic infection, is usually tuberculous.

Empyema may follow wounds of the pleura or lung. It is a common sequel of pleuropneumonia, is not infrequent in tuberculosis, and represents the usual direction of extension of the perinephric abscess.

In addition to the symptoms common to the pleuritic exudate those of septic absorption are usually pronounced. The nature of the infecting organism can be determined by removal and bacteriological examination of the purulent contents.

The purulent empyema of tuberculous origin may be latent. It is not infrequently complicated by pneumothorax.

Chylothorax, due to trauma of the thoracic duct or its obstruction by tumor, exhibits the symptoms of a pleural effusion and is recognized by the presence of a cream-like fluid withdrawn by puncture.

Exploratory puncture of the chest is accomplished by means of a syringe of adequate capacity with a needle at least four inches long, with a short point, and of sufficient caliber to evacuate by suction a thick fluid.

The points of election for puncture are the sixth interspace in the axillary line, the eighth interspace in the scapular line, or at such a position as the conditions present indicate. The skin is cleansed, anesthetized, and cut through by a stab with a sharp pointed tenotome to the subcutaneous fat, thus avoiding the danger of carrying skin infection to the deeper parts and enabling the surgeon to feel the lessened resistance to the needle point encountered when it has entered the pleural cavity. The needle, attached to the syringe, is then inserted, with the finger pressed against it at a distance from its point equal to the probable thickness of the chest wall in order to prevent it from going in too far, close to the upper border of the rib into the chest cavity. The piston is slowly withdrawn; if no fluid is obtained the needle is slowly pushed farther in. If the first puncture is negative, others should be made. A small amount of fluid suffices for the objects of an exploratory puncture. The opening is closed with collodion unless operation is to follow at once.

Fluid thus aspirated is examined for its cellular contents and the particular form of infection present, a portion being saved in a sterile vessel for culture and inoculation should this seem needful. Non-traumatic, blood-stained effusion is suggestive of malignant disease.

Abscess of the Lung.—Abscess of the lung usually follows pneumonia, and is suggested by a continuance and exacerbation of the symptoms of general infection beyond the time for resolution, without demonstrable evidences of further extension of the pneumonic process. Marked daily variation in temperature and, particularly, recurring attacks of chill, fever, and sweat are characteristic.

If the abscess be near the lung surface, circumscribed percussion dulness is the sign of major import, associated with the usual signs of consolidation. If, in the course of these symptoms, there be a sudden, profuse, purulent expectoration, and the signs of local consolidation are succeeded by those of cavity formation, the diagnosis is assured. The *x*-rays are helpful in establishing the presence of an abscess and in localizing it.

Suppurating bronchial glands, septic emboli, foreign bodies, extension of suppuration from the postperitoneal structures or the thoracic parietes are occasional causes of lung abscess.

Gangrene of the Lung.—Gangrene of the lung, usually a sequel of pneumonia, is attended by symptoms similar to those of abscess. The constitutional condition is one of profound sepsis. The expectoration is extremely foul.

Bronchiectasis.—Bronchiectasis, often associated with tuberculosis, and observed in alcoholics and diabetics, may closely simulate abscess. It is slow in onset, and the constitutional symptoms are those of chronic sepsis. In addition to cough, often altered in severity by position, there is a profuse purulent expectoration which may be almost odorless or extremely foul. It may contain blood, sometimes a considerable quantity of it. Constitutional symptoms are not in proportion to the amount of discharge.

Localized Tuberculosis.—Localized tuberculosis of the lung may be considered as a surgical affection when an inadequately drained cavity is formed. The symptoms are those of tuberculous infection, cavity, sepsis, and deterioration in health more pronounced than would be usually noted as a consequence of a limited process.

Echinococcus.—An echinococcus cyst, causing the symptoms of mechanical displacement, including shortness of breath, pain, dulness on percussion, and absence of respiratory murmur, is rarely diagnosticated as such without exploratory puncture.

Actinomycosis.—Actinomycosis (rare) in its primary form is characterized by the symptoms of chronic pulmonary tuberculosis. Pleural effusion may be the first symptom noted.

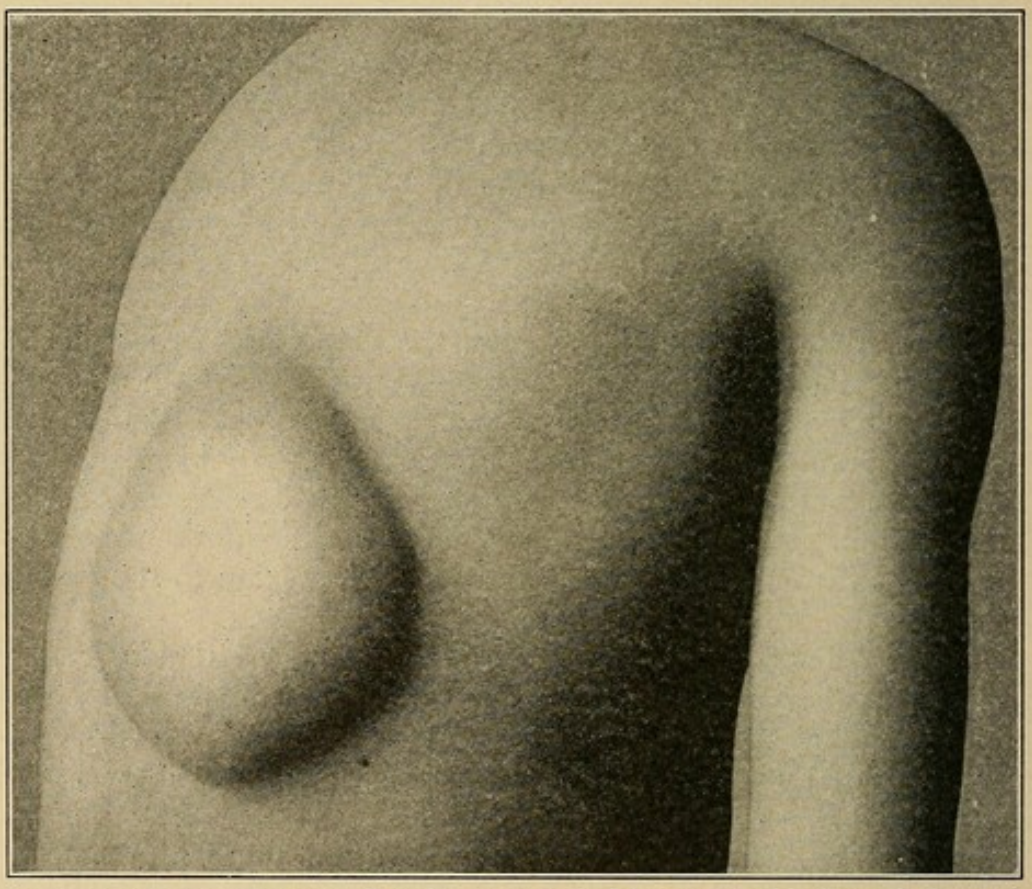
In its ultimate development hard infiltration of the chest wall with sinus formation may suggest malignant growth. The diagnosis from tuberculosis can be made only by the continued absence of tubercle bacilli from the sputum and the negative evidence of the tuberculin test. It is made occasionally by finding the ray fungus.

Syphilis of the Lung.—Syphilis of the lung, developing in its tertiary stage as a diffuse or circumscribed infiltration, exhibits the symptoms and local findings of pulmonary tuberculosis, nor can a differential diag-

nosis be made except by the persistent absence of the tubercle bacillus, the presence of other lesions or signs of syphilis, a history of spirochetal infection, and the result of efficient constitutional treatment.

Tumors of the Thorax.—Lymphangiomata and hemangiomata, subject to rapid enlargement, moles exhibiting malignant degeneration, and keloid, are congenital tumors common in the skin of the chest. Lipoma and fibroma are frequently seen here, the former simulating at times cold abscess, but exhibiting typical lobulations and freedom from deep attachment, except when it is of subpleural origin, the latter of slow growth and dense consistency, indistinguishable in its beginning from sarcoma.

FIG. 332



Subcutaneous lipoma of back. Sharply circumscribed tumor movable beneath skin and on underlying tissues. Uniform soft consistency simulating fluctuation. Skin dimples on being made tense. (Carnett.)

Subpleural lipoma may project, forming an external tumor, soft and lobulated, lying below the muscles and apparently adherent to the chest wall. The major part of it may be intrathoracic. Mediastinal lipoma may act precisely the same way. These tumors at times grow rapidly.

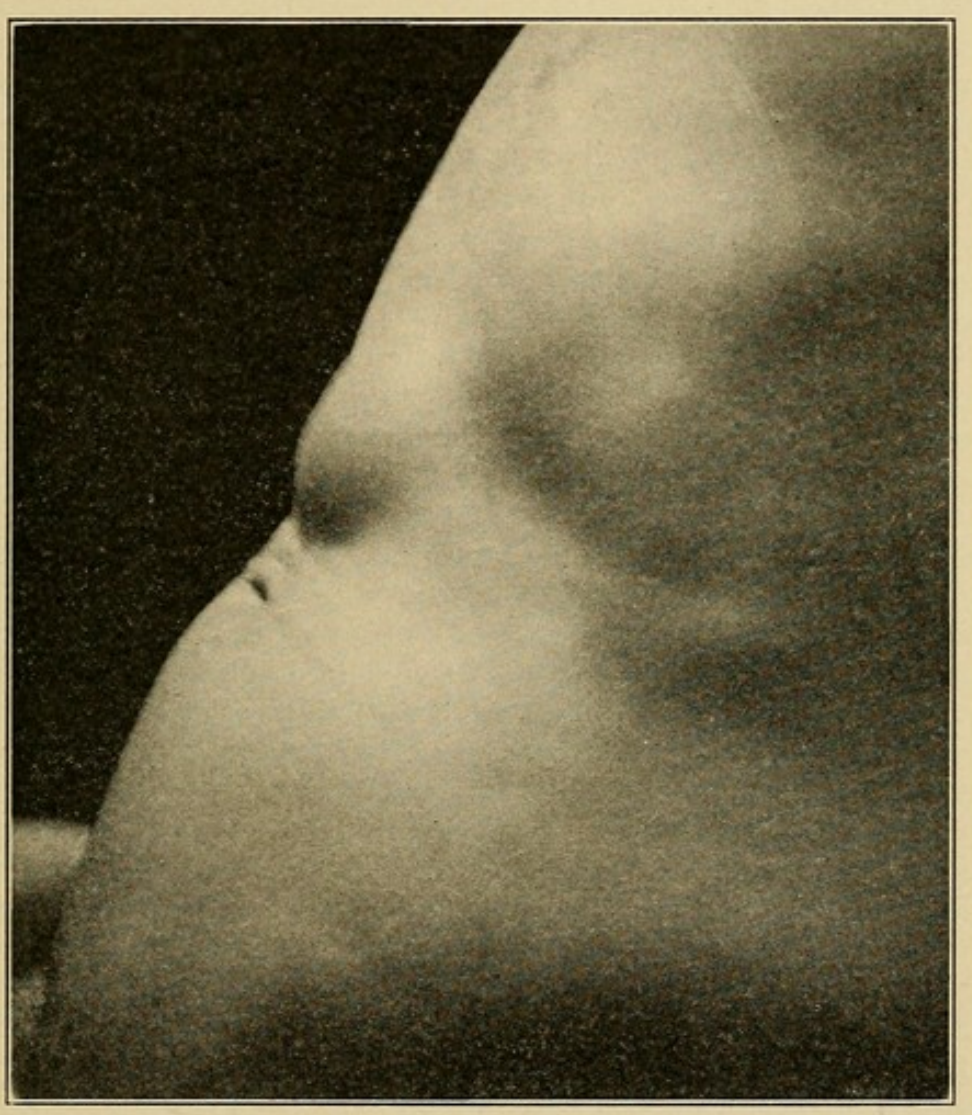
Sarcoma of the soft parts, rare, except in the region of the shoulder as an extension from the breast or as a malignant degeneration of a congenital skin lesion, is characterized by the rapid growth of an apparently causeless tumor. It should be diagnosticated by complete removal and microscopic examination.

Carcinoma of the chest wall is usually an extension from the breast,

occasionally in the form of a rapid (weeks, months), widely spreading, nodular infiltration (cancer en cuirasse) involving a large surface.

Epithelioma forms a chronic slowly growing ulcer which must be diagnosticated by excision.

FIG. 333



Hernia through linea alba. Sudden onset during heavy lifting; twenty years' duration; expansile impulse on coughing; incomplete reduction on lying down or by manipulation; small, irreducible nodule, probably omentum; ring admits tip of thumb. (Carnett.)

Tumor of the Ribs and Sternum.—The bone tumors of the thorax are usually sarcomata.

Osteoma and chondroma, growing from the region of the costochondral junction of the ribs and from that of the manubrium and body of the sternum, exhibit, if palpable, characteristic hardness, and in the case of osteoma, slow growth. The diagnosis should be made by the *x*-rays or by exploration.

Sarcoma, not infrequently post-traumatic, is characterized by its rapid growth and by the *x*-ray findings. Pressure pain may be severe. The distinction from a chronic osteomyelitis may, in the early stages of the affection, be impossible; later, the large size without sinus

formation or tendency thereto is characteristic. The inward growth is commonly much greater than would be suggested by external examination. The diagnosis should be made by early complete removal of a bone tumor which is not obviously benign.

Tumor of the Mediastinum.—Exceptionally benign (fibroma, lipoma) mediastinal tumor is usually of lymphatic origin, malignant and secondary to cancer of the breast, thyroid, lung, pleura, or esophagus.

Pressure symptoms, bulging of the chest wall, the development of a palpable tumor are the characteristic features of all mediastinal tumors, malignancy being suggested by rapid progression.

The pressure symptoms are radiating pain, both deep and localized; harassing, futile cough; dyspnea, often with stridor; pleural effusion; venous congestion of the head, chest, and upper extremities, with occasionally chest edema; hoarseness or loss of voice; displacement of the heart, displacement of the trachea, difficulty in swallowing, and rapid emaciation.

Percussion dulness will be elicited if the tumor lie near the sternum. Palpation deep in the suprasternal notch may enable the tumor to be felt. Lymphatic involvement of the lower cervical group of glands is a corroborative symptom. These tumors may pulsate and may closely simulate aneurysm. The *x*-rays may be helpful.

Tumor of the Pleura.—Tumor of the pleura, usually secondary endothelioma, if primary, is characterized by a pleuritic exudate and a profound deterioration in general health. It is usually regarded as tuberculous until aspiration reveals a blood-stained fluid. Positive diagnosis is made by direct exploration through an incision.

Tumor of the lung, rare except in its secondary form, is characterized by the symptoms of circumscribed consolidation without mucopurulent expectoration. There is commonly an associated pleural exudate, a profound cachexia, and later there may be bloody expectoration. The *x*-rays may be helpful in diagnosis.

Aneurysm of the Aorta.—Aneurysm of the aorta, usually from the ascending portion of the arch, if it produce symptoms, is characterized by those of pressure, such as are common to mediastinal tumor, but with dyspnea and difficulty in swallowing more marked, and not infrequently by tracheal tug. When the growth reaches sufficient size to form a palpable external tumor, the thrill and expansile pulse are usually characteristic. These symptoms may be absent.

The occasional difficulties of diagnosis are exemplified by the circumstance that such aneurysms have been opened because of the diagnosis of cold abscess.

The *x*-rays are often diagnostic. Aspiration should be employed in case of doubt.

THE BREAST.

In the superficial layer of fatty tissue overlying the muscles of the anterior chest wall is the mammary gland made up of from fourteen

to twenty lobes, each provided with a duct opening on the surface of the nipple, exhibiting a narrowing near its orifice, and a dilatation beneath the areola. These lobes are bound together by a fibrous investment which sends numerous extensions to the skin and which intimately connects the latter with the deep fascia at the lower margin of the gland.

Surrounding the breast there is an abundant fatty investment which penetrates between the lobes and which mainly gives the gland its full, rounded shape. The breast is loosely attached to the pectoral fascia, and, though in the main disk-shaped, exhibits aberrant extensions. The one toward the axilla is fairly constant and may be so widely separated from the rest of the gland as to suggest a distinct tumor.

Two peripheral extensions are usually found along the inner margin of the breast and the gland structure at times dips into the substance of the pectoral muscle.

The small nodules in the thin, pigmented skin of the areola which develop at puberty are sebaceous glands.

The arterial supply is from the internal mammary through perforating branches, from the axillary through the long thoracic and acromiothoracic, and from the intercostals.

The venous return is through the axillary and internal mammary vessels.

The superficial lymphatic vessels pass from the overlying skin of the breast, with the exception of that covering the nipple and areola, into the thoracic group of axillary glands; these vessels communicate freely with those of the other breast. The lymphatics of the nipple, areola, and glandular tissue pass to the upper inner group of the axillary glands, through the substance of the pectoralis major muscle to the retropectoral glands, and to the group lying below and above the clavicle and through the intercostal spaces to the retrosternal glands. All the axillary gland groups intercommunicate.

The breast remains rudimentary in both sexes until the age of puberty, when in the woman it attains its physiological development. It then forms a soft, semiglobular, movable mass, which, with its outlying nodules, can usually be distinguished from the investing fat by gentle palpation, giving to the examining hand a sense of density greater than that of the surrounding fat and of fine, soft lobulation.

Palpation of the mammary gland is best effected by placing the patient in the dorsal decubitus, with the hand of the side to be examined carried to the back of the neck. The skin should be freely movable over the gland at all points except at the areola and the submammary fold. Nodules or indurations are detected both by grasping the substance of the gland transversely and vertically between the forefingers of the two hands, by palpating portions of it between the finger and thumb of one hand, and finally by a pressing rolling motion of the fingers compressing the gland against the pectoral and serratus muscles.

Examination of the axilla for enlarged glands is facilitated by the patient placing her hand on the umbilicus. The examining finger should be carried to the deepest part of the arm pit, and should take in not only

its thoracic aspect but the inner and lower surfaces of its anterior wall. Moreover, the supraclavicular and infraclavicular regions should be carefully palpated.

General Symptomatology.—The most conspicuous and significant symptom of affections of the breast is swelling. This may be diffuse or localized, and may or may not be accompanied by symptoms of acute inflammation.

The affections which are characterized mainly by increased size of the entire breast, with inflammatory phenomena slight or wanting, are hypertrophy; the rapid gland growth incident to puberty, pregnancy, and lactation; mastitis of the newly born; the congestive enlargement in women at beginning of sexual life; and, exceptionally, infiltrating carcinoma.

Affections mainly characterized by acute or subacute inflammatory phenomena are furuncle, supramammary and submammary abscess, suppurative mastitis, and diffuse carcinomatosis.

Ulcerating lesions which begin superficially are fissure or erosion, chancre, mucous patch, eczema, Paget's disease, and epithelioma.

Affections which begin as circumscribed tumors with inflammatory symptoms slight or absent are neoplasms, solid or cystic, benign or malignant, tuberculoma, cold abscess (rare), and actinomycosis (rare).

The tuberculoma and gumma soften and ulcerate through the skin before they reach the size of a fist (two to six months); ulceration of malignant tumors does not occur until they reach much larger size.

The axillary glands are enlarged rapidly (days) in consequence of the congestion and hyperdevelopment of pregnancy, in all forms of acute infection of the nipple, breast, and surrounding fat, and in chancre. They enlarge slowly (weeks or months) in tuberculosis, cold abscess, and carcinoma, exhibiting in the former case a tendency to soften when they have reached the size of the thumb, often becoming converted into sacks of pus. The cancerous lymphatic enlargement is hard, and in the early stages multiple and discrete.

Discharge from the nipple other than milk occurs as an expression of vicarious menstruation, of acute and chronic mastitis, and of both benign and malignant growths. A blood-stained discharge is in itself not indicative of malignancy.

Malformations.—The breast may be absent (amastia) or aberrant and supernumerary (polymastia). It may be atrophied entirely or in part or hypertrophied. The nipple may be absent (athelia) or aberrant and supernumerary (polythelia). It may be extremely short, or retracted and umbilicated.

Congenital Malformations.—Amastia and athelia, or absence of breast and nipple, may be unilateral or bilateral. This deformity is extremely rare, and has been noted in association with congenital defects of the thorax and absence of the ovary of the affected side.

Polymastia and polythelia, or supernumerary breast and nipple, are fairly common deformities, toward the development of which heredity is a distinct predisposing factor. The misplaced glands are usually

small and functionless and are found in the anterolateral thoracic regions, though they have been noted on the face, thigh, external genitals, shoulder, and in a number of instances in the axilla. The anomaly is commonest in males. Lichtenstern found 3 out of 72 multimammiferous women who bore twins.

The short or umbilicated nipple due to malformation or the extreme invagination noted at times in the fatty, pendulous breast, must be distinguished from retraction which is a characteristic sign of carcinoma and which develops in the course of months in a nipple of previous proper conformation.

The diagnosis of supernumerary breasts and nipples is either obvious or possible only by excision and microscopic examination. A supernumerary breast without a nipple resembles closely a fatty tumor, and supernumerary nipples without underlying breasts may simulate pigmented warts and nevi.

Atrophy of the Breast.—Atrophy of the breast, rarely complete, attributed to the mastitis occurring shortly after birth, may be unilateral or bilateral, and is often associated with genital infantilism. The overlying fatty tissue may conceal the deformity.

There is no enlargement at puberty or milk secretion after gestation.

Hypertrophy of the Breast.—Hypertrophy of the breast affects both sexes and is characterized by a rapid and abnormal growth of the entire gland. It exhibits a predilection for young girls after puberty and for women in the early months of pregnancy, appearing as a rapid, painless enlargement of one or both breasts so symmetrical as to cause a feeling of satisfaction, which in the course of days or weeks is changed to one of alarm as the growth becomes a deformity. It progresses rapidly, reaches enormous dimensions, is attended by systemic depression, and is uninfluenced by medical treatment. That form which develops during the early part of gestation usually disappears after delivery, though the child is likely to be puny.

The diagnosis of hypertrophy of the breast is based upon the rapid symmetrical progressive increase in the size of the entire gland without inflammatory phenomena, localized induration or skin adhesion.

Hypertrophy of the male breast (gynecomastia) is usually bilateral and moderate in development, forming a globular projecting mass such as is normal to a young, unmarried woman, readily distinguishable upon palpation from the fat of this region.

Though often associated with genital defects, it occurs in healthy, sexually developed, potent men, the breast reaching its abnormal size at or shortly after puberty. It may follow the destruction or removal of the testes between the twentieth and the twenty-fifth year of life. Neither the completely grown adult nor the infant exhibits gynecomastia as a result of castration.

Nipple and Areola.—Dilatation of the galactophorous ducts may sometimes be seen as a soft, club-shaped swelling, lying just beneath the skin. Papilloma of the duct characterized by a bloody discharge has been felt as a slightly movable nodule.

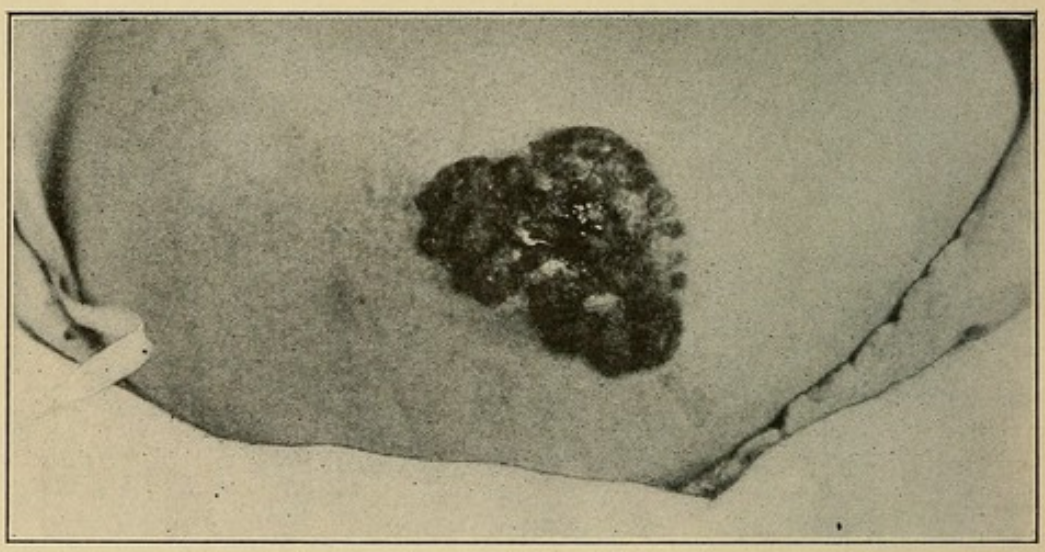
Furuncle.—Furuncle of the areola, commonest in nursing women, develops in the sebaceous glands, forming one or more small, superficial, painful, tender, inflamed, hard nodules which shortly soften and discharge. By confluence they may form short sinuses beneath the skin.

Fissures of the Nipple.—Fissures of the nipple, predisposed to by vices of conformation and uncleanliness, are caused by repeated traumatism and infection, hence are common in women who are nursing babies with sore mouths. They are often multiple and may be deeply destructive.

Chancre of the Nipple and Areola.—This is often bilateral and multiple, and may exactly simulate fissure. Axillary adenopathy, more indolent and hyperplastic in type than that characteristic of simple fissure, associated with an indurated ulcerating lesion which does not respond to local treatment, should excite a suspicion of syphilis. The diagnosis is made by finding the Treponema pallidum.

Eczema.—Eczema forms a red, raw, irregular, crusted patch of excoriated skin about the nipple, which yields to the treatment appropriate to this condition when it appears elsewhere.

FIG. 334



Paget's disease of the nipple; long duration; followed by carcinoma of the breast. (Hartzell.)

Paget's Disease.—Paget's disease closely resembles eczema, but differs from it in being rebellious to treatment. It is followed by carcinoma. The diagnosis is based on persistence and slow extension in spite of careful treatment, and finally on excision and microscopic examination.

Epithelioma of the Nipple and Areola.—This is characterized by the slow formation (months) in women past middle age of an indurated, jagged, destructive ulceration accompanied by enlargement of the axillary glands. The diagnosis should be made by immediate excision.

Supramammary and Submammary Abscess.—Acute supramammary abscess develops commonly in the fatty tissue lying about the lower segment of the gland, especially in those whose breasts are large and pendulous. The symptoms are acute and obvious, the rapid skin involvement showing the superficial nature of the infection.

Acute submammary abscesses are always secondary to suppurative mastitis, systemic infection, or traumatism. The loose, cellular tissue at this point favors the rapid accumulation of pus which thrusts the whole breast forward.

The diagnosis is based upon the presence of an adequate cause (mastitis), the forward projection of the entire breast, the finding of an edematous collar about it, glandular involvement, and the constitutional and blood symptoms of infection.

Chronic submammary abscess, usually secondary to caries of the ribs or sternum, or extension of pus from the mediastinum, forms a deeply placed tumor not movable on the chest wall. This fact should suggest the diagnosis, though it is not usually determined until operation.

Mastitis.—Swelling of the breast, with slight heat and tenderness, and at times an associated transitory adenopathy, is observed shortly after birth, at puberty in both sexes, and in the female at the beginning of sexual life and during pregnancy and lactation.

The mastitis of infancy develops in both sexes a few days after birth, is transitory, and is attended by a milky discharge from the nipple. Exceptionally abscesses form, or the inflammation, becoming chronic, may cause atrophy.

The mastitis of puberty (both sexes) may be attended by a serous discharge from the nipple. It subsides within a week. Exceptionally abscess forms; this is likely to be superficial and single.

With the assumption of sexual life the breasts of women swell and become tender, often vaguely nodular. This is a transitory condition not leading to infection.

Lactation mastitis is commonest in primipara who nurse their children, and develops, as a rule, in the first months after childbirth.

The essential predisposing conditions are overdistention of the breast with its normal secretion, exposure to cold, and infection, often from a fissured nipple.

Lactation mastitis may appear in the form of a tender induration which may subside promptly, may quickly develop the symptoms of acute suppuration, or may persist and slowly enlarge and soften, forming a chronic abscess.

If the primary induration does not subside, it usually becomes acutely painful, the overlying skin is edematous, the constitutional and blood symptoms of infection are present, and fluctuation soon develops.

Chronic mastitis is characterized by persistent induration which may form an indolent abscess or may undergo malignant degeneration.

The diagnosis as to the nature of a persistent infiltration or a fluctuating tumor of the breast developing during lactation should be made by exploratory operation.

Acute puerperal mastitis may be total (rare). This form of infection is characterized by sudden, violent, overwhelming inflammation of the entire breast. The constitutional symptoms are those of profound toxemia. It may terminate in gangrene characterized by dusky discoloration of the skin, vesication, and extrusion of large sloughs.

Tuberculous Mastitis.—Tuberculous mastitis in about half the reported cases has developed in young women without other tuberculous lesions. It is at times secondary to tuberculous axillary lymphadenitis. It is characterized by a slowly growing, vaguely outlined, painless, at first non-inflammatory, dense induration, usually in the central zone of the breast. In about three months this tumor, having reached the size of a child's fist, fluctuates and ulcerates through the skin which is undermined, but not infiltrated and adherent. The axillary glands are enlarged early (one month) and are more inflammatory in type than is the involvement of carcinoma. They may soften and discharge cheesy pus while the breast tumor is still forming.

Mammary tuberculosis might be suggested by the presence of tuberculosis elsewhere, and particularly of obviously tuberculous glands in the axilla. It begins precisely as does cancer. Hence its true nature should be determined by immediate excision and examination.

Syphilitic Mastitis (rare).—*Gumma of the Breast.*—This is often bilateral, forms a hard, painless, rounded tumor, unattended by either adenopathy or systemic symptoms. In one to three months, and before it has reached a size greater than that of an egg, it softens and ulcerates, forming a typical, punched-out, non-proliferating ulcer. Axillary adenopathy may now develop from mixed infection.

In its early stages this infiltration exactly simulates malignant growth. The differential diagnosis must be by excision and microscopic examination, though a clear history of syphilis with associated manifestations of this disease might suggest the therapeutic test of mercury and the iodides.

Hydatid Cyst.—Hydatid cyst (very rare) forms a round, hard tumor, which in the course of two years is prone to inflammation and suppuration. The diagnosis can be made only by excision.

Sebaceous Cyst.—Sebaceous cyst develops in the skin, forming a globular, finally disk-shaped, moderately hard tumor, superficially placed, slow in growth (years), and discharging from its central aperture on firm pressure or through a puncture the characteristic semisolid, cheesy substance. It has been mistaken for carcinoma.

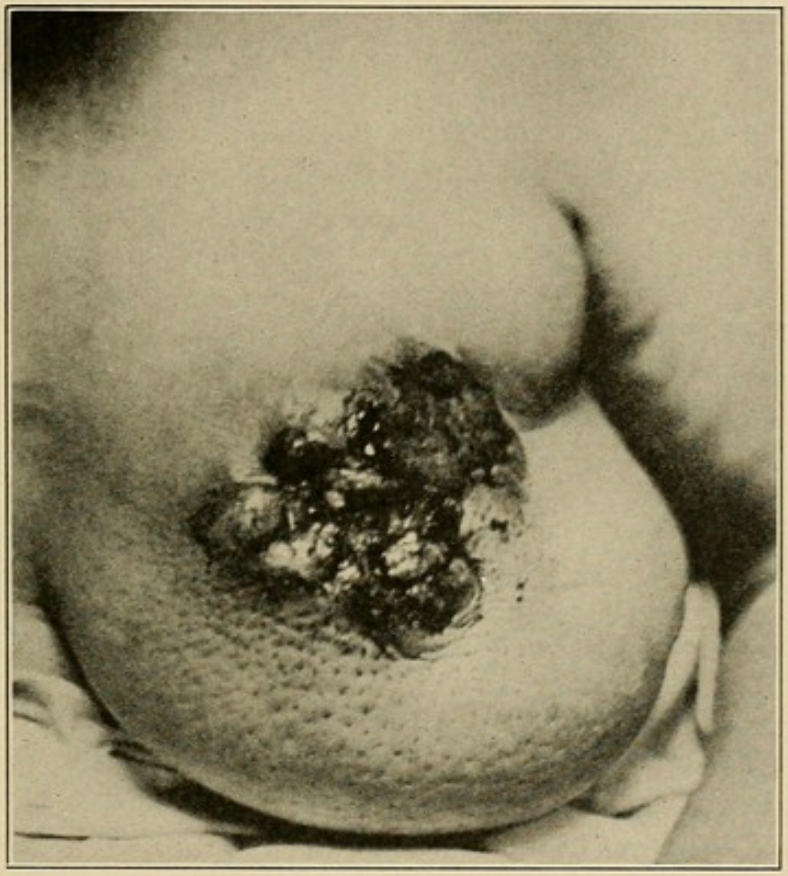
Galactocele.—Galactocele developing in the lactating breast is characterized by the rapid formation of a cyst without inflammatory phenomena. Pressure upon the cyst may cause milk to flow from the nipple. The condition may become chronic, the contents of the cyst then becoming thick and oily.

Tumors.—Since tumor of the breast is usually painless, its presence is often not suspected by a patient until it is sufficiently large to be accidentally felt or seen. This implies a growth of weeks or months, in which time it may have developed the characteristics of assured benignancy or of assured malignancy.

A great number of tumors when they first come under observation cannot be classified under either of these headings. If gumma be excluded, the diagnosis in these doubtful cases should be formulated immediately by removal of the tumor and the glandular tissue surrounding it, and macroscopic and microscopic examination.

Among the assuredly benign growths may be classed tumors which develop in the breasts of girls and young women, and which are rounded, firm, elastic, sharply circumscribed, movable, and unaccompanied by atrophy of the overlying fat, skin adhesion, or glandular enlargement. Such tumors (intercanalicular myxoma, adenofibroma, solid or cystic) may be single or multiple, but are usually small and slow of growth.

FIG. 335



Ulcerated cancer of breast; eighteen months' duration; cutaneous pitting resembling orange skin (pig skin); retracted nipple at lower third of ulcer. (Carnett.)

Of similar benignancy are the tumors which develop in women who have never borne children, at or about the menopause, and which are multiple, cystic, sharply outlined from the surrounding tissues, unaccompanied by atrophy of the overlying fat or skin adhesions, or more than a moderate enlargement of the axillary glands.

Finally, tumors which conform in type with those just described, and which have existed for a long time (years) without change in size are essentially benign.

Tumors which are certainly malignant are characterized by the development of a single, hard, infiltrating mass of irregular outline and vague definition, associated with atrophy of the overlying fat, skin dimpling, and retraction of the nipple. This last symptom, when but slightly marked, must be demonstrated by comparing its freedom of motion when drawn forward with that of the nipple of the healthy breast.

Skin dimpling and fat atrophy are elicited by broadly encircling the

breast tissue about the growth with the two hands, lifting this segment away from the chest wall, and pressing the hands together. Multiple, indurated, non-sensitive axillary glands, if present, afford further corroboration of the malignant nature of the induration. All forms of cancer in the late, usually inoperable, stage offer the clinical picture of assured malignancy.

Whether the tumor be single or multiple, solid or cystic, rounded or lobulated, if it exhibit rapid growth after a quiescent period, or if it be not clearly and definitely outlined from the surrounding breast tissue, the diagnosis should be formulated by operation.

The operative diagnosis of benignancy is based mainly upon the presence of distinct encapsulation; in the case of cysts upon the presence of clear or opalescent fluid, unless there be an associated intracystic papilloma, when the cyst contents may be blood-stained; and upon the thin white walls and distinct demarcation from the surrounding tissues.

The operative diagnosis of malignancy is based upon the absence of distinct and complete encapsulation, infiltration into the surrounding breast tissue, creaking under the knife and brittleness of tissue, and on the presence of granular debris in fibrous spaces.

In the case of cysts, the bloody or grumous contents, fungating intracystic growths, thickening and irregularity of the cyst wall, and particularly infiltration of the tissue surrounding the base of the fungating intracystic growth, are evidences of malignancy. In case of doubt after careful consideration of the clinical history and macroscopic examination of the excised growth a complete breast operation should be performed.

Mastodynia.—This is characterized by pain so severe and recurrent or persistent as to be crippling. It is most marked about the menstrual period. It may radiate widely, and may be associated with distinct induration, either local or disseminated, over the whole breast, giving to the examining fingers the sensation of a finely lobulated connective-tissue mass. Exceptionally the breast is entirely normal to palpation, though it may exhibit points of tenderness. The overlying skin is at times hyperesthetic.

The diagnosis is often entirely symptomatic. If careful palpation reveals one or more small, superficial, excessively tender nodules, neurofibromata would be suggested. Marked induration of the whole breast, giving to the examining fingers the sensation of a bag of fine and large shot, is indicative of chronic mastitis. Paroxysms of pain characterized by sudden swelling, with complete and rapid subsidence, especially if associated with other nervous phenomena, are, for lack of a better designation, termed hysterical.

The affection is persistent, exhausting, and unlikely to yield to treatment. In the presence of demonstrable lesions, therapeutic indications are plain.

Spontaneous ecchymosis of the breast has been noted, often preceded by severe pain and some swelling of the breast, accompanied by or without other symptoms. It is always associated with menstruation.

THE ESOPHAGUS.

The esophagus, beginning at about the upper border of the cricoid cartilage, on a level with the sixth intervertebral disk, ends a little short of an inch below the diaphragm, opposite the body of the eleventh dorsal vertebra.

Its beginning in the adult is five and a half to six inches from the line of the teeth, its termination at the cardia is from fifteen to sixteen inches from the same line, this last measurement being less or greater by two inches, in proportion to stature. The distance from the teeth to the cardia of children from two to twelve years old is from nine to eleven inches.

There are three points of narrowing—the beginning, the position of the crossing of the left bronchus, and the site of passage through the diaphragm.

In the adult the esophagus should admit from above an instrument 15 mm. in diameter; from the stomach aspect, three fingers as far as the first joint.

Its upper end cannot be reached by a finger introduced through the mouth, nor is it accessible to palpation, excepting in its cervical portion, where it bends slightly to the left.

It is explored by means of soft rubber tubes, flexible woven bougies (cylindrical, conical, rat-tailed, and elbowed), bougies made with a flexible handle twenty inches long, to which can be attached metal bulbs of varying diameter, or the esophagoscope.

Instrumental examination should be preceded by thrice painting the pharynx and base of the tongue at three minute intervals with 20 per cent. eucaine lactate and 0.01 per cent. adrenalin chloride solution. In weak patients death from cardiac inhibition has resulted from the attempt to pass esophageal instruments.

Soft, flexible instruments are passed with the patient in a sitting position, his head leaning slightly forward. The surgeon's left index finger is passed to the base of the tongue and guides the tip of the instrument backward against the posterior wall of the pharynx while it also holds the tongue forward. Muscular spasm, violent cough, dyspnea, and vomiting efforts usually make the first essay difficult. Once having entered the esophagus, the head of the patient may be extended. The further passage of the instrument into the stomach is, in the normal esophagus, unobstructed.

Direct inspection is practicable through the esophagoscope, a long straight tube of from 10 to 15 mm. diameter and varying in length in accordance with the needs of the case, provided with a cold lamp in its extremity and a conical obturator. Its introduction is possible only with the head in a position of extreme extension. It forces the cricoid cartilage forward and produces bruising of the upper extremity of the esophagus. It gives a view of the esophageal walls throughout their entire extent.

Auscultation of the esophagus to the left of the spine of the eleventh dorsal vertebra is useful at times. Fluid is by a swallowing motion squirted into the lower part of the esophagus, where it remains six seconds. The cardiac orifice of the stomach then opens and the fluid enters this viscus with a gurgling sound. Delay of this sound or its absence would suggest narrowing or spasm at or near the cardia.

The cardinal symptoms of esophageal disease are difficulty in swallowing, pain usually aggravated by this act, regurgitation of food which does not contain gastric juice, and often reflex cough.

These symptoms are also characteristic of inflammations of the pharynx and tonsils, postpharyngeal abscess, and palsy of the palate or of the pharyngeal constrictors.

The throat lesions which cause these symptoms are amenable to direct inspection and palpation, in cases of inflammation and abscess, and the pain is referred to the throat.

The regurgitation incident to palsy secondary to infectious disease, particularly diphtheria, is immediate and usually partly nasal.

Congenital Malformations of the Esophagus.—This portion of the alimentary canal may be transposed, duplicated, dilated, or strictured. It may be imperforate or may exhibit fistulæ.

Congenital stricture, characterized by lifelong difficulty of deglutition, is often associated with diverticula.

Esophagotracheal fistula causes a spasmodic coughing up of the ingested fluid when the infant is nourished.

Imperforate esophagus may take the form of diaphragmatic closure or complete absence.

Rupture of the Esophagus.—Rupture of the esophagus occurring during violent vomiting has been noted in the lower end of this tube, probably predisposed to by abnormal condition; characterized by violent pain, shock, inability either to swallow or vomit, emphysema at the base of the neck, and death within twenty-four hours.

Diagnosis might be suggested by the dysphagia and the prominence of the thoracic symptoms.

Acute Esophagitis.—Acute esophagitis, usually due to the ingestion of a corrosive liquid, is usually masked in its symptomatology by the associated lesions of the mouth and stomach which establish the diagnosis. The tissue necrosis is greatest at the three points of normal narrowing.

The esophagus may be traumatized from within by instrumentation or by the swallowing of small sharp or pointed foreign bodies which may or may not be arrested in its substance. Instrumentation may cause perforation and abscess, but not in a healthy esophagus. It often occasions an acute catarrhal esophagitis limited to the upper orifice.

The acute inflammation incident to the lodgement of a small sharp foreign body is characterized by sudden sticking pain fairly well localized behind the sternum, aggravated greatly by swallowing solids, growing worse shortly (hours or days), followed by dysphagia, the constitutional symptoms of infection, and often the eructation of blood and pus.

This condition is distinguished from the burning pain incident to an

esophageal scratch, from the circumstance that the latter within twenty-four hours begins to grow better, and the slight dysphagia is one of pain rather than of mechanical obstruction and muscular infiltration.

Acute inflammation secondary to periesophageal phlegmon of vertebral, glandular, or tracheal origin would probably be suggested by the symptoms of the primary disease and the absence of other adequate cause. There is burning pain aggravated by swallowing, or at times even by moving the neck, and usually the constitutional signs of profound toxemia.

Foreign Bodies.—Foreign bodies, particularly frequent in children, are arrested at either extremity of the esophagus or the position of the bronchial crossing. The characteristic symptoms are great and suffocating pain, fruitless vomiting efforts, strangling cough, and dysphagia. Fatal dyspnea may result from the high lodgement of a large body. In hours or days (exceptionally weeks) the constitutional and local symptoms of infection develop. Periesophageal suppuration may lead to mediastinal infection and inflammation of the pleura and pericardium, or perforation into the air passages or the great bloodvessels.

Though the immediate symptoms, because of the associated laryngeal spasm, are, exceptionally, much like those of foreign body in the air passages, the dyspnea and cough are usually moderate and the patient by his own sensations makes the correct diagnosis. This should be made absolutely and immediately by the *x*-ray when this is applicable (teeth, coins, etc.), the esophageal bougie, and, in the case of small sharp bodies (fish-bones), by the esophagoscope.

Esophagismus.—Esophagismus, manifested by involuntary contraction of the upper opening of the canal, is a neurosis usually occurring in young women exhibiting other signs of hysteria. It is an occasional reflex of an erupting wisdom tooth. The attack which comes on suddenly is characterized by dysphagia, eructation of the pharyngeal contents, pain, often severe, a sense of constriction, and dyspnea. These symptoms may recur at each effort at deglutition for days or months. More commonly they are distinctly intermittent, and the difficulty in swallowing corresponds to no mechanical law, since warm food can sometimes be taken with ease while cold food brings on the spasm, or one liquid may be taken with impunity while another equally bland is promptly rejected.

The diagnosis is suggested by the immediate rejection of food before it leaves the pharynx, the high seat of pain, the variability of the symptoms, and is confirmed by an examination with a bulbous bougie under an anesthetic.

Cardiospasm.—Cardiospasm may be acute in onset, especially when it follows traumatism to the chest wall. It may be reflex or incident to degenerative changes in the vagus. This nerve sends fibers to the intrinsic ganglia of the cardia which keep this muscle in a condition of tonic contraction; this contraction will be permanent if the inhibitory fibers are destroyed.

Cardiospasm is characterized in its beginning by much the same

symptoms as esophagismus, except that the burning pain and point of stoppage are located behind the midportion of the sternum. In the early stages food is regurgitated at once.

The symptoms may be evanescent, recurring, or persistent.

The bougie is resisted strongly just as it is about to pass into the stomach (sixteen inches from the line of the teeth), but on sustained gentle pressure passes in quite suddenly. Moreover, a large instrument will at times pass more readily than a small one.

Cardiospasm with Diffuse Dilatation of the Esophagus.—This is characterized by precisely the symptoms of deep diverticulum. There is increasing dysphagia, pain behind the sternum after eating, dry cough, and eructation of putrid food. On lying down, there is an almost effortless regurgitation of food unmixed with gastric contents. This regurgitation occurs at other times often assisted by voluntary muscular actions having for their end increased intrathoracic pressure. There is no vomiting or belching of gas.

These patients select their diet most carefully, and often go through extraordinary movements to force the food into the stomach. With the fusiform dilatation of the esophagus there is usually an associated muscular hypertrophy of its walls.

The diagnosis is based upon the deep position of the obstruction, 42 cm. from the line of the teeth, its yielding to steady gentle pressure, its irregularity, since at one time an instrument passes readily, while at another its introduction is impossible. Examination with the esophagoscope shows a lax, catarrhal, dilated esophagus, obstructed at the cardia by muscular spasm.

The prognosis of the affection in its progressive form (increasing dilatation) is bad. It may last through a long life unrecognized if the dilatation is adequately combated by hypertrophy.

The round peptic ulcer attacks the esophagus directly or in the form of an extension from the stomach. It may bleed freely, thus simulating gastric ulcer.

Both tuberculous and syphilitic lesions have been observed, but give no characteristic symptoms other than those incident to subsequent cicatricial contraction. Papillomata and retention cysts have been seen through the esophagoscope.

Varices of the lower part of the esophagus (in atrophic cirrhosis of the liver) may cause profuse bleeding indistinguishable from that coming from the stomach.

Stricture of the Esophagus.—Stricture of the esophagus may develop within ten days following a chemical destruction of tissue. Usually it occurs within six months. When caused by the ingestion of cauterizing agents, it is placed by preference at the points of physiological narrowing. There is usually a proximal hypertrophy of muscles, preventing dilatation, and always a chronic catarrhal condition of the mucous membrane, which in itself increases the narrowing. The stricture due to either the peptic ulcer, at the lower end of the tube,

or the gumma, is not preceded by symptoms sufficiently characteristic for the formation of a diagnosis of the exciting cause.

The characteristic symptom of stricture is dysphagia which may develop quite suddenly. As a rule, it comes on gradually, first being exhibited toward solids, later toward soft food and liquids. Patients thus afflicted learn to select their diet with great care, make violent efforts at swallowing, and regurgitate masticated food without admixture of the stomach contents. There is severe poststernal pain, relieved by regurgitation. When untreated, the tendency to complete obstruction is pronounced.

Diagnosis is suggested by the history of a preceding esophagitis and is assured by examination with bougies. The bougie will exclude paralytic dysphagia and esophagismus, and usually cardiospasm and diverticulum.

Stricture due to malignant infiltration is an affection of the middle aged, being commonest in men past fifty. It is exceptional before the fortieth year. The seats of preference are those of stricture, the greater number, perhaps, being found at the bronchial crossing. Chronic esophagitis is a predisposing factor.

The diagnosis is suggested by pain, worse at night and poststernal or referred to the back, toxic anemia and dysphagia, not necessarily very pronounced, occurring in a man past middle age. Nodular enlargement of one or more supraclavicular glands would be corroborative.

The passage of bougies and the esophagoscope often makes the diagnosis absolute.

In its early stages the condition is almost never recognized. In its later stages regurgitation of masticated food containing blood and mucus, harassing and spasmodic cough, alteration in the voice, contraction of one pupil (sympathetic), and supraclavicular glandular enlargement in conjunction with esophagoscopy suggest diagnosis. This disease may run its entire course without dysphagia or eructation.

Obstruction due to pressure from without, as from goitre, hyperplastic mediastinal gland, aneurysm, or malignant tumor, is usually recognized as such, since because of the movability of the esophagus it is not compressed untill these tumors reach such size as to be recognized by the physical signs. Malignant mediastinal infiltration may by extension involve the esophagus early and cause dysphagia before the original tumor is sufficiently developed to formulate a diagnosis.

Polypi.—Polypi (adenofibromata) are rare. They usually grow from the upper extremity of the esophagus or from the pharynx, and occasion no symptom except dysphagia and, when the pedicle is long, attacks of dyspnea.

Diagnosis should be made by examination with bougies, the laryngoscope, and the esophagoscope.

Diverticula of the Esophagus.—Diverticula of the esophagus commonly arise from the posterior wall of the pharyngo-esophageal junction at a point of normal weakness (constrictor fibers absent). The diverticulum is slow (many years) in development, ultimately forming a

pouch projecting downward along the canal, and, when filled with food, compressing the latter.

In its early stages, and at times through life, it is characterized by no other symptom than eructation of food, and can be distinguished from stomach rumination by examination of this food for gastric juice.

When of sufficient development to mechanically interfere with swallowing, it is manifested by dysphagia, pain relieved by eructation of stinking food without gastric juice, tumor of the neck in case of a high diverticulum (not always), which can be emptied into the pharynx by external pressure. A bougie usually passes directly into the diverticulum and is arrested by its fundus. A second bougie passed beside the first readily slips into the stomach.

Diverticula of the lower part of the esophagus, usually rising from the anterior surface near the brachial bifurcation, may be difficult to distinguish from dilatation secondary to cardiospasm. In each there may be slow onset, steady progression, dysphagia, pain, and eructation of large quantities of putrid but non-digested food with relief of pain. The opening into the diverticulum may be found or avoided at will by the use of an elbowed bougie or woven stomach tube. If two be passed in succession, after lodgement of one the other may pass by it and readily enter the stomach. On injection through these two bougies of a colored and a clear solution, one into the diverticulum, the other into the stomach, there will be no mixing of these two unless more has been poured into the diverticulum than it is capable of holding. The ingestion of bismuth and mashed potatoes may enable a characteristic *x*-ray picture to be taken.

The use of the esophagoscope may be needful before diagnosis is made. Indeed, this may remain doubtful even after careful examination with that instrument.

CHAPTER XVI.

THE ABDOMEN.

Contusion.—Contusion is followed by pain, shock, and vomiting. Exceptionally shock may be almost immediately fatal in the absence of demonstrable lesions.

As a rule, the shock and pain are proportionate in their severity and persistence to the intra-abdominal lesion. Neither vomiting of blood nor its appearance in the stool is in itself diagnostic of gastric or intestinal rupture.

The symptoms on which the diagnosis of rupture is based are severe and persistent pain, shock from which reaction takes place in the course of hours rather than minutes, tenderness to deep pressure, increasing rather than diminishing muscular rigidity, and the rapid development of symptoms of diffuse peritonitis.

In distinguishing between hemorrhage and perforation, the greater pain of the latter, the more rapid development of peritonitis, and increased vascular tension with the onset of inflammation would be significant.

A rapidly developing movable flank dulness may be elicited in severe hemorrhage, and often rectal tenesmus from accumulation of blood in the rectovesical peritoneal pouch.

In certain exceptional cases, after the first transitory pain and perhaps vomiting, neither shock nor other signs of intraperitoneal trouble develop for many hours. These cases are characterized after the immune interval by the sudden outbreak of symptoms of acute perforative peritonitis. The stomachs of habitual drunkards may be ruptured by slight violence or even in the absence of this. Intestinal rupture from contusion is commonest in the upper part of the jejunum.

PERITONITIS.

Peritonitis, intestinal obstruction, and gastro-enteritis so commonly complicate surgical affections of the abdominal viscera that a knowledge of their diagnostic features, aside from the agents which cause them, is important.

The peritoneum, a serous membrane about equal in area to that of the skin, exhibits an extraordinary power of both absorption and exudation; the former is best developed in its diaphragmatic portion. The latter is expressed as a serous, fibrinous, or purulent effusion, or combinations of these in accordance with the nature and progressive virulence of the exudative agent.

Peritonitis, almost never primary, with perhaps the exception of the pneumonic form observed mainly in children, is due to the extension of infection from the organs which this membrane covers.

It may be acute or chronic, local or diffused.

Acute Local Peritonitis.—Acute local peritonitis, usually incident to extension of inflammation from the appendix, gall-bladder, or Fallopian tubes, is characterized by persistent burning, stabbing, colicky pain, rapid in onset, at first referred to the umbilical region, later to the seat of inflammation, often with peripheral radiations or references.

Tenderness at or about the seat of maximum inflammation is elicited by deep pressure, palpation, or by coughing or forceful breathing.

There is local tympany and lessened or absent peristalsis in the portion of the gut involved, hence constipation and vomiting.

The overlying muscles are persistently rigid. There is usually general tympany and tenderness, nausea, vomiting, and constipation.

Fever and leukocytosis are usual. The pulse is hard and hurried.

Acute Diffuse Peritonitis.—Acute diffuse peritonitis, when due to a suddenly developing cause, usually the rupture of an ulcerated or inflamed hollow viscus or of an abscess lying within the peritoneal cavity or in a part covered by it, is characterized by sudden violent pain of overwhelming intensity, attended with shock, vomiting, and general abdominal tenderness, shortly followed by wooden rigidity of all the abdominal muscles, absence of peristalsis, tympany, absolute constipation, shallow thoracic respiration, and persistent vomiting. The frequently repeated vomiting becomes regurgitant in type, the patient spitting out brownish offensive fluid every few minutes.

With the constitutional and local reaction against irritation and infection, fever and leukocytosis develop. With fever there is a hurried, wiry pulse which, with the advent of tympany and overwhelming intoxication, becomes rapid, intermittent, and almost or quite imperceptible at the wrist.

Dorsal decubitus, with slightly flexed thighs and raised head and shoulders, is suggestive of the judgment of the nurse rather than the nature of the disease. Death from vasomotor paresis may occur without inflammatory reaction, the symptoms, aside from the agonizing pain, being those of profound shock. It is usually toxic, incident to septic absorption mainly from the bowel contents, peritonitis always occasioning paralysis of the intestinal muscles.

On no single symptom can the diagnosis of acute peritonitis be formulated. The pathognomonic symptom group is severe pain, tenderness, muscular rigidity, thoracic breathing, tympany, feeble or absent peristalsis, vomiting, and fever with hurried, wiry pulse and constipation. Very exceptionally, and usually significant of profound sepsis, the belly is flat and there is diarrhea.

In diffuse peritonitis the appearance is always that of serious illness. The diagnosis of the terminal stage is of little service.

Acute intestinal obstruction, especially when due to strangulation, is distinguished from peritonitis, in its early stages, by the absence of

fixation rigidity and the presence of exaggerated peristalsis. Later the conditions are combined.

Pulmonary affections and pericarditis may cause severe pain referred to the abdomen, with tympany, vomiting, and constipation, but tenderness is not best elicited on deep palpation, nor is there absent peristalsis nor pronounced or persistent rigidity; except in diaphragmatic pleurisy the abdominal respiratory movement is unaffected, while the hurried respirations in the one case and signs of local lesion in the other should at least suggest a diagnosis.

The abdominal pain of certain infections, such as typhoid, influenza, acute rheumatic fever, the exanthemata, or of angioneurotic edema, uremia, gout, ataxia, plumbism, or gastralgia, is accompanied by a history or other symptoms characteristic of each affection, nor is the convincing symptom-complex of peritonitis ever seen.

Angioneurotic edema, often hereditary, usually beginning in childhood, and characterized in its early development by the sudden appearance of edematous surface patches, may be characterized by visceral crises, strongly suggesting either obstruction or peritonitis. There is pain, which may be shocking in intensity, vomiting which often contains blood, and later diarrhea.

The abdomen is usually retracted. There is no true muscular rigidity, nor is there characteristic tenderness to deep pressure. Exceptionally these symptoms may be associated with tympany and intestinal paresis, in which case the history should be carefully considered in making a diagnosis, and search of the surface should be made for purpuric spots. Similar crises are noticed as prodromal of the erythematous skin diseases.

Inflammation of the abdominal wall is characterized by the local and usually readily demonstrable symptoms of this affection, by the fact that tenderness is located in the wall and not beneath it, and by the absence of the symptoms of peritoneal involvement. If subaponeurotic inflammation be complicated by local peritonitis, the recognition of the combined lesions may be difficult.

Rheumatic neuralgia of the abdominal muscles produces both tenderness and rigidity, which usually involves the whole of at least one side, is distinctly superficial, and is aggravated by movement. In this affection, as also in neuritis, cutaneous hyperesthesia is well marked, and in neuritis points of nerve tenderness can be demonstrated. Peristalsis is unaffected, there is no meteorism; unless the diaphragm be directly involved, it moves freely and muscular tenderness is relieved by warm, broad pressure.

Perirenal inflammation exhibits tenderness, best elicited by pressure in the costovertebral angle. The pain is in the renal region and is referred along the lower intercosto-abdominal nerves to the abdomen. It customarily radiates along the course of the ureter to the bladder. Though one side of the abdomen may be rigid, muscular fixation is most marked over the renal region.

Spinal caries, aneurysm of the abdominal aorta, spondylitis deformans, and acute osteomyelitis of the spine may occasion pain and rigidity

which in themselves may simulate peritonitis but are unaccompanied by other gastro-intestinal symptoms.

Arteriosclerosis is exceptionally characterized by crises of pain which may be attended by vomiting and tympany. Inflammatory symptoms are absent and nitrites may give relief.

Hysterical pseudoperitonitis may present many of the signs of grave inflammation, including in rare instances fecal vomiting, which, however, is likely to be attended by a violent retching. Neither fever nor leukocytosis is present; nor is the facies that of profound illness. The onset is unattended by the shock and vasomotor paresis of true fulminant peritonitis, and the symptoms will be found lacking in proper relationship to each other and often markedly influenced by suggestion.

The non-infectious forms of acute diffuse peritonitis, such as are incident to hemorrhage, as from a ruptured extra-uterine pregnancy, or extravasation of sterile urine, exhibit typical symptoms. The diagnosis as to cause must be based on the history and on findings other than those incident to the inflamed peritoneum, though the form of the affection is less fulminant in development and pursues a slower course than that characteristic of the septic type. The differential diagnosis should be made by celiotomy.

Chronic Peritonitis.—Chronic peritonitis, which may be local or diffuse, may be almost symptomless except for a serous exudate, or may be characterized by irregularly recurring subacute or acute attacks, convalescence from such attacks never being complete. Even during acute exacerbations pain, tenderness, and rigidity are never as pronounced as in acute pyogenic inflammation, and fever and leukocytosis are slight or wanting. Constipation often alternates with diarrhea and partial obstruction with muscular hypertrophy of the intestinal wall, and exaggerated peristalsis is common.

Chronic peritonitis may be due to tuberculosis (common), carcinoma (less common), actinomycosis (rare), or serositis (rare), and may exhibit either a serous or fibrinoplastic exudate.

Tuberculous Peritonitis.—Tuberculous peritonitis, especially an affection of children, is characterized chiefly by cachexia and fluid distention of the abdomen, which in the serous type may be painless. In the fibrinous type, recurring colicky pains with tenderness are common, and irregular nodular masses may be felt due to tuberculoma of the omentum or the mesenteric glands. In the absence of mixed infection fever and leukocytosis are but slightly marked.

Chronic fibrinous peritonitis, often most pronounced about the tubes or appendix, sometimes confined to these regions, is, if tuberculous, secondary to involvement of these structures. The symptoms may be those of mechanical obstruction caused by contracture and adhesions rather than those of inflammation.

Associated tuberculous lesions elsewhere, a positive tuberculin test, the injection of a susceptible animal with aspirated fluid, direct inspection through an incision, and microscopic examination are the diagnostic means.

Diffuse carcinoma of the peritoneum, usually secondary, is characterized by a serosanguineous exudate, and in the terminal stages by distinct nodulations.

Diagnosis is suggested by the history of a primary lesion, rapidity of progress, the profound and progressive deterioration in general health, and by exploratory operation.

Multiple serositis is characterized by chronic inflammation of the pericardium, pleura, and peritoneum, with serous exudate into the cavity of each of these structures.

INTESTINAL OBSTRUCTION.

Intestinal obstruction may be due to a paralytic condition of the bowel muscle, in which case it is termed dynamic, or to occlusion of its lumen, in which case it is termed mechanical. As opposed to peritonitis, intestinal obstruction, except in its dynamic form, is characterized by exaggerated peristalsis, straining and propulsive vomiting, and absence of fixation rigidity of the abdominal wall. The two conditions are often combined, since dynamic ileus is an almost invariable accompaniment of acute diffuse peritonitis, and peritonitis is equally certain to follow unrelieved acute obstruction.

Dynamic Ileus.—Dynamic ileus is most typically exemplified as it occurs in acute diffuse peritonitis. It may follow operation, in the absence of inflammation, as a consequence of rough or prolonged manipulations or of peritoneal chill. Exceptionally it develops after abdominal contusion, or is caused by excessive gaseous distention or splanchnic or spinal nerve degeneration. It is a common terminal condition, often directly causative of death in systemic diseases such as pneumonia, nephritis, meningitis, and typhoid fever.

In its mild and transitory form it follows all abdominal operations, probably incident to a traumatic non-infective peritonitis, accompanies renal, biliary, ovarian, or pancreatic colic, indeed, any acute intraperitoneal or juxtaperitoneal congestion or inflammation sufficiently pronounced to cause severe pain. It is then characterized by tympany, constipation, and absent or feeble peristalsis. The vomiting, if present, is of reflex pain origin and is not persistently recurring, nor do the symptoms of toxic absorption develop.

Characteristic symptoms of acute dynamic ileus are: absent peristalsis; progressive, uniformly distributed abdominal tympany, marked by a tense, rounded belly wall, in which individual intestinal coils cannot be felt; shallow, hurried respiration, because of upward pressure; rapid, weak, irregular heart action, caused at first by pressure, later by toxemia; profuse, persistently recurring, regurgitant vomiting of an offensive thin fluid, made brown or black by the presence of minute coagula; absolute constipation to both feces and flatus; and pain which, aside from that of the causative factor, is not severe, is not colicky in character, and is much bettered by the evacuation of gas.

The constitutional symptoms are those of toxic absorption. The urine is scanty, concentrated, and contains an excess of indican. When the condition, as is usually the case, is caused by peritonitis, the pronounced pain, tenderness, rigidity, and often fever and leukocytosis of this condition are present.

Incident to the enormous distention which follows hard upon paralysis of the bowel muscle and the consequent angulation of the gut, the dynamic ileus quickly becomes mechanical.

Mesenteric thrombosis and embolism depart from the type of strangulation ileus in the fact that, though they may begin with agonizing or shocking pain, vomiting, tenderness, and local meteorism, one or more profuse blood-stained passages are common and free fluid is early developed in the peritoneal cavity; occasionally a palpable blood tumor can be felt between the layers of the mesentery. In the embolic form of the affection there is usually valvular disease of the heart, and emboli may develop in other parts of the body, or they may have previously manifested themselves.

Mechanical Ileus without Strangulation.—This differs in symptomatology from that accompanied by strangulation in its less sudden, painful, and shocking onset and the much slower development of symptoms of profound intestinal toxemia and ultimate diffuse peritonitis. The absolute constipation, the recurring explosive vomit, the exaggerated peristalsis, and the progressive tympany are characteristic.

Fecal vomiting in any form of intestinal obstruction is a terminal symptom, hence of little use in framing a serviceable diagnosis.

Obturation Ileus.—Obstructive ileus, or mechanical obstruction of the gut by a plug or mass within its lumen, is in its mild form usually due to fecal impaction which occurs in anemic patients who have long been suffering from chronic intestinal catarrh. The onset is gradual, it is preceded by constipation which, though obstinate, is not inveterate, often by constipation alternating with diarrhea. When the blockage becomes complete, distention and hyperperistalsis are both marked, and vomiting is recurrent and the constipation absolute. The usual position of fecal impaction is in the rectum where it can be felt by digital examination. If in the colon, a doughy mouldable tumor may be detected.

Obturation by gallstone (rare) gives a preceding history of crippling peritonitis in the gall-bladder region.

Obstruction due to foreign body may be diagnosticated by the history and at times by the skiagraph.

Complete obstruction due to stricture formation or to pressure of a tumor or infiltration in the bowel wall, or external to it, is preceded by a history of repeated attacks of partial obstruction, and often before this the symptoms of the causative lesion. Since the obstruction is slow in its development, the muscular coat of the bowel lying above the seat of narrowing hypertrophies, and, if time be given, the gut dilates. The peristalsis in this segment is usually both palpable and visible, and, particularly in the case of stricture, is attended by annoying borborygmus.

Obstruction due to angulation of the bowel, incident to adhesion,

corresponds in type to obstruction without strangulation. The sudden painful onset is without pronounced shock. The major complaint is of severe recurring colicky pain, and often vomiting, usually with remissions or complete intermissions, since the obstruction is, as a rule, not persistently complete. Except when the sigmoid is involved, the history of a previous operation or a local peritonitis is usually obtained. This form of ileus is frequently observed as an early sequel to abdominal operation, particularly when drainage has been needful.

Strangulation Ileus.—Mechanical obstruction of the bowel lumen may be complicated by a devitalizing constriction of its bloodvessels, in which case it is called strangulation ileus. This is usually due to constriction of the gut by a hernial orifice. A similar constriction may be caused by fibrous bands incident to a former peritonitis, Meckel's diverticulum, appendicular or omental adhesions or openings in the mesentery or omentum.

With the onset of the symptoms of strangulation ileus, especially if these come on shortly after a violent muscular effort, the hernial orifices should be carefully examined; this is especially important if there is a history of previously existing hernia. In the case of strangulated iliac or obturator hernia there will be no tumor, but local pain and tenderness and radiations of pain may be suggestive.

In the absence of the signs of external hernia the possibility of diaphragmatic, duodenojejunal, and retroperitoneal herniæ should be considered. The chest signs of diaphragmatic hernia may be characteristic (see p. 507). Strangulation of other internal herniæ cannot be diagnosticated as such.

The characteristic symptoms of strangulation ileus are sudden, violent, agonizing, general abdominal pain, usually associated with shock, immediate nausea, and vomiting, the latter persistently recurring, and a temporary diminution or complete cessation of peristalsis (reflex). With recovery from shock peristalsis becomes reëstablished and palpably, audibly, and sometimes visibly exaggerated, and there is often an urgent desire to defecate, the efforts producing at the most one or two bowel movements.

Tympany shortly develops, demonstrable first in the strangulated gut segment, later becoming general above the point of obstruction, the gut below remaining undistended. The shocking pain of onset becomes more bearable and colicky in nature, exhibiting remissions and exacerbations incident to peristalsis. Constipation shortly becomes absolute. Vomiting is recurring, straining, and propulsive at first; later, with the onset of peritonitis, it becomes regurgitant and effortless. The constitutional symptoms are those of intestinal toxemia. The onset of gangrene, often characterized by a temporary diminution of pain, is followed by the rapid development of the symptoms of diffuse peritonitis.

At times strangulation ileus in onset and progress corresponds so closely with that characteristic of obturation that a diagnosis is formulated only on operation or by the development of acute diffuse peritonitis.

The distinction between internal strangulation and acute diffuse peritonitis from perforation is dependent upon the prompt reaction from shock in strangulation, the exaggerated peristalsis incident to this recovery, the explosive vomiting, and the absence of general abdominal rigidity and extreme tenderness. The preceding history is usually helpful. During the primary shock period a differential diagnosis cannot be made.

In distinguishing between strangulation and the reflex dynamic ileus incident to pulmonary, renal or cardiac affections, spinal degeneration, particularly ataxia, arteriosclerosis, renal and biliary colic, aside from the symptoms particularly characteristic of each of these conditions, the moderate primary tympany usually not actively progressive, the feeble or absent peristalsis, and the cessation of constantly recurring vomiting, with the subsidence of the agonizing pain, are characteristic. Moreover, purgatives given in full doses are usually efficient. In acute mechanical obstruction their one useful purpose is to so aggravate symptoms that previously unwilling patients welcome surgical treatment.

Intussusception, or invagination of one portion of the gut within another, usually downward and in the ileocolic region, essentially an affection of infancy and childhood, and the usual cause of acute intestinal obstruction at this age, is frequently caused by a polyp, sometimes follows abdominal trauma, and is an occasional sequel or accompaniment of diarrhea and dysentery. It may develop in the midst of perfect health.

Because the bowel is usually not completely occluded and the constriction not immediately devitalizing, intussusception departs from the type of strangulation in that it is usually characterized by tenesmus and straining and the frequently repeated passage of bloody mucus with a fecal admixture; the primal shock is slight, the vomiting not constantly recurring, and meteorism is slow in development. Colicky pain with remissions of minutes or hours and exaggerated peristalsis, are usually associated with the detection of a soft tumor placed along the course of the colon. At times the invagination can be felt by rectal examination.

When there is no palpable tumor, the diagnosis from acute or subacute gastro-enteritis should be based upon the complete absence of stools, or the passage of bloody mucus containing at most a very slight fecal admixture.

Acute Volvulus.—Acute volvulus, or twisting of the intestine upon its mesentery as a base, may involve nearly the whole of the small gut, or one or more loops of it. Usually it is observed in the sigmoid of constipated elderly people, and is distinguished in addition to the symptoms common to all forms of strangulation by a rounded, tympanitic, quiet tumor, which may be felt in the left flank or may extend above the umbilicus and beyond the median line. There is usually absolute constipation, pronounced tenesmus, and diminished capacity to rectal injection. The symptoms may be sudden in onset or may have been preceded by recurring attacks of partial obstruction.

GASTRO-ENTERITIS.

Catarrhal inflammation of the stomach and bowels frequently simulates surgical affections of these organs and complicates many of them.

Acute Gastritis.—Acute gastritis is characterized by epigastric tenderness, distress or pain aggravated by eating, nausea, eructations and vomiting of undigested food or of mucus sour from butyric, lactic, or other acid fermentation unless there be bile admixture. In severe cases the vomitus contains blood. Headache, constipation, foul breath, and coated tongue are associated symptoms. Children exhibit fever.

Acute Enteritis.—Acute enteritis is characterized by colic, which may be agonizing in intensity, but is rarely accompanied by shock, general abdominal tenderness, exaggerated peristalsis, and diarrhea, excepting when the process is confined to the duodenum. The evacuations are foul, bilious, mucoid, at times bloody, and are copious and recurring in proportion to the colonic involvement. Moderate tympany is usual, and is least marked when the diarrhea is profuse. The same, with some modification, is true of fever.

When the inflammation is confined to the duodenum it is not infrequently associated with jaundice unattended by colic and usually of brief duration (days). The greatest tenderness is above and to the right of the umbilicus. It is from this source that infection of the biliary passages usually arises. Ileocolitis is characterized by pain and tenderness, most pronounced in the right iliac fossa and along the course of the colon, and copious and frequent fluid passages, containing large quantities of mucus. The complication of appendicitis, which is not unusual, is characterized by the substitution of constipation for diarrhea, of fixation rigidity by protective contraction of the right rectus muscle.

Sigmoiditis and proctitis are attended with pain, tenderness in the left iliac fossa, with burning, teasing, and often tormenting tenesmus resulting in small mucoid, frequently bloody evacuations. The diagnosis can at times be made by a proctoscopic examination.

Chronic gastritis and enteritis are usually associated. The combined affection is characterized by eccentricities of appetite or its complete loss, belching and rectal passage of flatus with much borborygmus, or even vomiting, particularly in the morning or some hours after the ingestion of food. Except in that form of chronic gastritis accompanying ulcer, or in certain neuroses, hydrochloric acid is either diminished or absent. In chronic gastritis constipation is usual.

In chronic colonic catarrh, diarrhea is the rule. The stools are offensive and contain mucus. Pain and tenderness may be absent, insignificant or periodically harassing. The colic is likely to be recurring. The tenderness can usually be elicited by deep palpation in the region of maximum involvement. There is usually gastric and intestinal tympany, excepting shortly after attacks of vomiting and purging, and the noisy belly of an active peristalsis working on gaseous and liquid contents.

Foul breath, flabby, coated tongue, chronic pharyngitis, and the general systemic condition incident to chronic intestinal toxemia are observed. The urine is diminished and contains an excess of indican.

Chronic obstruction from any cause is attended with the symptoms of gastritis or enteritis dependent on its position, together with those of interference with the onward passage of the intestinal contents. Obstinate constipation alternating with diarrhea, and associated with local pain and tenderness, and a neurasthenic condition are highly characteristic of the association of symptoms in the case of chronic sigmoiditis dependent on redundancy and angulation.

Before assigning a surgical cause to gastro-enteritis it is necessary to eliminate the general medical causes of this affection, among which may be mentioned dietetic errors characterized by simple catarrh, cholera morbus, or ptomain poisoning, local expressions of the exanthemata, gout, purpura, scurvy, uremia, generally associated with constipation, sepsis of any kind, or intestinal parasites.

Gastro-enteritis dependent upon infiltration, ulcer, visceral prolapse, cicatricial contracture, or partial obstruction from any cause is distinctly surgical and calls for surgical treatment. The symptoms of the causative factor can usually be found if carefully sought for. It should be remembered that chronic gastro-enteritis may be characterized by abdominal pain, nausea, vomiting, or diarrhea.

ABDOMINAL TUMORS.

The diagnosis of abdominal swelling is dependent upon the point of origin of such swelling, its nature, whether gaseous, fluid, or solid, and in the latter case whether hyperplastic, inflammatory, or neoplastic; its mobility, its extent, its relation to systemic conditions or organic lesions.

In forming an opinion the condition of general nutrition, the rapidity of development, antecedent disease, and the age of the patient are all factors to be considered, nor can the examination be regarded as complete without a record of the urine, blood, the daily temperature range, the pulse rate, and often the data derived from fecal examination.

In general terms acute or subacute abdominal inflammation is characterized, in addition to swelling, by the blood changes and temperature reaction which are incident to this condition in other parts of the body. These symptoms, when marked, associated with local tenderness and, in cases of peritoneal or intraperitoneal involvement, muscular rigidity establish the diagnosis.

Chronic inflammation is, however, at times characterized by such slightly marked constitutional and local symptoms of this condition as to be entirely misleading. Under such circumstances the tumor is the major symptom, together with toxic anemia and perhaps slight temperature fluctuations not greater than are frequently observed in malignant disease.

The diagnosis must often be made by operation. Sometimes even then it is decided only by microscopic examination of the tissue removed.

The detection of intra-abdominal tumors by palpation is particularly difficult in patients with muscular and rigid belly walls, in those who are chronically tympanitic, in those cursed by an enormous adipose panniculus, or in those suffering from ascites.

Examination for abdominal tumor should be preceded by a thorough evacuation of the bowels and by emptying the bladder.

Neoplasms involving the parietes are usually accidentally discovered by the patient, and are readily detected by inspection or palpation, or both. The true nature of such growth is usually determined by operation, though the rapidity of growth and age incidence are both important factors in framing an opinion.

The presence of intra-abdominal neoplasms is usually not suspected until by their growth they produce pressure symptoms, as a rule those of chronic intestinal obstruction. Occasionally they are detected by palpation before such pressure symptoms develop.

Cysts, if tense and thick-walled, cannot be distinguished by palpation from solid tumors, though, when they reach large size, they usually exhibit distinct fluctuation. When soft walled and flaccid, their detection may be quite impossible except by means of an exploration.

Swellings Limited to the Abdominal Wall.—Such swellings are characterized by their superficial position, obvious both to palpation and inspection, and the absence of symptoms referable to involvement of internal organs. If the abdominal walls are lax, the mass can be grasped between the thumb and finger or between the two hands, and thus differentiated from the abdominal contents. They have neither respiratory nor other movement independent of the abdominal wall, except in the case of hernia. Contraction of the abdominal muscles does not flatten the tumor or cause it to disappear, but often accentuates it.

From an intra-abdominal tumor fixed to the parietal peritoneum the distinction may be difficult.

Diffuse swelling of the abdominal wall is rarely limited to this region, though it may be most marked here. The umbilicus is usually drawn in.

The diffuse swelling due to obesity does not pit on pressure, gives the characteristic finely lobulated sensation of fat to the palpating fingers, and exhibits the characteristic transverse folds at the umbilicus and just above the pubes.

Edema pits on pressure and, except as an expression of local inflammation, is not confined to the abdominal wall.

Emphysema exhibits crackling and pitting on palpation, and is associated with fractured rib or gangrenous cellulitis.

Cellulitis, usually due to extravasated urine, is preceded by a history of urethral obstruction, is attended by a pronounced edematous scrotal swelling, is limited in its downward extension by Poupart's ligament, pits on pressure, and exhibits the constitutional symptoms of profound sepsis.

Circumscribed Swellings of the Abdominal Wall.—The commonest parietal swelling is that due to hernia usually occurring, in the absence of preceding wound or severe trauma, in the inguinal or umbilical region or in the midline above or below the umbilicus, and exhibiting the char-

acteristic features of this condition (see p. 500). The midline herniæ are usually small (the size of a finger tip), and can be distinguished from a projection of the subperitoneal fat through the linea alba only by operation, since either condition may be reducible and give slight impulse on coughing. These herniæ often cause persistently recurring gastro-intestinal symptoms.

Abscess of the abdominal parietes, if acute, presents the characteristic symptoms of this condition. It is usually secondary to intra-abdominal suppuration, particularly of the appendix, and is preceded by symptoms characteristic of local suppurative peritonitis.

Spinal osteomyelitis may lead to extensive pus formation in the abdominal walls.

Tuberculous bone infection usually causes a cold abscess, the dominant symptom of which is a fluctuating, non-sensitive, slowly progressive, painless tumor. A favorite seat of pointing is in the lumbar region.

Actinomycosis due to direct extension from the intestine, and noted, as a rule, in the ileocecal region, is characterized by the progressive involvement of the parietes in an induration which softens and discharges pus and which contains the ray fungus.

A similar condition may result from tuberculosis, nor can the diagnosis be made except by microscopic examination and associated manifestations of the disease.

Rupture of the Abdominal Muscles.—Rupture of the abdominal muscles, commonly involving the rectus, and observed in the late course of diseases such as typhoid, though it has been reported in healthy individuals as the result of severe strain, is characterized by sudden severe pain, rapid (minutes) tumor formation which may reach great size, and the detection of a break in continuity by palpation, though intraparietal bleeding in the absence of the last sign would be sufficiently characteristic.

Syphilis.—Syphilis in the form of gumma (rare) closely simulates malignant infiltration. A history of infection and the presence of associated lesion, or the evidence of such in the past, and the application of the therapeutic test are diagnostic helps.

Lipoma.—Of the benign tumors, lipoma is the one most frequently encountered; unmistakable in its superficial form, the diagnosis is suggested by its extremely slow growth (years) and absence of symptoms other than bulk. When subaponeurotic, the diagnosis is more difficult, but would be suggested by its softness and its gradual development.

Lipomata at the midline are generally above the umbilicus. They originate in the preperitoneal fat, projecting along the course of a blood-vessel through the aponeurosis until they become subcutaneous. These lipomata are often reducible; they not infrequently drag a pouch of peritoneum with them, thus forming a true hernia.

Fibroma.—Fibroma, single or multiple, developing in the lower quadrants, particularly from the rectus sheath of women who have borne many children, and often first noticed during pregnancy, are characterized by their hardness and slow (years) growth.

Phantom Tumor.—Phantom tumor observed in hysterical women, usually near the midline below the umbilicus, and due to muscular contraction, forms a smooth, non-sensitive mass, which is not flattened or made less conspicuous by muscular contraction and does not move independently of the muscle. It disappears during deep ether anesthesia.

Sarcoma.—Sarcoma, at times of traumatic origin, usually apparently causeless, is marked by its rapid growth (months). The early diagnosis should be based upon the prompt removal and microscopic examination of a recently discovered and steadily progressive parietal tumor.

Carcinoma is usually secondary.

Cyst of the urachus, due to a persistent patulousness of a part of this canal, is most frequent in males. A fixed midline tumor between the navel and symphysis, sometimes varying in size proportionate to the fulness of the bladder, exceptionally reaching huge size, is characteristic of this condition.

Hydatid cyst (rare), noted in the midline below the umbilicus or in the lumbar region, forms a rounded, slow growing (years) tumor, often solid to palpation. The diagnosis is usually not made until operation, though fluctuation, hydatid thrill, the finding of hooklets in the evacuated fluid, and the precipitin reaction would be characteristic.

The Umbilicus.—The umbilicus, the scar of the obliterated umbilical cord, is weakest at its upper part (scar of the obliterated umbilical vein). Its lower part is strengthened by the remains of both the urachus and umbilical arteries.

Pouting umbilicus is usually due to hernia or ascites. It is occasionally caused by prolonged gaseous distention.

Congenital anomalies occur in the form of failure of the lateral plates to properly come together at the midline, thus leaving the abdominal contents without muscular or fascial covering, and resulting in congenital umbilical hernia; also there may be persistence of the urachus, constituting a urinary fistula, or of the vitelline duct, constituting a fecal fistula.

Persistent vitelline duct is characterized by a pouting of mucous membrane at the umbilicus which closely resembles a small prolapsed anus. Through the opening feces may or may not be discharged. In the former instance the diagnosis is absolute. In the latter the affection must be distinguished from patent urachus.

Persistent urachus results in the formation of a midline cyst which usually bulges somewhat at the umbilicus as well as below it, or, if a fistula or pervious urachus is present, it is characterized by a leakage of urine from a small opening in the lower part of the umbilical scar.

Myxoma may occur in the umbilical scar of infants and produce a good-sized, soft, non-inflammatory mass.

Lipoma, sarcoma, and gumma occur at the navel. The last named, when it ulcerates and becomes indurated, must be differentiated from malignant tumor by the history, associated lesions or their scars or pigmentations, and the therapeutic test.

Carcinoma of the navel may originate at the umbilicus or may be

secondary to cancer of the stomach, intestine, or liver, of which it often may be taken as evidence. This may be due to direct extension or metastasis along the lymphatics. The diagnosis is made by incision and microscopic examination of a fragment of tissue.

Inflammatory infiltration, abscess, and eczema, particularly noted in the uncleanly, exhibit their characteristic symptoms at the umbilicus. Diagnosis is not difficult.

General Intra-abdominal Swellings.—Tympanites.—Tympanites, or gaseous distention of the intestines, when sufficiently pronounced and persistent to constitute a surgical affection, is incident to a paresis of the muscular coats of the stomach and bowel, allowing of a dilatation so great as seriously to interfere with the functions of both respiration and circulation. The full, rounded abdomen, exhibiting the pseudorigidity of tension, the obliteration of anatomical irregularities of the surface, universally tympanitic even well up into the thorax, and the associated dyspnea, costal breathing, and in hyperacute cases pulse hurry, are characteristic.

Tympany in its congenital form appears in Hirschsprung's disease, or idiopathic dilatation of the colon, and may be so marked as to overdistend the entire abdomen, pushing the other hollow viscera aside.

Either the stomach or the sigmoid, if greatly distended, produces a degree of tympany quite similar to that of general gastro-intestinal paresis.

Diffuse Peritoneal Effusion.—Diffuse peritoneal effusion, when it reaches such a degree as to interfere with the respiratory or circulatory functions, becomes a surgical affection independent of its cause.

These diffuse effusions are characterized in their early development by a globular belly, peripherally dull on percussion, but resonant about the navel. Change in the percussion note from dull to resonant occurs on shifting the patient's position. Fluctuation may be felt in one flank when the other is jarred. In extreme cases the umbilicus forms a knob-like projection.

The effusion may be serous, serofibrinous, or purulent.

Ascites, or serous effusion, if unattended by general dropsy, is usually dependent upon obstruction to the portal circulation or tuberculous peritonitis.

Atrophic cirrhosis of the liver, in its terminal stage, is the common cause of portal obstruction in adults. It is characterized by a small liver, often not demonstrable as such until the fluid has been withdrawn, and a characteristic preceding history.

The portal obstruction caused by multiple serositis, or Pick's disease, is characterized by enlargement of the liver and spleen, adhesive pericarditis, heart enlargement and usually valvular disease, pleural effusion, and marked ascites, which may be tapped repeatedly without deterioration of the patient's condition. The latter fact helps to distinguish it from atrophic cirrhosis.

Cancer of the liver and of the head of the pancreas may produce

similar symptoms. The affection is rapidly progressive, other pressure symptoms usually develop, and, if the liver be involved, the tumor often can be felt.

In diffuse carcinomatosis the fluid removed by tapping is often blood-stained and contains cancer cells.

Tuberculous peritonitis, commonest in the first three decades, the usual cause of ascites in children, may be without symptoms other than the swelling, or may exhibit slight rigidity and tenderness to pressure. In any form it is attended with emaciation, irregular fever, pulse hurry, and absence of leukocytosis. The fibrous or adhesive variety is characterized by slight serous effusion and the formation of demonstrable masses due to adhesion of the intestinal coils and thickening and rolling up of the omentum. The ulcerative variety runs a rapid course and forms a purulent exudate which is nearly always localized.

Ascites attended with demonstrable edema is usually secondary to disease of the heart or kidney. It may also be an expression of profound anemia.

The distinction between diffuse peritoneal effusion and ovarian cyst is based on the midline dulness and flank resonance of the latter condition, the corroborative results of vaginal examination, and the comparatively slight difference in the area of percussion dulness and resonance incident to change in posture. An enormous hydronephrosis should give a suggestive previous history, nor does the fluid show the same mobility as that of diffuse peritoneal effusion.

Diffuse Blood Effusions.—Diffuse blood effusions, usually traumatic, postoperative, or incident to rupture of ectopic gestation, are characterized by the symptoms and physical signs of grave hemorrhage, rapidly formed movable dulness in the flanks, pain, tenderness, tympany, and often by the desire to urinate and to defecate.

Localized Intra-abdominal Swellings.—Swellings of the midline or near it, if fixed, are usually retroperitoneal and neoplastic in origin, those of the upper and lower right quadrant are usually inflammatory, and those of the upper and lower left quadrant are usually neoplastic, while those of the lumbar region are, as a rule, renal, perirenal, or spinal in origin, and either inflammatory or neoplastic. To these rules there are many exceptions.

Midline Swellings.—Midline swellings include those of the retroperitoneal tissues, the body of the pancreas, the left lobe of the liver, the fundus of the stomach, the transverse colon, the omentum, the small intestines, the mesentery, the bladder space, and the uterus.

The *retroperitoneal midline swellings*, if they reach conspicuous size, are usually of the lymphatic glands and neoplastic; sometimes they are inflammatory. Aortic or iliac aneurysm appears near the midline, as do lipomata and lymphatic, chylous, serous, dermoid, and hydatid cysts.

The retroperitoneal origin of the swelling is suggested by its deep seat, though on light palpation it may seem superficial, its slight or absent mobility, often its distinct conveyance of aortic pulsation, the

obscuring effect incident to gaseous distention of the intestines, and its pressure effects as shown by edema of the lower extremities, pain radiating downward, gastro-intestinal disturbances, and emaciation.

Acute inflammatory affections of the midline retroperitoneal space are distinguished by the local and constitutional symptoms of inflammation rather than by those of tumor.

Tuberculous inflammation exceptionally forms a tumor either due to cold abscess, secondary to bone involvement, or incident to tuberculous adenitis; other and more pronounced symptoms of the tuberculous process are usually present.

Malignant infiltration, commonly sarcomatous, exceptionally primary, usually secondary to involvement of the testicle, ovary, or other organ contributing lymph vessels to the postperitoneal lymphatic chain, causes a rapidly growing (months) nodular tumor which usually presents the typical characteristics of postperitoneal growths. Because of their great vascularity and of the pressure they exert upon the artery, these growths exceptionally give both bruit and expansile pulsation, making, in the absence of a primary peripheral focus, a non-operative differential diagnosis difficult, if not impossible.

Retroperitoneal cysts (rare), if they reach large size, tend to grow between the mesenteric layers. Though their symptomatology conforms to that of the retroperitoneal growths, and they are obscured by inflation of the gastro-intestinal canal, the diagnosis generally has been made at operation.

Postperitoneal lipoma grows forward between the mesenteric layers slowly (years), forming a large, usually soft, semifluctuating tumor, giving midline dulness and peripheral resonance, and by its pressure causing pain, gastro-intestinal disturbance, and emaciation. The distinction from postperitoneal cyst is usually made by operation.

Aneurysm of the aorta or the iliac arteries, or of any of the large branches near their point of origin, forms a postperitoneal swelling which, when it becomes of palpable size, usually exhibits the characteristic symptoms of this affection. Exceptionally the distinction from vascular neoplasm may be difficult.

Swellings of the body of the pancreas appear as midline tumors in the epigastric region. They are distinguished from intraperitoneal tumors by their fixation, conveyance of aortic pulsation, and obscuration by gastric inflation. The induration of chronic pancreatitis may be detected in thin persons. Pancreatic cysts present anteriorly either above or below the stomach. Cancer of the body of the gland forms an elongated nodular tumor, which cannot be distinguished by palpation from a similar infiltration of the posterior stomach wall.

Effusion of blood or serum into the lesser peritoneal cavity, usually secondary to acute hemorrhagic pancreatitis, forms an epigastric midline swelling usually masked by the gastric distention, tenderness, and rigidity of acute peritonitis. Later, when this effusion becomes purulent, a distinct fixed tumor is formed and is accompanied by characteristic inflammatory symptoms.

Midline intraperitoneal swellings are from the left lobe of the liver, the stomach, the transverse colon, the mesentery, the omentum, the uterus, and the urinary bladder.

Tumors from the liver exhibit the freest respiratory movement. If inflammatory, the local and constitutional signs of this condition are commonly present. Gumma must be distinguished by the history and the therapeutic test. Cancer is a late manifestation of involvement elsewhere.

Tumors of the stomach, in the absence of adhesions, give a respiratory excursion and are freely movable, and if of the anterior wall or greater curvature, are made more pronounced by inflation. The nature of the tumor must be determined by other symptoms, since by palpation the distinction between chronic indurated ulcer and carcinoma cannot be framed, nor by the sense of touch can an infiltration of the posterior wall be distinguished from pancreatic involvement when, as is common, adhesions have formed.

Palpable tumors of the pylorus, usually neoplastic, sometimes inflammatory, are usually found slightly to the right of the midline, and between the ensiform process and the umbilicus. They are freely movable, particularly toward the left, exhibit respiratory excursion, and are pushed downward and to the right on inflation.

Abscess resulting from the slow perforation of a gastric ulcer is characterized by inflammatory symptoms rather than those of tumor, except when it involves the abdominal wall in front.

Gumma and benign tumors of the stomach are rare.

Midline swelling of the colon (rare), usually malignant, is characterized by free mobility and superficial position.

Omental swellings may present in the midline or well to either side. They are characterized by their superficial position and the readiness with which they contract adhesions to the parietal peritoneum.

Hematoma of the omentum, usually postoperative or traumatic, exceptionally spontaneous, exhibits a tumor of rapid (hours) development, superficial to the intestines, and attended with the symptoms of a mild local peritonitis.

Torsion of the omentum is characterized by the formation of a tumor (hours or days), with the symptoms of a diffuse peritonitis, giving, however, less primal shock, and exhibiting much slower progress than peritonitis of the perforative type.

Diffuse tuberculous peritonitis, except that of the serous type, is usually characterized by an enormously thickened adherent omentum which in its conformation and consistency may closely simulate an enlarged and displaced kidney or spleen. Other characteristic symptoms of tuberculous involvement are usually present.

The omental seat of cysts and tumors might be suggested by the demonstrable fact that they lie superficial to the intestines. Diagnosis should be made by operation.

Mesenteric cysts, generally chylous, may lie in the midline or at a considerable distance from it. They are usually freely movable,

rounded in shape, are of sufficient consistency to suggest a displaced spleen or kidney, and are diagnosticated at operation.

Swellings of the bladder may lie either in the midline or to one side of it. Either by percussion or palpation, usually both, the swelling can be traced into the pelvis. The common cause for such swelling is overdistention, a symptom of which is constant dribbling. Combined rectal and suprapubic palpation will establish the diagnosis, or, if this be unconvincing, the passage of a catheter.

Tumors of the bladder, usually malignant when large and involving its upper portion, are often felt by suprapubic palpation.

Urachus cysts and abscess of the space of Retzius form extra peritoneal midline tumor which may be difficult to distinguish from those lying within the peritoneum.

Abscess of the space of Retzius, usually secondary to prostatic infection, causes a hard, tender swelling behind the pubic symphysis, which in its development may extend as high as the umbilicus; it is attended with the constitutional symptoms of suppuration.

Abscess of Douglas' cul-de-sac, when it reaches large size, is prone to form a midline suprapubic swelling. The symptoms of local peritonitis and the results of combined rectal and suprapubic palpation establish the diagnosis.

The womb, if enlarged from pregnancy or pathological cause, exhibits a midline swelling which can be traced into the pelvis and the seat of which is determined by bimanual palpation.

Swellings of the Right Upper Quadrant of the Abdomen.—These are usually of the liver, gall-bladder, renal, or suprarenal origin.

The acute inflammatory swellings are distinguished from the hyperplastic retention or neoplastic enlargements by local tenderness and rigidity and the constitutional symptoms of acute infection. In chronic infections the diagnosis must often be made on the basis of the history or by exploratory operation. The swellings of the liver can be felt to be continuous with this organ and exhibit its respiratory motion.

Floating liver, usually observed in women and associated with pronounced visceral proptosis, is recognized by the normal conformation and size of the organ and its free mobility and the ease with which it can be pushed into its normal position.

The enlargement of hypertrophic cirrhosis or amyloid degeneration, or of Banti's disease, is diffuse, symmetrical, and freely movable, and associated with other characteristic symptoms of these conditions.

The enlargement incident to syphilis may be fixed and exceedingly painful and tender.

Riedel's lobe, usually observed in women, and often in connection with stone in the gall-bladder, forms a tongue-like projection downward which cannot be distinguished from tumor by palpation, except for its smooth, non-nodular surface. In itself it causes no symptoms. Corset liver forms a smooth, painless, superficially placed tumor, exhibiting the respiratory movements of the liver, and usually showing an obvious connection with this organ. It does not present in the flank.

Subphrenic abscess of the right side, usually secondary to appendicitis or to suppuration of the liver or gall-bladder, or of the perirenal space, may form a demonstrable tumor by pushing the liver downward, and by extending upward, causing a dome of percussion dulness, or, if the abscess contains gas, one of hyperresonance. Constitutional symptoms of acute or chronic infection are present, usually severe local pain and tenderness, and often a complicating serous or purulent pleuritis.

Given the history of an abdominal infection no longer active, the continuance of sepsis not otherwise to be accounted for, local pain and tenderness, and an increase in the area of liver dulness, the diagnosis should be made by exploratory incision.

Liver Abscess.—The tender, swollen liver of acute cholangitis or multiple abscess is a minor symptom as compared with the constitutional symptoms of profound sepsis. Single abscess, usually placed near the upper surface of the right lobe, is rarely recognized as a tumor until parietal adhesions have formed when tenderness, edema, and later fluctuation, combined with pressure symptoms or chronic sepsis, call for incision and drainage.

Echinococcus cyst, having by preference the liver as its seat of lodgement, when it becomes large enough to be palpable, forms a smooth rounded tumor which may give fluctuation or may seem solid. It is of slow growth (months, years), and in the absence of inflammation or pressure upon bile ducts or large bloodvessels, causes no symptoms. When it suppurates the symptoms are those of abscess. The hydatid tremor is neither commonly present nor is it diagnostic when found. The absolute diagnosis should be made by exploratory operation.

Other cysts present the symptomatology of echinococcus cyst nor can the differential diagnosis be made without operation and often microscopic examination.

Carcinoma of the liver forms a tumor or tumors characterized by dense nodular surface, usually secondary to malignant growth elsewhere, particularly of the alimentary tract, and of the breast, multiple, and accompanied by profound cachexia.

Primary carcinoma (rare) of the liver, when it forms a palpable tumor, can be recognized as such only by the careful exclusion of syphilis and of the existence of a primary focus elsewhere. Its diagnosis is of importance, since it is amenable to surgical operation.

Ascites and jaundice develop only if the neoplasm in its growth causes pressure upon the portal vein or on the bile ducts.

Gumma of the liver forms a dense nodular tumor or tumors, which by palpation cannot be distinguished from carcinoma. Jaundice or ascites may develop as a result of pressure or cicatricial contraction. The diagnosis is based upon the history of syphilis and the therapeutic test. As a result of syphilitic infiltration, lobulation may occur resulting in a movable mass which may closely simulate floating kidney except for its shape and its loose, but obvious, connection with the liver.

Tumors of the gall-bladder are felt just below the costal arch at the point crossed by a line drawn in the male from the nipple to the umbilicus. They are characterized, in the absence of adhesions, by free mobility, participation in the respiratory movements of the liver, and percussion dulness continuous with the organ. Colonic inflation pushes them upward, stomach inflation to the right. Except when they reach great size, they are neither palpable nor rendered markedly more obvious by pressure of an examining hand in the costovertebral angle. In distinguishing such tumors from those originating in the kidney or the suprarenal body this failure to feel the mass by each examining hand in bimanual palpation is the most characteristic feature. Colonic inflation will demonstrate the postperitoneal position of small renal tumors.

The gall-bladder tumor, incident to overdistention from blocking of the cystic (hydrops) or common duct, if palpable, forms a smooth pyriform tumor, usually preceded by a history of colic in the former case, always accompanied by signs of jaundice in the latter.

The tumor of acute cholecystitis is usually masked by the accompanying tenderness and rigidity.

The tumor of malignant disease is usually preceded by a history of gallstone colic. If palpable, it forms a nodular mass in the gall-bladder region, and should be diagnosticated in the absence of disseminated lesions by exploratory operation. A palpable tumor is rarely found as a result of the chronic cystitis of cholelithiasis, except as the result of omental adhesions.

Renal or suprarenal tumors may be palpated in the right upper abdominal quadrant, but usually present in the loin between the costal border and iliac crest. They are made more obvious in front by deep pressure in the costovertebral angle, exhibit a respiratory excursion less free than that characteristic of the swellings of the liver, and, until they have reached great size, can be demonstrated as postcolonic by inflation of the colon. Moreover, the pain and tenderness of renal swelling, if these be present, are referred to the costovertebral angle and to a point on the anterior belly wall directly in front of this, and the pain radiates downward to the bladder, external genitals, and thighs.

The swelling of acute infections is masked by the local tenderness and rigidity of inflammation, tumor rarely being detected until the perinephric tissues are involved. The urinary findings in pyelonephritis are usually more characteristic than is swelling.

Movable or floating kidney is characterized by the renal conformation of the freely movable tumor, ability to press it into its normal position, accessibility to lumbar palpation, recurrence of the displacement on deep breathing or coughing, and a good *x*-ray picture.

Hydronephrosis, in addition to forming a distinctly lumbar tumor, and being preceded by recurring attacks of renal colic, commonly exhibits fluctuation, and while still small can be shown to be postcolic. Marked alterations in size are characteristic of intermittent hydronephrosis.

Neoplasms of the kidney, if sufficiently large to form palpable swell-

ings, are usually malignant; sarcoma in children, hypernephroma or sarcoma in adults. The diagnosis is based upon rapid growth, lumbar projection, postperitoneal position, and blood in the urine.

Polycystic disease is characterized by bilateral nodular renal tumor and the urinary findings of chronic interstitial nephritis.

Tumors of the suprarenal bodies (rare) are not palpable until they reach large size; their diagnosis as such is dependent upon their position, the absence of blood in the urine, and, possibly, displacement of the kidney. Orbital metastases are noted in sarcoma.

Swellings of the Right Lower Abdominal Quadrant.—These may be retroperitoneal or intraperitoneal. If movable kidney be excepted they are fixed, are deeply placed, and are obscured by colonic inflation.

Congenitally misplaced kidney forms a tumor which may be fixed in its abnormal position. Its nature may be suspected from its shape.

Movable kidney is recognized by its shape and freedom of excursion, particularly in the direction of its normal site. The *x*-rays will be useful in demonstrating the absence of the kidney from its normal position.

Aneurysm of the external iliac artery will exhibit the characteristic features of this affection (see p. 99).

Glandular enlargement, usually malignant and secondary, if large enough to be palpable, is suggested by the presence of a constitutional cause or a primary focus and a nodular mass occupying the position of the lymphatic chain.

Iliac Abscess.—Tuberculosis of the sacro-iliac articulation or of the os innominatum may cause first an infiltration, later an abscess beneath and into the iliacus muscle. This may be felt by palpation. The abscess usually opens externally before fluctuation can be felt through the abdominal walls. The *x*-rays are helpful in framing a diagnosis.

Psoas abscess forms a palpable fluctuating tumor in the right lower abdominal quadrant usually long before it presents in the inguinal region below Poupart's ligament. The symptoms of spinal caries are usually pronounced.

Perinephric abscess points in the right lower quadrant. The tenderness and induration may be followed into the renal region.

Malignant growth from the pelvic bones or deep muscles forms a rapidly growing fixed tumor which pushes the viscera aside and which bimanual examination shows is not attached to the pelvic organs.

Intraperitoneal Swellings of the Right Lower Quadrant.—These are usually due to inflammation of the appendix, to cecal carcinoma, or to tuberculosis of the ileocecal region. Rare causes of swelling are abscess secondary to gastric or duodenal perforation and actinomycosis.

The tumor of *appendicitis* is usually due to omental adhesion and thickening, or to abscess formation. In acute cases tenderness and rigidity obscure the tumor and are the dominant symptoms.

The tumor of acute cases which have gone on to abscess formation is usually fixed and extremely tender. If the parietal peritoneum be uninvolved and the abscess be limited by intestinal coils, tumor with

slight tenderness may be the only symptom, the diagnosis here depending upon the seat of the tumor and its fairly rapid (days, weeks) development, following an attack of acute appendicitis. In the absence of such a history, or with an inflamed appendix lying wide of its normal position, the diagnosis would have to be made by operation.

Chronic abscess or inflammatory thickening may form a mass in the right iliac fossa of slow growth (months) and ultimately large size, which may so closely simulate malignant infiltration as to require operation for a differential diagnosis. Fever is more likely to be marked in the inflammatory affection, the onset is usually acutely inflammatory, there is a pronounced polymorphonuclear leukocytosis, and the tumor is less sharply defined than is the case with cancer.

Malignant growth of the appendix rarely forms a palpable tumor. The distinction from chronic appendicitis should be made by operation.

Tuberculosis of the cecum forms a right iliac intra-abdominal tumor, movable or fixed, of slow growth (years), presenting inflammatory symptoms of moderate severity, and attacking by preference children and young adults. The hyperplastic form extends along the ascending colon, forming a sausage-shaped tumor without mucous membrane ulceration, hence there is no blood in the stools. The ulcerative form, usually secondary, is attended with parietal involvement and fistula formation. The diagnosis from carcinoma, at a time when this is serviceable, can be made only by operation, though the age incidence and slow progression are suggestive features.

Carcinoma of the cecum forms a right iliac tumor, movable or fixed, hard and nodular, of slow growth (months), affecting by preference the middle aged or elderly, usually attended with ulceration of the mucosa, hence giving blood in the stools. The diagnosis from chronic appendicitis and tuberculosis should be made by incision.

Actinomycosis (rare) forms a right iliac tumor of slow growth (months), which involves the parietes, opens through blind fistulæ, and is distinguished from the ulceration found in tuberculosis only by microscopic examination of the discharge.

Swellings of the Left Lower Abdominal Quadrant.—If tumors of the retroperitoneal structure, including subacute or chronic abscess, glandular enlargements, aneurysm, and displaced or enlarged kidney, be excepted; likewise those tumors incident to pathological conditions of the uterus, tubes, and ovaries of women, or the bladder in either sex, swellings of the left lower abdominal quadrant are usually due to acute intussusception in children, cancer or acute or chronic diverticulitis of the sigmoid in the middle aged or elderly, either of these conditions or fecal impaction in the feeble and aged.

Intussusception is marked by a mass which is movable, often freely so, and may palpably vary in size as a result of peristaltic contractions, is sausage-shaped and attended with acute or subacute symptoms of intestinal obstruction, often together with rectal tenesmus and the passage of bloody mucus.

Cancer may be unsuspected until a tumor is felt. This is likely to be nodular, irregularly rounded in shape, and more superficial and movable than a retroperitoneal growth. Usually detection of the tumor is preceded by persistent deep-seated pain with colicky exacerbations and the other symptoms of progressive chronic intestinal obstruction. There is likely to be occult or obvious blood in the stools.

The distinction from chronic diverticulitis, with narrowing of the lumen of the gut, might be suggested by the absence of occult or obvious blood in the stools in the latter condition, the greater tenderness, the more marked blood changes of infection, and the younger age incidence. Usually the differential diagnosis must be an operative one, at times a microscopic one.

Fecal impaction occurring in the sigmoid forms a mouldable, freely movable tumor, the diagnosis of which must often depend upon the patient and skilful use of laxatives and high enemata. Occult or even obvious blood in the stools may be present as the result of mechanical erosion. Such a fecal accumulation may be the result of intestinal angulation, volvulus, or stenosis from inflammation or neoplasm.

Intra-abdominal Swellings of the Left Upper Quadrant.—These usually originate in the kidney or suprarenal body, in which case they present in the loin or in the spleen. In the latter case they are made more obvious by colonic inflation, thus differing from renal tumor.

Floating spleen may have a range of motion so great as to admit of its presence in any part of the abdomen. It is usually found in the left upper quadrant, or at least can be more readily moved in this direction than in any other, and its position is recognized by its shape, the notch being characteristic.

The *general symmetrical enlargement* of the spleen incident to malaria, typhoid, miliary tuberculosis, Banti's disease, leukemia, and pseudo-leukemia is attended with other characteristic symptoms.

Abscess of the spleen may be so latent as to defy diagnostic efforts. Enlargement of the spleen occurring in the course of rheumatic fever, typhoid, malaria, or other infectious process, characterized in its further development by chills, fever, sweat, and the blood changes of suppuration, and particularly by pain, tenderness, and fixation of the diaphragm and the development of slight basal pleurisy, should suggest splenic abscess.

Echinococcus cyst forms a round, usually fluctuating tumor of slow growth (years) and not prone to contract adhesions until suppuration develops. The constitutional symptoms of other forms of splenic enlargement are absent. Hydronephrosis may be eliminated by colonic inflation, examination of the urine, and catheterization of the ureters.

Sarcoma of the spleen is characterized by comparatively rapid (months), somewhat nodular, painful growth of the organ and the elimination of constitutional conditions which attend other forms of enlargement.

Subphrenic abscess to the left of the suspensory ligament of the liver is usually due to perforation of the stomach, pancreatitis, splenic abscess, perinephric suppuration, perforating empyema, or necrosis of the verte-

bræ or ribs. Depending on the primal cause, the onset will be stormy or insidious. In its developed form the diaphragm is displaced upward and fixed. The spleen and stomach are pushed down. The symptoms are similar to subphrenic suppuration of the right side.

Tumors, when they are not observed until they reach large size, may so fill the abdominal cavity that their point of origin may be difficult to determine except by operation.

Certain acute conditions are attended with tumor formation which may vary in its location. The rapid distention of the sigmoid incident to volvulus may force this loop of gut, normally pelvic in position, as high as the lower border of the stomach. Internal strangulation or incarceration by twist or band, depending on its seat, may be characterized by the rapid development of a resonant tumor in any part of the belly. The same may be said of acute obstruction incident to enteroliths, foreign bodies, masses of round-worms, large gallstones which have ulcerated into the gut, malignant growths of the small intestine, hematoma, torsion or infection of the omentum, disseminated carcinoma or tuberculosis of the peritoneum. The abscess due to appendicitis may be wide of its usual seat.

HERNIA.

Hernia, as the term is generally used, implies the protrusion of an abdominal organ through a parietal opening. The affection is commonest in infancy, old age, and puberty.

The usual predisposing causes are congenital malformation, a flabby musculature, and looseness of cellular tissue, often incident to emaciation. The pull of a subserous lipoma, the recurring push of a chronic cough, repeated straining incident to obstructed urination or defecation, the intra-abdominal pressure of violent muscular effort, trauma—these are the common exciting causes.

Diagnostic symptoms of hernia are: The presence of a tumor, usually in a hernial region, or in one weakened by traumatism, generally of gradual formation (weeks, months), at times developed suddenly, unattended with inflammatory symptoms, varying in size and consistency in accordance with the position of the patient and changes in intra-abdominal tension, giving expansile impulse on coughing, usually resonant on percussion, reducible, often with a gurgling sound, and readily retained by moderate pressure over its orifice of escape. The examining finger can be pushed deeply into this orifice.

An omental hernia will exhibit neither resonance on percussion nor gurgling on manipulation and reduction, and, if irreducible, may not obviously change in size or conformation with changes in the patient's position, nor give an expansile impulse on coughing. The neck of such a tumor can, however, usually be traced through the hernial orifice and canal into the interior of the abdomen, and there can be obtained a history of its gradual development and of its repeated spontaneous or manual reduction in its early course.

Internal herniæ into the jejunoduodenal, pericecal, and sigmoid fossæ, or through the foramen of Winslow, can be diagnosticated only by operation called for by the complication of incarceration or strangulation.

The external herniæ are readily recognized if present at the time of examination, except in the case of small protrusions occurring in fat people. The patient may, however, give a history quite typical of hernia, yet fail to exhibit the lesion. Enlargement of the ring usually can be demonstrated. Protrusion may be accomplished by violent coughing, by lifting a heavy weight with the knees straight and the back bent forward, or by seating the patient on the edge of a chair with flexed knees and the legs moderately separated and directing him to make straining efforts as in defecation.

The bulging of the abdominal wall over Poupart's ligament is a natural conformation in many men, nor is impulse against the finger passed through the patulous external ring of absolutely diagnostic moment, in so far as the presence of a hernia which is likely to be progressive is concerned.

A hernia is termed irreducible when it remains permanently in its sac. This is usually due to adhesions between the hernia and the sac wall.

Incarcerated hernia is one in which there is obstruction to the onward passage of the intestinal contents from massing of feces incident to angulation or sharp flexion of the gut, or the pressure of the hernial ring. The circulation of the involved bowel loops is not obstructed. The symptoms are those of an irreducible hernia larger than usual and accompanied by colicky pain, active peristalsis, vomiting, and constipation, with remissions or intermissions and exacerbation. There may be local tenderness, but inflammatory symptoms are absent.

A strangulated hernia is one in which there is blood stasis from constriction. This constriction, which may lie in the ring or in the sac at its neck, may become suddenly operative by an added loop of gut or portion of omentum being suddenly thrust through it.

Strangulation is attended at times with shock, usually by severe pain exhibiting paroxysmal exacerbations, vomiting, constipation, and, following this, the hyperperistalsis of acute obstruction. The hernia itself is painful, tender, and swollen. There is no impulse on coughing, and a preceding resonance may be exchanged for percussion dulness incident to effusion into the sac.

Strangulation occurring in long-standing irreducible herniæ, particularly those of the aged, may be marked at first by no symptoms other than colicky pains, moderate vomiting, constipation, and a slight increase in tenderness. In these cases the rapid development of profound toxemia may be the most conspicuous symptom. Under such circumstances, when there is a double hernia, a not unusual condition in the aged, the determination as to which one is responsible for symptoms may be impossible without operation.

When strangulation is due to bands or adhesions within the sac, the reduction of the hernia will not be followed by relief of symptoms.

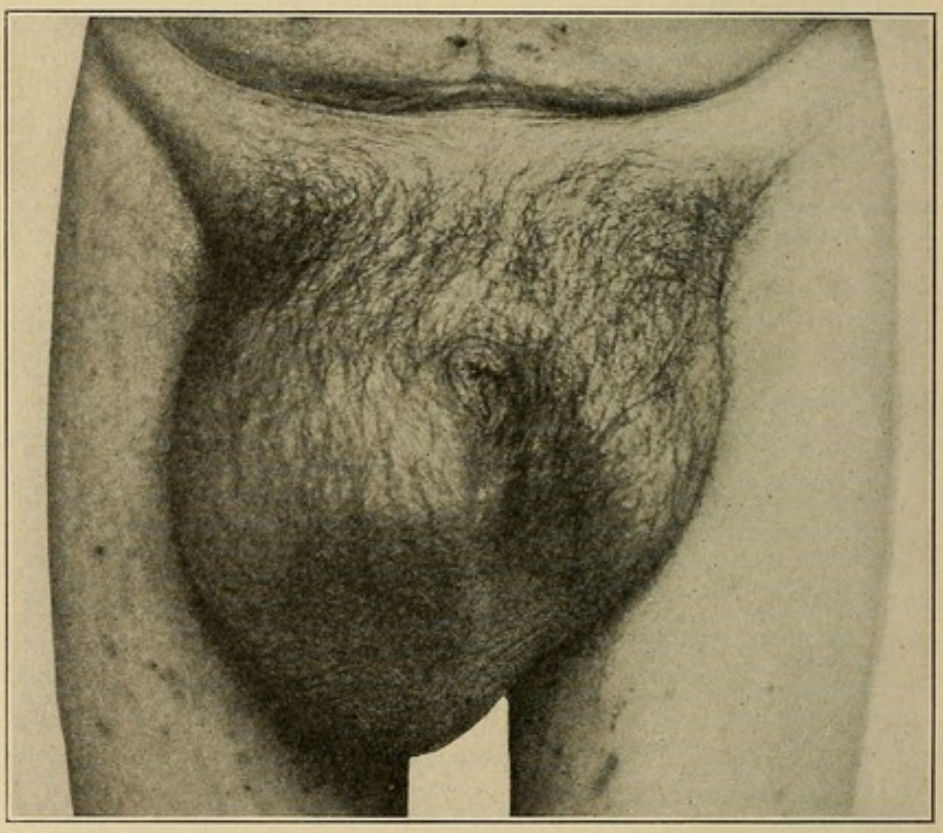
The severe abdominal pain of uremia, with vomiting and consti-

pation, if associated with hernia, may cause error in treatment, nor is an examination of urine helpful, except in that it may show chronic nephritis. If, with such symptoms, local tenderness and increased size were present in an irreducible hernia, the diagnosis would have to be made by operation.

The distinction between strangulation and incarceration, or simple inflammation, when this is not clear, should be made by timely operation.

Inguinal Hernia.—This, the commonest form of hernia, may be incomplete or complete, congenital or acquired, and is most frequent in males.

FIG. 336



Large bilateral inguinoscrotal hernia. Incompletely reducible; penis concealed by downward dislocation of skin. Preputial orifice at middle of swelling. All characteristic signs of hernia present. (Carnett.)

Indirect, or oblique, inguinal hernia passes primarily through the internal ring, with the deep epigastric artery necessarily internal to the neck of its sac. It usually contains the ileum and omentum, not infrequently the cecum or appendix, or both, on the right side, or the colon on the left side, in which cases the sac may be incomplete (sliding hernia).

At times, especially in herniæ which have recurred after radical cure, the bladder forms a part of the hernial projection, usually without a peritoneal investure, and may be wounded during operation. Its presence is suggested by a mass of fat pulled into the wound at its lower angle.

When a considerable portion of the bladder is included in the hernia and the portion communicates freely with the rest of the bladder cavity, there will be a diminution in the size of the tumor after urination; or, if this is not the case, after having urinated, and having emptied the sac by manipulation, a further considerable quantity of urine can be passed.

There is usually an associated cystitis, and the hernia can be made more prominent by filling the bladder with an injection.

The indirect or oblique hernia is usually dependent for its development upon a persistent patulous condition of the peritoneal pouch which accompanies the testicle in its descent. When this pouch remains completely open, and the hernial contents pass down to the testicle, the hernia is called congenital. When the pouch is closed just above

FIG. 337

Oblique inguinal hernia, showing fulness along inguinal canal and at external ring, but not extending into the scrotum.

the testicle, the hernia descending with the cord, it is called funicular. When the pouch remains open excepting at the internal ring, either an infantile or encysted hernia may develop. In the former case a sac forms behind the patulous funicular process; in the latter, a sac becomes invaginated into its lumen.

The hernial sac incident to a patulous condition of the vaginal tunic not infrequently exhibits constrictions, valve-like folds, and diverticula, which may be even larger than the direct sac. These diverticulæ may pass between any of the abdominal layers, and may mislead the surgeon into the belief that he has accomplished a reduction of the hernia when

in reality he has pressed it into a side pocket. The hernia can be made to alternate between its two positions. A properitoneal hernia is one which habitually lodges in an intraparietal peritoneal diverticulum.

Direct, or internal, inguinal hernia passes to the inner side of the deep epigastric artery between it and the outer border of the rectus muscle. It is always acquired, of slow formation, occurs in elderly males, and is due to muscular and fibrous relaxation.

The sac of the indirect or oblique inguinal hernia passes downward and inward, then forward. The direct hernia comes directly forward. From long-continued drag, an oblique inguinal hernia may seem direct. The position of the deep epigastric artery in relation to the sac, if it can be felt, which is exceptional, will establish the distinction. The herniæ of the young and vigorous are practically always oblique. The herniæ of the old and debilitated are often direct and bilateral.

When an inguinal hernia is incomplete, it must be distinguished in infants from retained testicle. Absence of this gland from its usual position would seem a suggestive feature, but is often overlooked. The testicle can be distinctly outlined, and never exhibits an expansile impulse on coughing. The two conditions of non-descent and hernia are often associated.

Hydrocele of the cord, common in infants, exhibits a high degree of translucency and fluctuation. It may traverse the entire length of the inguinal canal, and in rare cases may be completely reducible; this is accomplished very slowly, nor is there sudden return of the complete swelling, as is the case in hernia. It is always dull on percussion and does not exhibit expansile impulse on coughing. A slight translucence is sometimes observed in the herniæ of infants. Cyst of the canal of Nuck, occurring in women, rarely offers diagnostic difficulties.

The distinction between an irreducible omental hernia and a lipoma of the cord may be extremely difficult. The possibility of tracing the neck of the hernia into the abdominal cavity through its aperture of escape would be suggestive of hernia. Pronounced movement imparted by traction upon the testicle would be more characteristic of lipoma of the cord.

Hematocele exhibits the characteristics of hydrocele, except that it is less soft and fluctuating and gives no translucence to light.

Dermoid of the inguinal canal (rare) exhibits a distinct outline, and except for its position has none of the characteristics of hernia.

Postperitoneal abscess commonly points below Poupart's ligament. The symptoms of the cause underlying this condition are usually sufficiently obvious. Unless it be acute or subacute, the swelling can be traced to the inguinal fossa and is attached to the deeper structures.

An inflamed inguinal gland, if complicated by hernia, may occasion some diagnostic difficulty, since by its extension it may occasion inflammation of the sac, deep pain, nausea, vomiting, and constipation. Diagnosis in the presence of obstructive symptoms should be made by operation.

Femoral Hernia.—Femoral hernia, protruding through the femoral ring and canal and the saphenous opening, never attains the huge size noted in inguinal hernia. It is always acquired, and is commonest in adult females. It appears as a globular swelling below the inner third of Poupart's ligament, and often turns upward, thus simulating inguinal hernia. Its neck lies below Poupart's ligament and external to the spine of the pubis, while the neck of an inguinal hernia is above Poupart's ligament and internal to the pubic spine. This bony point is located by abducting the thigh and following upward the adductor longus tendon which is attached just below it.

The distinction between irreducible femoral epiplocele and lipoma may be impossible unless there be given a clear history of the gradual formation of a tumor at one time distinctly reducible, or the lipoma exhibit its characteristic lobulations, skin adhesions, and free mobility on the deeper parts. In case of doubt the diagnosis should be made by operation.

The distinction between femoral hernia and psoas abscess or cold abscess from necrosis of the pelvic bones is based in part upon the usual seat of the two affections. The hernia lies to the inner side of the femoral artery, the abscess points to the outer side. The psoas abscess usually can be traced through the abdominal parietes, passing upward along the psoas muscle or backward and outward into the iliac fossa, and fluctuation can be elicited in it by abdominal pressure. It may exhibit both partial reducibility and expansile impulse on coughing.

Cyst in the region of the femoral hernia, due possibly to obliteration of the abdominal opening of a femoral sac, is suggested by fluctuation if this can be clearly elicited. It often exhibits the consistency of an epiplocele and should be distinguished from the latter condition by operation.

The distinction from inflamed glands is based upon the presence of an adequate cause for this condition, the rapid development, induration and tenderness, and the early appearance of the skin phenomena of inflammation in the absence of any marked gastro-intestinal disturbance.

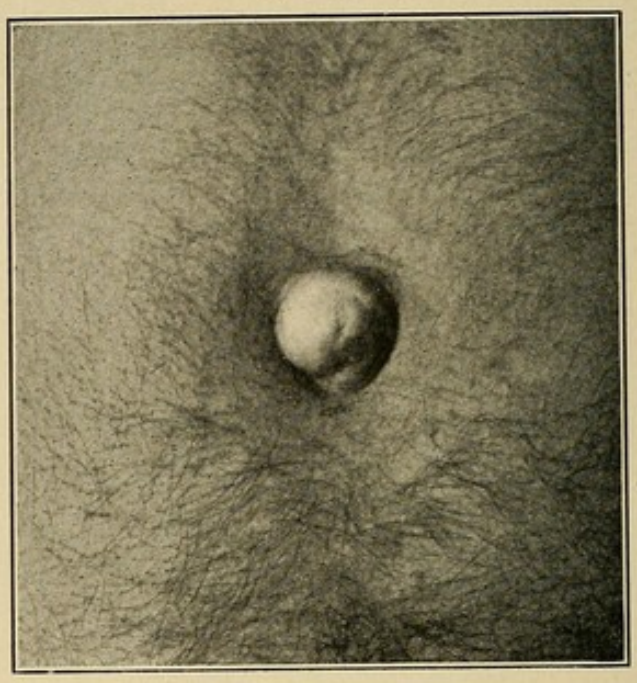
Lymphangiectasis or venous varicosities may form a tumor in the femoral region markedly influenced in size by position and abdominal tension, and in the case of the veins, giving expansile impulse on coughing. The convolutions of the dilated vessels are usually distinctly seen, if not at the seat of maximum swelling, at least below, nor does diagnosis present difficulties if the possibility of tumor formation from these sources be borne in mind.

Umbilical Hernia.—Umbilical hernia is a protrusion of one or more abdominal structures at the umbilicus. The congenital form is due to imperfect union of the two lateral plates of the abdomen at the mid-line; the protrusion occurs into the base of the cord, and the contents are visible through the amniotic layer which covers them.

Acquired umbilical hernia occurs either in early infancy or in women after their twenty-fifth year. Repeated pregnancy and obesity are favoring factors. The upper and weaker part of the navel is the seat

of predilection. The umbilical hernia quickly becomes irreducible, attains huge size, and is subject to strangulation. The diagnosis is obvious.

FIG. 338



Umbilical hernia. Type commonly seen in infants. Easily reducible. Impulse on coughing. Ring tight to tip of finger.

Ventral Hernia.—Ventral hernia may occur through any part of the abdominal wall weakened by scar, muscular or fascial rupture, or diastasis. That form due to separation of the recti muscles is best demonstrated by directing the patient to lie on her back and raise her head and shoulders from the pillow without the aid of the arms; the hernial protrusion can then be seen and the median borders of the recti muscles can be felt.

Lumbar Hernia.—Lumbar hernia, if not due to scar, usually occurs through Petit's triangle, a weak space lying between the external oblique and latissimus dorsi muscles, slightly behind the summit of the iliac crest, or through a vascular opening on the latissimus slightly behind this.

The lumbar region is a favorite seat for both abscess and lipoma. The former may be reducible and give impulse on coughing, but exhibits characteristic symptoms of the causative lesion. The latter is usually lacking in hernial symptoms.

Sciatic, or Ischiatic, Hernia.—Sciatic, or ischiatic, hernia occurs through the greater or lesser sacrosciatic foramen and may be either above or below the pyriformis muscle. It may remain under the gluteus maximus muscle or protrude beneath its lower border.

Obturator Hernia.—Obturator hernia (rare) is not likely to be recognized except when symptoms of strangulation call, as they invariably do, for a careful examination of the hernial orifices. Under such circumstances there may be felt a tender tumor in the region of the pecti-

neus muscle. As a means of lessening tension, the thigh of the affected side will be kept flexed, nor can it be moved without pain. Moreover, there will probably be pain referred along the course of the obturator nerve and disturbance of sensation on the inner surface of the thigh and leg.

The obturator hernia lies below and internal to the position of femoral hernia.

Perineal Hernia.—Perineal hernia protrudes through some part of the pelvic floor, usually between the fibers of the levator ani muscle, or between it and the coccygeus. It may lie beside the rectum or the vagina, bulging into their lumina, or appear in the labium majus, forming a vulvar hernia. Since the sac invariably contains gut, the tumor is readily reducible, and exhibits practically all of the characteristic hernial features; a diagnostic failure is scarcely possible if the existence of hernia in this region be recognized.

Littre's Hernia.—This is one made up of a Meckel's diverticulum.

Richter's Hernia.—This is one in which only a portion of the circumference of a knuckle of intestine is involved.

Strangulation of either of these two herniæ should give mild symptoms. The diagnosis should be made by operation.

Internal Herniæ.—The duodenojejunal, pericecal, intersigmoid, and foramen of Winslow herniæ can be diagnosticated as such only when, because of symptoms of internal strangulation, operation is required.

Diaphragmatic hernia, usually following a wound of the diaphragm, either immediately or long after, is characterized by the acute onset of dyspnea, shock, and the symptoms of intense strangulation, with the tympany of an abdominal organ elicited by chest examination, and displacement of the left lung and the heart. If of gradual formation incident to congenital malformation, intestinal gurgling heard on chest auscultation may suggest the diagnosis. Displacement of the heart to the right in the absence of pleural effusion is suggestive. Diagnosis is usually not made until the symptoms of internal strangulation call for operation.

THE STOMACH AND DUODENUM.

From the subdiaphragmatic portion of the esophagus the empty stomach hangs as a flaccid sac, the long axis of which, at first vertical, swings forward and to the right until the pylorus is reached.

When distended, the stomach assumes a pyriform shape, the larger expansion, or fundus, extending to the left and rising posteriorly one to two and one-half inches above the level of the cardia, thus lying behind the apex of the heart. The greater curvature of the full stomach is usually one or two inches above the level of the umbilicus.

The cardia, which is the most fixed part of the stomach, is placed at a depth of about five inches, directly behind the sternal articulation of the left seventh costal cartilage. The extremely movable pylorus lies, when the stomach is empty, an inch below and the same distance to

the right of the tip of the ensiform cartilage, on a level with the body of the eleventh or twelfth dorsal vertebra.

The capacity of the stomach at birth is from 20 to 30 c.c. This rapidly increases until at the end of the third month it is about 100 c.c. Thereafter, for a period of three months, there is very little increase in size. Then follows a capacity development commensurate with the general body growth. The adult stomach holds from 1500 to 2000 c.c., but these figures by no means represent the extremes of normal variation. Moreover, the position of this organ and the direction of its long axis may depart greatly from that just given, without other signs or symptoms of impaired function.

The larger bulk of the stomach, lying to the left of a line dropped in the long axis of the body from the right side of the cardiac orifice, and including the fundus, the body, and a large part of the greater curvature nearly to the antrum pylori, is mainly a secreting reservoir and a mixing chamber for the conversion of food into chyme. Its few collecting lymph glands communicate with the splenic group. It is this portion of the stomach which is principally affected by dilatation.

The thicker and more muscular pyloric end of the stomach lies to the right of the vertical line just given, and is not only a secreting but an actively moving part which accomplishes the thorough mixing of the food with the gastric juices and propels this when it is properly prepared through the pylorus into the duodenum. Collecting lymph glands are abundant about this portion of the stomach, particularly along its lesser curvature, the direction of the lymph flow, even from the lower border of the antrum, being toward this group.

This portion of the stomach is mainly affected by ulcer and cancer and perigastric adhesions.

The stomach is essentially a secreting and not an absorbing organ. Its secretion, hydrochloric acid, propepsin, and lab ferment, is actively excited by psychical influences, but is in the main under the direct control of its essential ganglia. This is also true of its movements. Its function is that of proteid digestion, particularly of connective tissue, thus facilitating the later action of the pancreatic secretion upon the fats and muscle cells. Its secretion has a distinctly antiseptic action upon food.

The cardia is a physiologically incompetent valve in infancy. In adults it is occasionally subject to spasm. It admits from the stomach side three fingers to the first joint. The pylorus, occasionally subject to spasm and hypertrophy in infancy, a frequent seat of ulceration in the adult, should normally admit the index finger past the first joint. It has a free range of motion, and, unless distinctly indurated, is not palpable.

The normal stomach should have disposed of an ordinary full meal in six hours, vomiting efforts or expressage showing no remains of such a meal after this interval. The test breakfast of tea and toast is often passed from the stomach in one hour. Persistent delay in transmission indicates either a deficient propulsive power or obstruction, usually the latter.

The cardinal symptoms of surgical affections of the stomach are pain, evidences of pyloric obstruction, hemorrhage, and tumor.

Pain, which in its time of onset and maximum severity bears a relation to food ingestion, which is sharply localized and which is relieved by vomiting, is a symptom to which great importance is justly attached, particularly when it is associated with an area of tenderness to deep palpation, and, exceptionally, with a sharply localized area of parietal hyperalgesia.

Hemorrhage, as shown by examination of the vomitus, or of the matter expressed from the stomach, or of the stools, is of diagnostic value in accordance with its severity, recurrence, persistence, and its association with other symptoms.

Pyloric obstruction is characterized by delay in the passage of the stomach contents, hypertrophy, visible peristalsis in thin persons, gurgling sounds, eructations and postprandial discomfort, and, in the late stages, gastric dilatation and vomiting of food taken many hours before, and exceptionally tetany.

Either absence or excess of hydrochloric acid or of the digestive ferments constitutes a corroborative rather than a pathognomonic sign of surgical disease. The bacteria and ferments of decomposition are indicative of obstruction, and depend upon its degree rather than upon its nature.

Tumor, a late manifestation of gastric disease if congenital hypertrophic stenosis be excepted, is usually perceptible to palpation only when it involves the pylorus or the anterior stomach wall. Extensive infiltration of the posterior wall can be felt when the stomach is not distended.

The duodenum, the thickest-walled, widest, and most vascular part of the small intestine, ten to twelve inches long, and forming in its course a V or U, within the angle or concavity of which lies the head of the pancreas, is movable and provided with a complete peritoneal investment only for the first two inches of its course. The direction of this movable part is transverse, with an upward and backward tilt, its distal end forming the lower border of the foramen of Winslow, while behind it lie the common bile duct, the hepatic artery, and the portal vein. Below is placed the head of the pancreas.

The rest of the duodenum is covered with peritoneum only in front. The descending portion, about three inches in length, lies to the right of the head of the pancreas, with the common bile duct passing behind it and entering 1.4 inches below a crescentic fold of mucous membrane placed at the junction of the first and second parts of the duodenum on the posterior aspect. At the point of entrance there is a papilla which caps the ampulla of Vater, a space lying within the wall of the bowel and receiving both the biliary and the pancreatic duct. These ducts may enter by separate orifices. The accessory pancreatic duct (duct of Wirsung) enters the duodenum above the papilla.

The longest portion of the duodenum, the third, or transverse (five inches), passes below the pancreas across the great vessels from right to

left and slightly upward, behind the superior mesenteric vessels and the root of the mesentery. The ascending fourth part lies almost as high as the beginning of the duodenum, on a level with the first or second lumbar vertebra, and is sharply angled forward at its continuation with the jejunum, being held in position by a musculofibrous band —the ligament of Trietz—which, in conjunction with the peritoneal fold passing from the duodenum to the right parietal peritoneum, forms the duodenojejunal fossa, into which retroperitoneal hernia may occur.

As is the case with the stomach, the duodenum is essentially a secreting and not an absorbing organ. Under the stimulating effect of the acid chyme of the stomach it forms a product, secretin, which not only excites its own cellular activity but stirs the liver and pancreas to hypersecretion. The duodenal secretion also contains invertin which splits cane sugar, lactase which acts on lactose and, of major importance, enterokinase which converts the trypsinogen into trypsin, thus activating the pancreatic secretion.

Just below the entrance of the bile and pancreatic ducts there has been described a sphincteric arrangement of fibers (Ochsner), the presence of which there is clinical evidence to support. The invariable or usual presence of such a sphincter, however, has not been confirmed anatomically (Boothby).

The crossing of the superior mesenteric vessels and root of the mesentery over the third, or transverse, portion of the duodenum has been considered the etiological basis of some cases of acute gastric dilatation.

The lymphatic glands of the duodenum, few in number, lie along its inner angle or curve, their vessels passing to the glands along the lesser curvature of the stomach.

The symptoms of surgical affections of the duodenum are pain, tenderness, hemorrhage, obstruction to the onward passage of chyme from the stomach, or bile or pancreatic juice from their secreting glands, and very exceptionally, palpable tumors. The pain has a constant and distinct relation to gastric function, coming on some time (hours) after eating and being temporarily relieved by taking food. The pain and associated tenderness on deep palpation are often placed to the left of the tip of the ensiform and somewhat below it. The hemorrhage may appear only in the stools.

Trauma of the Stomach.—**Contusion.**—Contusion is characterized by shock, vomiting, sometimes of blood, severe pain and very often localized tenderness and rigidity. There may be free bleeding either into the stomach itself or into the peritoneal cavity without actual rupture of all the gastric coats.

The diagnosis from rupture is based upon prompt recovery from shock and the retrogression of symptoms.

Rupture of the Stomach.—Rupture of the stomach is usually due to external violence, exceptionally in surfeited drunkards to muscular action. It is characterized by severe pain, shock, and the rapid development of symptoms of diffuse peritonitis. Initial shock may be absent.

Diagnosis must be based upon the suddenness of onset, steady progression of symptoms, and exploratory operation.

Wound of the Stomach.—Wound of the stomach may be suggested by vomiting of blood after traumatism, and the nature of the vulnerating body and the direction taken by it. When this is practicable, the following under general or local anesthesia of the track of the wound will lead to a correct conclusion. Perforation, excepting in the case of modern small caliber weapons of high velocity, is denoted shortly by the beginning symptoms of a local or diffuse peritonitis.

Foreign Bodies in the Stomach.—Foreign bodies in the stomach are blocked by the pylorus, this being the narrowest part of the alimentary canal. Unless these bodies cause either obstruction or ulceration, they may lie for years and cause no symptoms.

The diagnosis is based upon the history, the use of the *x*-rays when applicable, and the symptoms of either ulceration or obstruction.

Acute Dilatation of the Stomach.—Acute dilatation may follow surfeit, anesthesia (particularly by chloroform), operation (especially on the gall passages), traumatism, infection (particularly pneumonia), or systemic intoxication.

It is characterized by a muscular and vasomotor paresis, the former allowing of great dilatation, the latter of a copious transudate appearing as an offensive but not feculent, thin, brown vomitus.

As the distended stomach forces the colon and the small intestines downward, the drag upon the root of the mesentery and the superior mesenteric vessels completely occludes the third part of the duodenum, thus adding to the dynamic obstruction a mechanical one. This mechanical obstruction is regarded by many as the primary cause of the dilatation.

Acute dilatation of the stomach begins with sudden acute pain, if postoperative usually within the first twenty-four hours, at times not for many days. This pain is placed in or about the stomach and is associated with moderate tenderness. The stomach rapidly dilates forming a tense resonant swelling most marked at first in the epigastric region, later filling and distending the entire belly. The vomiting is recurrent and profuse, often effortless. The constitutional symptoms are profoundly adynamic, the pulse becoming weak and running, the respirations hurried and shallow, the face gray and pinched.

The diagnosis is based upon the early epigastric swelling, the character of the fluid vomited and its extraordinary quantity, and the beneficial effect of gastric lavage and, at times, the Trendelenburg or knee-chest position. Stomach splash is said to be characteristic.

This affection is more rapid in onset than peritonitis, except that of the perforative type, is not marked by the characteristic rigidity or extreme tenderness of the latter condition, and exhibits promptly the symptoms of an overwhelming toxemia rather than those of an inflammatory reaction.

The distinction between the paresis and dilatation of both the stomach and intestines, characteristic of the terminal stage of postoperative diffuse

peritonitis, and acute dilatation of the stomach, in the absence of a demonstrable infective cause, may be most difficult. The prognosis of this condition when well developed is grave.

Pyloric Obstruction.—Pyloric obstruction may be due to muscular hypertrophy or spasm, or both, to gastroptosis, inflammatory or neoplastic infiltration, cicatricial contracture, perigastric adhesions, or pressure of external tumors. The symptoms of the condition bear but little relation to the cause, being incident to the amount of obstruction.

Hypertrophic stenosis of the pylorus, commonly called pylorospasm, is essentially an affection of early life, developing shortly after birth (first month). It is occasionally observed in older children, exhibiting a tendency to recur. The obstruction is partly due to muscular spasm of the hypertrophied pyloric sphincter and partly to redundant folds of mucous membrane.

It is characterized by colicky pain, vomiting, visible peristalsis, the presence of a movable nodule about the size of a hazelnut in the pyloric region (80 per cent. of cases, Nicoll), great hunger, wasting, and constipation. The vomiting is frequent, explosive, occurs shortly after eating, and is free from bile, mucus, or blood. In the later stages, when gastric dilatation supervenes, several nursings may be retained, followed by vomiting in quantity.

Wasting and persistent vomiting are so common in improperly nourished infants that the diagnosis of pylorospasm should not be seriously considered until the effect of judicious feeding has been carefully studied. The cyclic vomiting, usually accompanied by acetone and diacetic acid in the urine, is characterized by its comparatively brief recurring paroxysms, with intervals of complete health. The vomiting of Henoch's purpura (angioneurotic edema) is characterized by its sudden, violent, painful onset—often blood in the vomited matter and the stools and especially by purpuric skin spots. Cerebral vomiting is in children usually attended with characteristic symptoms of chronic meningitis (tuberculous or syphilitic).

Gastroptosis.—Gastroptosis, usually associated with enteroptosis, right nephroptosis, at times with dilatation, is most often found in emaciated and hysterical females, and, even though extreme, occasions no symptoms unless there be angulation at the pylorus. The pylorus is always displaced downward or to the left or in both directions, sinking from the level of the first lumbar vertebra, its normal position, as low as that of the fifth.

The condition may be incident to congenital pyloric displacement or abnormal mobility, colon drag, relaxed gastrohepatic ligament, or pressure on the part of the sagging liver. Above the lesser curvature the body of the pancreas may be felt at times where this structure crosses the lumbar vertebræ.

The symptoms of gastroptosis, when these develop, are those of pyloric obstruction and ultimate dilatation. The latter may become recurringly acute. Physical examination supplemented by the stomach tube and inflation usually satisfactorily reveals the condition. The assured diag-

nosis is, however, best made by means of the *x*-rays with the patient in a standing position. By this may be demonstrated the size, shape, position, and mobility of the stomach

Perigastric Adhesions.—Perigastric adhesions, incident to a local peritonitis, usually caused by gastric ulcer or cholecystitis, symptomless except when the region of the pylorus is involved, are characterized by pain at times constant, but most marked after eating, exaggerated peristalsis, and gastric indigestion; exceptionally by retention of food, dilatation, and vomiting. The diagnosis is based upon the elimination of non-surgical causes for such a symptomatology, the history of a previous local peritonitis, and the fact that the symptoms are stationary or at the worst but slowly (years) progressive.

Volvulus of the Stomach.—Volvulus of the stomach, by which is meant a twist of the organ on its long axis, an extremely rare accident, is only possible in conditions of gastroptosis. It is characterized by pain, shocking in intensity, rapid distention of the stomach, and inability to vomit or eructate.

Ulcer of the Stomach.—Ulcer of the stomach may appear as an erosion so slight as to escape even postmortem examination, as an abrasion, as acute round ulcer, or as an indurated chronic ulcer.

The acute ulcer, either of the superficial or deep type, may appear in any part of the stomach, particularly on the posterior wall and along the lesser curvature. It is common in anemic hysterical young women (about twenty-five years old), is probably a local expression of sepsis, and, when placed on the anterior wall, is prone to bleed and to perforate.

The diagnosis of gastric ulcer is based upon hemorrhage, which may be occult, slight, profuse, or very exceptionally promptly fatal; pain, often localized, markedly aggravated by taking food, and relieved by vomiting or stomach lavage or orthoform (Murdoch); tenderness, also frequently well localized, hyperperistalsis, and excess of hydrochloric acid in the gastric content.

When the ulcer is placed near the pylorus, and either by its hyperemia, induration, or cicatricial contracture causes spasmodic contracture or pronounced mechanical narrowing of this orifice, there will be added to the symptoms just noted those of pyloric obstruction characterized by retention of food, hyperperistalsis, dilatation, absence of hydrochloric acid, and lactic fermentation.

As symptoms of corroborative, but not diagnostic value, anemia, emaciation, constipation, and the occasional association with pulmonary tuberculosis may be mentioned.

Referred pain and cutaneous hyperalgesia are at times well marked, the seats of preference being over the ensiform cartilage or to one side of it, and at a point in line with the scapular angle at the level of the ninth dorsal spine (Head).

The one symptom upon which most reliance can be placed is hemorrhage. This, if profuse and vomited, in the absence of adequate traumatism, blood dyscrasia, or vascular back pressure, can be regarded as almost pathognomonic of ulceration. Constantly recurring slight hemorrhage,

shown by the presence of occult blood in the vomited matter or that drawn from the stomach by lavage, is considered equally diagnostic in the absence of either renal or hepatic disease.

Abdominal arteriosclerosis may cause acute attacks of pain, suggesting perforation, or may be characterized by recurring paroxysms closely simulating those of ulcer or carcinoma. Berger reports cases suffering from postprandial pain, emaciation, and bleeding, in which an autopsy failed to demonstrate the erosions from which the bleeding came.

Though in typical cases the symptoms of gastric ulcer are sufficiently characteristic to make the diagnosis well-nigh certain even in the absence of exploration, the frequency with which the first symptoms, barring slight digestive disturbance, are those of acute perforative peritonitis, proves that ulcer may exist without offering any symptoms upon which even a probable diagnosis can be based.

From the surgical point of view the diagnosis is important because of the complications of hemorrhage, pyloric obstruction, diffuse perforative peritonitis, localized peritonitis with gradual extension of inflammation, perigastric adhesions, or pus formation. These conditions, developing in the absence of a preceding history of gastric ulcer, can be distinguished as to their etiology only on the basis of probability and exclusion.

The distinction between a chronic indurated gastric ulcer and gastric carcinoma may be impossible both clinically and at operation. The subsequent course of these cases shows that even careful microscopic examination may leave the examiner in error. Hence, when radical surgical procedure is possible, this in doubtful cases should take the form applicable to cancer.

Carcinoma of the Stomach.—Carcinoma of the stomach is an affection of middle age and old age without sex predilection, usually involving the pylorus and lesser curvature, and growing toward the stomach rather than toward the duodenum. It may develop without symptoms other than moderate pain and those of gastric indigestion, until a palpable tumor is found, unless the lesion is placed near the pylorus or cardia and causes obstruction. Under such circumstances the symptoms do not differ from those of obstruction thus placed due to other causes except for their rapid (weeks or months) and inevitable progression.

Apparently causeless and progressive loss of weight and toxic anemia in a person who has reached middle age, associated with persistent gastric pain of moderate severity, often localized tenderness, and gastric indigestion resistant to carefully regulated diet, are regarded as sufficient evidences of gastric carcinoma, particularly if associated with habitual absence or deficiency of hydrochloric acid and occult or obvious blood in the vomitus or the stomach washings.

The symptoms upon which diagnosis is usually based are: Pain; emaciation; frequent vomiting of gastric contents, exhibiting the coffee-ground appearance of slight hemorrhage and deficient in hydrochloric acid, with lactic acid present and a large bacterial content, particularly the Oppler-Boas bacillus; later, vomiting of food taken many hours before, and with the demonstrable signs of gastric dilatation; and

finally, the detection of a tumor, hard, rounded, nodular, if the adjacent lymph glands are extensively involved, usually movable and best palpated when the stomach is empty.

These, with the exception of tumor, are the symptoms of pyloric stenosis, and may be equally well marked from obstruction of equal degree due to other causes. When the symptomatology is complete and unmistakable the time for radical operation has generally passed.

Hypochlorhydria is supposed to be particularly characteristic of cancer, and is noted even when this lesion is non-obstructive. Hydrochloric acid is subnormal in quantity, however, in many apparently healthy persons.

The distinction between carcinoma and an indurated and obstructing ulcer can often not be made even at operation, the ultimate decision depending on microscopic examination.

An early positive diagnosis of cancer can be made only by exploratory operation.

Hourglass Stomach.—Hourglass stomach, possibly congenital, usually due to cicatricial contracture or infiltration of carcinoma, exhibits, as a rule, the constriction near the pylorus, the fundus being dilated. If the pylorus is also narrowed, both gastric pouches may exhibit dilatation. It is characterized by the symptoms of obstruction. The sudden return in quantity of turbid fluid through the tube after the stomach apparently has been washed clear is characteristic. Palpation and percussion of the inflated stomach at times give evidence of the condition. It is best detected by the *x*-ray after the ingestion of bismuth.

When both the pyloric and the cardiac pouch are dilated even an exploratory operation may fail to reveal the true condition of affairs unless the exploration be thorough.

Sclerosing Gastritis.—Sclerosing gastritis (linitis, rare) is characterized by an enormous fibrous thickening of the gastric walls, with consequent encroachment upon the lumen of the viscus. Its symptoms are those of inveterate gastric indigestion, pain, often severe, paroxysmal and most marked after eating, and vomiting, never profuse. It is slow in progress (years), the rigid gastric walls cannot be demonstrably inflated though efforts to accomplish this cause agonizing pain, and the hard, contracted stomach may be difficult to find even on exploration.

Carcinoma of the Duodenum.—Carcinoma of the duodenum, rare as compared to this affection of the stomach, is, if obstructive, attended with the symptoms of pyloric stenosis, nor can it be differentiated except by exploration.

When placed at or near the papilla, the symptoms are those of steadily progressing biliary obstruction, associated, in the absence of calculi, with little or no biliary colic, with a distended gall-bladder and the evidences in the stools of absent or deficient pancreatic secretion.

Duodenal Ulcer.—Duodenal ulcer, an affection of middle-aged men (about forty years), developing usually on the anterior wall of the bowel near the pylorus, is probably symptomless, as a rule, its presence

not being suspected until the complications of perforation or hemorrhage occur.

Diagnosis of the condition in the absence of these complications is based upon pain which, if localized, is often placed to the right of the ensiform cartilage and slightly below it, tenderness on deep pressure at this same point, and blood in the stools or the vomit, or both. Eructation, recurring vomiting, and impaired general health are corroborative symptoms. The one which is most characteristic is the effect of food on pain; the latter is relieved by eating a full meal, but recurs some hours later; vomiting and gastric lavage also give relief.

The distinction between duodenal ulcer and hepatic colic is based upon the slower onset and less severity of the pain attacks of the former, the alleviating effect of eating, alkalies, vomiting, or lavage, the presence of blood in the stools or vomited matter, the usual hyperacidity of the latter, and constipation.

The local tenderness and rigidity are in about the same region in both affections and in each jaundice may be present; the backward and upward radiations and pain on deep pressure are characteristic of hepatic colic, while referred surface pain and hyperalgesia in the right upper abdominal quadrant are more marked in ulcer.

THE LIVER.

The liver occupies the right upper abdominal quadrant, extending about two inches beyond the midline into the left upper quadrant. The surface marking of its upper border, which is moulded to the diaphragm, forms a curved line convex upward, extending from a point one and a half inch to the left of the base of the ensiform to a point half an inch below the right nipple (middle of the fourth intercostal space), thence to the ninth interspace in the scapular line. Its lower anterior margin corresponds with the costal border and a line drawn from the ninth costal cartilage to a point two inches to the left of the base of the ensiform cartilage.

The liver is held in place by intra-abdominal pressure, by the falciform ligament extending practically from the diaphragm to the umbilicus and completely dividing the subphrenic space into two parts, and by its vascular attachments to the vena cava.

The blood supply of the liver is through the hepatic artery. The portal vein brings blood from the spleen, pancreas, and gastro-intestinal tract. These two systems finally merge into the hepatic veins, which are without valves and which empty directly into the vena cava.

The lymphatics empty into infradiaphragmatic and supradiaphragmatic nodes placed about the vena cava, into those placed about the celiac axis, and into those lying in the region of the cardiac end of the stomach.

The nerve supply is from the solar plexus, the left pneumogastric, and the right phrenic.

The gall-bladder, a diverticulum from the gall tract, from three to four inches long, with a capacity of one and a half ounces, lies with its

fundus nearest the anterior abdominal wall at the point of crossing the costal margin by a line drawn from the right nipple in the male to the umbilicus (ninth costal cartilage). It is usually attached to the liver along its upper surface. Occasionally it is provided with a distinct mesentery. Its duct, about one and a half inches long, often sharply angled as it enters the common duct, presents a lumen so obstructed by mucous folds as to make the passing of a probe difficult or impossible.

The gall-bladder is an unessential organ, provided with elastic but extremely strong walls. It is probably a provision for a continuous slow secretion, which is intermittently stimulated to hyperactivity when it is needed in the process of duodenal digestion. It has a secretion of its own independent of the bile which it contains.

In the transverse fissure of the liver, two ducts, each coming from its own lobe, unite to form the hepatic duct, which, after a course in the gastrohepatic omentum of from one to two inches, is joined by the cystic to form the common duct.

The common duct passes downward, either through the head of the pancreas or between this organ and the duodenum, and, after dilating into the ampulla of Vater and being joined by the pancreatic duct, discharges through a narrow, valve-like opening into the lumen of the duodenum.

Along the course of the common duct, and particularly at the angle or junction between the cystic and the hepatic duct, are found lymph glands.

The liver secretes two to three pints of bile in twenty-four hours. The flow is constant, but is increased by eating and by secretin.

The bile is helpful, but not essential, to digestion. With the bile are excreted organisms, mostly dead, carried to the liver through the portal circulation, and at times toxic substances of such virulence as to cause ulceration of the intestine.

Among the metabolic functions of the liver the formation of glycogen and urea are conspicuous.

The cardinal symptoms of surgical liver affections are tenderness, pain, tumor, jaundice, gastric indigestion and the constitutional symptoms of infection or impaired metabolism. When ascites, together with varicosities of the hemorrhoidal, superficial epigastric, and esophageal veins, develops the case is usually no longer a surgical one, though a stone pressing on the portal vein may cause these symptoms.

The pain of liver affections is a dull ache, subject to paroxysmal exacerbation, often traceable to errors in diet. It is felt in the region of the liver or near the midline at the tip of the ensiform cartilage. Its radiation is toward the central line, backward or upward and backward, to the right, exceptionally to the left, shoulder (phrenic and superior acromial nerves).

When due to gallstone obstruction the pain is sudden in onset, extremely severe, attended with early vomiting, which may or may not bring relief, and accompanied by tenderness in the gall-bladder region.

When due to acute inflammation of the investing peritoneum, the pain is attended with the tenderness and rigidity of local peritonitis.

The tenderness of liver affections is elicited by direct palpation, and particularly in case of the gall-bladder by pressing the fingers of the examining hand deeply upward and backward in the gall-bladder region during expiration. The following inspiration will be abruptly arrested (Murphy).

Tenderness thus elicited may be referred to the midline.

Protective rigidity of the upper portion of the right rectus is in itself diagnostic of deep tenderness.

The tumor of hepatic affections is detected by direct palpation and by percussion, the area of dulness being convex upward when due to solid growths or fluid accumulation below the diaphragm.

Jaundice, earliest detected in the serum of blood drawn into a capillary tube and in the urine and first seen in the conjunctiva, is a symptom of obstruction of the ducts. It is usually absent in stones confined to the gall-bladder, ephemeral when due to catarrhal swelling; is inconstant in abscess or neoplasm, or granuloma, depending upon the amount of direct pressure; is intermittently recurring and attended with paroxysms of pain in gallstone disease involving the common duct; is persistent and slowly progressive in carcinoma or chronic inflammation of the head of the pancreas, or in duct cancer.

Malformation.—Transposition of the Liver.—This organ, being placed to the left side, is usually associated with malposition of other organs.

An accessory lobe in the form of a tongue-like projection (Riedel's lobe) extending downward over the gall-bladder in itself causes no symptoms. Its smooth outline, rounded borders, position immediately beneath the abdominal wall, attachment to the liver, and free respiratory movements are characteristic.

Corset Liver.—Corset liver is characterized by the formation of a constriction in the right lobe, dividing this portion of the liver into two masses separated by a groove. It is usually observed in women given to tight lacing. The diagnostic symptoms are those of Riedel's lobe.

Movable Liver.—Movable liver, hepatoptosis, usually associated with general visceral ptosis, is characterized by a downward displacement with forward rotation of the diaphragmatic surface of the organ. The characteristic sharp edge and smooth, dome-like surface associated with percussion resonance in the liver region establish the diagnosis.

Trauma of the Liver.—Severe subcutaneous injury is characterized by shock and symptoms of hemorrhage, the liver being easily ruptured because of its friability and bleeding freely because of its vascularity. Absolute diagnosis must be made by operation. Rupture of the gall ducts has usually caused rapid jaundice and the symptoms of a subacute diffuse peritonitis.

Symmetrical Enlargement.—Symmetrical enlargement of the liver appears most frequently in the form of cirrhosis, an expression of interstitial hepatitis due to alcohol and other forms of chronic poisoning. It is occasionally associated with peritoneal and intestinal tuberculosis.

It is characterized by jaundice, big, tender, uniformly enlarged liver, and constitutional symptoms incident to this condition.

The symmetrically enlarged amyloid liver consequent on prolonged suppuration, exceptionally in syphilitic infection, exhibits neither jaundice, pain, nor tenderness. The stool may be light colored because of the diminished secretion of bile.

Passive congestion incident to venous back pressure from circulatory failure, especially that incident to tricuspid insufficiency, is characterized by tender, often pulsating, hepatic enlargement.

Banti's disease or splenic anemia is characterized by enlarged liver, secondary to that of the spleen. This term probably includes a number of affections of different origin, among which may be mentioned cirrhosis of the liver with early splenic involvement, malaria, and congenital syphilis.

Cysts, Tumors, and Infections of the Liver.—**Echinococcus Cysts.**—Echinococcus cysts are usually multilocular, placed in the right lobe on its upper surface, can be detected only by slow growth, and not then unless they approach the surface anteriorly, project upward at the expense of the thoracic cavity, or become acutely inflamed.

Diagnosis must be made by operation.

Dermoid cysts have been reported, but must be diagnosticated by operation.

Carcinoma.—Carcinoma, usually secondary to cancer of the stomach, rectum, or breast, exceptionally primary, is characterized by dull, deep-seated pain, often some tenderness, and the detection of a nodular growth. The distinction from gumma must be made by the associated history and the result of the therapeutic test.

Sarcoma.—Sarcoma, usually secondary, occurs, as a rule, in younger people, and grows more rapidly. The diagnosis depends upon the finding of a primary focus, usually upon operation.

Angioma or Lymphangioma.—Angioma or lymphangioma (rare) might be suggested by marked changes in consistency and size without obvious cause. The diagnosis is usually formulated at operation or autopsy.

Syphilis of the Liver.—Syphilis of the liver in the form of a diffuse infiltration, producing a uniform enlargement, sometimes accompanied by nausea, vomiting, and fever, may simulate abscess. The diagnosis must be based on the history and the therapeutic test.

Gummata form circumscribed hard tumors, palpable along the anterior border, which may or may not be painful and tender. The distinction from cancer by palpation is impossible, and must be based upon the previous history of syphilis, the presence of other specific lesions or traces of them, the absence of a primary or demonstrable cancer focus, or symptoms suggesting the presence of such a one and the beneficial effect of mercuric treatment.

Tuberculosis.—Tuberculosis is always secondary, and the same is true of actinomycosis. In either case a tumor may form with the local and general symptoms of subacute abscess. Diagnosis depends upon micro-

scopic examination of the discharge, associated with the history of the case.

Abscess.—Abscess of the liver due to trauma, direct extension, or infection carried from the gastro-intestinal tract (appendicitis, typhoid ulceration, amebic dysentery), either through the portal vein, the lymph channels, or the common duct, or infection carried through the hepatic artery (osteomyelitis, pyemia), may be single or multiple, usually the latter, excepting when the abscess is secondary to trauma, direct extension from perihepatic suppuration, or amebic dysentery.

The condition is characterized by local pain, tenderness, usually general enlargement of the liver, and the gastro-intestinal, systemic, and blood symptoms of infection. Jaundice may or may not be present, but is usually observed to a slight degree. Pain and friction sounds of perihepatitis are at times noted. Upward extension is characterized by the symptoms of a basal pleurisy on the right side. This may be followed by purulent expectoration due to rupture of the abscess through the lung into a bronchus. Pain radiations are backward and upward.

The symptoms in the case of single amebic abscess, usually placed on the upper surface, may remain latent for months, percussion demonstrating an increased area of dulness extending dome-like into the chest. The diagnosis is often not suspected until edema and tenderness indicate surface pointing.

When the abscesses are multiple (suppurative cholangitis) the constitutional symptoms of profound infection far outweigh those of local reactive inflammation.

THE GALL-BLADDER.

The gall-bladder may be absent, bifid, or hourglass in shape.

Injuries.—Injuries to the gall-bladder or ducts, barring direct wound, are not common, except in connection with extensive and usually fatal trauma to neighboring organs. The immediate usual sequel is peritonitis; in the absence of this, the evidence of free fluid in the peritoneal cavity and jaundice from bile absorption.

Distention.—Distention of the gall-bladder may be due to the retention of its own secretion incident to blocking of its pelvis or duct, or to prolonged backing of the bile into it because of obstruction to the common duct.

It is characterized by the presence of a rounded, smooth tumor in the gall-bladder region, growing downward and inward toward the umbilicus, and usually neither tender nor painful.

The position of the tumor above or in front of the colon and not palpable in the flank, its participation in the respiratory movements of the liver, and its attachment to the latter organ distinguish it sufficiently from renal enlargements. When the distention has become so great as to form a large tumor filling the greater portion of the right abdomen, or even overlapping the middle line, the distinction from renal tumor,

or even cysts of pelvic origin, is more difficult. The history of the development of the growth, the attachment of its pedicle to the liver, the comparatively moderate bulging in the flank, are all elements favoring its gall-bladder origin. This form of distended gall-bladder is usually not accompanied by jaundice, but, if the latter exists, it is moderate in degree.

When the distention is due to obstruction of the common duct there is always associated an intense jaundice. ???

Cholecystitis.—Cholecystitis, usually associated with calculi, may appear in the catarrhal, suppurative, or necrotic form. It is characterized by pain, tumor, local tenderness and rigidity, and constitutional symptoms of infection. Often, also, by a moderate jaundice.

The acute, suppurative form, commonly secondary to typhoid fever, pneumonia, or appendicitis, is characterized by pronounced symptoms of both local peritonitis and constitutional infection.

Gangrene or perforation may be characterized by the development of either the symptoms of local abscess of hyperacute type, or those of diffuse peritonitis.

Membranous cholecystitis exhibits much the symptoms of gallstone disease, *i. e.*, colic and local tenderness and rigidity. This rare affection might be suggested by the finding of membranes in the stools since it is associated with membranous enteritis.

The rupture of a gall-bladder abscess may occur externally, usually below the border of the ribs or in the umbilical region, into the colon, the duodenum, the stomach, the subphrenic space, or the renal pouch.

Cholelithiasis.—*Stones in the Gall-bladder.*—Stones, usually formed in the gall-bladder of physically indolent, gouty, fat people, particularly women (3 to 1) past the age of thirty-five, are due to infection which in turn is often secondary to typhoid fever or appendicitis.

When there is no effort made to extrude them from the bladder, they may cause no symptoms other than heaviness after eating, gaseous eructations, deep pain, referred to gastric indigestion, and the symptoms of pyloric stenosis of moderate degree.

When stones in the gall-bladder cause symptoms which may be regarded as diagnostic, they are expressed either in the form of pain, harassing, deep, diffuse, in the liver region, associated with gastric indigestion and often a dorsal reference (to the right of the eleventh and twelfth spinous processes); tenderness elicited by hooking the fingers under the rib at the ninth costal cartilage during expiration and directing the patient to take a deep breath, sometimes referred to the epigastrium; recurring fever paroxysms exhibiting a sudden jump and equally sudden drop of temperature, the steeple chart; or in the form of colic, characterized by the rapid or sudden onset of severe crippling often shocking pain in the liver region, with radiations backward and upward, tenderness readily elicited in the gall-bladder region unless the rectus be protectively rigid, nausea, vomiting, which may or may not bring relief, intestinal tympany, and constipation.

Fever is present or absent in accordance with the degree of infection

and the completeness of obstruction. The attack may last minutes, hours, or days, and be paroxysmally recurrent in type. Convalescence is, considering the severity, astonishingly rapid and complete.

Following the attack, soreness and tenderness last for several days. Relief of acute symptoms, prompt or gradual, signifies that an obstructing stone has become so no longer, either because it has passed on or has dropped back into the gall-bladder.

In the cases characterized by constant or recurring pain, but not of crippling intensity, the distinction between gallstone and gastric or duodenal ulcer will depend upon the more nearly midline seat of pain and local tenderness in the latter conditions, the finding of obvious or occult blood in the material expressed from the stomach, or obtained by examination of the stools, the prompt, decided, and usually certain aggravation of pain incident to taking food in the case of gastric ulcer, its immediate alleviation and subsequent (one or two hours) exacerbation in case of duodenal ulcer, the more pronounced effect on general nutrition of ulcer, and the prompt and usual relief incident to vomiting or the administration of chloretone.

Catarrhal jaundice may be present in either duodenal ulcer or stone in the gall-bladder, and hyperchlorhydria is common to both conditions, particularly in the case of stone as a prodrome to an attack of colic.

The pain due to efforts to pass a stone through the cystic duct, and the obstruction incident thereto is more sudden in onset and more crippling in intensity than that incident to ulcer. Attended as it often is with shock, vomiting, and tympany, it suggests rather a perforative peritonitis. The distinction from this condition is, in the early stages, suggested by the history of a previous attack, by the direction of pain radiation, and by the fairly sharp localization of tenderness over the gall-bladder; shortly by the absence of symptoms of a rapidly progressing diffuse peritonitis.

From renal pain gallstone colic is distinguished by its upward and backward pain radiations, absence of tenderness in the ileocostal angle, and usually by urinary findings in the latter condition.

The distinction between hepatic colic and the abdominal crises of ataxia, of angeoneurosis, or the referred pain of thoracic infections is referred to elsewhere.

Stones in the gall-bladder, or its duct, may be complicated by hydrops, or acute or chronic cholecystitis; usually when they excite symptoms, often in the absence of these, by local peritonitis with the formation of adhesions to the omentum, colon, stomach, and duodenum; occasionally by fistulous openings into hollow viscera, or pericystic abscess formation; occasionally by catarrhal cholangitis of sufficient intensity to cause intermittent jaundice; exceptionally by portal phlebitis, incident to direct pressure, with ascites, and, if the common duct also be involved, pronounced and continuous jaundice.

Stones in the hepatic or the common duct are characterized by much the same symptoms as those of stone in the cystic duct, with the usual addition of jaundice, either intermittent or continuous, which varies in

intensity from day to day or even in the same day, which deepens with each attack of pain, and fever, coming on with the jaundice-pain paroxysms, intermittent in type, and exhibiting the steeple fluctuation, and deterioration in weight and strength, which may be rapid (weeks, months) or slow (years).

The gall-bladder is usually contracted, adherent, and cannot be palpated; the liver is enlarged, often markedly so, and particularly during acute pain and jaundice attacks. The stools are putty colored and fatty and the urine is bile stained.

Stones in the common duct are complicated by cholangitis, which may become widespread, suppurative, and rapidly fatal, by ulceration and abscess formation, or discharge into surrounding hollow viscera, by phlebitis and ascites, and particularly by acute, subacute, or chronic pancreatitis.

From cholangitis, without stones, the diagnosis is mainly based upon the history of recurring attacks of pain.

From obstruction of the common duct by malignant growth or pancreatic infiltration, by the fatally progressive nature of the jaundice, in the latter case, the more complete and permanent occlusion of the duct as shown by examination of the stools, the palpable enlargement of the gall-bladder, and the absence of a history of recurring attacks of hepatic colic.

Aneurysm of the hepatic artery may cause by pressure both the colicky pain, the gastric disturbances, and the jaundice characteristic of duct stone. Theoretically, the detection of a pulsating tumor, giving a characteristic bruit, should establish the diagnosis.

Cancer of the Gall-bladder.—Cancer of the gall-bladder, usually due to stone, is characterized, aside from the symptoms of this latter condition, by nodular tumor in the gall-bladder region. Diagnosis should be made by operation and before tumor becomes demonstrable.

Gall-bladder cancer, secondary to infiltration of the liver, usually gives no history of stone, and is of minor moment as compared to the primary disease. In either case, if the cystic duct be occluded, acute suppurative cholecystitis, with its characteristic symptoms, may develop and mask the original lesion.

Occlusion of the common duct by *cancer of the papilla* cannot be distinguished from that due to stone, since it is usually secondary to this condition, except for the lack of intermittence in obstructive symptoms and the development of ascites from vein involvement. The complicating gastric disturbance, the constitutional manifestations of cholangitis, and the symptoms and signs of pancreatic involvement, are the same in both affections

THE PANCREAS.

The pancreas is a lobulated, postperitoneal gland, without fibrous capsule, the head of which fits into the loop made by the V-shaped duo-

denum or may completely surround this portion of the gut, and the neck and body of which pass almost transversely across the abdomen behind the stomach on a level with the body of the first lumbar vertebra about three inches above the umbilicus. There may be aberrant growths of normal tissue connected with the substance of the gland by ducts only, or an accessory pancreas without any connection with the gland may develop in the gastric or intestinal walls.

The main duct, the canal of Wirsung, traverses the entire length of the gland, parelleling the common bile duct as it approaches the latter and finally uniting with it in the duodenal wall to form the ampulla of Vater. The accessory duct (duct of Santorini), communicating with the main duct at the neck of the gland and collecting the secretion from its head, discharges into the duodenum by a separate orifice placed about three-quarters of an inch above the opening of the ampulla of Vater.

The common bile duct and the pancreatic duct may unite at some distance from the duodenum or may open side by side at the apex of the caruncle.

Between the head of the pancreas and the duodenum, or completely surrounded by pancreatic tissue, lies the common bile duct. The pancreas is encircled by anastomosing arteries derived from the splenic hepatic and superior mesenteric vessels; the veins pass directly into the splenic and superior mesenteric veins. Nerves are from the vagi and the solar plexus. The lymphatics pass into the duodenal, superior mesenteric, and splenic glands.

The function of the pancreas, aside from an internal secretion effecting carbohydrate metabolism, is the secretion of from half a pint to a pint of alkaline juice daily, the quantity varying in proportion to that of the acid chyme passed from the stomach. The acid chyme forms secretin from the duodenal epithelium, which in turn excites the pancreatic cells to activity.

The pancreatic fluid is the universal digestant except for connective tissue, acting with vigor upon fats, particularly when the latter are mixed with bile and hydrochloric acid. Its proteolytic ferment, trypsinogen, is not activated into trypsin until it reaches the duodenum and becomes mingled with enterokinase. Its diastatic ferment is not observed in the first few months of life.

Affections of the pancreas are characterized by pain, tumor, tenderness, interference with function, and metabolism.

Pain in acute pancreatitis is shocking in severity, is often attended with pronounced dyspnea, and is usually placed in the epigastric region. The pain of chronic pancreatitis is at times recurrent and severe, or may be absent. Any rapid growth or infiltration or arteriosclerosis may occasion paroxysms of agonizing pain. A backward and upward radiation of pancreatic pain has frequently been noted; exceptionally it has been downward to the right iliac region or even along the course of the sciatic nerves. The epigastric tenderness is extreme in acute cases, and is usually accompanied by the rigidity of peritonitis. In chronic inflammations midline tenderness on deep pressure is usual.

Robson states that in thin persons with relaxed abdominal walls, and especially in those with ptosed stomachs, the body of the normal pancreas can be readily defined by palpation in the epigastric region, and that in both acute and chronic inflammation a distinct swelling can often be felt, giving a communicated, non-expansile pulsation and slight respiratory movement. The head of the gland is so deeply placed that the enlargement must be great before it can be detected by palpation.

Interference with function and metabolism is most characteristically marked by large, foul, dirty white, acid, fatty stools, containing often undigested muscle fibers. Such stools are distinctly altered for the better by administration of pancreatic emulsion by the mouth.

The neutral fat is much in excess of the combined fatty acids. In steatoma of biliary origin the quantities are more nearly equal, the combined fatty acids being somewhat in excess.

Distaste for food, particularly for fats and meats, the symptoms of pronounced and inveterate indigestion, loss of weight, rapid in the case of neoplasm, usually marked anemia, oxalates, acetone, and diacetic acid in the urine, in inflammatory cases the pancreatic reaction (Cammidge), a tendency toward spontaneous hemorrhage or bleeding long continued from slight wounds, occasionally glycosuria. These are symptoms which when grouped strongly suggest extensive involvement of the pancreas.

Growths of the pancreas occlude, either by their mechanical bulk or by infiltration, the common duct, the portal vein, or the duodenum.

Injuries of the Pancreas.—If extensive, injury is usually associated with lesions of neighboring organs and exhibits no characteristic symptoms.

Abscess or cysts may develop subsequently as a result of exudation into the lesser peritoneal cavity, with closure of the foramen of Winslow. Post-traumatic cysts usually grow directly from the pancreatic substance.

Pancreatitis.—Pancreatitis, predisposed to by traumatism or obstruction, congestion or hemorrhage, caused directly by infection extending from the common duct or duodenum, exceptionally carried by the blood and still more exceptionally due to extension from the adjacent organs, may be acute or chronic. It is usually secondary to cholelithiasis, and primarily or secondarily hemorrhagic.

Acute pancreatitis is characterized by the rapid or sudden onset of agonizing epigastric pain attended with shock or even collapse, dyspnea, cyanosis, painful vomiting, and epigastric tenderness and tympany. The tympany shortly (hours) becomes general, and there is often an associated slight jaundice, which, if the affection is secondary to common duct stone, may become pronounced. Referred pain is to the back between the shoulders or below the angle of the scapula on the left side, often to the precardial region or the right inguinal fossa.

Following the acute onset, if there be a reaction from shock, the general tenderness and tympany, muscular rigidity, feeble or absent peristalsis, constipation, and recurring vomiting indicate a diffuse

peritoneal irritation. The affection is commonest in fat men with a previous history of chronic indigestion, the latter doubtless secondary to an unsuspected chronic inflammatory condition of the pancreas.

Acute pancreatitis may occur in the course of mumps; marked by vomiting and epigastric pain and sometimes definite tumor. This form of pancreatitis is less violent in onset than the hemorrhagic type, the symptoms are transitory and the prognosis is good.

The framing of a prompt diagnosis is usually based upon the shocking severity of onset, the high midline pain, tenderness and tympany, pain radiation backward and to the left, and the finding of areas of fat necrosis at exploratory section. The latter have been found in the absence of pancreatic involvement (Fawcett).

Later (hours, days), the symptoms of hyperacute diffuse peritonitis which usually follow gastric or duodenal perforation are wanting, though the belly is generally swollen, tender, and moderately rigid, and peristalsis is feeble. The feces contain an excess of fat and the urine gives, according to Robson and Cammidge, the pancreatic reaction which they regard as diagnostic. Sugar in the urine is exceptional.

The pain of biliary colic has usually right radiations, and the tenderness is placed to the right of the median line. Since the two conditions are often associated, a differentiation may be impossible.

Abscess of the Pancreas.—Abscess of the pancreas, usually secondary to gallstones and cholangitis, may have an onset suggesting hemorrhagic pancreatitis, with symptoms less marked, particularly those incident to shock or collapse. Tenderness over the pancreas, absence of marked general tympany and diffuse peritoneal irritation, the detection of tumor, constitutional symptoms of infection, rapid loss of weight and the evidences of pancreatic involvement shown by examination of the urine and the stools will be elicited. The recurring paroxysms of pain and vomiting closely simulate those due to gallstone with which this condition is often associated.

Catarrhal Pancreatitis.—Under this caption, Robson and Cammidge describe an affection which they believe a cause of acute and chronic catarrhal jaundice of non-calculus origin, the obstruction to the common duct being not within its lumen but due to pressure of the swollen pancreatic head. They state that catarrh of the pancreas can be usually verified by digestive and metabolic signs and by swelling of the gland, which can, in some cases, be recognized by palpation through the abdominal wall, but in others only by manipulation of the pancreas through the open abdomen.

Suppurative Catarrh.—Suppurative catarrh is a term employed by Robson to designate a pancreatic condition similar to suppurative cholangitis, with which it is usually associated. The symptoms are essentially septic, and the diagnosis of pancreatic involvement is apparently dependent upon the presence of the pancreatic reaction in the urine.

Chronic Pancreatitis.—Chronic pancreatitis, usually incident to long-standing obstruction, associated with catarrhal inflammation, hence a

common accompaniment of common duct stone, but occurring in the absence of this, is characterized by progressive wasting (months, years), inveterate gastric indigestion, tenderness on midline on deep pressure, the tumor lying behind the stomach and carrying aortic pulsation, pain paroxysms with left posterior radiations, persistent and steadily deepening jaundice in the late stages, and, when the common duct passes through the hardened pancreatic head and the gall-bladder has not been previously diseased, painless enlargement of this viscus.

The laboratory examination should show pancreatic reaction, oxaluria, and, in the late stages, an excess of neutral fat and often free fat globules in the large pale, offensive stools.

The distinction from cancer of the pancreas may be impossible even at operation, though the usual painless onset, comparative rapidity in progress (months), age incidence (over forty), completeness of obstruction, ascites, hemorrhoids, and tendency to bleeding are characteristic of cancer. Pancreatic reaction is usually absent in this latter condition, unless there be an accompanying inflammation.

Pancreatic sclerosis associated with a similar condition of the liver, incident to syphilis and tuberculosis, and as a consequence of arteriosclerosis, is observed.

Pancreatic Calculus.—Pancreatic calculus (rare) is distinguished by the symptoms and the urinary and fecal findings of subacute pancreatitis. Recurring paroxysms of vomiting and severe pain with posterior or left radiation are recorded. The diagnosis is based upon *x*-ray examination, which shows these stones, since they are made up of lime salts, particularly the carbonate. Jaundice will develop if the stone impinge upon the common duct or be lodged in the ampulla of Vater.

Pancreatic Cysts.—Pancreatic cysts, frequently following trauma by months or years, and usually attended with pain, tenderness, and gastric indigestion with recurrent exacerbations, are marked by the formation of a tense rounded tumor, the deep origin of which is demonstrated by inflation of the stomach or colon, or both. The tumor is slightly movable, may extend forward above or below the stomach, behind or even below the colon, and may cause obstructive symptoms from mechanical pressure, and gives in the urine the pancreatic reaction (Robson). Except it reach huge size it has little tendency to present in the flanks.

The diagnosis of the pancreatic origin of such cysts is, even at operation, not always possible, though the presence of the pancreatic ferments, other than the diastatic, in the evacuated fluid may be regarded as positive evidence. These ferments are usually absent. Characteristic alteration in the urine and feces and jaundice will depend upon the amount of destruction of pancreatic tissue and the pressure effects of the tumor on the main ducts.

Cancer of the Pancreas.—Pancreatic cancer, usually of the scirrhous type, and occurring after the fortieth year, is characterized by rapid (months) loss of weight and strength, progressive anemia, and, if the head of the gland is affected, painless jaundice with swollen liver and

non-sensitive, enlarged gall-bladder; large, fatty, pale, offensive stools, with excess of neutral fat over combined fatty acids, and absence of stercobilin; often edema of the feet and ascites, tendency to hemorrhage, and early fatal termination. The tumor, if felt, is fixed, hard, deep, and conveys aortic pulsation. The pancreatic reaction is usually absent, unless there be an associated pancreatitis. Extension to the liver and to the stomach is common.

When the body of the gland is primarily involved, the tumor can often be readily palpated, its postgastric position being established by gastric inflation. At times the pain incident to pancreatic cancer is harassingly severe, with paroxysms of intensity associated with vomiting which suggest gallstones. When the body of the gland is involved, the referred pain is behind and to the left.

From chronic sclerosing pancreatitis the rapid course of cancer is diagnostic, also in the former position the pancreatic reaction in the urine is always present, nor is the absence of bile and pancreatic juice in the intestinal contents ever as complete. Even at operation, however, it may be impossible to distinguish between these two affections, the diagnosis then depending upon the result of conservative operation or autopsy.

From syphilitic infiltration the diagnosis must depend upon the result of medicinal treatment suggested by the history.

Since by its mechanical pressure pancreatic cancer may produce symptoms of pyloric stenosis, the distinction from cancer of the stomach may be difficult; the stools, however, in cancer primarily pyloric do not exhibit the characteristics of those devoid of pancreatic secretion, and the vomitus of the stomach lesion is usually characteristic, though in either case free hydrochloric acid is likely to be absent.

THE SPLEEN.

The spleen is a ductless gland, averaging 5 inches in length, 3 in width, 1½ in thickness, and 7 ounces in weight. It lies in the posterior part of the upper left side of the abdomen between the fundus of the stomach in front and to the right and the arch of the diaphragm behind; it extends from the upper border of the ninth to the lower border of the eleventh rib, and its long axis corresponds to the back part of the tenth rib. It is limited in front by the midaxillary line and posteriorly it reaches to within 1½ inches of the spine. Its sharp anterior border is distinctly notched, forming a characteristic feature when it can be palpated.

The organ is almost completely surrounded by peritoneum, and is held in place by the phrenosplenic ligament which connects it to the left crus of the diaphragm, and by the colon, which is held up by the phrenocolic ligament which forms a pocket-like support. Through the gastrosplenic ligament connecting this organ with the stomach, but affording no support to it, pass the vessels which are

extremely large, entering the spleen on its anterior surface at the hilus. The splenic artery, which also supplies branches to the pancreas and the stomach, breaks up into about half a dozen branches about an inch before it enters the spleen. The splenic vein unites with the superior mesenteric to form the portal vein.

The nerve supply is from the solar plexus, and from the right pneumogastric.

The spleen is brittle, highly vascular, and fairly mobile. When normal it cannot be palpated, nor can it be satisfactorily percussed.

The spleen of infants is relatively large, and in them can often be felt when normal. To palpate the spleen, the finger tips are pressed firmly just in front of the tips of the eleventh and twelfth ribs and the patient is instructed to inspire deeply. During this manipulation the abdominal muscles must be relaxed. In case of any considerable enlargement, the anterior border and the lower anterior angle of the spleen can readily be felt.

Percussion dulness can be detected only in case the spleen is decidedly enlarged.

The function of the organ remains unknown, but it is supposed to both produce and destroy red blood cells. It is not essential to life or health.

The diagnosis of surgical affections of the spleen is based upon enlargement or displacement; usually both.

Enlargement is commonly an expression of systemic infection, blood dyscrasia, localization of infection or neoplasm.

Enlargements due to systemic infection and blood dyscrasia are characterized by preservation of the splenic conformation, particularly of the notch. There is a projection beneath the left costal margin of a superficial mass, with no intestine in front of it, exhibiting respiratory movement, and, when comparatively small and not fixed, easily slipping back into its usual position.

The lower part of the diaphragm, as it bulges forward on deep inspiration, has been mistaken for the spleen.

Anomalies.—Absence, imperfect development, or supernumerary spleens give rise to no symptoms. The diagnosis can be made only by incision.

Movable, or wandering, spleen, an affection of adults and rare, excepting where the spleen is enlarged and the belly wall lax, is characterized by the presence of a tumor corresponding in outline with the spleen, extremely mobile, superficially placed, and readily reduced to the normal position of this organ. When a wandering spleen becomes fixed in a faulty position, diagnosis may be suggested by percussion resonance in the normal position of the spleen, but usually it is made only by operation.

When a wandering spleen becomes twisted on its pedicle, the symptoms are similar to those of perforative peritonitis, that is, sudden, severe pain, vomiting, and shock. Diagnosis is based upon the history of a wandering spleen, if this be obtainable, and by the detection of

a hard, tender mass. If rigidity and tympany obscure this tumor, diagnosis may not be made until an exploratory operation reveals the cause of the symptoms. As a complication of this condition, profuse bleeding may occur. When the vascular obstruction is not complete, the symptoms, pain, tenderness, and tumor are more distinctly characteristic.

Traumatism.—Rupture.—Rupture of the spleen, except in association with other extensive visceral lesions, is rare when the organ is healthy. When it is enlarged, this accident is not uncommon, even from comparatively trifling violence because of its friability. Rupture has been known to result from muscular contraction.

The diagnosis is difficult and not often made except at operation or necropsy. It would be aided by previous knowledge of enlargement of the spleen as well as by inquiry into the nature of the accident. The symptoms are, generally speaking, those of serious intra-abdominal injury. Most subjects suffer severe hemorrhage, which proves fatal, as a rule, within an hour. The abdomen is rigid, and percussion reveals fluid blood within its cavity. However, on account of the formation of large clots in the region of the spleen, the left side continues to give a dull note even when the patient is put on the right side; the right side, however, becomes resonant when the patient is put on the left side. This is known as Ballance's sign, and is pathognomonic of rupture of the spleen (Moynihan). There is a continuous severe pain over the splenic area.

Wounds.—Wounds of the spleen are diagnosticated by the character of the wound, by the signs of internal bleeding, and by exploratory operation.

Hypertrophy.—Hypertrophy of the spleen has been observed as an idiopathic affection. Diagnosis is based upon the absence of other causes of splenic enlargement, nor is the affection of surgical interest unless it be associated with displacement, torsion, or other accident.

Congestion.—Congestion causes enlargement, often distinctly palpable, in the course of affections of the lungs, liver, and heart. Diagnosis is based upon the adequacy of the primary condition to produce such condition. Aortic insufficiency complicated by an acute infectious disease may be accompanied by a pulsating splenic enlargement.

Inflammations.—Splenitis.—Splenitis is a complication of infection, particularly malaria and typhoid fever. It is characterized by enlargement which is a phase of the systemic disease. The affection is usually transitory but may become chronic, particularly in the course of malaria. It is of importance when it is complicated by rupture, displacement, or torsion. In the case of syphilis there is often perisplenitis accompanied by tenderness, pain, slight rigidity, and ultimately contractions, adhesions, and deformity.

Acute Suppurative Infection of the Spleen.—This is a rare affection, usually secondary to suppuration elsewhere or to traumatism, or typhoidal or malarial infection. Pain, tenderness and tumor, with local peritonitis and the systemic symptoms of infection, are the dominant

symptoms. Splenic abscess usually opens into the general peritoneal cavity or the colon or kidney. It may burrow through the phrenosplenic ligament to the cutaneous surface or into the pleural cavity.

Syphilitic Enlargement of the Spleen.—This occurs particularly in infants and children, and is the usual cause of enlargement in them. It may appear as an acute enlargement in the early course of the disease, as chronic indurative splenitis, or as a gumma. In the latter case the tumor is rarely of sufficient size to be detected. The diagnosis is based, as a rule, upon the effect of antisyphilitic treatment.

Tuberculous Enlargement.—This is nearly always secondary to tuberculosis in other parts of the body. The affection is usually masked by other abdominal symptoms.

Cysts.—*Hydatid* cysts (rare) are always unilocular in the spleen, are usually associated with manifestations of the disease elsewhere, and have rarely been diagnosticated except at operation.

Serous, blood, lymphatic, and dermoid cysts are extremely rare, and could be diagnosticated only by fluctuation or by operation. In contrast with the parasitic cyst, these collections of fluid develop mainly in the lower part of the spleen, and hence become palpable before they reach very great size.

Tumors.—Tumors are rare. They are characterized by irregular, usually nodular enlargement, commonly associated with pain and tenderness and not infrequently creaking due to perisplenitis.

Sarcoma, the primary tumor most frequently observed, is characterized by its rapid growth. Carcinoma is secondary. Extremely rare tumors are lymphangioma, cavernous hemangioma, and fibroma.

Splenic Anemia, or Banti's Disease.—A distinctly surgical affection, characterized by an indurated, often enormous, spleen, resulting from hyperplasia of the connective tissue and endothelial cells. The lymphatic glands are not involved, nor is there a characteristic blood picture. There is an associated cirrhosis of the liver, usually of a hypertrophic type, secondary to the splenic enlargement. There is pain associated with profound weakness, muscular atrophy, hemorrhages, fever, together with the usual symptoms of anemia and later ascites. This affection is distinguished from the splenic enlargement secondary to hepatic cirrhosis by the much greater size attained by the spleen; from sarcoma by the slower course and the associated liver enlargement; from chronic malaria by the absence of malarial organisms and malarial history. From syphilis by failure to respond to treatment. From leukemia by the blood findings.

Amyloid Degeneration.—Amyloid degeneration usually incident to prolonged suppuration and associated with a similar condition of the liver and kidneys, is characterized by uniform, indurated enlargement.

Leukemic Enlargement.—This occurs in the splenomyelogenous variety and is characterized by a soft, symmetrical tumor, later becoming hard and reaching an enormous size, accompanied by perisplenitis and adhesions. Diagnosis is based upon the blood findings.

The leukocytes are enormously increased in number and many myelocytes are present. There is marked reduction and nucleation of red cells.

The splenic enlargement of *pseudoleukemia*, or *Hodgkin's disease*, is accompanied by tumor of the lymphatic glands which begins in the neck, axilla, or groin. This in itself establishes the diagnosis. Aside from the reduced number of red cells and hemoglobin, the blood picture is not characteristic.

THE INTESTINES.

The jejuno-ileum, twenty-two feet long, lies in the central part of the abdominal cavity and in the pelvis, being bounded laterally and above by the large intestine. The mesocolon with the great omentum lies in front and more or less completely separates the small gut from the anterior abdominal parietes. At its beginning, where, forming a sharp angle with the terminal portion of the duodenum, it emerges from beneath the transverse mesocolon, it is held in fixed position by a musculofibrous band from the left diaphragmatic crus, the ligament of Trietz.

The upper portion of the jejuno-ileum is thicker, larger, more vascular, darker in color, and more abundantly supplied with valvulæ conniventes than is the lower part of the gut. The arterial loops of the upper part of the bowel are imperfectly developed, long straight vessels running directly to the gut wall (Monks). Passing downward, both primary and secondary loops become well developed, being distinctly marked at about the fourth foot. Still lower, secondary and tertiary loops are observed; the latter progressively approach closer to the inner margin of the gut.

The parietal mesenteric attachment of the small gut is about six inches in length, starting to the left of the spinal column at the duodenojejunal junction (body of the second lumbar vertebra) and running obliquely downward and to the right to a position in front of the sacro-iliac articulation. Between the two peritoneal layers of this mesentery course the vessels, nerves, and lymphatics.

The arterial supply is through the superior mesenteric, the venous return is through the portal system. The nerves are derived from the celiac plexus and the pneumogastric; connections of the latter and the sympathetic with the lower dorsal segments, explain pain irradiations and muscular rigidity in cases of intraperitoneal affections. The nerve terminals communicate with two plexuses, that of Auerbach lying between the circular and longitudinal muscle fibers, and having control over motion, and that of Meissner, passing to the mucosa and dominating secretion and probably absorption. The lymphatic vessels, after passing through a series of mesenteric glands, one or two hundred in number, terminate in the thoracic duct.

The function of the small intestine is essentially that of absorption of carbohydrates, fats, and proteids, excepting in its extreme upper part, where some secretin is produced. Its muscular coats by their con-

traction occasion repeated rhythmic segmentation (Cannon) and propulsion. These muscular motions, though they may be centrally stimulated or inhibited through the pneumogastric and sympathetic fibers, seem to be dependent in the main upon the action of intrinsic ganglia.

On clinical evidence, in case of obstruction there seems to be a reverse peristalsis, by virtue of which the intestinal contents are thrown back into the stomach, though in many cases in which this is supposed to have taken place the vomited matter is in reality an expression of an enormous gastric transudate.

In adults the ileocecal valve corresponds in its surface marking almost to the position usually given to the base of the appendix, *i. e.*, one and one-half to two inches from the anterior superior spine of the ileum in a line toward the umbilicus. It may depart greatly from this position in accordance with the placing of the cecum. Its entrance into the large gut is at a right angle and is protected by a valve, the most efficient part of which seems to be a loose mucous flap opening toward the cecum and incompetent against sustained back pressure.

The colon, beginning at the cecum and ending at the junction of the sigmoid flexure with the rectum (third sacral vertebra), has about twice the diameter at its beginning as in the terminal portion of its course. Its capacity up to six months of life is about a pint; up to the second year, between two or three pints; and in adults, about a gallon. The cecum, the transverse colon, and the pelvic colon (sigmoid flexure) are freely movable. The splenic flexure is placed far back and high, and is suspended by the phrenocolic ligament, which in turn acts as a support to the spleen.

The colon is distinguished by its large size, its sacculated form, the presence of longitudinal bands and appendices epiploicæ, and in the transverse portion by the attachment of the omentum. The pelvic colon (sigmoid flexure) exhibits neither sacculation nor longitudinal bands and normally lies in the pelvis. In the fossa made by the failure of its mesentery to completely unite with the peritoneum of the posterior wall hernia sometimes takes place.

The cecum, lying below the entrance of the ileum into the colon, about two and one-half inches in length, often completely invested with peritoneum, is the largest and most superficial portion of the gut, lying in the right iliac fossa with its blind end about on a level with a line joining the two anterior superior spines of the ileum. From imperfect descent this portion of the gut may lie much above this position. In shape the cecum may be funnel-like, the appendix forming the small end of the funnel, or may exhibit symmetrical or asymmetrical pouches divided by the longitudinal bands.

The appendix, originating at the termination of the longitudinal bands, usually about three inches in length, is a blind tube composed of a large quantity of lymphoid tissue, exhibiting a tendency to atrophy with advancing years. It has a valve-like arrangement (the valve of Gerlach) at its colonic opening when it enters this viscus at an angle (Piersol). It

is provided with a mesoappendix coming from the left side of the mesentery and from the cecum, attached for a variable distance, and, because of its relatively short base, commonly causing either a coil or a twist in this organ. In women a second mesenteric fold sometimes extends from the broad ligament and contains a branch of the ovarian artery.

In the mesoappendix lies the appendicular artery derived from the posterior branch of the ileocecal. The veins pass to the portal system, the lymphatics to the mesenteric, iliac, and postperitoneal groups. In the female the bloodvessels communicate with those of the ovary. The nerve supply is from the superior mesenteric plexus.

The appendix is predisposed to disease because it is a rudimentary organ which contains an excess of lymphoid tissue, is poorly drained, and is subject to twists or turns which interfere with blood supply.

The surface marking of the root of the appendix lies two to three inches from the right anterior superior spinous process of the ilium on a line passing directly to the corresponding bony process of the opposite side.

The function of the colon is essentially that of absorption. Cannon has shown that there normally exists in its proximal part an antiperistalsis, *i. e.*, waves of constriction running backward from the cecum. The contents of the transverse colon are almost as inspissated as those of the sigmoid.

It is calculated that about 15 per cent. of the nutritive material and the greater part of the fluid of the bowel contents are absorbed by the large intestine. From the stomach downward the bacterial richness of the gastro-intestinal contents increases.

General Symptomatology.—Surgical affections of the intestines are characterized by pain, tenderness, exaggerated, diminished, or absent peristalsis, the presence of mucus, blood, or pus in the stools, the symptoms of acute or chronic obstruction, wasting and toxemia, and at times by palpable tumor. They are frequently complicated by local or diffuse peritonitis.

The pain, attributed to a drag on the mesentery, since the intestine has no sensory nerves, is usually colicky in character, exhibiting remissions and exacerbations incident to distention and peristalsis. It may be a constant and localized ache. The tenderness is rarely acute, unless the peritoneum be involved.

Exaggerated peristalsis is a symptom of acute irritation or of mechanical obstruction; in the latter case it is associated with muscular hypertrophy if the obstruction be chronic and incomplete. There is an exaggerated peristalsis of psychic origin easily recognized as such. Absent peristalsis may be of central origin; it is usually due to peritonitis. Mucus in the stools is nearly always a proof of catarrhal inflammation. Blood is often occult, and is then detected only by careful chemical examination of the stools after a meat-free diet.

Congenital Anomalies.—Transposition and malposition of the intestines in the absence of obstructive symptoms cannot be diagnosticated without operation, except in the case of the descending colon and

sigmoid, when rectal insufflation or injection with bismuth, followed by the use of the *x*-rays, will demonstrate the condition.

Obstruction developing shortly after birth, if persistent, is, in the absence of inflammatory symptoms, characteristic of narrowing or occlusion. The diagnosis must be made by operation.

Opening of the bowel in an abnormal position (vagina, urethra, bladder) will be denoted by characteristic symptoms. Meckel's diverticulum is at times congenitally patent at the navel, and from it will be discharged fecal matter, and about the umbilical ring will be found the mucous membrane of this diverticulum firmly attached.

Hernia of the colon into the thorax through a congenital defect, if detected in the absence of obstructive symptoms, would be characterized by encroachment upon the lung capacity varying in extent at different times and by gurgling and peristaltic sounds preternaturally clear on direct auscultation.

Idiopathic dilatation of the colon (Hirschsprung's disease) an affection of infancy and childhood, which involves mainly the pelvic colon (sigmoid), though the gut immediately above is often similarly affected, is due to defective development of the intestinal walls and is characterized by an obstinate and persistent constipation, which yields more readily to rectal stimulation than to medicine by the mouth, and by a bulbous, tympanitic belly practically filled by the dilated loop of gut. The rectal tube passed high usually drains some fluid feces.

The diagnosis is based upon rectal inflation, and upon the *x*-ray picture after bismuth injection of an obstinately constipated child with a chronically bulging, tympanitic belly.

Ulcer.—Simple ulcer may occur in either the large or the small intestine and particularly in the latter. It exhibits raised indurated edges and is of obscure etiology, though doubtless started in some cases by fecal stasis. It has been noted in the course of nephritis and after poisoning by mercury.

The symptoms are persistent localized pain, and tenderness on deep pressure, intestinal indigestion, and obvious or occult blood in the stools. Later, as a result of cicatricial contraction, the gurgling, constipation, colicky attacks, exaggerated peristalsis, and tympany of chronic obstruction may develop.

Peptic ulcers of the jejunum following gastrojejunostomy, more common in men than in women (Gosset), and not observed after operation for cancer, are characterized by severe recurring pain, local tenderness, and blood in the stools, vomiting being rare; or by symptoms of acute perforative peritonitis, in some cases occurring without previous symptoms, in others preceded by pain and tenderness and rigidity.

Dysenteric ulcerations of surgical import are characterized by pain, tenderness, bloody stools, profound systemic depression, and usually the finding of the characteristic ulcerations by proctoscopic examination.

Tuberculous ulceration, usually secondary to pulmonary consumption, in its diffuse form characterized by diarrhea, the stools containing occult blood, and at times by the symptoms of local peritonitis, is not a surgical

affection. Single or multiple tuberculous ulcers, affecting by preference the small intestine, often involving both the small and the large, may perforate, in which case they are characterized by the symptoms of acute perforative peritonitis. More commonly they heal, and, as the long diameter of these lesions lies at right angles to that of the bowel, they are prone to produce stenoses which may be single or multiple, and characterized by the symptoms of chronic obstruction (see p. 481). They usually develop between the twentieth and thirtieth year in persons giving a tuberculous history or exhibiting signs of tuberculous lesion elsewhere.

Syphilitic ulcer is unattended by symptoms other than those of intestinal indigestion. Theoretically, persistent occult blood in the stools, associated with a normal rectum and a history of syphilis, might suggest the diagnosis. The resultant stenosis would be characterized by symptoms of chronic obstruction.

Typhoid ulcer becomes a surgical affection only when it perforates or threatens so to do.

This accident commonly occurs in the third week of the disease, though it may be noted at any period, nor has it a relation to the severity of the fever. The perforation is usually single, occurring in the lower part of the ileum.

The most characteristic feature of this complication is the sudden onset of agonizing, shocking pain, usually referred to the lower right abdominal quadrant, the almost immediate development of a weak, rapid running pulse, and a sudden drop in temperature. Neither vomiting, flank dulness, nor absence of liver dulness are of service in forming an early diagnosis. In some cases there is a rapid and marked increase in the number of leukocytes. Probable diagnosis is further confirmed by the rapid development of the tenderness, tympany, rigidity, and regurgitant vomiting of diffuse peritonitis (see p. 478). Its symptomatology is the same as that of perforation of an acutely infected gall-bladder, of a suppurating mesenteric gland or of a gangrenous appendix, each an occasional complication of typhoid fever.

The distinction between perforation and hemorrhage is based upon the rapid progressively weak pulse of the latter condition, unassociated with the severe pain of perforation; and shortly by the rectal evacuation of blood. Neither local tenderness nor rigidity is marked. The reaction from hemorrhage is usually prompt and well marked.

From appendicitis the distinction would be based upon the slower onset, absence of primary shock, milder local and general symptoms and their stationary character for a time (hours or days). The differential diagnosis has frequently been made only by operation.

Cholecystitis, a common complication in typhoid fever, exhibits severe pain, placed, however, in the right hypochondriac region, and often referred to the back and shoulder, associated with almost immediate and persistent vomiting. It does not exhibit the symptoms of primary shock and there can be demonstrated a tenderness, rigidity, sometimes a tumor in the region of the gall-bladder.

Right-sided pneumonia and pleurisy are customarily not attended by such marked primal shock. Vomiting, tympany, tenderness, and rigidity may all be present, but the latter two signs, the ones of cardinal importance, are more marked on superficial than on deep pressure, nor are they by any method of examination developed in as typical a form as when they indicate an underlying peritonitis; respirations are hurried out of proportion to the temperature, and after a brief time the local signs of lung involvement can be elicited.

Iliac and femoral thrombosis are less stormy in onset and more suggestive of appendicitis, since they may be characterized by right iliac pain, tenderness, and rigidity. The primal shock is wanting, and there is an elevation in temperature rather than a sudden drop. The symptoms are rarely so violent as to justify an immediate operation; as a rule, they lead to a suspicion of deep-seated abscess rather than acute diffuse peritonitis.

Tumors and Infiltrations of the Intestine.—Of the benign tumors, polypoid adenoma is the commonest form. An affection of youth, it is often multiple, and is usually detected only in the course of operation necessitated by its complications, *i. e.*, invagination, obstruction by bulk, or, rarely, hemorrhage. Exceptionally it may attain a size sufficiently great to be detected by palpation.

Such a tumor occurring in an adult cannot be distinguished from malignant growth except by operation unless there be a history of its long continuance (years) and slow growth.

Lipoma and Myoma.—Lipomata and myomata (rare), subserous in origin and not projecting into the lumen of the bowel, may reach large size without symptoms other than that of a palpable and usually freely movable tumor.

Diagnosis is suggested by the slow development (years) of these tumors. It should be made by operation, since they are prone to undergo malignant degeneration.

Sarcoma.—Sarcoma of the small and large intestine can be distinguished as such only by operation, often not until microscopic sections have been made. In general terms a sarcoma develops in younger people, grows more rapidly, invades the gut more extensively, contracts adhesions to surrounding structures more widely, gives metastasis to the liver and other intraperitoneal organs more promptly, and kills sooner than carcinoma. Moreover, in a fair percentage of cases it reaches larger size before obstructive symptoms develop. A pseudoleukemic growth may start in a Peyer's patch.

Carcinoma.—Carcinoma, rare in the small intestine, has for its seat of preference, if the rectum be excepted, the ileocecal junction, thereafter the sigmoid and the splenic and hepatic flexures of the colon.

Glandular epithelioma, the common type, occurs in middle life (forty to sixty years), with many exceptions to this rule, and is slow in giving glandular extension or remote metastases. In the early stages there are no symptoms; exceptionally deep-seated, localized pain, and persistent tenderness and occult or obvious blood in the stools.

The diagnosis is usually based upon irregular gaseous distention, constipation alternating with diarrhea, recurring colicky pains, persistent, gaseous gurgling, exaggerated peristalsis, local tenderness, and the detection of a tumor usually movable. When the splenic or the hepatic curvature is involved, it is usually impossible to palpate the tumor, even though it be carcinoma of large size (small fist). Rectal inflation may make a sigmoid tumor obvious which could not be felt otherwise. An attack of acute obstruction is sometimes the first symptom.

Tuberculosis of the Intestine.—Tuberculosis of the intestine may be primary or secondary. In its secondary form, which rarely produces stenosis, it appears as multiple ulcers, their presence being suggested by colicky pains, intestinal indigestion, and occult or obvious blood in the stools. The mesenteric glands may be involved, and tuberculous peritonitis at times complicates the condition. The diagnosis is suggested by the progressive development of intestinal symptoms in a person suffering from pulmonary tuberculosis.

Tuberculosis of the intestine in the localized hypertrophic form, having its seat of preference about the ileocecal valve, developing at times in the sigmoid, is usually primary in the cecum and extends along the ascending colon. The appendix may be greatly thickened or atrophied and obscured by a connective tissue and fat outgrowth.

The early symptoms are those of intestinal dyspepsia, *i. e.*, flatulence, colicky pains, and, not infrequently, alternating diarrhea and constipation. In the ulcerative type these symptoms are referred to the seat of involvement, usually the right iliac fossa, and an inflammatory tumor is associated with tenderness to deep pressure and often muscular rigidity. Fistulæ opening externally into the general peritoneal cavity are rare. In the hypertrophic type a hard, cylindrical mass forms, either preceded or followed by symptoms of chronic obstruction. This tumor may be movable or bound down.

The distinction from carcinoma is based upon the comparative youth of those affected, the slow course of the disease (years), and the finding of tubercle bacilli in the stools. Even at operation the condition may so closely simulate carcinoma that the distinction can be made only by microscopic examination.

From actinomycosis the distinction must be made by bacteriological examination of either the discharge or an excised mass.

The distinction from chronic appendicitis can be made only by operation.

Diverticulitis.—Acquired diverticulitis may occur in any part of the intestinal tract, including the vermiform appendix. Its usual seat is the sigmoid flexure, the diverticula projecting into the appendices epiploicæ or through the openings for the bloodvessels at the mesenteric attachment. Constipation seems a predisposing factor, and middle-aged or old fat men, or those who have been fat (Telling), are especially subject to the formation of diverticula. The diverticula are usually filled with feces, often contain concretions, and may become inflamed, gangrenous, or perforate.

The most important and characteristic result of multiple diverticulitis is a chronic proliferation of the submucous and subserous coats of the bowel resulting in stenosis, tumor formation, and mimicry of carcinoma (Telling) so close that the more benign nature of the affection may not be recognized, either at operation or necropsy (Moynihan). The gut exhibits at most fistulæ or abscesses, never a fungating ulcer.

The diagnosis must be made by operation; at times by microscopic section of the excised mass.

The inflammatory, suppurative, and adhesive complications are characterized by symptoms precisely like those of appendicitis, but are placed on the left rather than on the right side of the belly. A fistulous communication with the bladder and resultant cystitis is noted in 10 per cent. of the recorded cases.

The distinction between diverticulitis and tuberculosis of the hyperplastic type must be made by microscopic examination of the excised gut segment.

Impaction of feces (rare excepting in its rectal form) usually occurs in the pelvic colon or proximal to the splenic flexure, and is characterized by constipation alternating with diarrhea, vomiting, the systemic symptoms of intestinal toxemia, and the formation of a tumor which can be moulded and changed in conformation by deep, continued pressure. This is essentially an affection of the aged excepting in its rectal form. The stools often contain mucus, blood, and scybala. The absolute diagnosis may be dependent on the effect of repeated high enemata.

Actinomycosis.—Actinomycosis is characterized by a preliminary period of intestinal diarrhea with bloody passages, usually not painful, later by localized pain and tenderness, and tumor which involves the parietes, softens, reddens, and changes to a violet blue spreading from the centre to the periphery, held by Volkmann to be of diagnostic significance. Multiple fistulæ ultimately form, healing in one direction and extending in others. The diagnosis is made by the microscope or is based upon the presence of other foci of the disease.

THE APPENDIX.

The appendix may be absent (rare). It is about three inches long but varies from half an inch to nine inches. It usually lies behind the cecum, exceptionally extraperitoneally and is coiled by its mesenteric attachment. Its free end varies in position in accordance with its length and the extent of its mesenteric attachment. It may be found as high as the gall-bladder or to the left of the midline. A process of non-inflammatory atrophy and partial or complete obliteration of the lumen of the appendix is frequently noted.

Though the appendix is subject to tuberculous and malignant infiltration, these conditions are not suspected until demonstrated by examination of specimens removed in the course of operation called for by associated

inflammation. Malignant tumors have usually been found only by microscopic examination of the removed organ; hence from the diagnostic point of view acute and chronic inflammation of the appendix are mainly to be considered.

Acute Appendicitis.—Acute appendicitis, essentially an affection of vigorous young men, common in childhood, rare in infancy and old age, is characterized by pain, tenderness, rigidity, vomiting, fever, and constipation.

The pain, which at first may be general, umbilical, or epigastric, shortly becomes most marked in the right iliac fossa. It is usually continuous, with recurring exacerbations, and is aggravated by coughing, vomiting, deep breathing, or abdominal movements.

Tenderness on palpation, the most important single localizing symptom, is best elicited by deep pressure at McBurney's point made with the tips of two fingers. When the anterior parietal peritoneum is inflamed, superficial tenderness is so marked that deep palpation is not possible.

Pain and tenderness are both sometimes referred to the left iliac fossa, and are then suggestive of the pelvic seat of the tip of the appendix. This same position causes frequency of urination or pain at the end of the act. If the ureter be involved, the pain may radiate into the testicles or penis.

An inflamed appendix lying posteriorly commonly occasions some rigidity of the psoas muscle characterized by slight flexion of the thigh and pain in efforts at extension. Pain is sometimes referred to the hip-joint or down the posterior inner surface of the thigh.

Muscular rigidity involves particularly the lower half of the right rectus muscle, usually all the muscles of the inguinal region. A fixed contraction of a portion of the internal oblique or transversalis may closely simulate tumor.

Nausea and vomiting are common accompaniments, sometimes initiating the attack, usually developing some hours after its beginning. Vomiting is not likely to be persistent or recurring in the absence of diffuse general peritonitis.

The bowels are usually constipated. There is commonly a preceding history of constipation, or of gastro-intestinal disturbance, occasionally of abdominal chill, contusion, or strain.

There is fever, usually moderate, sometimes high, and leukocytosis. In uncomplicated cases the pulse is proportionate to the temperature.

Inspection of the abdomen shows breathing of the thoracic type of about normal frequency, at times bulging in the right iliac fossa due to muscular contraction or local distention, and often moderate general tympany.

The onset of symptoms affords no reliable index as to the subsequent course of the appendicitis. The sudden lessening of pain and tenderness may denote the relief of tension incident to gangrene or the internal rupture of an abscess. Rupture into the general peritoneal cavity is at times characterized by an immediate and shocking aggravation of pain.

The subsidence of the local symptoms, associated with a weak, rapid pulse, is of grave prognostic import.

The complications of acute appendicitis are: Local peritonitis, with or without abscess formation; intestinal obstruction; diffuse peritonitis; phlebitis, epecially pylephlebitis; subphrenic abscess; pyelitis, pyelonephritis, and cystitis.

Local peritonitis is practically an invariable accompaniment of appendicitis, and it is not until the symptoms of this condition develop *i. e.*, fever, tenderness, and rigidity, that a diagnosis can be made.

Abscess formation is characterized by a persistence or aggravation of the symptoms of local peritonitis together with those of septic absorption. Tenderness becomes more marked and more circumscribed, rigidity more pronounced, and if the abscess is placed anteriorly or in the pelvis, tumor may be felt either by external palpation or rectal examination.

Abscess incident to suppuration of a postperitoneal gland or of the appendix behind the colon or to its outer side occasions tenderness best elicited by pressure in the loin. Pelvic abscess usually causes marked pain on urination.

Appendicular abscess may follow subacute appendicitis, attended by symptoms so slightly marked that in the absence of a careful examination they are attributed to indigestion. Such an abscess, insidious in onset, of slow growth, and attended by moderate toxic symptoms, may closely simulate carcinoma, from which it may be impossible to distinguish it except by operation, though the size of the resultant tumor in the absence of obstructive symptoms and the gradual merging of its induration with the surrounding tissues would suggest inflammation rather than carcinoma.

Intestinal obstruction, partial in its mildest form and incident to local inflammatory paresis, is a usual symptom of acute appendicitis, and is the cause of the constipation and local tympany, associated with demonstrable, but not exaggerated, peristalsis.

Exceptionally from inflammatory adhesion the obstruction becomes absolute; it then exhibits in addition to the tympany of local peritonitis the colicky pain, the exaggerated peristalsis, the recurring and persistent vomiting, the absolute constipation, and the toxemia characteristic of this condition when due to other causes. Acute or subacute and recurring obstruction is usually a late (weeks, months, years) sequel of appendicitis and is then due to strangulation beneath a band or kinking of the gut by adhesion.

Diffuse peritonitis is the commonest immediate sequel of appendicitis if local abscess be excepted. It exhibits typical symptoms (see p. 478), and, when well-developed, may entirely obscure its original cause, the diagnosis of this being based upon the history of onset and possibly upon an intensification of pain and tenderness in the right iliac fossa.

Phlebitis may be secondary to appendicitis, as it is to other forms of infection. It occurs generally during convalescence, and, when it attacks the mesenteric veins, is marked by diffuse pain and tenderness, moderate tympany, fever, and leukocytosis. In the case of the iliac or femoral vein, pain and edema of the leg and the detection of the swollen,

tender vein on palpation are diagnostic. When intra-abdominal veins are involved the diagnosis must be by exclusion, possibly confirmed by the detection of an inflamed peripheral vein.

Pylephlebitis, the most serious manifestation of secondary vein infection, accompanied by suppuration of the liver, is a late (weeks) sequel of acute appendicitis, particularly of the insidious form. It is characterized by the symptoms of violent sepsis, and pain, tenderness, and swelling in the region of the liver.

Subphrenic abscess, usually of the right side, and due to peritoneal extension, the infection exceptionally reaching the diaphragmatic region postperitoneally, is often complicated by a serous or purulent pleurisy. The symptoms are similar to those of suppurative pylephlebitis, but less markedly septic.

Pleurisy, even in the absence of subphrenic abscess, is an occasional complication of appendicitis as it is of other septic processes.

Pyelonephritis and cystitis are caused by extension of inflammation or rupture of an abscess into the pelvis of the kidney or the bladder, an exceptional ultimate result in intestino-urinary fistula.

Septicemia and pyemia with their various expressions may be complications of infection of the appendix.

Chronic Appendicitis.—Chronic appendicitis, usually consequent upon an acute or subacute attack, often developing in the absence of a history of such, may be manifested by recurrent acute attacks, with intervals of perfect health, or by a condition of chronic invalidism, with some symptoms referred to the right iliac fossa or with simply those of a chronic gastro-enteritis with toxic absorption.

Localized pain and tenderness occurring with exacerbations usually incident to imprudence in diet attended by muscular rigidity and perhaps slight fever are sufficiently diagnostic of the recurrent or relapsing forms. The latent form, characterized mainly by a mild but inveterate toxemia, may be exceedingly difficult to diagnosticate.

Chronic constipation, flatulence, distaste for food, and impaired stomach digestion, sometimes diarrhea, and pain which may be placed in any part of the abdomen or may exhibit radiations downward simulating sciatica, sacro-iliac disease, or coxalgia, are symptoms which may arise from many different conditions, all of which must be eliminated before a diagnosis of chronic appendicitis can be made. It is in this condition particularly that the Head sign—*i. e.*, cutaneous hyperalgesia in the region immediately overlying the appendix—may be of service.

A diagnosis formulated on the basis of the symptoms of a chronic intoxication, other sources of which have been eliminated by careful examination or treatment, is often corroborated by operation, but this should not be performed until the surgeon is willing to definitely state before operation his belief in his diagnosis.

In this class of patients, always neurasthenic, a McBurney point tender to deep palpation can always be elicited, as could a tender spot on any other part of the abdomen toward which the attention had been directed by repeated and perhaps rough examination.

The complications of chronic appendicitis are those incident to toxemia, and may be manifested in the form of neurasthenia, gastro-intestinal indigestion, albuminuria, neuralgia, neuritis, arthralgia, arthritis, or exanthemata.

Of the abdominal complications, abscess, adhesions, and partial or complete obstruction and pylephlebitis and hepatic suppuration are those most frequently encountered.

There are some non-surgical conditions which so closely simulate the local peritonitis of the right iliac fossa which is characteristic of appendicitis that mistakes in diagnosis have been made and needless operations have been performed.

1. *The Invasion Enteralgia of Typhoid Fever.*—There may be severe pain in the right iliac fossa and pronounced tenderness. The tenderness is not sharply localized, the muscular rigidity is not well marked, and the symptoms of local peritonitis are wanting. The characteristic prodromes of typhoid and particularly the leukopenia and the slow dicrotic pulse are suggestive as to the true nature of the affection. The enlarged spleen, rose spots, and the serum reaction do not appear sufficiently early (eighth day) to be helpful in differential diagnosis. After the first week the symptoms of a local peritonitis in the right iliac fossa may become pronounced and typical, and are then due to appendicitis or a deep ulcerative lesion of the ileum or colon.

2. *Referred pain, tenderness,* and *rigidity* secondary to right-sided pleurisy or pneumonia. The tenderness is superficial and may be relieved by deep, broad pressure, the rigidity is not well marked, the local symptoms are suggestive rather than diagnostic, and the unduly rapid breathing should indicate the diagnosis even before the physical signs make this assured. Observation of such a case shows subsidence rather than aggravation of the signs in the right iliac fossa.

3. *Dysmenorrhea.*—The pain and voluntary rigidity simulate appendicitis mainly to the enthusiastic seeker for the disease. The patient usually makes the correct diagnosis, based on previous experience and knowledge of a cause for a more than usually severe attack.

4. *Ileocolitis* incident to simple catarrh, ptomain poisoning, gout, uremia, rickets, tuberculosis, exanthematous skin lesions, and arthritis (Osler) may exhibit the pain of appendicitis but without its localization, nor are the other symptoms of local peritonitis present. The sudden cessation of diarrhea, the substitution of fixation for protective rigidity of the right rectus muscle, the increase in temperature and leukocytes and an aggravation of pain and tenderness in the right iliac fossa indicate a local peritonitis usually due to an associated appendicitis.

5. *Inflammation of the kidney* or obstruction of its ducts exhibits most marked tenderness on deep pressure at the costovertebral angle with radiation of pain along the ureter and to the external genitals. Examination of the urine is usually suggestive, and unmistakable symptoms of peritonitis in the right iliac fossa are absent.

6. *Inflammation or obstruction of the gall passages* exhibits the symptoms of a local peritonitis in the gall-bladder region, with evidences of

backing of bile if this be a complication. It occurs in the middle aged and is often a sequel to enteritis or typhoid fever. The differentiation between cholecystitis and appendicitis may be impossible with an inflamed appendix lying in the gall-bladder region.

7. *Inflammation of the right tube or ovary* causes pain, tenderness, and rigidity at a point lower than that characteristic of the inflamed appendix; it is preceded by vaginal discharge and is diagnosticated by vaginal examination. The two conditions may be combined.

8. *Seminal vesiculitis* at times causes an inflammation of the overlying peritoneum, and is then characterized by pain, tenderness, and rigidity located in the right iliac fossa. The seat of greatest tenderness is not over McBurney's point, the urine contains pus, there is a history of urethritis, and a rectal examination demonstrates the tender and enlarged vesicle.

In children the symptoms of appendicitis are similar to those in the adult. The affection, however, seems more prone to follow slight traumatism, and the abdominal symptoms of a pleurisy or pneumonia are more likely to lead to error.

Intussusception, strangulated hernia, beginning typhoid fever, perinephric abscess, pyelitis, inflammation of a retained testicle, and acute coxitis may exhibit symptoms sufficiently like those of acute appendicitis to lead to a mistaken diagnosis.

THE ANUS AND RECTUM.

Examination of the anus and rectum is best conducted in the knee-chest or the exaggerated lithotomy position, though the left lateral position is usually satisfactory. A careful inspection of the perianal skin is followed by palpation of the tissues about the anus. Thus may be detected not only skin inflammations, fistulous openings, and tumors, but by the tenderness and induration, abscesses and fistulous tracts. By drawing the buttocks aside and directing the patient to strain as in defecation, fissures, hemorrhoids, prolapse, and polyps are usually seen.

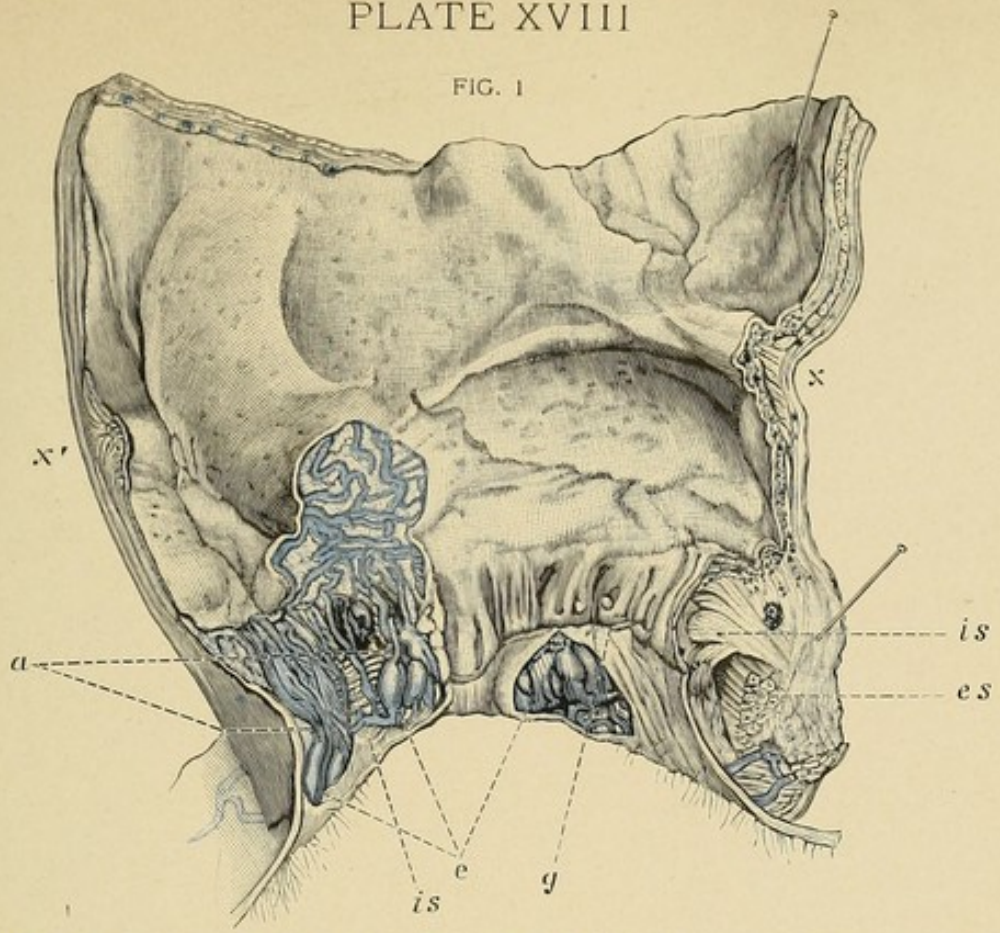
Digital examination should always precede the introduction of an instrument. The finger should be covered by a thin, smooth rubber cot, and should be lubricated by an Irish-moss preparation; thus is the examination made less painful. When the anus is hypersensitive the examination may be preceded by a 20 per cent. lactate of eucaine solution applied by means of a cotton swab which is passed within the grip of the sphincter and allowed to remain for five minutes. The finger is introduced upward and forward until the sphincter (half an inch) is passed; it is then turned backward.

Stricture, polyp, fissure, ulceration, foreign body, often the inner orifice of fistulæ, perirectal abscess, infiltration, or tumor, can be detected by such an examination.

The ocular examination of the rectum is best conducted by means of straight tubes. For examination of the anus when there is a sphincteric

PLATE XVIII

FIG. 1

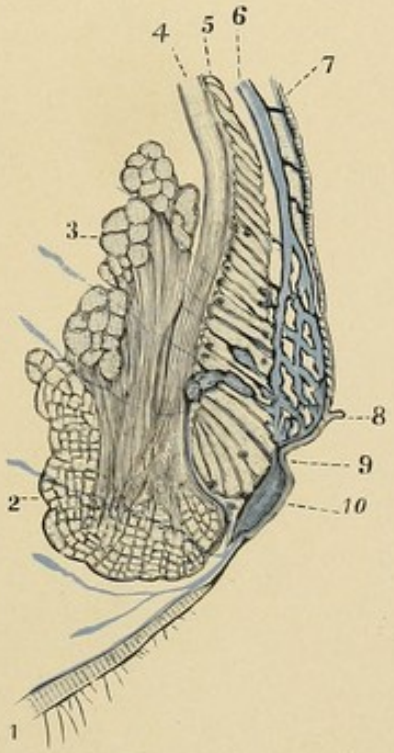


Dissection showing the Arrangement of the Anorectal Veins. (Otis.)

An alcoholic preparation of the lower rectum opened lengthwise in the median line anteriorly, a portion of the mucous membrane and mucocutaneous tissue having been removed to expose the internal and external hemorrhoidal veins.

x, *x'*. The lowermost plica transversalis recti, one of a series of ineffaceable transverse folds that are present in the rectum, with considerable variation as to their number and distinctness in different individuals. *a*. The short and narrow anastomoses between the dilated portion of the internal hemorrhoidal veins above and the dilated portion of the external hemorrhoidal veins below. *e*. Dilated external hemorrhoidal veins. *g*. The sulcus or groove that encircles the anal orifice. Just above are to be seen the columnæ and lacunæ of Morgagni. *i s*. Internal sphincter. *e s*. External sphincter.

FIG. 2



Longitudinal Section through the Rectal Outlet (Semidiagrammatic). (Otis.)

1. Skin. 2. External sphincter. 3. Levator ani. 4. Longitudinal muscular fibers. 5. Circular muscular fibers terminating in the internal sphincter. 6. Internal hemorrhoidal veins in the submucosa. 7. Mucous membrane. 8. One or more papillæ often seen on the bases of the columns. 9. The anorectal groove which is produced by the distention of the internal veins just above it and the external veins just below it. In the dead body, where the veins are empty, the groove will not be apparent. 10. Dilated portion of an external hemorrhoidal vein.

contraction of such obstinacy as to make gentle digital stretching of the anal opening inadequate, Kelly's short speculum and a headlight answer best. For deeper examination a proctoscopic tube carrying an electric light is to be preferred. For examinations of the upper part of the rectum and the beginning of the sigmoid, the distal end of the proctoscope should be provided with a window and an inflating bulb, allowing of colonic distention. The proctoscope should not be passed more deeply than four inches unguided by the eye.

Congenital Malformation.—The anus may be narrowed, occluded, or absent, the rectum in the latter case ending in a blind pouch, often at a considerable distance from the perineal surface or communicating with the bladder, urethra, or vagina, or provided with an inadequate fistulous opening leading to the surface in the perineal region. The rectum may be absent, though the anus is normal.

In cases of occlusion incident to absence of the anus or rectum, or both, the diagnostic problem has to do with the determination of the thickness of the occluding tissue. A thin partition will bulge during crying efforts and will give a sense of fluctuation to palpation when tense and one of yielding when relaxed.

In the absence of these symptoms the position of the blind rectal pouch must be determined by perineal dissection, supplemented, if needful, by colostomy and the insertion of a sound into the descending colon.

Narrowing of the anus or rectum is characterized by passage of ribbon-like feces. Unless extreme, it is usually undetected, constipation and the gradual dilatation of the bowel above being attributed to other causes. The infant anus should admit, under gentle pressure and without undue stretching, the well-lubricated rubber-covered little finger of the average sized man.

The Skin Surrounding the Anus.—The perianal skin is especially subject to dermatitis, eczema, intertrigo, pruritus, folliculitis, marginal abscess, external thrombotic piles, and skin tabs. Also are found in this region the openings of perineal abscesses and fistulæ, papillomata, herpetic, syphilitic, tuberculous, chancroidal, and epitheliomatous lesions.

Dermatitis.—The thin pigmented folded skin about the anal orifice rich in hair follicles and sebaceous and sudoriferous glands affords a moist and sensitive surface for the action of irritants such as fermenting discharges from the anus or in women from the vagina.

Burning pain, redness, often excoriation, and a serous or seropurulent discharge are characteristic features associated with prompt recovery on removal of cause.

Eczema.—Eczema is distinguished from dermatitis mainly by its persistence; it is often associated with a like lesion elsewhere, particularly on the scrotum, and, as is true of a simple dermatitis, it exhibits a thickened cracked, excoriated, or fissured skin, moist with a chronic discharge, and attended by harassing burning and itching, accompanied by erosions and a distinct seropurulent discharge. Itching is usually distressingly persistent.

Pruritus.—Pruritus has for its dominant symptom itching, usually worse at night, and unattended by skin changes other than the lesions of scratching, and nearly always a white, thickened skin about the anal margins. Its usual underlying cause is an anal or rectal lesion causing a slight discharge. Careful examination, however, often does not result in finding such a cause.

Folliculitis.—This develops about the anal margins, often incident to chafing or the conditions which cause dermatitis, in the form of small pimples or boils, tender to pressure, healing after discharge, often persistently recurring, at times confluent, resembling a small carbuncle. Sometimes resulting in marginal fistulæ. These lesions make walking and bodily activity painful, but do not interfere with defecation. Their superficial induration and acute course are characteristic.

Marginal abscess due to folliculitis, a broken-down thrombus, or infection from abrasion, is attended by tenderness and pain, usually slight, unless the abscess extend within the grip of the sphincter, when it is severe, is greatly aggravated by defecation, and is associated with constitutional symptoms of infection. Examination shows the tender, edematous inflammatory infiltration. Its rupture is followed by a persistent sinus or superficial fistula, which may have numerous openings; the tracts, however, remain just beneath the skin or mucous membrane. Their openings are exposed and they are readily followed if the skin folds about the anus are smoothed out by stretching.

The onset of these abscesses is often so symptomless that the surgeon is not consulted until the annoying discharge and the resultant dermatitis make this seem advisable. Such an onset is suggestive of tuberculosis, as is extensive undermining of the skin.

The distinction between thrombotic pile and a marginal abscess would be suggested by the sudden onset of the former. It should be made absolute by incision under local anesthesia.

Thrombotic external hemorrhoids, due to venous rupture and blood extravasation, are characterized by a sudden perineal ache, often following defecation, urination, seminal emission, or muscular strain, and the rapid development (within the hour) of a hard, tender marginal tumor, which becomes edematous and remains tender and painful for several days. If the tumor lies within the grip of the sphincter the pain is severe and persistent and is greatly aggravated by defecation.

The diagnosis, based upon the sudden onset of pain, is made by direct examination and the discovery of the tender swelling, which, if it be mucocutaneous, its usual position, shows dark blue through its thin covering. If the blood effusion be too deep to exhibit characteristic color, and be not seen for one or two days, when inflammatory reaction has developed, the diagnosis from abscess should be made by incision.

Inflamed Skin Tabs.—Because of a varicose condition of the external hemorrhoidal venous plexus and consequent stretching of the overlying skin, its natural radiating folds are exaggerated. An acute inflammation of one or more of these folds is characterized by an edematous, tender swelling and often some eversion of the mucous membrane.

These acutely inflamed tabs are exceedingly tender, and in the furrows between them there are often fissures or short superficial fistulæ. Each acute attack is followed by a permanent enlargement. Even in the absence of a history of acute inflammatory attacks these tabs may become greatly enlarged, forming pendulous fringes about the anal aperture. The condition is usually secondary to a slight dermatitis due to irritating discharge.

Fissure.—Fissure, an ulcer within the grip of the external sphincter, is an affection of the adult, occasionally seen in children. It is characterized by severe defecation or post-defecation pain and blood-streaked feces, often by a few drops of blood squeezed out at the end of defecation. The pain may last for hours, due in this case, in part at least, to muscular spasm, and may be associated with painful, difficult urination.

The diagnosis is made by direct examination, which reveals, first, a rigid sphincter, next a sentinel pile, *i. e.*, a mucous or mucocutaneous hypertrophied tag projecting below the seat of the ulcer, finally a point of sensitiveness on external pressure. Usually on gentle introduction of the finger, if this be practicable, the induration of the ulcer is found in the posterior commissure and just within the aperture. The ulcer can be seen by gently stretching the buttocks apart, with the patient in the left lateral or knee-chest position. A satisfactory proctoscopic examination will often have to be preceded by 20 per cent. eucaine solution because of the associated severe spasm. A superficial ulcer placed within the grip of the sphincter does not necessarily exhibit the symptoms of fissure.

Ischiorectal Abscess.—Ischiorectal abscess, secondary to trauma or rectal or anal abrasion, or exceptionally to the extension between the fibers of the sphincter, or through the levator of a submucous or a perirectal abscess, is characterized by the local and systemic symptoms of acute inflammation, both well marked. The pain is greatly aggravated by defecation. The tenderness and induration are elicited by a finger passed within the rectum for the purpose of making counterpressure against external palpation. The seat of the tender induration and its acute onset are sufficiently characteristic. Later, surface heat, redness, and edema develop. Free suppuration usually forms a burrowing cavity which, if undrained, communicates directly with the bowel.

Deep pelvic abscess, placed either laterally above the levator muscle or postrectally, gives rise to symptoms of septic absorption. This condition may be suspected in its early course if a history of high rectal trauma or ulceration or lesion of the vesicles and prostate is present. Digital examination may show the presence of a boggy swelling.

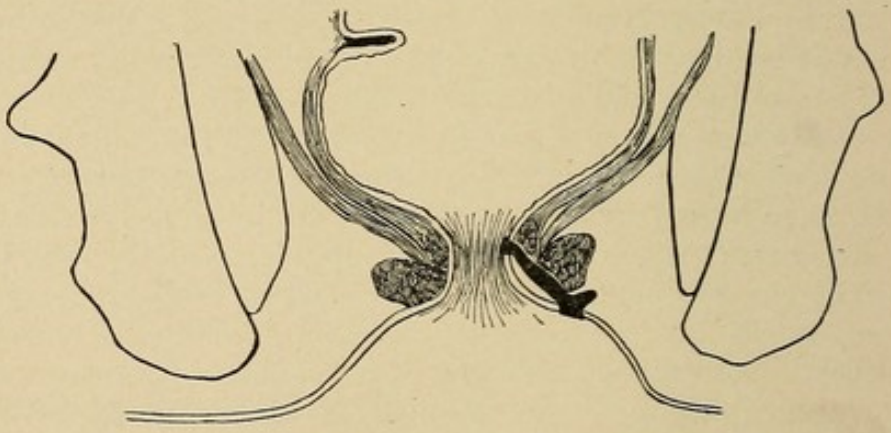
Fistulous Openings.—Fistulous openings, consequent to abscess and often tuberculosis, are the commonest rectal affections for which patients seek relief. They are characterized by indurations indicating their general direction, best detected by combined rectal and perineal palpation, and by the presence of one or several undermined or exuberantly granulating openings from which is discharged pus.

Fistula.—The tract is usually complete, *i. e.*, leads from the mucus to the skin surface. In many cases it is external and incomplete, having only a skin opening (blind external fistula). In a small percentage of cases it is internal and incomplete (blind internal fistula), having only one or more mucous openings.

The short superficial marginal fistula, if complete, opens into one of the sinuses of Morgagni or below it. The ischiorectal fistula usually opens within the grip of the sphincter, usually in the pocket of a sinus. It may have multiple orifices both into the gut and on the skin surface.

Tuberculous fistula can be suspected from its absolute indolence, tendency to burrow and undermine, failure to show any reactive or healing power under treatment, and, if the fistula be complete, the presence on the mucous membrane of a ragged, undermined ulcer. Fistula is rarely an isolated lesion of tuberculosis.

FIG. 339



The most common form of fistula in ano; incident to marginal abscess.

Fistulæ originating in bone disease may open into the perineum or the rectum. The symptoms of the major malady and the depth and duration of the sinuses are characteristic.

Urinary fistula may be perineal, the urine burrowing backward to the anus, which may be completely surrounded by the suppurating tract.

Diagnosis is formulated by tracing the perineal induration, by the escape of urine from the tract, and by a preceding history of urethral obstruction. Suppurating bartholinitis is an occasional cause of perianal fistula in women.

In the median line, sometimes near the anus, usually over the coccyx or sacrum, lies the postanal fissure or dimple, which contains hair, sebaceous matter, and not infrequently forms a suppurating sinus.

Dermoid cysts, developing in or near the middle line over the coccyx or the last sacral vertebra, may, after suppuration, leave a persistent discharging sinus which might be mistaken for one of rectal origin. The history of the preëxisting, painless tumor and the finding of hair in the sinus or its discharge will establish the diagnosis.

The course of fistulæ may be traced by perineal palpation, by careful probing, by injection with peroxide of hydrogen under gentle pressure

and palpation for crepitation or by injection with methylene blue solution, and following the stained sinuses by means of the probe, grooved director, and knife.

When the fistulæ are complete, *i. e.*, have both skin and mucous membrane opening, the inner orifice can be felt by palpation and seen and probed through the proctoscope. Because of the winding course of many of these complete fistulæ the passing of a probe from one orifice to another may be impossible.

Papilloma.—Papillomata, or warts, about the anal margin are usually confluent and may exhibit extensive growth. They are seen especially in women in association with similar growths about the genitalia. They are neither indurated nor extensively ulcerated at their bases.

Syphilis of the Anus and Perianal Region.—Exceptionally, this begins as a chancre, usually single, appearing in the form of an indolent, indurated crack at the anal margin rather than as a typical rounded sore, though the latter may develop.

The diagnosis is suggested by the indolence of the affection and the development of bilateral polyganglionic inguinal enlargements. It can be made by the finding of the spirocheta or the subsequent progress of the case.

During the secondary period mucous patches are common about the anus and are prone to ulcerate, forming painful fissures which from persistent recurring irritation may become deep and destructive ulcers or may be complicated by ischiorectal abscess. The condyloma latum, characterized by flat, raised, round, or oval patches of papillary overgrowth, is a not unusual manifestation.

Tertiary syphilis, except in the form of diffuse myositis paralyzing the anal sphincter, is rare. The perineum may, however, be riddled by fistulæ, the result of breaking down gummata or infiltrations of the rectum.

Chancroids of the anus exhibit the characteristics of these lesions on the genitals in that the lesion is acutely inflammatory, rapid in development, and multiple and progressively so from auto-inoculation of skin surfaces lying in contact. When they appear in the fissured form, from inoculation of cracks between the radial skin folds, they are likely to be indolent and persistent.

Chancroids remain superficial and are complicated by buboes in the inguinal region. In the grip of the sphincter they exhibit the symptoms of fissure except that they are more rapid in development and are always associated with external lesions. Rectal chancroid represents an extension from the anus.

Tuberculosis.—Tuberculosis may appear in the anal and perianal region in the form of a papillomatous growth, or a primary ulcer. Usually as a fistula, secondary to perianal or rectal abscess, in turn caused by tuberculous folliculitis near or in the pouches of Morgagni. The lesions are characterized by indolence, persistence, slow extension, moderate infiltration, and association with tuberculous lesion elsewhere; finally, by the discovery of the tubercle bacillus in scrapings.

Malignant tumors of the anus, anal epitheliomata, are rare. They may be either of the superficial type, spreading slowly (months), with typically indurated borders surrounding a chronic ulcer, which gradually deepens; or, when the malignant infiltration begins in the follicle, they may be characterized by hard, deep, densely indurated ulceration (months). Infiltration of the inguinal lymphatic glands occurs early. The diagnosis is suggested by the persistence of an ulcerating lesion which is not syphilitic. It is based upon the microscopic examination of a portion of the growth.

The rectum, by which is meant the portion of the bowel extending from the third sacral vertebra to the anus, is the seat of fecal accumulation, hence is especially prone to inflammatory and ulcerating lesions.

Inflammatory lesions of the rectum are characterized by mucus, pus, and blood; obstructive lesions by obstinate constipation, often varied by spurious diarrhea. There will be little pain until the anus or the perirectal tissues are involved. The surgical affections of the rectum are proctitis, hemorrhoids, prolapse, traumatism, foreign body and fecal impactions, ulceration and internal fistulæ, tumors and strictures.

Proctitis.—Acute catarrhal proctitis, which may be due to irritating fecal matter or enemata, is characterized by urgent desire to defecate, frequent repetitions of the act, with the passage of small quantities at a time, failure to obtain relief therefrom, and a sense of burning pain in the rectum, often associated with some difficulty in micturition. The fecal matter, if it be formed, will be coated with mucus and perhaps a little blood. The attack is characterized by its rapid onset and quick subsidence, usually hours or days.

Dysenteric Proctitis.—Dysenteric proctitis is characterized by frequent painful passage of bloody mucus. The dysenteric lesions are likely to become deeply ulcerous, those of the amebic type of dysentery being characteristic because of their linear shape.

Diphtheritic Proctitis.—Diphtheritic proctitis has been reported as a secondary condition.

Gonorrheal Proctitis.—Gonorrheal proctitis is due to inoculation by unnatural practices, or, in the case of women, by discharges running backward. The symptoms are those of acute proctitis, of pain and burning in the rectal region, followed by small, frequent, painful stools, containing a small quantity of bloody mucus.

Diagnosis is based on finding the gonococci in the discharge.

Chronic Proctitis.—Chronic proctitis is a common accompaniment of chronic inflammation of the large bowel. The symptoms of the local infection are usually merged in those of the major disease, excepting that there may be a constant mucous discharge from the relaxed sphincter, associated with dermatitis of the surrounding thickened skin and marked itching. Or the affection may be associated with constipation and the passage of feces coated with mucus and blood. The condition is commonly complicated by hemorrhoids. There may be multiple mucous membrane erosions.

Internal Hemorrhoids.—Internal hemorrhoids are capillary or venous. **Capillary hemorrhoids** exhibit no symptoms other than bleeding, which is free, recurring, and persistent; they may complicate venous hemorrhoids. The diagnosis is based upon the bleeding and upon proctoscopic examination, which shows one or more nevous-like patches which even the gentle passage of the instrument makes bleed.

Venous hemorrhoids are evidenced by the sensation of a full rectum not relieved by the act of defecation, bleeding, and prolapse, the latter occurring at first only when the bowels are opened and readily reduced either spontaneously or by manual pressure; later the sphincter becomes relaxed and the prolapse may become constant or constantly recurring as a result of increased intra-abdominal tension.

Often internal hemorrhoids give no symptom. The diagnosis is made by direct examination. When the piles have not been thrombosed and contain little connective tissue, they cannot be felt. If they are subject to prolapse this condition may be brought about by causing the patient to defecate, giving him an enema to accomplish this end if needful, or having him assume the position of defecation and bear down as though accomplishing the act while the protected finger which has been introduced into the rectum is withdrawn. A Sims or short cylindrical speculum will bring the hemorrhoidal tumors into view.

When the prolapsed internal hemorrhoids are prevented from retracting or being forced back by the grip of the sphincter, they become greatly swollen and excessively painful.

The external hemorrhoid, which is a subcutaneous blood clot, is sometimes taken for an internal pile strangulated by the sphincter and violent painful and useless efforts are made to reduce it. They may look much alike, but there is no complete sulcus between the external pile and sphincter, and inspection shows it to be extrasphincteric.

Prolapse.—Prolapse may involve the mucous membrane only or all the coats of the bowel.

Mucous membrane prolapse, the commonest form, is usually observed in young children, as the result of recurring straining efforts such as are symptomatic of vesical calculus or dysentery, though it is common in the feeble and aged as an expression of muscular relaxation. It is of gradual development, and may involve a part or the entire circumference of the gut which projects for a distance of one or two inches, exhibiting an abnormally red and thick mucous membrane which is continuous with the circumanal skin, there being no sulcus between the two.

The central aperture appears at the end of the projection and from it pass radiating folds.

Complete prolapse, which may contain peritoneum and loops of small intestine, forms a thicker, larger tumor, usually more than two inches in length, curved backward in the male and forward in the female, and exhibiting a slit-like orifice. It is often an after-development of mucous prolapse, but exceptionally may develop suddenly as the result of a violent strain. There is usually little pain in this affection, and reduction

is easy. Repeated inflammation may make it irreducible. If the exposed bowel becomes inflamed and eroded, defecation may be exceedingly painful.

The distinction from a prolapsed intussusception is based upon the finding of a sulcus between the projecting mucous membrane and the anal margin, the skin and the mucous membrane not being continuous.

Trauma of the Rectum.—Trauma of the rectum, noted most frequently in sexual perverts, may occur from the rough introduction of an injection pipe or, if there be preceding disease, from even the gentle passage of rectal bougies. If the wound be perforating, there may be little or no immediate bleeding or pain. Rectovesical fistula, perirectal abscess, pelvic cellulitis, or peritonitis follows in accordance with the depth and direction of the perforation. The diagnosis is made by direct examination.

Foreign Bodies.—These may be introduced through the anus. Usually they have been swallowed, finally lodging in the rectal ampulla. Since this is devoid of sensibility, perirectal abscess, diffuse cellulitis, or peritonitis may develop without preceding local symptoms.

Usually there are pain, tenesmus, the passage of mucus, often blood-stained, and a sense of fulness in the rectum. If the body is large, obstructive symptoms will develop, and are unrelieved by the act of defecation which in itself is usually painful. Urinary reflexes are at times marked.

A small foreign body, such as a seed or fish-bone, lodged in one of the crypts of Morgagni may occasion a constant burning associated with distressing sphincterismus.

Diagnosis is based upon digital and proctoscopic examination.

Fecal Impaction.—Impacted masses of feces may remain in the rectal ampulla for weeks or months, there being no symptoms other than obstinate constipation alternating with diarrhea, and mucus and blood in the stools. A persistent or frequently recurring diarrhea, especially if characterized by small passages containing mucus and blood, should always suggest rectal examination.

Ulceration of the Rectum.—Ulceration of the rectum may be traumatic, dysenteric, dependent upon a blind internal or rectovesical fistula, carcinomatous, tuberculous, or syphilitic.

Abrasions or erosions accompanying acute irritating catarrh or mild dysenteric attacks are characterized only by mucus and pus in the stool and symptoms of acute proctitis. Anal tenderness usually prevents a satisfactory proctoscopic examination, nor is this needful, since the symptoms are transitory.

Traumatic ulceration, even though there be no definite history of injury, heals promptly or develops fistula. Dysenteric ulceration of the rectum is multiple and a minor feature of ulceration of the bowel higher up.

Blind internal fistulæ are particularly marked by pain, purulent, sometimes blood-stained discharge; exacerbations and remissions of inflammation, the remissions being accompanied by increased discharge

and the detection of induration on palpation, and by direct inspection and probing. Blind internal fistulæ may have two openings, and, if well drained, may be difficult to find.

Syphilitic Ulcers.—Syphilitic ulcers, very rarely chancrous, nearly always beginning as infiltrations or gummata of the tertiary disease, are characterized by the painless, symptomless development of one or many punched-out ulcers upon an infiltrated rectal wall. They are sometimes complicated by the formation of gummatous fistulæ which may call attention to the rectum. Women are particularly subject to tertiary involvement of the rectum, which begins just within the grip of the internal sphincter.

The diagnosis is usually not made until either abscess or fistula has developed, or by cicatricial contracture the rectum is so narrowed that partial obstruction is produced. It is then based upon the history of the case, the insidious onset, the extensive area of infiltration, or, if the affection be seen earlier, the nodosities of gummata and the typical punched-out ulcers. The distinction from malignant disease should be made by excision and microscopic examination of a portion of the ulcer.

Tuberculous Ulcers.—Tuberculous ulcers, found in the lower part of the rectum, may begin as inflamed follicles which coalesce and break down, leaving undermined, slightly indurated ulcers, exhibiting soft, pallid granulations with bluish borders, and often a peripheral mucous membrane infiltration of minute tuberculous nodules.

Malignant Ulcers.—Malignant ulcers are characterized by extensive, dense, peripheral infiltration, and friable, at times exuberant, granulations. The diagnosis is based upon the presence of the ulcer, and is corroborated or disproved by the result of microscopic examination of a portion of the ulcer.

Stricture of the Rectum.—Strictures of the rectum are consequent to ulceration and cicatricial contraction. Ulcers which cause strictures are usually malignant, syphilitic, or tuberculous. Traumatic and dysenteric strictures are rare and usually give a history which, associated with the absence of infiltration and the clearly outlined constricting fibroid tissue, is diagnostic.

Stricture, when developed, is characterized by constipation which becomes progressively more obstinate, requiring for its relief not only laxatives and solvent enemata, but violent muscular efforts on the part of the patient, often assisted by digital manipulations where the narrowing is low down. This constipation is accompanied by dilatation above the point of narrowing, often by an accumulation of feces which can be felt through the thin abdominal wall, not infrequently by a spurious diarrhea representing an overflow of the more liquid parts of the feces mingled with mucus, pus, and blood, and accompanied by the symptoms of gastro-intestinal indigestion and ptomain absorption. The feces are broken, but not necessarily ribbon-like.

When the stricture lies low there is usually an associated atony of the sphincters, allowing a constant or intermittent discharge of blood-stained

mucopus. Perineal fistulæ are common complications. When the stricture is beyond the reach of the finger, the proctoscope should be used for its diagnosis. This, after having passed the sphincter, is introduced under the guidance of the eye until the point of narrowing is reached.

Spasmodic stricture, due to chronic contracture of the internal and external sphincter, can generally be traced to some local inflammatory lesion.

Malignant stricture is characterized by the deep, friable ulceration surrounded by its nodular, indurated wall, involving not more than two or three inches of the bowel in its long axis, usually its entire circumference. The diagnosis is made by microscopic examination.

Syphilitic stricture exhibits a more extensive infiltration often with trifling and superficial ulceration, at times associated with perirectal abscess and multiple sinuses. It rarely appears as a single destructive, indurated ulcer. Such a stricture may form in the absence of preceding ulceration.

The diagnosis is based upon the history of the case and the microscopic findings. The therapeutic test is usually of no avail, since the affection, when seen, has reached its cicatrizing stage.

Tuberculous stricture is rare, since tuberculosis is essentially a slowly destructive process. The ulcer is soft, undermined, and destructive, and usually complicated by perineal fistulæ. The diagnosis is based upon the finding of other tuberculous lesions and upon microscopic examination.

Narrowing of the rectal lumen by the pressure of a perirectal tumor will cause obstruction and, from back pressure, a catarrhal inflammation. The bloody, purulent discharge of ulcer will not be found, and a pelvic tumor of sufficient size to occlude the rectum may be felt.

Tumors of the Rectum.—These may be benign or malignant.

Polyp.—Polyp is the common benign tumor. It may have an adenomatous, fibromatous, myxomatous, lipomatous, or lymphangiomatous basis.

Polyp is common in children and is single or, at most, in small number. In the adult it is often single, but at times is amazingly multiple, the rectum being studded with hundreds of small tumors which may be rounded or pointed.

Bleeding and tenesmus are the only symptoms and both may be absent until a polyp prolapses sufficiently to be grasped by the sphincter. Often a palpable prolapse is the first symptom. Bleeding from the rectum of a child unattended by other symptoms is usually due to polyp.

The diagnosis can usually be made by digital examination. This may deceive, however, since the polyp is readily pushed up by the examining finger, and, moreover, if made up of mucous tissue, may exhibit very much the consistency of the surrounding rectal wall. By sweeping the finger around the circumference of the rectum after it has been introduced as far as possible and drawing it toward the anus the pedicle may usually be felt.

The diagnosis is made absolutely by a proctoscopic examination which

shows the mass or masses usually pallid and watery in appearance. The fibrous polyp may be quite hard.

The villous polyp (rare) exhibits a bright red, easily bleeding, warty surface, distinguished from malignant growth by the absence of the tendency to deep ulceration and induration about the base. It is an affection of the adult.

Fibroma, enchondroma, and myoma have all been noted as non-pedicled growths from the rectal wall (rare).

Cancer of the Rectum.—Cancer of the rectum, commonest in men past middle age, but also observed in early life, particularly in the soft or gelatinous form, is usually placed in the rectal ampulla just above the anus. It forms a deep friable ulcer, with irregular, nodulated, densely indurated borders, which ultimately become adherent to the surrounding parts. The infiltration and cicatricial contracture not only constrict the lumen of the bowel, but lessen it in length. The area of narrowing is usually not more than one to three inches in width, except in the case of the soft or medullary cancer, when it may be as broad as that of tertiary syphilis.

The diagnosis of malignant ulceration is suggested by the habitually recurring passage of small, offensive stools containing pus and blood. This is most marked in the early morning. At the time of first examination, the ulcer is usually completely circumferential. There is obstinate constipation, difficulty and pain in moving the bowels, exhaustion following the act, and rapid deterioration in health. The diagnosis is made early by the character of the infiltrated ulcer and the microscopic examination of a portion of it.

Sarcoma.—Sarcoma, an affection of middle age, begins as a sharply defined submucous nodule which grows rapidly, forming a soft rounded tumor with a clearly defined, non-indurated base. It ultimately ulcerates, bleeds, and obstructs. It is diagnosticated by rectal examination, excision, and microscopic examination.

Perirectal Tumor.—Perirectal tumor may appear in the form of dermoid cyst, characterized only by obstructive symptoms and the detection of a mass either behind or in front of the rectum, sharply outlined. It is found mainly in women, and diagnosis is made by the finding of normal uterus and ovaries and the removal of the tumor. From the anterior surface of the sacrum and coccyx, lipoma, lymphangioma, and teratoma develop as congenital tumors. Anterior spina bifida in the sacral region may by projection of its sac into the upper rectum produce the effect of a cyst. The diagnosis can be made by deep palpation or by aspiration.

Papillary hypertrophies of the borders of the semilunar valves, characterized by pallid, wart-like projections of their borders, are regarded as fertile sources of all the neuroses. The same may be said of catarrhal inflammation of crypts or follicles made by these valves. The relation between cause and effect in both these conditions still remains to be demonstrated.

CHAPTER XVII.

THE LOWER EXTREMITY.

THE FOOT AND ANKLE.

The skin covering the dorsum of the foot is thin, freely movable, and overlies a loose subcutaneous fascia in which are many veins. The tough plantar skin, prone to callosities, is intimately connected with its dense fibrofatty subcutaneous fascia.

The malleoli constitute the most conspicuous bony landmarks of the foot and ankle. Two fingers' breadth below the inner malleolus can be felt the sustentaculum tali, a finger's breadth in front of this bony point the head of the astragalus, an equal distance farther forward the tuberosity of the scaphoid, the most distinct bony projection of the inner border of the foot.

A finger's breadth below and slightly in front of the tip of the external malleolus the peroneal tubercle or ridge can be felt, and three fingers' breadth in front of this the base of the fifth metatarsus, the most prominent bony point on the outer border of the foot.

The weight of the body is supported by an elastic arch, the bases of which are the internal tuberosity of the calcaneum and the heads of the metatarsal bones.

The tibiotarsal joint allows of flexion and extension through an angle of about 75 degrees. The midtarsal joints allow of adduction, abduction, inversion, and eversion, with combinations.

The swelling incident to joint effusion is early characterized by obliteration of the slight depression which is observed to the inner and outer side of the extensor tendons in front, and a similar fulness in the space between the tendo Achillis and the posterior malleolar surfaces.

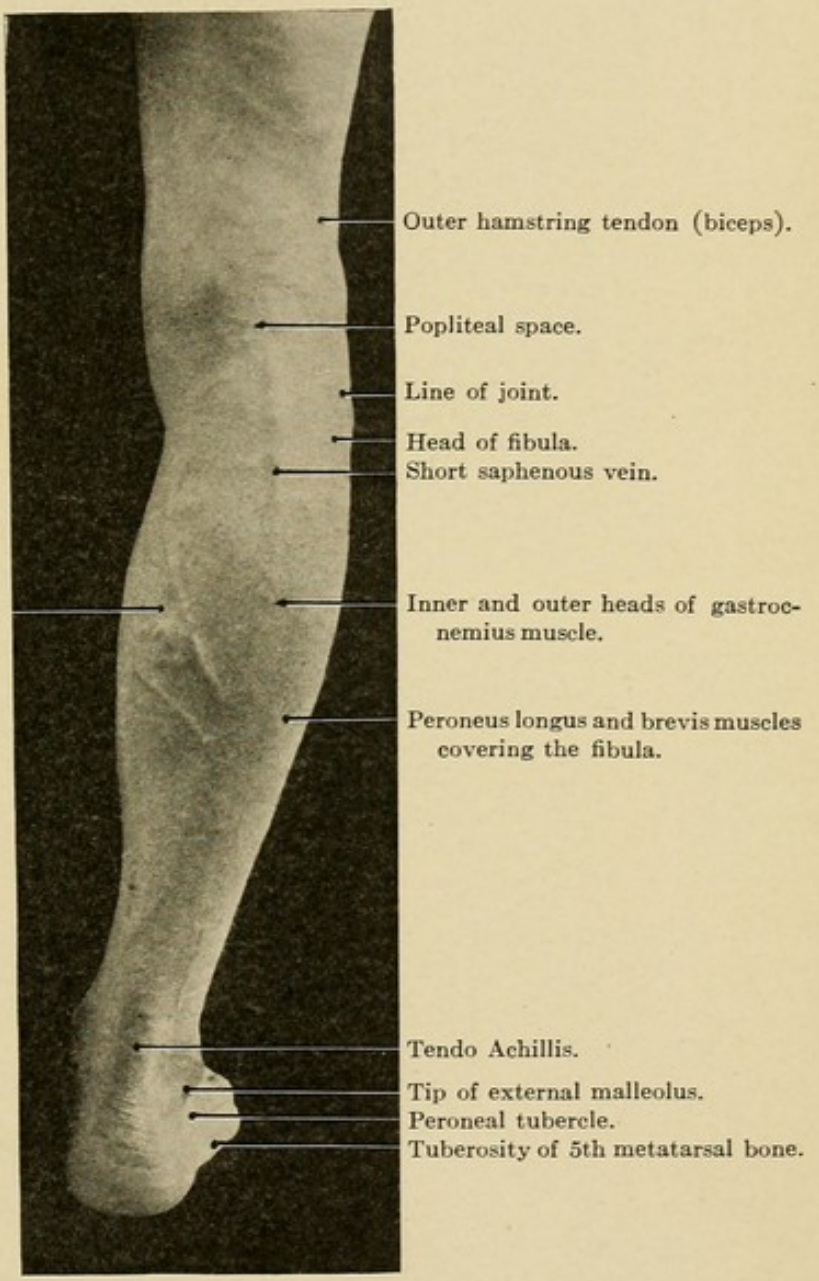
Deformities of the Foot.—These may be congenital or acquired. Such congenital deformities as acrodactylism, syndactylism, polydactylism, macrodactylism, absence of bony parts, and talipes varus are obvious on inspection. That the varus of the newly born, though usually acquired incident to intra-uterine pressure, may be primary is shown by the fact of its being hereditary.

Acquired deformities incident to pressure, inflammation, or contracture, as affecting the toes commonly appear in the form of an over-riding usually of the second and fourth toes, troublesome only because of the incident skin maceration and the formation of corns at the points of pressure.

Hammer Toe.—Hammer toe, involving particularly the second and the third toe, is marked by sharp flexion of the second phalanx upon the

markedly extended first. Bursæ underlying the corns forming over the point of pressure are prone to suppurate and involve the neighboring phalangeal joint.

FIG. 340



Surface markings of the leg and ankle. (G. G. Davis.)

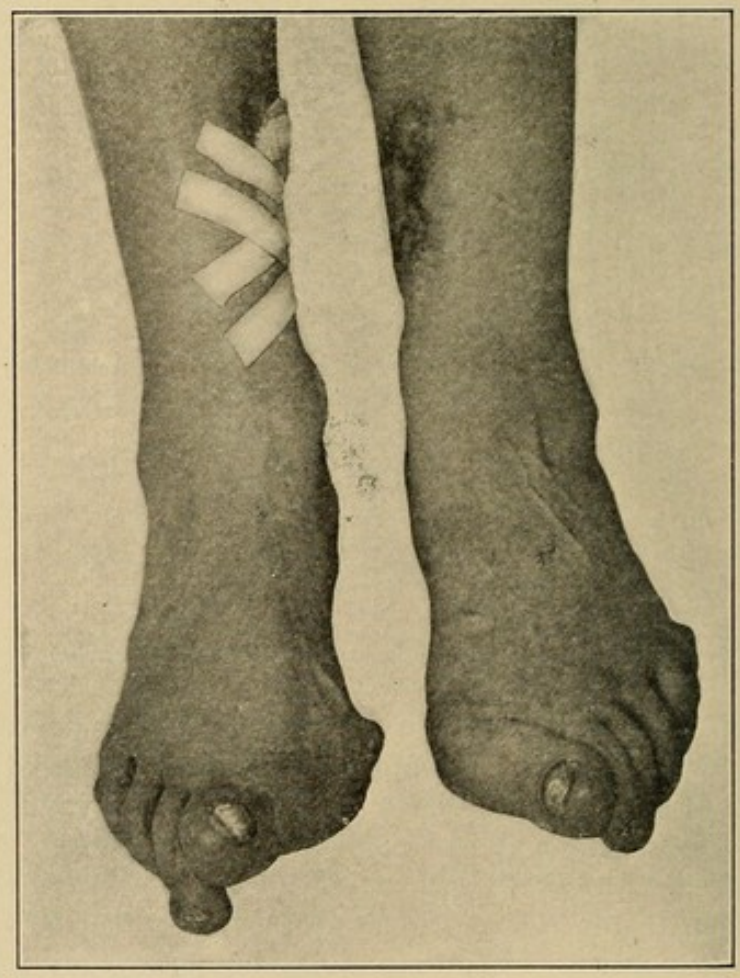
Hallux Rigidus.—Hallux rigidus, evidenced by tenderness, swelling, and fixation of the metatarsophalangeal joint of the great toe, usually in a position of slight plantar flexion, is observed in young people as a part of the symptomatology of weak foot.

Hallux Valgus.—Hallux valgus, or outward deviation of the great toe, usually incident to the wearing of improperly constructed shoes, exceptionally due to gouty or rheumatic joint changes, may be so marked as to constitute a subluxation outward of the first phalanx. Over the

FIG. 341

Common deformity incident to wearing narrow shoes.

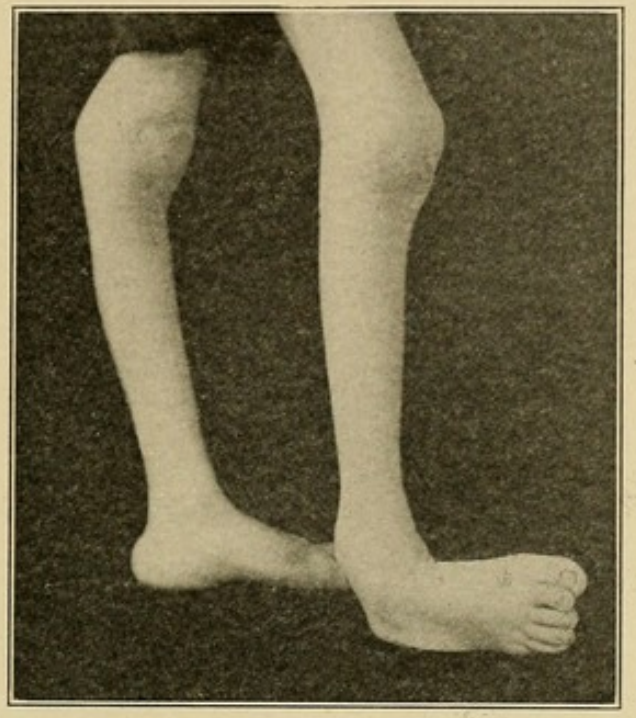
FIG. 342



Bilateral hallux valgus and bilateral bunion. Subluxation of first metatarsophalangeal joints. Repeated acute inflammation of right bunion. (Carnett.)

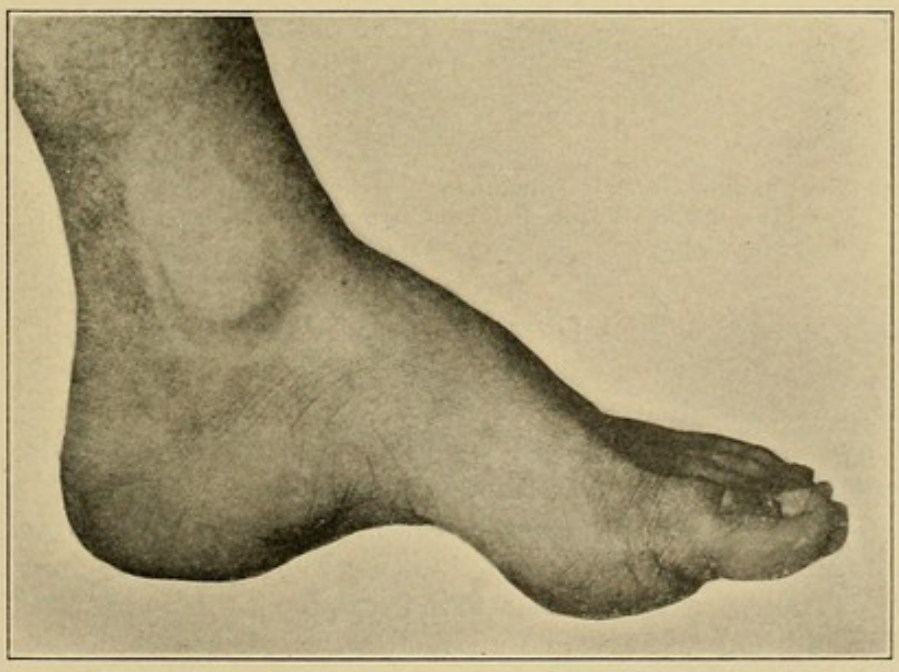
head of the usually enlarged metatarsus there develops a tender corn or bursa. The latter, called bunion, is prone to suppuration, which, because of the greatly thinned ligaments lying beneath, readily penetrates to the joint.

FIG. 343



Club feet secondary to infantile paralysis. Right talipes equinovarus. Heel elevated. Foot inverted. Callus and bursa formation over surface of weight bearing along outer border of foot. Left pes planus. Flattening of arch and lengthening of foot. Relaxation of ligamentous structures at knee shown by the hyperextension. (Willard.)

FIG. 344



Pes cavus. High arch and short foot (Carnett.)

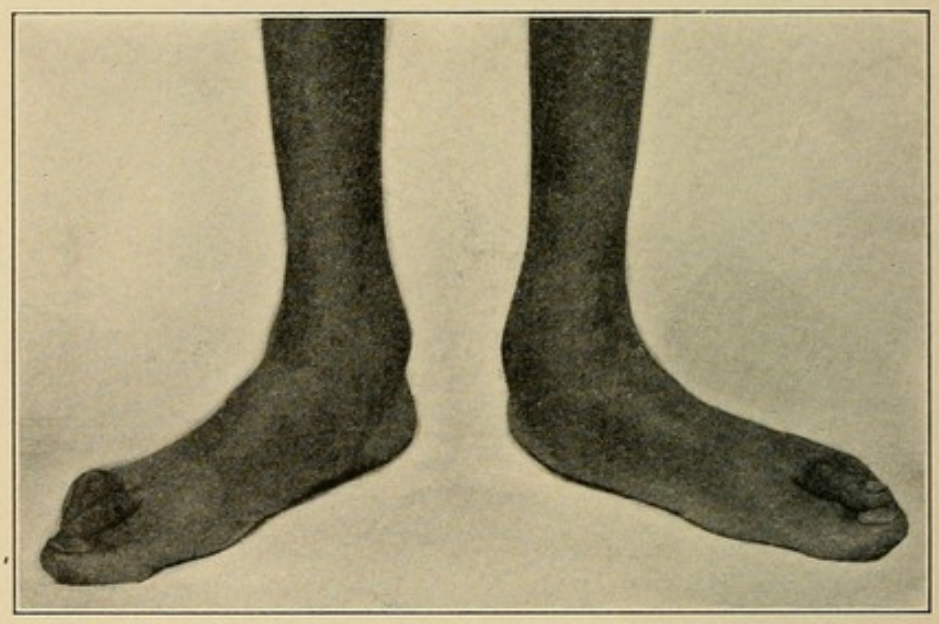
Hallux Varus.—Hallux varus is the term applied to an inward deviation of the great toe more pronounced than normal.

Club Foot.—This deformity, exceptionally congenital, usually acquired as the result of muscular paralysis and failure to counteract the pull of the sound muscles and the drop incident to the weight of the part, appears as an equinus (plantar flexion), calcaneus (dorsal flexion), varus (inversion), or valgus (eversion), two or more of these forms being commonly combined. In their ultimate development these deformities are accompanied by both malformation and displacement of the bones of the foot. The congenital form usually appears as an equinovarus.

Flat and Hollow Foot.—Flat foot, or pes planus, often a natural formation and in itself implying no weakness, and hollow foot, or pes cavus, are more or less obvious departures from the ideal mould which are readily detected by inspection.

Flat foot as an acquired condition, is often, but by no means always, a feature of painful foot. The same may be said of the high arched foot.

FIG. 345



Flat feet (bilateral pes planus). Obliteration of arches. Lengthening and eversion of feet. Prominent scaphoids and internal malleoli. Contractures of toes with secondary corns. Painless. Tires easily on walking.

Affections of the Foot Characterized Mainly by Pain.—The pain incident to wounds, contusions, sprains, joint inflammations, gout, rheumatism, and the remote effects of traumatism is usually accompanied by other symptoms or signs of the underlying cause, and a more or less characteristic history.

Painful Foot.—Painful foot, observed in lax-fibered youths and young adults, is characterized by a ligamentous weakness sufficiently pronounced to make standing or walking at first irksome, later painful. The foot is tender and often cold and clammy. The pain is usually referred to the midtarsal joint. The movements of the foot are limited by associated muscular spasm, often accompanied by cramp of the foot and leg. As the ligaments yield, a distinct flattening takes place, the head of the

astragalus forming an obvious projection below the malleolus and in front of it.

Pain is usually more pronounced before the development of marked deformity, the latter representing an adaptation which allows of considerable use without very grave discomfort. The walk is characterized by slightly flexed knees and short steps, mainly on the heels with the toes widely turned out, the shoe soles being habitually worn down on the inner side.

Arteriosclerotic Pain.—This, usually observed in the aged, at times in the young, is characterized by its severity and persistence. It may precede by months or years the development of senile gangrene. The diagnosis is based upon the associated local and general symptoms of arteriosclerosis and the exclusion of other adequate causes.

Painful Heel.—Painful heel is characterized by tenderness on pressure, so great as to make walking difficult or even impracticable. It is often associated with bony outgrowth; at times sufficiently pronounced to be palpable, usually demonstrable only by the *x*-rays. With such outgrowths, or independent of them, a chronic bursitis may develop.

Chronic inflammation of the plantar fascia, injury or abnormal growth of the epiphysis, or chronic inflammation of the bursa lying between the tendo Achillis and the calcaneum, characterized by a hardness which simulates bone, may be the underlying cause of painful heel, the point of local tenderness indicating in each case the seat of lesion.

Anterior Metatarsalgia.—Anterior metatarsalgia, or Morton's disease, is a term applied to pressure neuritis due to a distortion of the anterior transverse arch incident to the wearing of tight or narrow shoes, thus causing the heads of one or more metatarsals to bear unduly upon the sole of the shoe or to be crowded laterally together. The nerve pressure is often accentuated by the growth of a corn. The affection is characterized by severe pain usually beneath the head of the fourth metatarsal bone, brought on by walking or standing. This may be sudden and cramp-like in origin, or may be preceded by burning or discomfort. Relief is afforded by removing the shoe and kneading the foot.

Affections of the Skin of the Foot.—The skin of the foot is particularly subject to hyperidrosis and bromidrosis.

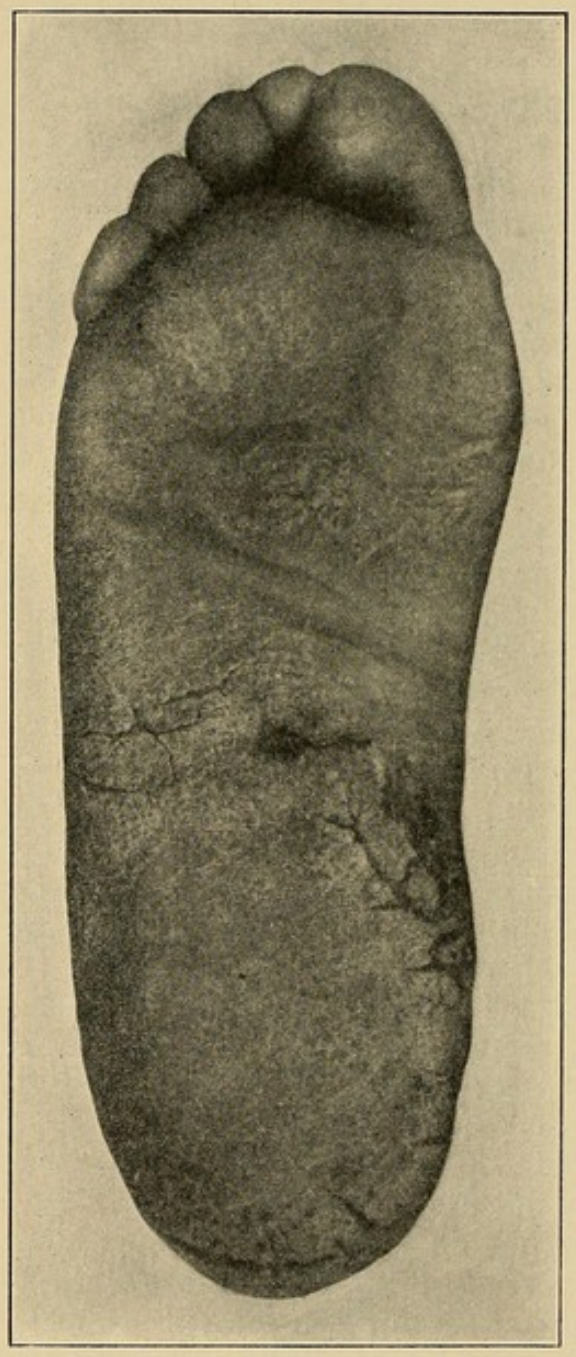
Chilblain.—Chilblain, usually attributed to a frostbite, but often independent of this, occurring at any age, is characterized by a burning sensation, often accompanied by redness and tenderness; most pronounced in cold weather and aggravated by external heat. The surface of the burning foot is often cold and wet.

Erythema Intertrigo.—This appears as a macerated hyperemic area incident to chafing. It may lead to ulceration, papillary outgrowth, or eczema.

Erythema Multiforme.—Erythema multiforme may in its nodular form develop on the dorsum of the foot and simulate the swelling due to a bruise or the sting of an insect. It occurs in the spring and fall, attacks young people, usually exhibits multiple lesions, but is characterized by neither the pain nor tenderness of traumatism.

Urticaria is characterized as elsewhere by rapid appearance and disappearance of burning wheals. It may be due to local irritation or may be incident to diet or medication. Angioneurotic edema, called giant urticaria, is characterized by a red, burning swelling which may involve the whole foot. It more commonly appears as a circumscribed edematous area.

FIG. 346



Keratosis plantaris following chronic eczema. (Hartzell.)

Lymphedema, involving the whole of the foot, is usually secondary to recurring erysipelatous inflammation or to the obstruction of the lymphatic vessels from other cause. It is characterized by a brawny infiltration differing widely from the soft, pitting edema incident to bloodvessel insufficiency.

Eczema.—Eczema of the feet, affecting by preference the sole, is usually marked by a vesicular eruption which becomes scaly or crusted, and is attended by paroxysmal attacks of severe itching. When it is complicated by fissures it may constitute a distinct disability. It is usually associated with gouty or rheumatic diathesis and with gastro-intestinal disturbances. It is likely to be symmetrical and seasonal.

Dermatitis.—Dermatitis is usually incident to an infected abrasion, and presents the features common to this condition elsewhere. It may be of such devitalizing severity as to cause gangrene of the skin, which subsequently invades the deeper tissues. This is particularly noted in diabetes and nephritis.

Erysipelas exhibits its characteristic features. Erysipeloid is also observed on the toes.

Diffuse phlegmon appears in its typical form following wound.

Keratosis.—Keratosis, appearing in the form of a circumscribed, yellowish patch of cornification, is sometimes the predecessor of epithelioma on the feet.

Plantar keratosis, or skin thickening, particularly at the expense of the corneous layer, is normal at points of pressure. It may occur, however, in the absence of pressure, as a congenital perversion of growth, or as an expression of a central neurosis. It may involve the whole sole, may appear in disseminated patches, or in the form of hard, shot-like bodies which can be dug out from their beds. It is sometimes associated with capillary dilatations, particularly in those subject to chilblains.

Corns and *warts* are obvious to inspection.

The skin sarcomas exhibit the features which characterize them in other parts of the body.

Ulcerating and Gangrenous Skin Lesions.—Any of the skin lesions may become ulcerative or gangrenous, incident to virulent infection, continued irritation, or lack of tissue resistance, singly or combined. The deep and destructive ulcers, if those secondary to syphilitic infiltration and neoplasm be excepted, begin as skin lesions. The same is true of gangrene except in its angiosclerotic or angioneurotic type.

Ingrowing Toe Nail.—This, usually observed at the outer side of the great toe nail, appears in the form of a swollen, extremely tender nail fold, discharging usually from exuberant granulations a bloody pus. It may be the starting point of cellulitis or gangrene.

Gummatous Ulcer.—Gummatous ulcer begins as an infiltration, which shortly (weeks) softens and discharges characteristic pus through a central round, punched-out opening. A suggestive history and evidences of other lesions are usually to be found.

Lupus in either its superficial or deep form presents characteristic symptoms.

Perforating ulcer of the foot, commonly observed in middle-aged or elderly men who are suffering from arteriosclerosis, lesion of the spinal cord or peripheral nerves, chronic nephritis, or diabetes mellitus, is characterized in its beginning by a callosity at a point of pressure, usually to the inner or outer side of the sole beneath the heads of the metatarsals, followed by ulceration beneath this cornified layer with slowly progressive destruction of the deeper tissues. The diagnosis is based upon the painless persistence of the lesion and its tendency toward deep rather than peripheral extension.

Mycetoma, or Madura Foot.—Mycetoma, or Madura foot, usually an infection of the tropics, exceptionally observed in the temperate zone, and affecting adults who walk barefooted, is characterized in its beginning by nodulation of the skin of the sole following traumatism or abscess. The nodule slowly extends both peripherally and in depth and becomes riddled with sinuses. Diagnosis is based upon the multiple sinuses, the enormous chronic thickening, particularly marked about the sole, and essentially by the finding in the pus of the yellowish or blackish granules which contain the Streptothrix maduræ.

Gangrene of the Foot.—Gangrene of the foot, when due to arteriosclerosis, is often preceded by harassing pain. The starting point is usually a dermal trauma or ulceration. It is characterized by a mummification incident to the gradual obliteration of blood supply.

The moist gangrene due to the sudden circulatory obstruction, which may be local, incident to destruction or overwhelming infection, or may involve the main vessels of supply (trauma, thrombus, embolus), is characterized by putrid sloughing and profound toxemia. When it occurs as a complication of lesions in themselves trifling, angiosclerosis with a complicating diabetes or nephritis is usually present. The diagnosis of gangrene is obvious.

Traumatic Affections of the Foot and Ankle.—Aside from wounds, the usual injuries of the foot and ankle are contusions or sprains. Unusual swelling, unduly prolonged pain, disability, and localized tenderness to deep pressure should suggest fracture.

Dislocations in the absence of complicating lesions are comparatively rare.

Contusion.—Contusions of the sole of the foot are often attended with severe pain and marked tenderness. Marked aggravation of these symptoms, after three days of rest, is usually indicative of suppuration. Local heat, leukocytosis, and fever are corroborative signs.

Persistent deep tenderness and disability after contusion are suggestive of fracture and call for the use of the *x*-rays.

Sprain.—Sprain of any joint of the foot is possible and is characterized by local swelling and pain, aggravated by motion. If these symptoms are unduly severe and persistent, bone injury should be excluded by the *x*-rays.

Sprain of the Ankle-joint.—This is usually due to forced inversion and inward rotation, exceptionally to eversion and outward rotaton. In the latter case it is often complicated by fracture of the inner malleolus, the bone yielding rather than the exceptionally strong inner ligaments. Sprain is manifested by pain, tenderness, usually located below and in front of the malleolus, and swelling due first to blood effusion, later to inflammatory reaction.

Convalescence from simple sprain should be early and complete. When there remain persistent pain, disability, and tenderness in spite of treatment appropriate to sprain, this in itself is suggestive of complicating fracture or intra-articular traumatism.

Fractures of the Bones of the Foot and Ankle.—Fracture of the metatarsals and phalanges exhibits, in addition to the symptoms of sprain, crepitus and unnatural mobility. Eliciting these last two symptoms in the case of the metatarsals may be difficult or impossible, the diagnosis being then suggested by the persistent sharply localized tenderness to deep pressure or to sudden thrusting of the corresponding toe backward and demonstration by the *x*-rays.

The proximal end of the fifth metatarsal may be fractured in running or jumping. Usually neither crepitus nor preternatural mobility can be elicited. Pain not disabling at first but increasing daily in severity and sharply localized tenderness being the only symptoms.

The midmetatarsals of heavy persons or those carrying weighty burdens are at times broken by a slip or twist occurring at that period of the step when the weight is thrown on the forepart of the foot.

Moderate pain which persists and grows worse, dorsal swelling, with late ecchymosis (hours, days), and persistent localized tenderness are the usual symptoms. This is, at times, the mechanism of the painful and disabled foot observed in soldiers after long marches.

Luxation of the metatarsals and phalanges is usually obvious to inspection and palpation.

Fracture of the tarsal scaphoid, usually the result of a fall from a height on the toes, is characterized by pain, localized tenderness, often crepitus. Deformity is masked by swelling. If the scaphoid be displaced, it can be readily felt.

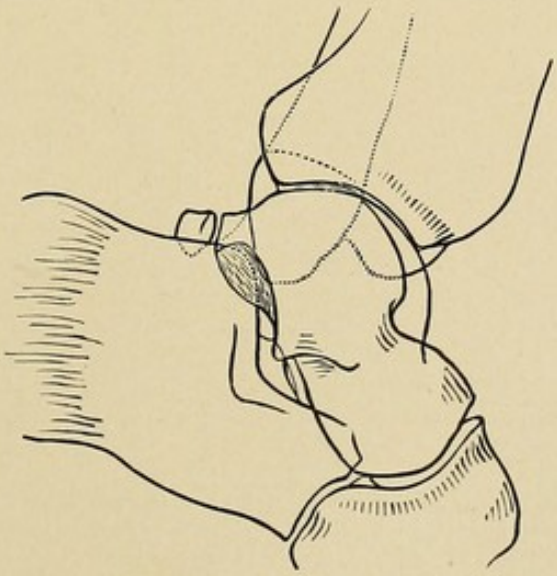
Diagnosis is made by the *x*-rays.

Fracture of the Astragalus.—This is usually due to falling from a height and alighting on the feet. The fracture may be simple, running through the neck and breaking the bone into two parts, with or without forward displacement of the anterior fragment. It is usually comminuted, representing a crush, and is further complicated by a break of the os calcis.

Severe pain, absolute crippling, possibly crepitus, and flattening of the foot may suggest a diagnosis. Swelling is so great, however, that the *x*-rays are usually needful. Pain and disability are out of proportion to that customarily observed in sprain, nor is the tenderness so definitely and superficially placed.

Fracture of the Calcaneum.—The os calcis may be broken in its sustentacular portion or through any part of the body or tuberosity.

FIG. 347[1]



Instance of the "os trigonum" of the astragalus existing as a separate ossicle, in a male, aged twenty-three years. Its appearance has been mistaken for fracture, which was suggested at first in this case, as an injury was followed by pain and local tenderness at this point, but a radiograph of the opposite ankle showed same appearance and excluded fracture.

[1] Figs. 347 to 353. Fractures involving the bones of the tarsus. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. White and Carnett, and from dispensaries.

Fig. 348

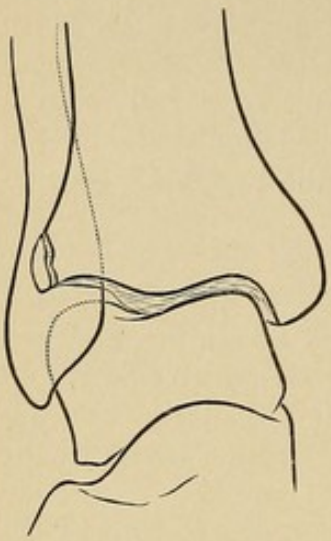


Fig. 349

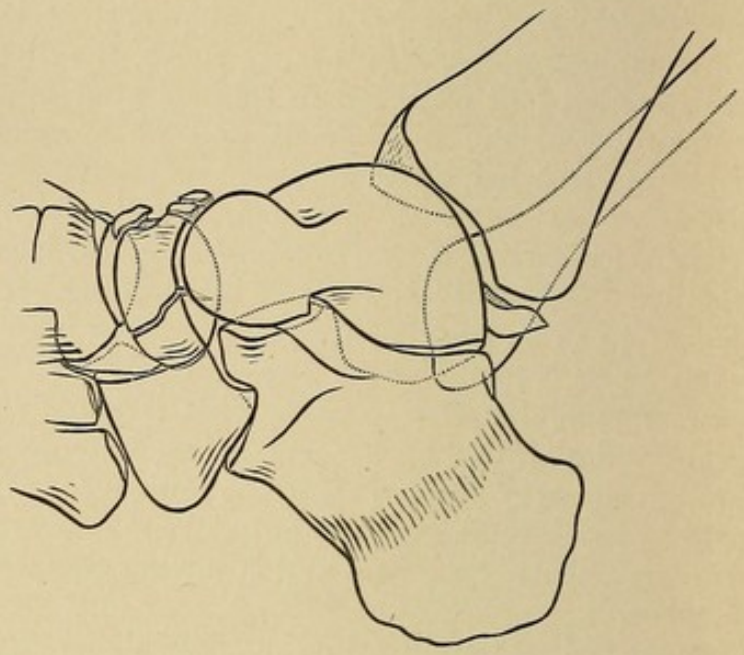


Fig. 350

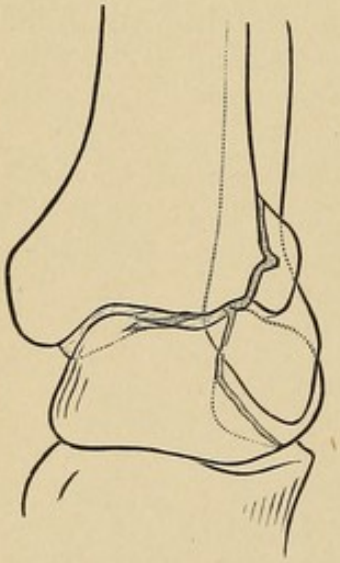
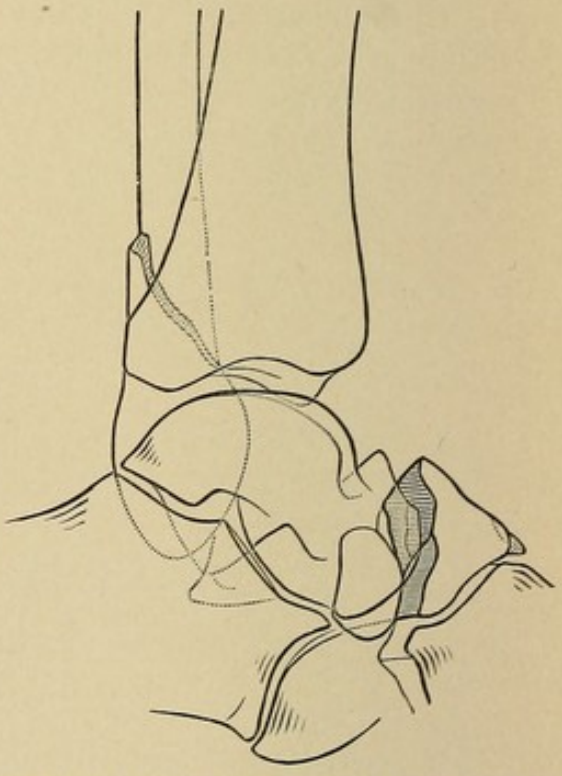


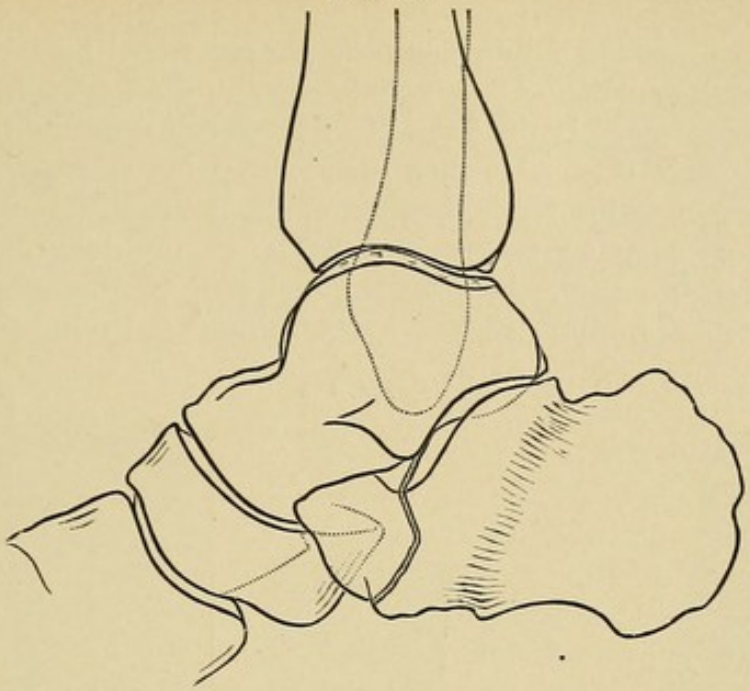
Fig. 351



Figs. 348, 349, and 350.—Unusual injuries in regions of both ankles of an adult male, resulting from fall from telegraph pole, landing on both feet. Fracture of posterior and outer part of articular surface of tibia in each ankle. In addition, scaphoid broken in left tarsus; fracture astragalus and compound dislocation ankle right side. Latter was reduced at time, and radiographs made several weeks later, and after union in fractures. Fig. 348, anteroposterior view of left ankle, shows forward end of tibial fragment only. Fig. 349, lateral view of same, indicates seat of latter fracture and shows crush of scaphoid. Fig. 350, anteroposterior view right ankle, shows fracture of entire outer margin of articular surface of tibia and slight crushing of astragalus. (Neither shown in lateral view, which is omitted.)

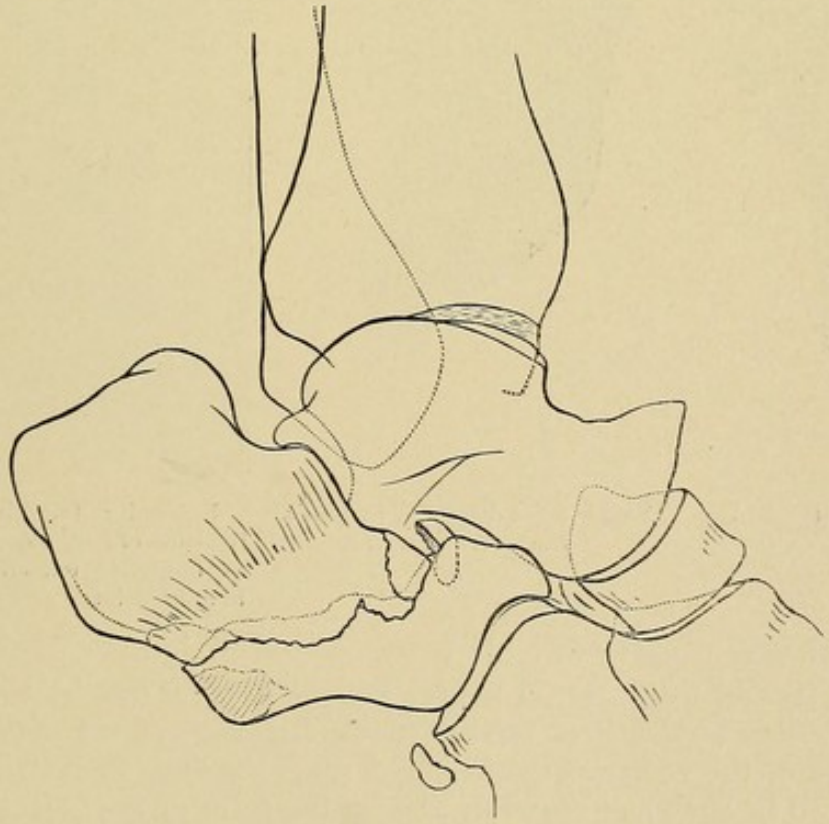
Fig. 351.—Oblique fracture of external malleolus of fibula and crush of scaphoid, in an adult male. Former easily diagnosticated clinically, but tarsal injury not identified, although a fracture somewhere in the tarsus was suspected.

FIG. 352



Fissured fracture of os calcis, without displacement, in a male, aged thirty-eight years. Line is in front of sustentaculum and attachments of calcaneoscaphoid ligament, and more anterior than usual. Clinical diagnosis of fracture difficult in such a case, and not made in this instance, injury having been regarded as a *sprain* of ankle, but patient was referred for usual routine *x*-ray examination.

FIG. 353



Comminuted fracture of os calcis in adult male. Arches of both bone and foot broken down, implying considerable laceration of ligaments. Injury represents unusual amount of violence. Fracture is accompanied by a disturbance in relations of tarsal bones suggestive of a subastragaloid dislocation. Clinical diagnosis not exceptionally difficult, but *x*-ray diagnosis easier, more certain, and more humane. Oval body under calcaneocuboid joint probably not a fragment of bone, but an ossified sesamoid often found here (in tendon of peroneus longus) and appearance in radiograph sometimes mistaken for fracture.

Fracture of the sustentaculum has been characterized by sinking of the arch and simulation of the valgus deformity of Pott's fracture. Often the injury is expressed in the form of an extensive comminution.

When the tuberosity is broken there may be marked separation, owing to the pull of the tendo Achillis, making the diagnosis easy. In the absence of such separation, flattening of the longitudinal arch, swelling about the heel, deep tenderness, and pronounced disability suggest a diagnosis which should be corroborated by the *x*-rays.

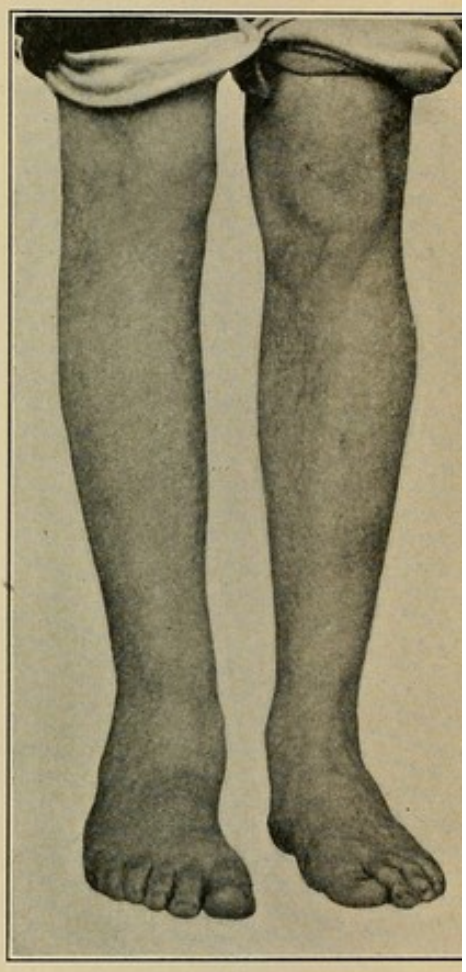
FIG. 354

Pott's fracture. (Hoffa.)

FIG. 355

Exaggerated deformity in Pott's fracture. (Park.)

FIG. 356



Deformity following Pott's fractu Eversion of foot. A not uncommon seq to imperfect reduction. Serous effusi in ankle-joint.

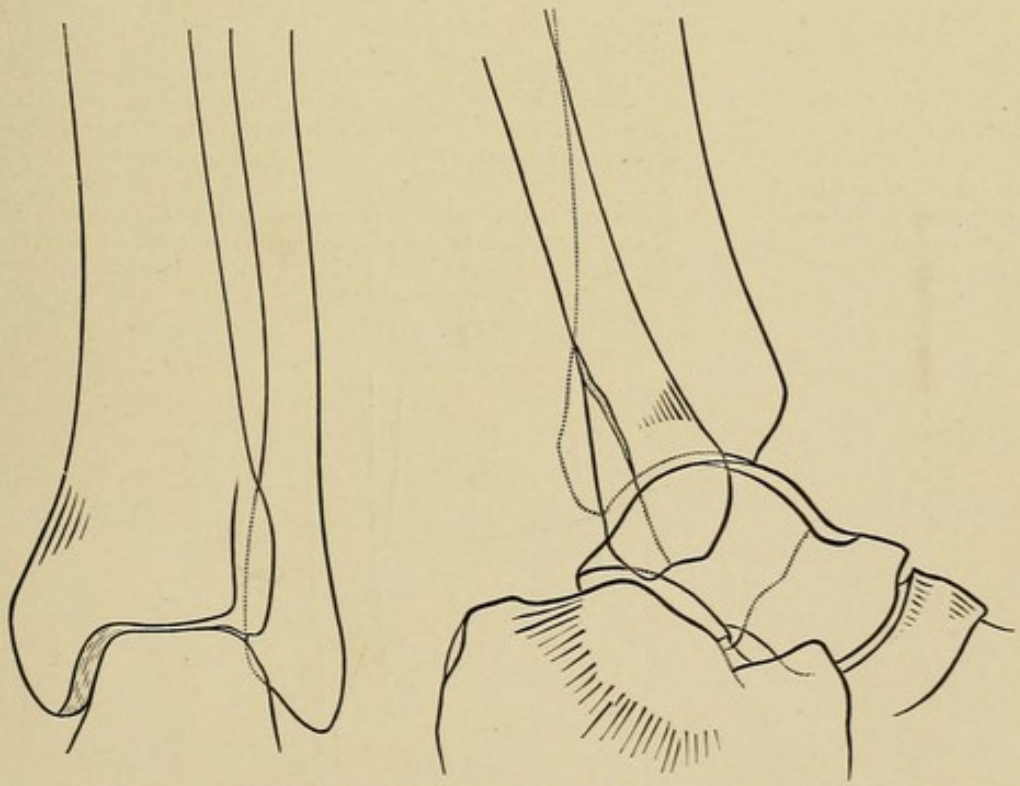
Pott's fracture, due to forcible eversion and abduction, is characterized by a tear of the internal lateral ligament, or, if this be sufficiently strong, avulsion of the tip of the internal malleolus, and a fracture either at the base of the external malleolus, a short distance above this point, or, if the fall be such as to forcibly abduct the front of the foot, the break may be oblique and at a much higher level. The tibiofibular ligament is ruptured or avulses a fragment of the tibia, and the astragalus is displaced outward, or it may be jammed upward between the two leg bones if they are widely separated or the outer articular surface of the tibia is split off.

Fracture of a single malleolus may be attended by but moderate immediate disability and no deformity. The only sign of fracture may be persistent, deep tenderness at the seat of break, associated with some joint effusion.

Supramalleolar fractures, commonly due to jarring weight of the body, as from a false step, associated with a twist of the foot, usually abduction, is likely to be comminuted and extremely irregular. Aside from crepitus, preternatural mobility, great pain, and rapid joint swelling, there is no means of accurately determining the amount of injury and joint displacement aside from the *x*-rays. The foot may be displaced in any direction.

Separation of the lower epiphysis of the tibia, more frequent than that of its upper epiphysis, usually combined with fracture of the fibula and often with a chipping off of the outer tibial articular margin, is caused by an ankle twist (eversion), and exhibits the characteristics of fracture. It is suggested by the seat of the transverse break, by its age incidence (before eighteen), the absence of intra-articular blood effusion, and particularly by the *x*-rays. The foot and the malleoli are usually displaced

FIG. 357[1] FIG. 358



FIGS. 357 and 358.—Fracture of malleolus of fibula. A frequent type in which the line of fracture extends longitudinally from above downward and behind forward, and down to end of bone. As a rule, it shows in the lateral view only (Fig. 358), as there is seldom lateral displacement. Clinical diagnosis often difficult, no deformity, and preternatural mobility and crepitus not obtainable in many instances. Fracture frequently overlooked, or diagnosis made only by *x*-rays. (Adult male, aged thirty-six years.)

[1] Figs. 357 to 370. Fractures of the bones of the leg at or near the ankle. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. White, Martin, Frazier, and Carnett, and private cases of Dr. Pancoast.

Fig. 359

Fig. 360

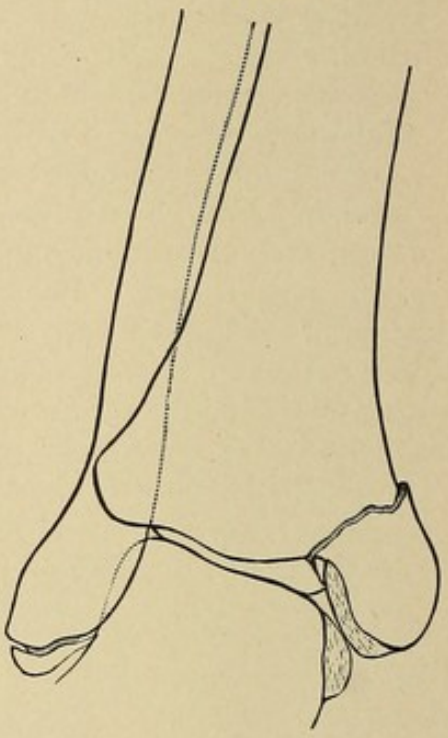
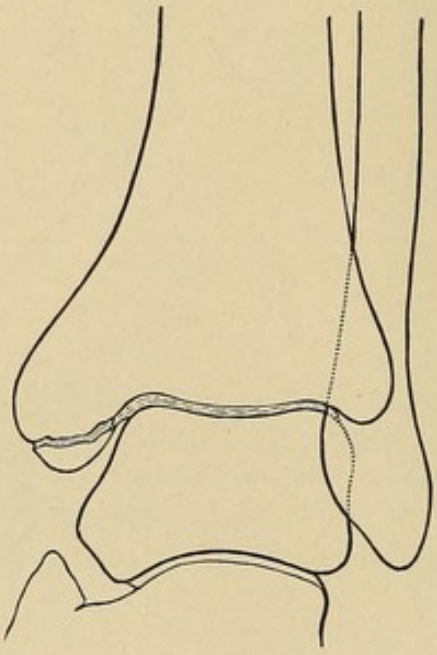


Fig. 359.—Another very common type of fracture of lower end of fibula, due to inversion. In this instance the break shows in the anteroposterior view only. Patient, an adult male, could walk, and a definite clinical diagnosis of fracture could not be made, although suspected from pain on manipulation and local tenderness.

Fig. 360.—Fracture both malleoli, in adult male, resulting from a jump from the top of a freight car. Fibular fracture at extreme tip. Both show in anteroposterior view only. Clinical diagnosis not difficult.

Fig. 361



Fracture of lower edge of inner malleolus of tibia, in male, aged thirty-three years. Important because of possibility of rupture of external lateral ligament instead of fracture of fibula. Shows in anteroposterior view only.

FIG. 362

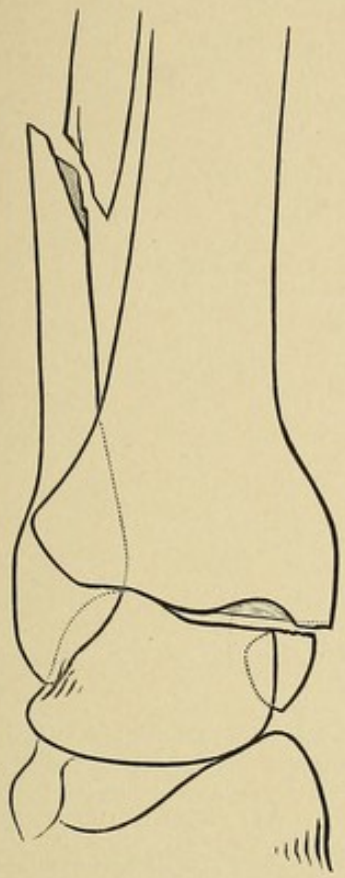
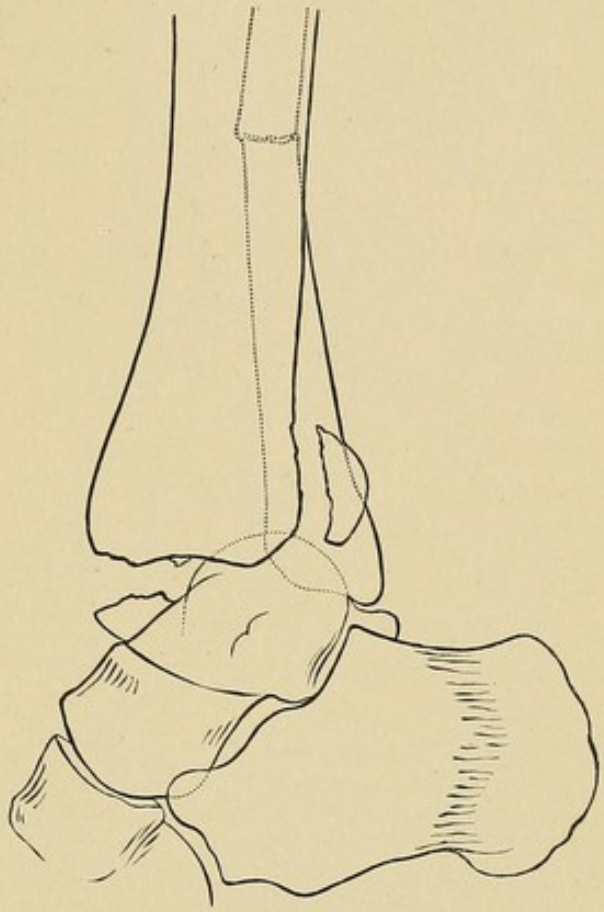


FIG. 363



FIGS. 362 and 363.—Fracture both bones; tibia, inner malleolus, and posterior portion of articular margin; fibula, shaft at lower and middle fourths. Adult male. Anteroposterior view, Fig. 362, shows slight outward displacement of foot and fibular fragments not in apposition, but does not show posterior tibial fracture. Lateral view, Fig. 363, shows almost complete posterior dislocation at ankle.

backward and outward with an obvious change in the relation of the malleoli to the long axis of the bones.

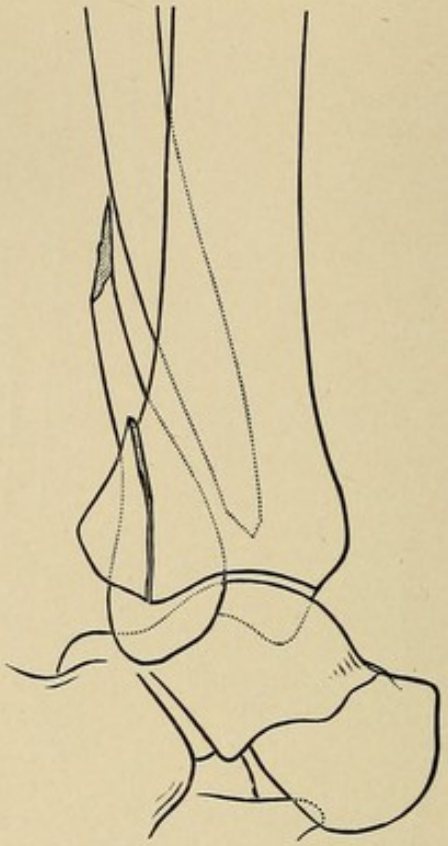
Luxation of the Foot and Ankle.—Luxation of the digits and the metatarsal bones exhibits characteristic deformity and disability. It is usually due to direct trauma, and is often complicated by destructive lesions of the bones and soft parts.

The displaced scaphoid in the absence of great swelling is easily recognized as such.

Subastragaloid dislocations may be in any direction. The relation of the malleoli to the astragalus is not disturbed, but the foot is thrust forward, backward, inward, or outward, and is fixed in its position; characteristic deformity in the absence of great swelling can be detected. This injury is often complicated by fracture, and a complete diagnosis cannot be made without the *x*-rays.

The astragalus may be driven from its bed between the os calcis, scaphoid, tibia, and fibula, forward or backward, or may be rotated. The outward and forward displacement is the usual one, resulting in inward rotation of the foot with the displaced bone readily palpable.

FIG. 364



Fracture of both bones; fibula longitudinal through lower fifth; tibia, posterior margin of articular portion. Male, aged twenty-three years. Lateral view. Neither fracture is shown in the antero-posterior view. Diagnosis of tibial fracture difficult clinically.

Tibiotarsal Dislocation.—The foot may be displaced in any direction, usually outward and forward, with a complicating fracture.

Backward dislocation is characterized by shortening of the anterior part of the foot, lengthening of the heel, prominence of the lower articular surface of the tibia over the instep where its sharp anterior rim may be felt, unless the swelling be excessive, and tense prominence of the tendons of the back of the ankle, unless the leg is shortened by a complicating fracture of the tibia.

Associated malleolar fracture with great swelling and tenderness, may so obscure diagnosis as to make the *x*-rays or examination under ether needful.

Outward and inward luxations, characterized by obvious deformity, are necessarily complicated by malleolar fracture.

Upward luxation, in which the astragalus is driven between the tibia and fibula results in fixed foot with an apparent depression of the malleoli, almost to the level of the sole, and a lateral separation so pronounced as to be obvious to inspection and mensuration.

Luxation of the Tendons.—Luxation of the tendons, usually of the peronei (rare) incident to violent muscular action, is characterized by severe pain, pronounced disability, local tenderness, and palpation of the displaced tendons, which usually can be snapped back into place.

FIG. 365

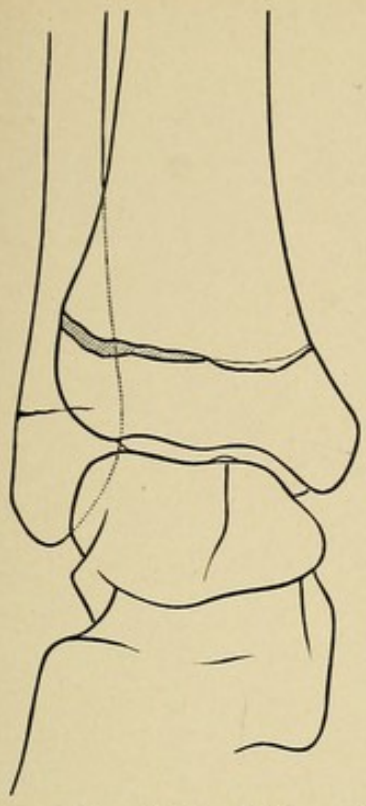
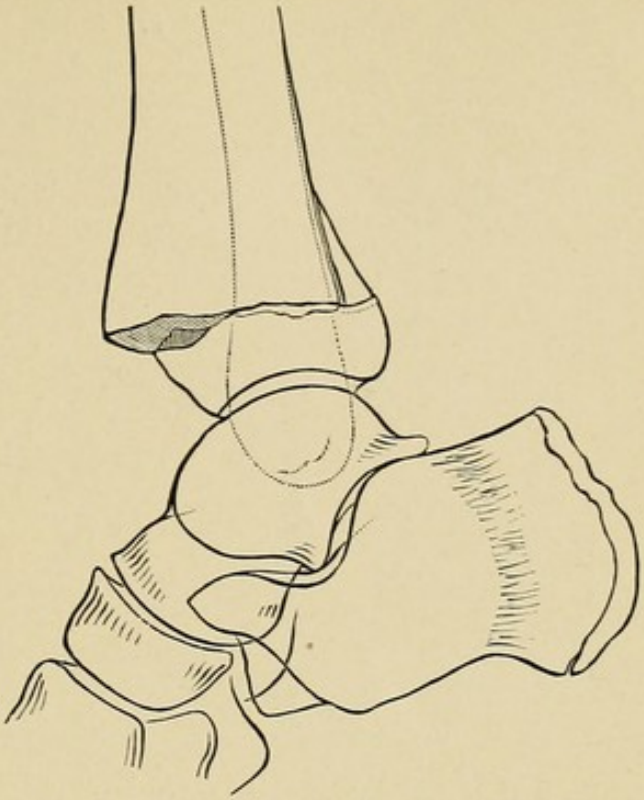


FIG. 366

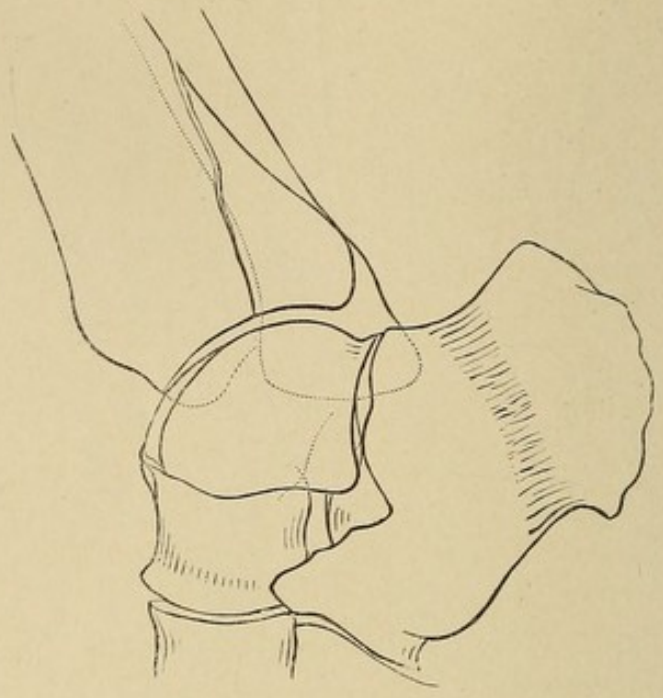


FIGS. 365 and 366.—Epiphyseal separation of lower end of tibia with posterior displacement of epiphysis, carrying with it a fragment of posterior portion of diaphysis. Patient, a boy about sixteen years of age, caught his foot on the top bar when jumping a hurdle. Clinical diagnosis of exact nature of injury difficult, but a correct diagnosis and accurate reduction were essential. Anteroposterior view, Fig. 365, gives practically no information in this instance. Fig. 366, lateral view.

FIG. 367

Longitudinal fracture of lower end of tibia, with separation of anterior portion of bone which is displaced relatively forward with foot. Injury resulted from patient, a physician, being thrown from his carriage. Exact mechanism not known, as there were numerous other injuries. Clinical diagnosis of exact nature of injury difficult. Lateral view.

FIG. 368



Longitudinal fracture of the posterior aspect of the tibia extending downward to about middle of lower articular surface. Patient an adult male. Injury caused by wheel of an automobile passing over the part. No displacement. This fracture could not be diagnosticated clinically, although one was suspected, mainly because of inability of patient to walk on foot. Anteroposterior view shows no indication of a fracture. (Lateral view.)

Rupture of the Tendons.—Rupture of the tendons, usually the tendo Achillis, frequently incomplete, is characterized by pain, partial or complete disability, local tenderness, and the detection of a break in continuity on palpation. This gap becomes promptly filled with blood, hence firm pressure may be needed to detect its presence.

Tenosynovitis.—Tenosynovitis, or peritendinitis, in the region of the ankle-joint, commonest about the tendo Achillis, often affecting the sheaths of the peronei and the tibialis anticus and digital tendons, usually due to prolonged and unwonted use, at times a local expression of infection, particularly that incident to gonorrhea or rheumatism, is characterized by pain on movement, tenderness and swelling along the course of the tendon, and often fine crepitation.

The tuberculous form, commonly secondary to bone or joint involvement, is characterized by insidious onset, slow progression, and a fluctuating, often loculated and crepitating swelling along the course of the tendon sheaths. In the tuberculous ulcerative form there is soft infiltration and abscess formation.

Retrocalcaneal Bursitis.—Retrocalcaneal bursitis, or inflammation of the bursa between the os calcis itself and the tendo Achillis, commonly due to excessive use or a local expression of general infection, particularly gonorrheal rheumatism, is expressed by pain increased on motion, and tenderness and swelling, best elicited by pressure to either side of the tendo Achillis just above its insertion into the os calcis. The swelling

Fig. 369

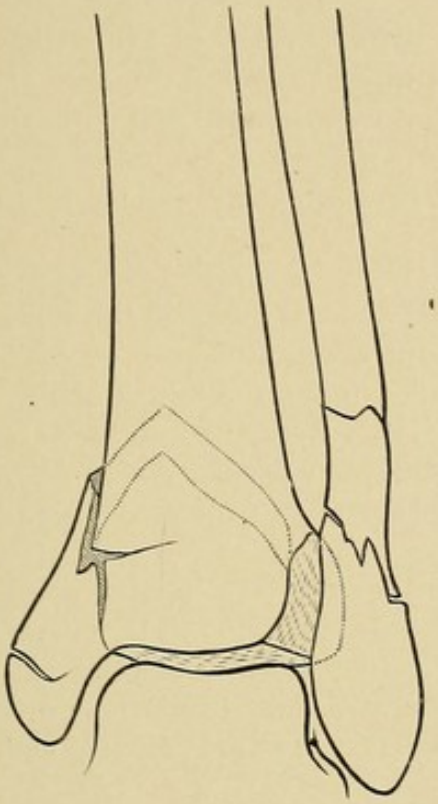
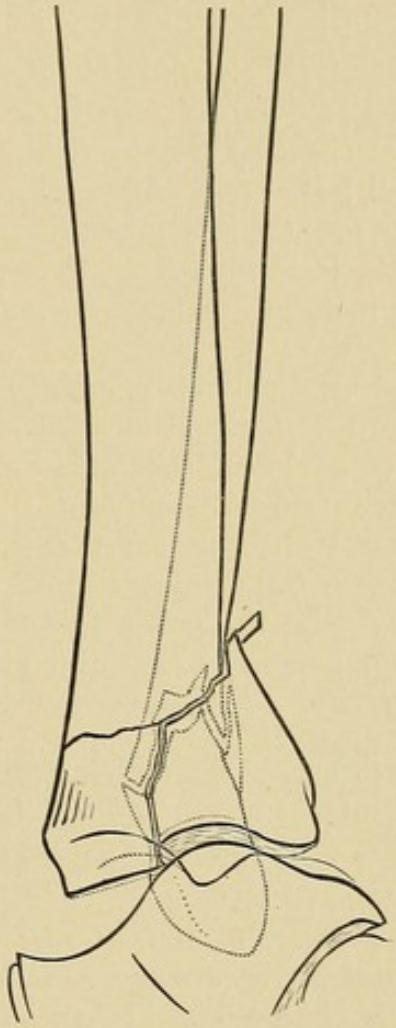


Fig. 370



Figs. 369 and 370.—Compound comminuted fracture of both bones at ankle, in a male, aged thirty-four years, resulting from direct violence—crush by a car wheel. (Other leg similarly broken higher up.) Clinical diagnosis of exact nature of injury difficult. Lateral view, Fig. 370, shows in addition a posterior luxation of ankle and foot with the lower fibular and lower and posterior tibial fragments, complete reduction of which could not be accomplished.

is usually hard, nor is fluctuation readily demonstrable. The acute affection may become chronic.

Inflammation affecting the bursa on the lower surface of the os calcis may be secondary to trauma, an evidence of fissured fracture or a local manifestation of constitutional infection. It is not infrequently accompanied by periosteal outgrowth in the form of a spur. The diagnosis is suggested by the *x*-rays, but must often be tentatively made by exclusion.

Inflammation of the Joints and Bones of the Foot and Ankle.—Acute Arthritis.—Acute arthritis, commonest in the ankle-joint, if trauma and direct infection be excluded as causes, is usually incident to systemic infection, particularly that due to rheumatism and the gonococcus. Any of the infections may, however, be expressed in the joints of the foot. The symptoms are those of arthritis, namely, pain aggravated by motion

involving the joint, tenderness and swelling about the joint, limitation of motion, and, in the case of pyogenic infection, constitutional symptoms.

Acute Arthritis of the Metatarsophalangeal Joint.—Suppurative arthritis of this joint is usually secondary to an infected bunion. It is characterized by pain, swelling, and disability out of proportion to the original lesion and wide of it, by the rapid (days) formation of fistulæ leading into the interior of the joint and by extension of pus beneath the deep fascia of the sole. There is local tenderness, edema of the dorsum of the foot, and a tendency to point between the great toe and the one lying next to it.

Gout particularly manifests itself in the metatarsophalangeal joint of the great toe. It is marked by the sudden onset of the local symptoms of a violent inflammation without adequate cause or corresponding constitutional symptoms. A similar inflammation of the joint, but one less violent in onset and slower in subsidence, follows tonsillitis and other forms of infection localized elsewhere. As in other parts of the body, the gouty toe has a tendency to exhibit chalky deposits with final degeneration and ulceration.

The red, edematous, painful, and exquisitely tender swelling of acute gout closely simulates a pyogenic infection. It often follows slight trauma. The inadequacy of the cause, the absence of marked constitutional symptoms, the limitation of the inflammation to the periarticular structures, and the history of the case are usually sufficiently characteristic.

Acute arthritis of the tarsal and metatarsal joints, in its suppurative form usually secondary to infected wounds or suppuration of the soft parts, is characterized by the seat of swelling and tenderness, rapid and multiple fistulization, and the tendency to spread along the tendon sheaths of the leg.

The tarsal and tarsometatarsal joints are subject to both gonococcal and rheumatic inflammation of crippling severity.

Acute arthritis of the ankle-joint, characterized by pain, fixation in slight plantar flexion, swelling, and tenderness most marked to either side of the extensor tendons anteriorly and between the tendo Achillis and the malleoli posteriorly, may develop in the serous, fibrinous, or suppurative form. The diagnosis of the causative lesion is dependent upon the recognition of the systemic infection, usually gonorrhea or rheumatism.

The gonococcal arthritis, except in its ephemeral serous form, is characterized by an especial intensity and persistence of pain, an early involvement of tendon sheaths and a tendency toward ankylosis. The grippal, exanthematous, typhoidal, and pneumococcal infections are in themselves not characteristic.

The suppurative arthritis incident to infected wound, osteomyelitis, suppurating tenosynovitis is characterized by the rapid onset and progression of both the local and general symptoms of sepsis.

Suppuration complicating pyemia does not materially add to the

severity of the constitutional symptoms, nor are the local signs as pronounced as they would be from a traumatic pyogenic infection.

Chronic Arthritis.—Chronic arthritis of the joints of the foot and ankle, when beginning insidiously is usually tuberculous. It may be post-traumatic or may follow any of the acute forms of infection. When no other cause can be assigned, it is termed rheumatic.

When accompanied with deformity out of all proportion to the pain and disability it is usually tabetic.

Post-traumatic arthritis usually incident to unrecognized fracture, or one in which perfect restoration of normal mechanical conditions has not been accomplished, is characterized by pain, tenderness, limited function, muscular atrophy, and at times bone thickening and deformity so great as to suggest malignant infiltration or tuberculosis.

The diagnosis of the cause of the condition is usually dependent upon *x*-ray examination, but must often be made by exclusion, by careful consideration of the history, and by observation of the clinical course. The tibiotarsal and midtarsal joints are particularly affected by this form of chronic arthritis.

Tuberculous Arthritis.—Tuberculosis of the tibiotarsal joint, commonly secondary to involvement of the astragalus or the tibial epiphysis, is manifested at first by a serous effusion, the fluctuating swelling incident to which is detected to either side of the extensor tendon, later by a uniform, elastic, indolent swelling involving the entire joint.

Pain, limp, limitation of motion, muscular atrophy, onset and progression without other adequate cause, and reaction to tuberculin are characteristic features.

Tuberculosis of the midtarsal joint is characterized by the seat of swelling which is placed in front of the malleoli. Flexion and extension movements are those least limited and least painful.

The serous effusion of the ankle-joint incident to acute inflammation of the lower epiphysis of the tibia (rare) can be distinguished from a true arthritis only by the history of the onset of inflammatory symptoms, the seat of maximum pain and tenderness, and possibly the *x*-rays.

The calcaneum is more frequently tuberculous than any of the other tarsal bones. Nor is the extension of the process so likely to invade the joints. The affection is characterized by an indolent, slowly progressive thickening of the bone, the swelling being most pronounced below the malleoli and its bone limitations being most distinctly marked when the infection lies farthest back. The ankle motions are not painful and are but little restricted. The *x*-rays supplemented by the tuberculin test are diagnostic.

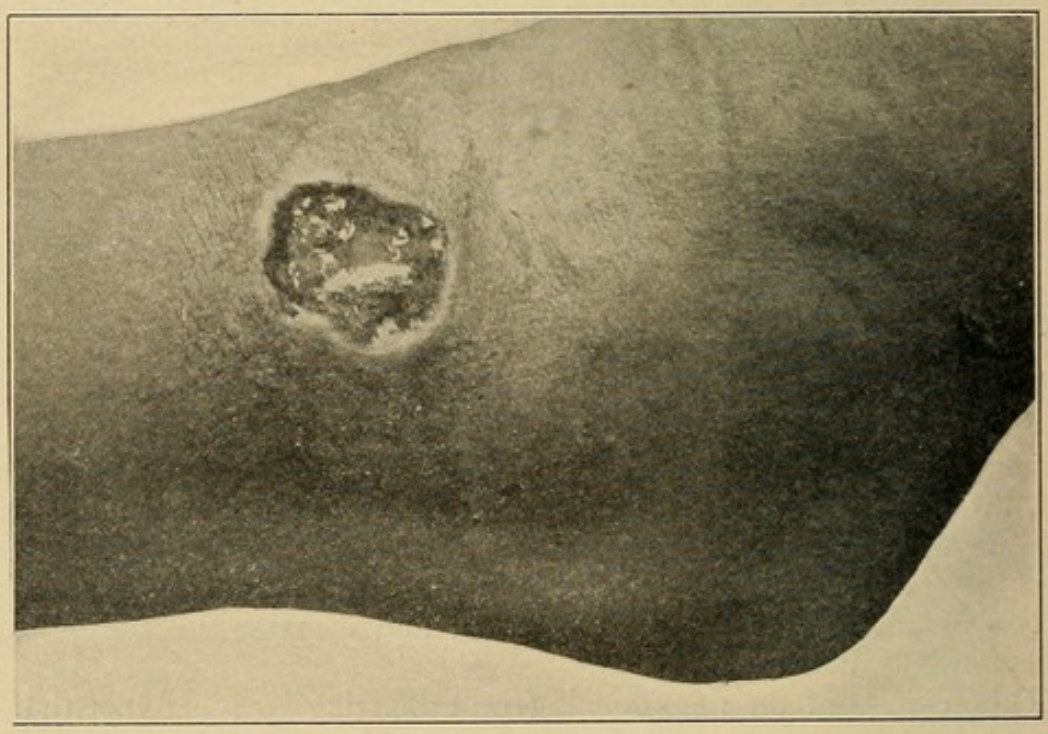
If the calcaneo-astragaloid joint is involved, the submalleolar swelling is less distinctly outlined, and inversion and eversion are painful and are markedly limited.

Tuberculosis of the metatarsals (rare) affecting by preference that of the great toe in adults, usually involves several bones. It is characterized by an indolent, fusiform swelling, exhibiting a tendency toward softening and fistulization. The distinction from syphilis is difficult, and depends

FIG. 371

Tuberculous arthritis of ankle-joint. Patient aged twenty-two years. Joint symptoms for six months. Swelling most marked on outer and inner aspects of ankle. Motion limited. Position one of moderate plantar flexion. Fluctuation present. No heat or redness. Crepitation of joint surfaces. Atrophy of leg muscles.

FIG. 372



Gumma of ankle. Superficial sloughing ulcer of rounded outline and undermined edges. Similar lesion on shoulder.

in the early stages upon the history, results of the tuberculin test and mercurial treatment, and finally upon the microscope.

Tabetic Arthropathy.—Tabetic arthropathy, usually of slow development, often preceding other symptoms of the disease, is characterized by swelling and deformity which may ultimately become grotesque without the usual amount of pain, tenderness, and fixation. The midtarsal or the tibiotarsal joint, commonly both, are involved. The appearance may be suggestive of sarcoma. The want of correlation between the subjective and objective symptoms is almost diagnostic.

Tumors of the Foot.—Of the benign neoplasms, *lipoma* is perhaps the commonest and may be congenital. It exhibits the softened consistency and the slow growth of this neoplasm as observed elsewhere.

Exostoses are not uncommon in the heel, where they may give rise to pain on walking before they form a sufficient enlargement to be detected by palpation. Diagnosis may be made by the *x*-rays.

A subungual bony outgrowth, springing from beneath the nail of the great toe, occasions in its early stage of growth pain on pressure. Later, it lifts the nail. The slow growth (months, years) without inflammatory symptoms, the dense consistency when palpation is possible, and the *x*-rays establish the diagnosis.

Chondroma, frequently multiple, having for its seats of predilection the metatarsals and phalanges, is characterized by dense nodulation, slow growth, and negative *x*-ray. findings.

Epithelial cysts are observed on the sole as on the palm.

Angioma is often associated with a fatty growth; it is usually indicated by involvement of the skin vessels. The changes in size incident to vascular tension are characteristic.

Sarcoma, occasionally congenital, growing from either the skin, subcutaneous tissues, or the bones, can be distinguished from benign lesions only by its rapid course.

Developing as a subungual growth, if of slow progression, it cannot be distinguished from subungual osteoma except by excision and microscopic examination. Osteosarcoma simulates in its early stages chronic inflammation of the bone. The *x*-rays give a fairly characteristic picture. In its further development the bone tumor forms a more distinctly outlined mass than do the inflammatory lesions, nor does it show an early tendency toward softening or fistulization. The metatarsals, the phalanges, and the calcaneum are the bones most commonly invaded.

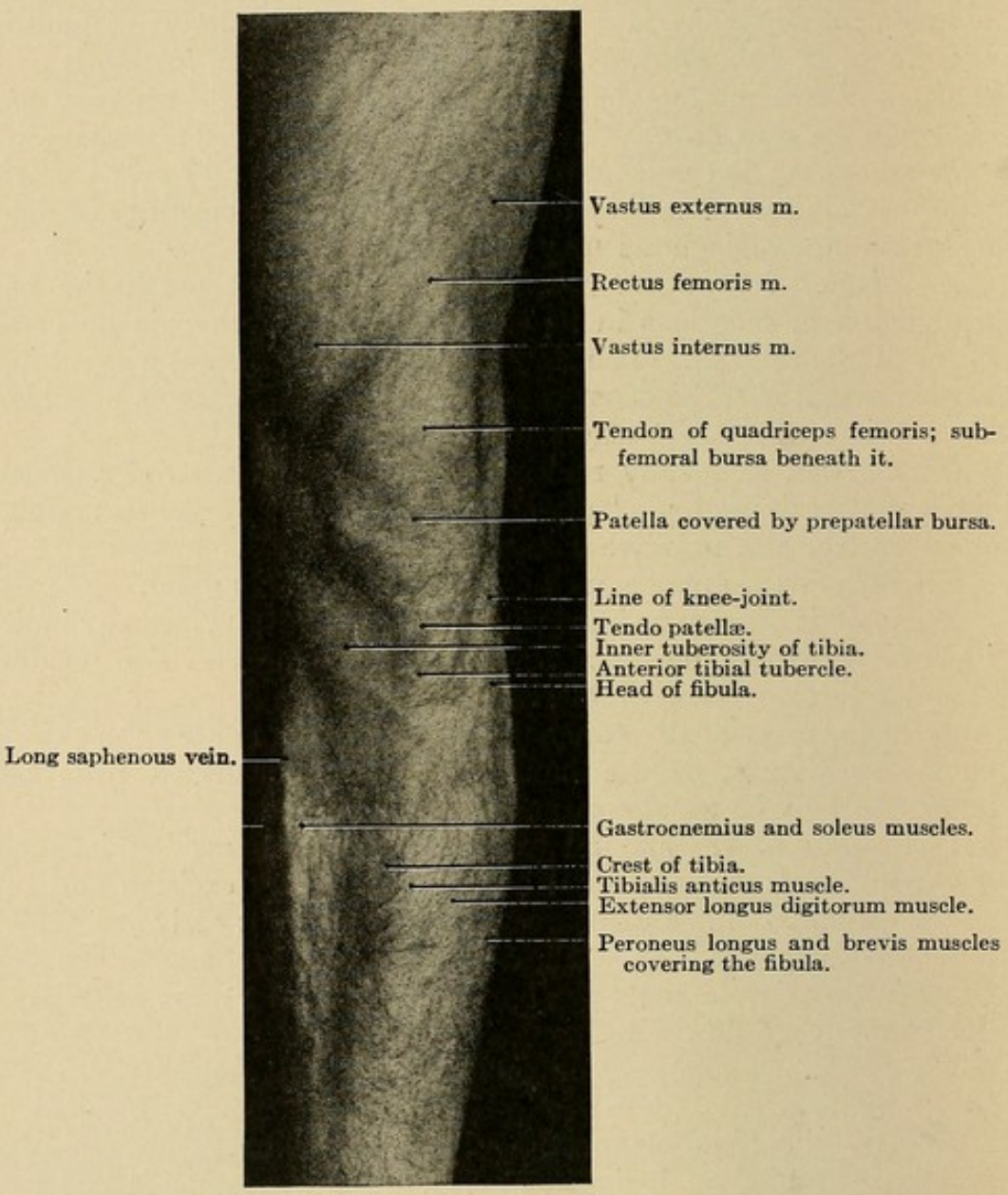
Sarcoma should be diagnosticated by excision and microscopic examination, the operation being performed when the tumor is first located by the *x*-rays, provided it is probably not specific.

THE LEG.

The crest of the tibia is subcutaneous and readily palpable through its whole extent. The head of the fibula and the lower third of its shaft can also be felt.

The abrasions and contused wounds to which the skin overlying the tibial crest and the malleoli is subject, because of a dependent position, constant use of the part, and often an associated valvular incompetence of the veins, are slow to heal. These lesions, whether they become acutely and repeatedly inflamed or develop into chronic ulcers, are

FIG. 373



Surface markings of the leg and knee. Anterior surface. (G. G. Davis.)

accompanied by an obstructing or obliterating lymphangitis which renders reparative processes slow and incomplete. Hence the leg is the common seat of chronic ulcers.

Varicose veins of the leg, fundamentally incident to incompetent valves, are usually attributable to prolonged standing, or interference

with the return flow, as from intra-abdominal pressure, thrombosis, tumor formation, or mitral regurgitation.

Varicose veins, if superficial, are obvious to inspection and palpation. If deep, they are characterized by pain of a rheumatic character made worse by standing, edema about the ankle not otherwise to be accounted for, and dilatation of the small veins over the dorsum of the foot.

Superficial varices are usually dependent for their progression upon valvular incompetence in the long saphenous vein. A similar condition in the short saphenous vein is less common. Valvular incompetence is determined by holding the leg and thigh in a vertical posture for several minutes with the patient supine. The lower third of the thigh

FIG. 374

Lymphedema of the leg. Extensive inflammatory exudate in left pelvis. Swelling in part disappeared under prolonged rest in bed, but recurred on getting up. Diffuse, firm swelling, yielding slight pitting on pressure, extending to top of shoe and crippling in character.

is then bandaged with sufficient pressure to compress the superficial but not the deep veins, and the patient is put upon his feet. If the saphenous vein fills abruptly above the bandage, the valves are certainly incompetent.

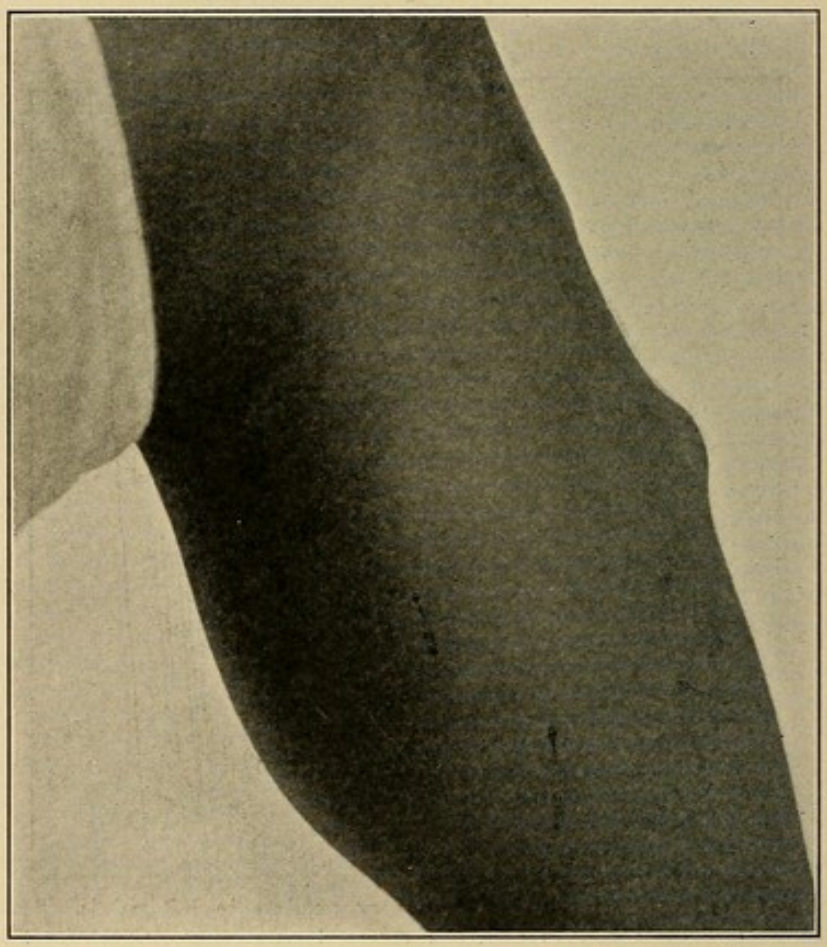
Varicose veins are complicated by eczema, leg ulcer, rupture and hemorrhage, thrombosis, embolism, and the formation of phleboliths.

Thrombosis is characterized by the appearance of a tender cord in the course of the vein, usually accompanied by edema and skin redness. If septic, the thrombus exhibits the features and constitutional symptoms of abscess. The nodular, subcutaneous, usually multiple phleboliths are the traces of former thrombosis.

Chronic Ulcer of the Leg.—Chronic ulcer of the leg may be incident to the action of the ordinary pyogenic organisms upon an ill-drained, poorly vascularized skin and subcutaneous area, may be syphilitic, blastomycotic, tuberculous, or malignant, or may be an ultimate skin expression of suppurating bone lesion.

Simple chronic ulcer, often associated with obvious varicosities, is observed at times in overfat, middle-aged people; usually in the aged, ill-nourished, and uncleanly. It has for its beginning an abrasion, a wound, an inflamed thrombus, a ruptured varicose vein, or a patch of

FIG. 375



Gumma of subcutaneous tissue. Painless, causeless, indurated, adherent to skin. Freely movable over the underlying bone. Duration, weeks.

eczema. The affection, usually above the malleoli and on the lower third of the leg, is characterized by indolence and slow extension (months, years) which is mainly superficial, but may destroy tissues down to the bones.

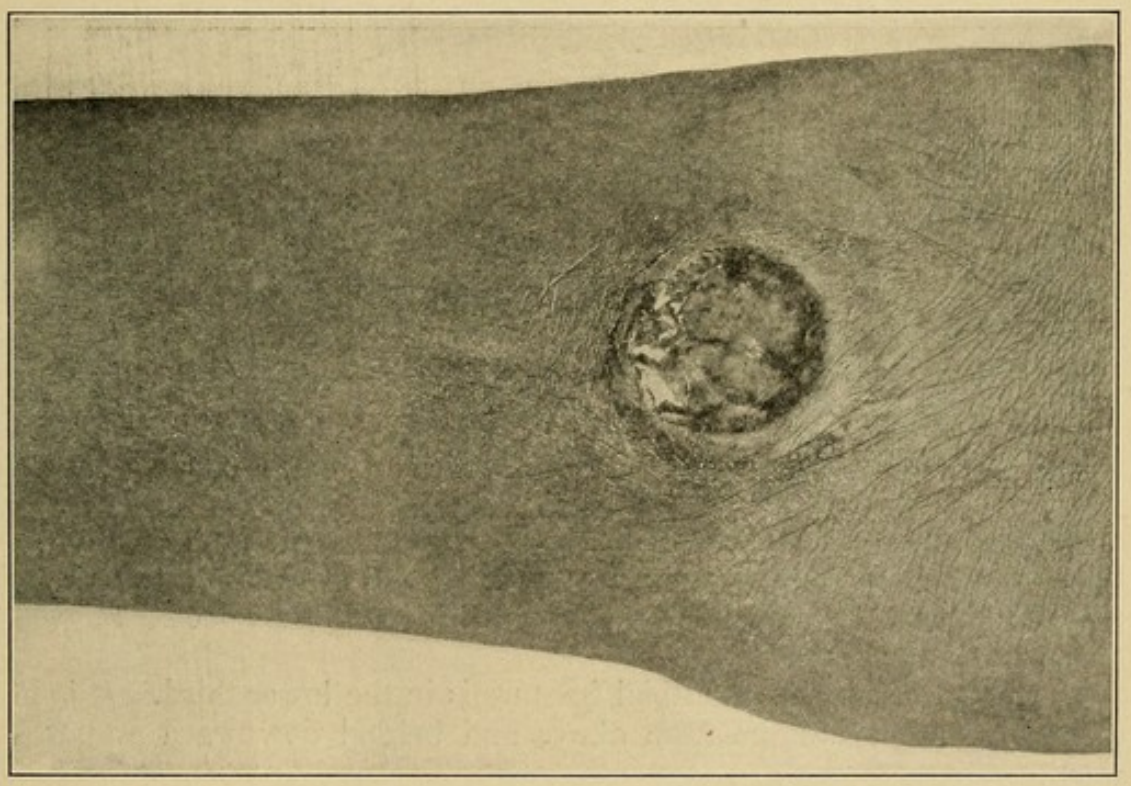
It is usually painless and unattended with constitutional symptoms; there is commonly an associated pronounced skin pigmentation, often obstinate eczema, occasionally lymphedema, producing a brawny swelling of the foot and leg.

Syphilitic ulcer, often multiple, begins as a painless, non-inflammatory infiltration of the skin or underlying soft parts, which slowly reddens

and softens (weeks), leaving a deep, punched-out, rounded ulcer with bacon-like walls. It is common in the upper third of the leg, a position so unusual for simple ulcer that this in itself is suggestive. When it occurs over the regions favored by simple ulcer and is not seen until its characteristic features are obscured by inflammation incident to irritation and neglect of treatment, the diagnosis must depend upon the history, the presence of other lesions or their scars, and the therapeutic test.

Tuberculous ulcer is usually a skin manifestation of underlying bone infection. It is characterized by feeble anemic granulations, undermined skin, and a tendency to fistulization.

FIG. 376



Gumma of leg. Superficial ulcerating lesion, circular in outline, in upper half of leg. Eight weeks' duration. Began as painless swelling. No varicose veins. No trauma.

Blastomycotic ulcer (rare) appears as a rounded, spreading, painless, indolent area made up of exuberant granulations containing multiple small abscesses. The diagnosis is based upon microscopic examination.

Malignant degeneration of a chronic ulcer (Marjolin's ulcer) may be suggested by its nodular surface and border. The diagnosis must be made by the microscope.

Erysipelas and cellulitis of the leg conform to type, nor is the diagnosis difficult. Direct extension of infection from the foot through the synovial sheaths of the tendons is less common than is the case with the hand.

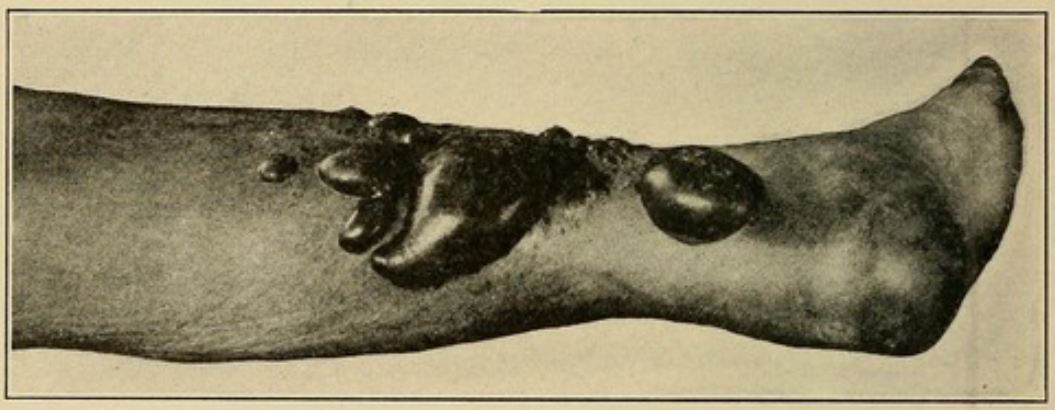
Extension by the lymphatics and veins may involve either the superficial or the subaponeurotic tissues.

Following slight foot infections, contusion or strain of the leg, or in the absence of these predisposing factors, there may be extensive collections of pus, either beneath the skin, or subfascial between the muscles characterized by local and general symptoms of such moderate severity that diagnosis is not formulated until fluctuation is developed.

Such purulent collections may gravitate from the popliteal space, may be an extension of chronic osteomyelitis of the bones with perforation, or may be secondary to deep thrombosis.

Contusion.—Contusion of the leg is often attended by extensive blood extravasation, producing a skin discoloration not unlike gangrene—the similarity is the greater if the skin be raised in the post-traumatic bullæ which often complicate fracture.

FIG. 377



Bleb and vesicles following (hours) severe contusion of the leg. (Frazier.)

Fracture of the Bones of the Leg.—The tibia and fibula are commonly both broken; if from direct violence, at the point of application of this; if from indirect violence, the fibula at a higher level than the tibia, even close to its upper extremity.

The common seat of the tibial fracture is in the lower third. It is in direction usually oblique from above and behind downward and forward.

Spiral fractures from twisting force are common and are usually comminuted. Fissures frequently pass downward to the ankle-joint. The lower fragment is commonly displaced upward and backward.

Diagnosis is usually obvious because of the gross deformity, or is readily elicited because of subcutaneous position of the tibial crest. Crepitus may be wanting because of soft parts interposed between the fragments.

Measurements for shortening when these seem needful should be taken between the adductor tubercle and the internal malleolus.

When the associated fibular fracture is placed high, its seat may be determined by local tenderness to deep palpation, often crepitus and lessened resistance to pressure or by preternatural mobility.

Fracture of the tibia alone may occur without displacement, in which case the diagnosis will be suggested by persistent local tenderness and

moderate disability. It is possible, however, for a person with such fracture to be comparatively able-bodied. The *x*-rays constitute the final means of determining not only the presence of fracture, but its exact seat and its nature.

Fracture of the fibula alone, usually in the middle third and from direct violence, is characterized in the absence of displacement, by local pain and tenderness on deep pressure; usually by crepitus and obscure preternatural mobility. The power of locomotion is not materially interfered with.

FIG. 378[1]

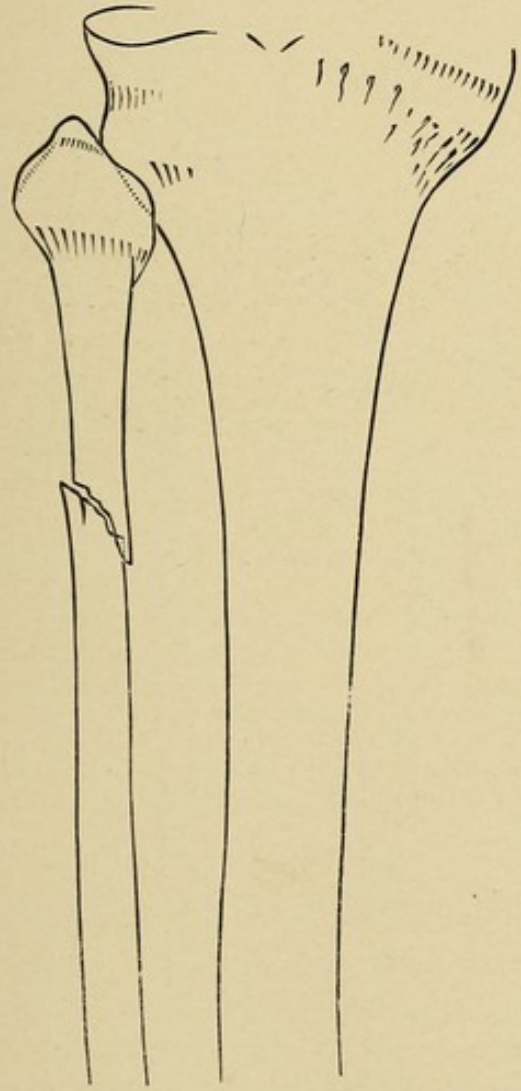


FIG. 379

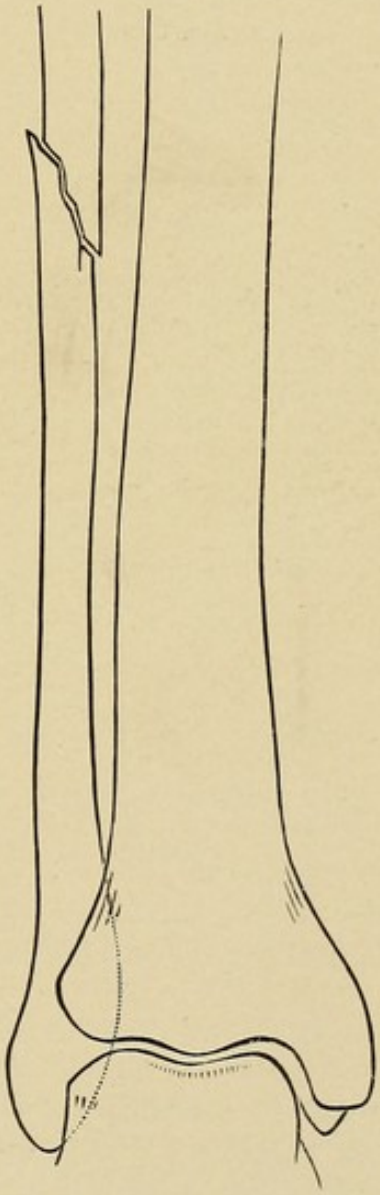


FIG. 378.—Uncomplicated fracture in upper portion of shaft, in a male, aged forty-six years. Clinical diagnosis somewhat difficult in absence of crepitus and because of thick covering of muscles. Pain and local tenderness most suggestive signs.

FIG. 379.—Uncomplicated fracture about middle of the shaft in a male, aged thirty-one years. Cause, direct violence.

[1] Figs. 378 and 379. Fractures of the shaft of the fibula above the lower fifth. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from services of Drs. White and Frazier.

The lower third of the fibula is very commonly broken as a further manifestation of an everting force which ruptures the internal lateral ligament of the ankle-joint or tears loose the bony attachment. The seat of fracture is usually about two inches above the malleolus and is characterized by eversion of the foot, loss of resistance on deep pressure, marked local tenderness, and usually crepitus.

Fracture of the upper extremity of the fibula may be unattended by the ordinary signs of the lesion aside from deep and persistent tenderness. Because of the close relation of the peroneal nerve and the neck of the fibula, fracture of the bone in this position is sometimes associated with

FIG. 380[1]

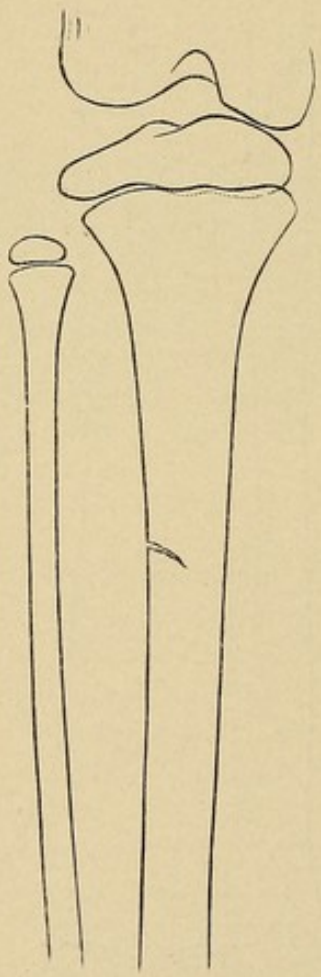


FIG. 381

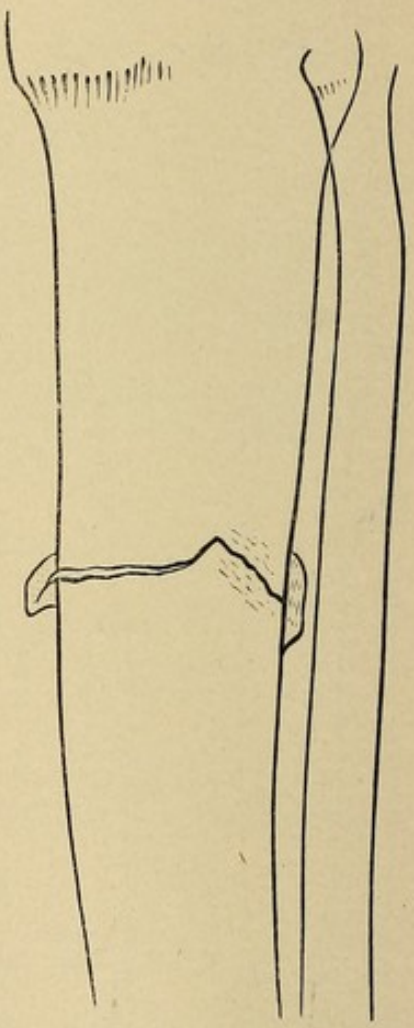


FIG. 380.—Fracture of the middle and upper thirds of the shaft in a child, aged six years. Cause, direct violence—struck by fender of trolley car. Typical example of incomplete fracture. Not diagnosticated clinically, purely an *x*-ray diagnosis. Anteroposterior view.

FIG. 381.—Old and partially united transverse fracture of upper and middle thirds of shaft in a male, aged fifty-three years. Was never diagnosticated or treated for a fracture. Radiograph made because of a second recent injury (negative). Note excessive callus for such a break. Shows necessity of *x*-ray examination for such injuries, even in absence of pathognomonic signs of fracture. Anteroposterior view.

[1] Figs. 380 to 386. Fractures of the shaft of the tibia. Outline drawings of radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred from dispensaries.

Fig. 382 Fig 383 Fig. 384

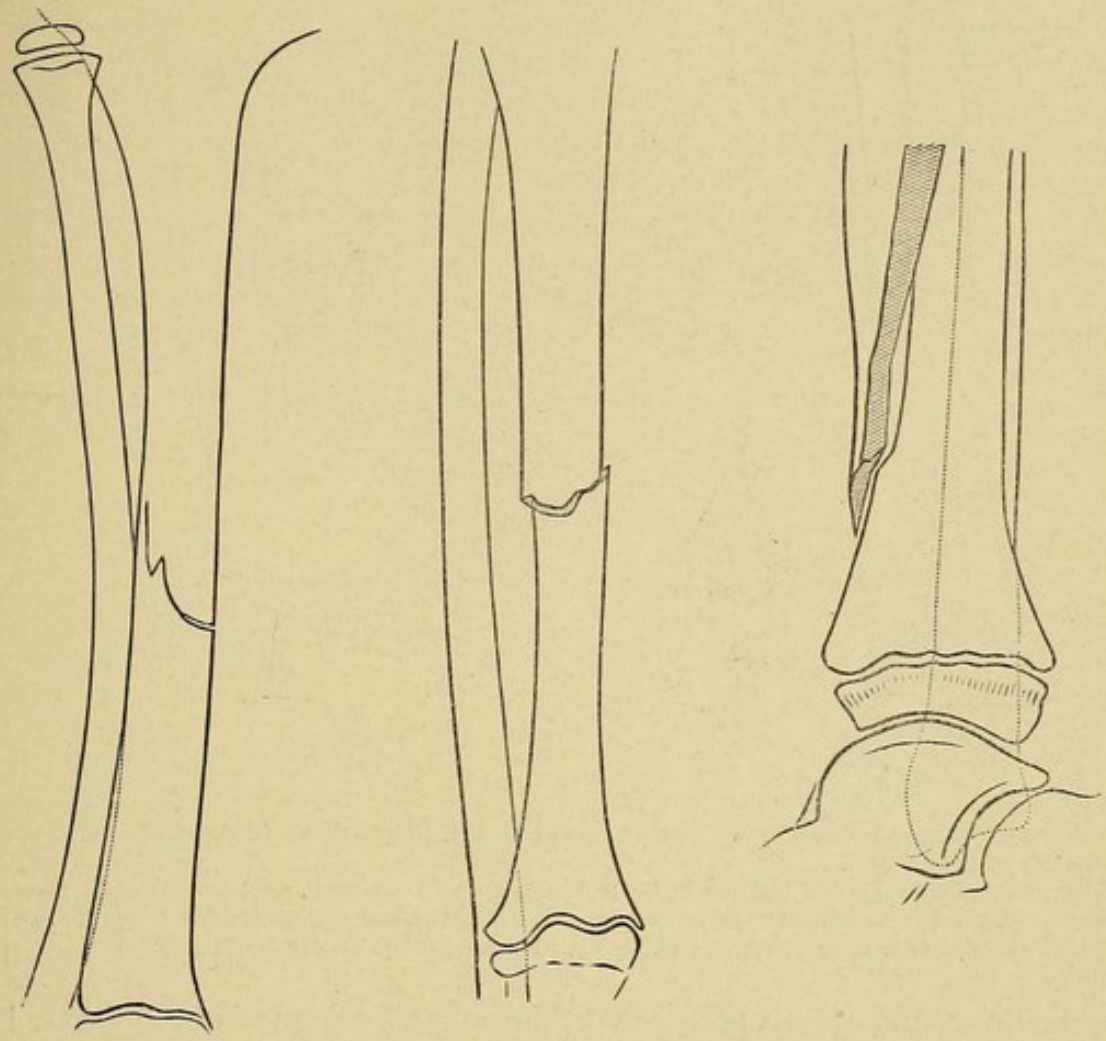


Fig. 382.—Incomplete fracture middle of shaft in a boy, aged five years. (Compound.) Note bending of fibula without fracture. Anteroposterior view.

Fig. 383.—Lateral view of same case, shows that fracture must be very nearly complete.

Fig. 384.—Very oblique fracture in lower third of shaft in a boy, aged fifteen years, caused by a horse falling on his leg. Clinical diagnosis not difficult. Lateral view.

either rupture or contusion of this nerve trunk. Such injury is characterized by pain referred to its course of distribution, or local anesthesia and extensor palsy.

Fractures of the lower third of the leg often fail to unite. This condition is characterized by prolonged disability and recurring pain on use, usually there is an enormous growth of callus and preternatural mobility. It may be difficult to elicit this last symptom. The findings of the *x*-rays are conclusive. Fracture from trifling cause always suggests an underlying bone lesion. In the case of the tibia, bone cysts and central sarcomata should be considered.

Inflammation of the Tibia and Fibula.—**Osteoperiostitis** of the tibia in its acute form may be due to traumatism or may appear as a local expression of systemic infection, particularly of syphilis or typhoid.

Acute traumatic osteoperiostitis, incident to contusions, is characterized by excessive pain, great tenderness, swelling which is obviously attached

Fig. 385

Fig. 386

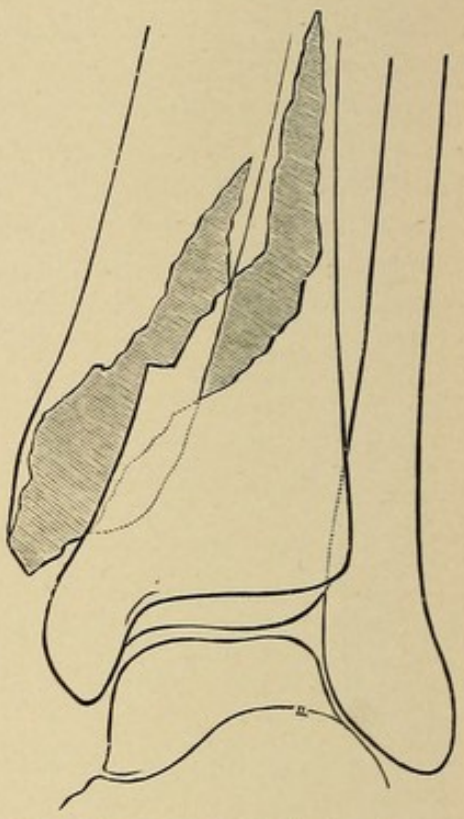


Fig. 385.—Anteroposterior view of same case as Fig. 384. Remarkable in showing no evidence whatever of the fracture.

Fig. 386.—Oblique spiral fracture in lower fourth of shaft in a man, aged seventy-eight years. Clinical diagnosis not difficult. Reduction (outward displacement and shortening) very difficult. Anteroposterior view after attempted reduction. (Lateral shows no displacement.)

to the bone, and often a permanent thickening. Diagnosis from fissured fracture must be made by the *x*-rays. Secondary suppuration is denoted by aggravation of symptoms with increasing edema.

Syphilitic osteoperiostitis, which exhibits a preference for the tibia, may occur in either the secondary or tertiary stage of the disease. In the form of painful, extremely tender, rapidly developed nodules, it is an early secondary symptom which yields readily and completely to specific treatment.

Gummatous osteoperiostitis, exhibiting a predilection for the lower third of the tibia, develops slowly and apparently causelessly, or following inadequate trauma. It is at times painless, or may be extremely painful. The diagnosis is based upon associated symptoms of syphilis and the prompt yielding to mercurial treatment.

Typhoid Osteoperiostitis.—Typhoid osteoperiostitis is superficial, subacute, usually painless, follows the type as seen elsewhere. Diagnosis is based upon the apparent causelessness of a superficial subacute osteitis other than a preceding attack of typhoid fever.

Acute Osteomyelitis.—Acute osteomyelitis exhibits a special predilection for the tibia, attacking by preference the ends of the bone, often involving the entire shaft. Epiphyseal and joint involvements are secondary processes.

In the hyperacute form the onset is characterized by the constitutional symptoms of profound sepsis, while locally there is intense pain which may be referred to the nearest joint, extreme sensitiveness to deep pressure, and absolute crippling. Edematous swelling of the soft parts rapidly supervenes.

The effusions in the knee and ankle-joints, occurring as complications of osteomyelitis of the tibia, is in the early stages serous. Later, it may become seropurulent, or even frankly suppurative, the original infection being then complicated by the symptoms of a purulent arthritis.

There is an acute non-suppurative osteomyelitis which can be dis-

FIG. 387[1]

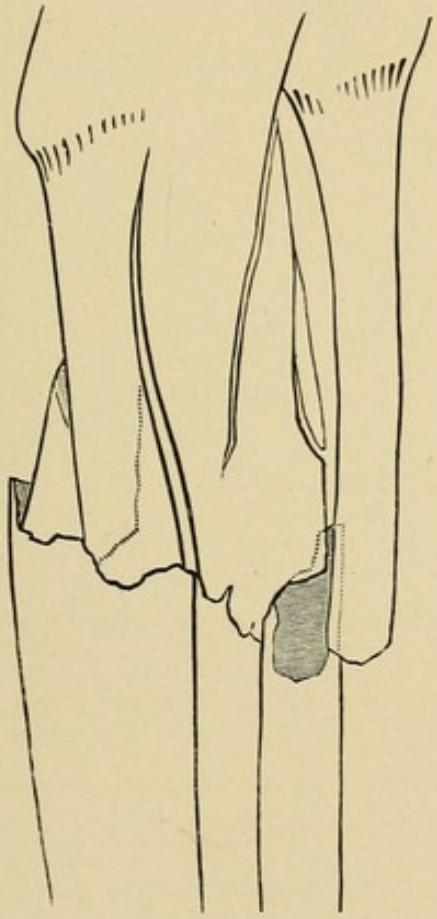


FIG. 388

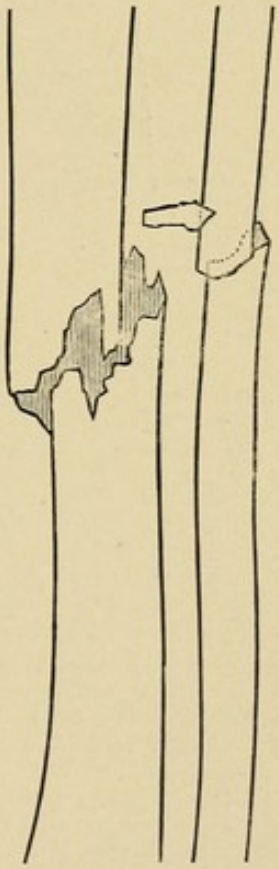


FIG. 387.—Fracture of both bones at about junction of upper and middle thirds of shafts, and about same level, tibia being comminuted. Radiograph made several weeks after injury, and indicates delayed union in tibia and no attempt at union in fibula. Lateral view. (Male, aged thirty-five years.)

FIG. 388.—Fracture of both bones just below middle of shafts. Both oblique; fibula slightly comminuted and tibial fracture very irregular. This fracture somewhat unusual from standpoint of cause, a fall from a roof, patient, a boy, aged eleven years, landing on his feet. Note fairly good apposition and position of fragments indicated in this view (fore-and-aft) and compare with Fig. 389.

[1] Figs. 387 to 400. Fractures of the shafts of both bones of the leg. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. Frazier, White, and Martin, and private cases of Dr. Pancoast.

FIG. 389 FIG. 390 FIG. 391

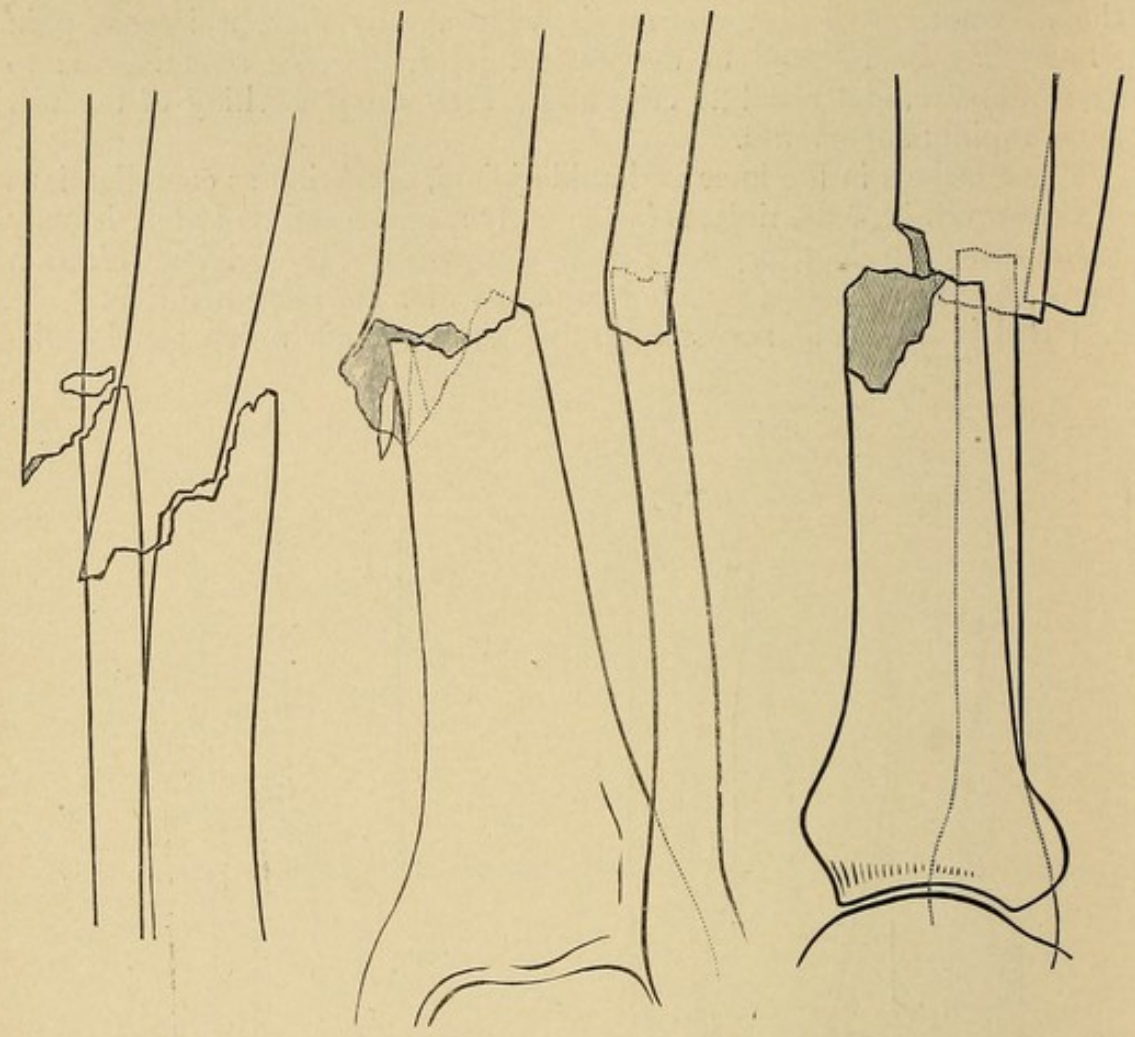


FIG. 389.—Lateral view of same case as Fig. 388 Note shortening and forward displacement of lower fragments, neither of which is indicated in anteroposterior view.

FIG. 390.—Fracture of both bones at about lower and middle thirds of shafts, transverse, and at same level. This is the type usually resulting from direct violence at seat of fracture. Patient, male, aged twenty-four years. Anteroposterior view shown here indicates only an angular deformity. (Compare with Fig. 391.)

FIG. 391.—Lateral view of same case as Fig. 390. Note additional deformity shown and requiring correction.

tinguished from the phlegmonous form only by its slower progress and the absence of pus formation, the exudate being serous.

The subacute form of osteomyelitis may develop with slight constitutional symptoms, moderate pain, tenderness localized in the bone, and local swelling. The exact seat of inflammation is determined by the *x*-rays. The distinction from tuberculosis, rare as a primary lesion of the shaft, is based upon the seat of the inflammation, the examination of the pus discharge, and prompt recovery after extrusion or removal of the sequestrum.

The diagnosis of the chronic, sclerosing, non-suppurative form of osteomyelitis is based upon the persistence of pain, tenderness, and disability, in the absence of pronounced constitutional symptoms and the findings of the *x*-rays. The onset of this form may closely simulate that of acute

Fig. 392

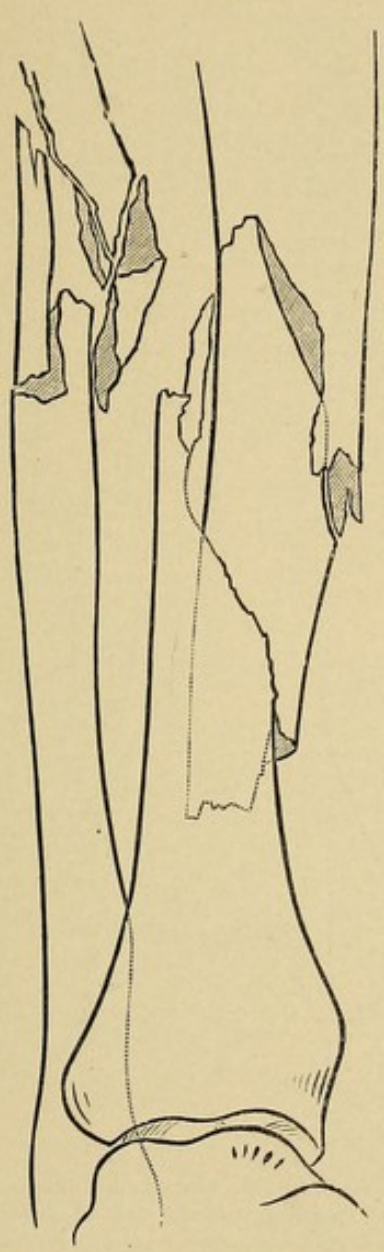


Fig. 393

Fig. 392 —Compound comminuted fracture of both bones at about lower and middle thirds of shafts, with fibular break at a slightly higher level. Cause was a fall from a second-story window, the patient, a male, aged about twenty-six years, landing on the foot of this side. Compare this fracture with the one represented in Figs. 388 and 389, which was due to practically the same cause. Fore-and-aft view.

Fig. 393.—Lateral view of same case as Fig. 392, showing excellent apposition of fragments.

osteomyelitis. It is a rare affection, complicated at times by acute suppurative inflammation in other bones, or sequent to a previous osteomyelitis.

Abscess of the Tibia.—In the cancellous structure of the upper part of the tibia an abscess may remain partly encapsulated for years, giving no symptoms, save tenderness to deep percussion and pressure, and thickening of the bone, either palpable or demonstrable by the *x*-rays.

There is a previous history of acute osteomyelitis, non-progressive in type, subsiding under local treatment without operation, but recurring,

Fig. 394

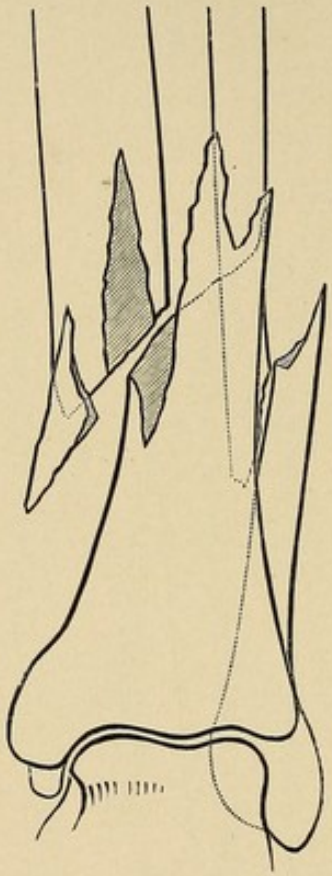


Fig. 395

Fig. 394.—Fracture of both bones at about junction of middle and lower fourths of shafts. Both oblique, and fracture of tibia comminuted and tending toward the so-called "spiral" type. Both bones broken at practically the same level. Anteroposterior view is represented and shows complete lateral displacement with over-riding. (Female, aged thirty-six years.)

Fig. 395.—Fracture of both bones at different and unusual levels—tibia at lower and middle thirds of shaft and fibula just above its malleolus. Both oblique and readily permit shortening. (Male, aged fifty-three years.) Anteroposterior view.

at least so far as pain and tenderness are concerned, at irregular intervals, and usually as a result of slight trauma or overuse.

Positive diagnosis is suggested by the *x*-rays, and is made by trephining the bone. Nor can timely differentiation from central sarcoma always be made in any other way.

As the result of osteomyelitis the bone may be extensively destroyed or its growth may be stimulated or inhibited, with the local resultant deformities.

Tuberculosis.—Tuberculosis of the bones of the leg is usually limited to the epiphysis, manifesting itself mainly in the form of chronic

FIG. 396 FIG. 397 FIG. 398

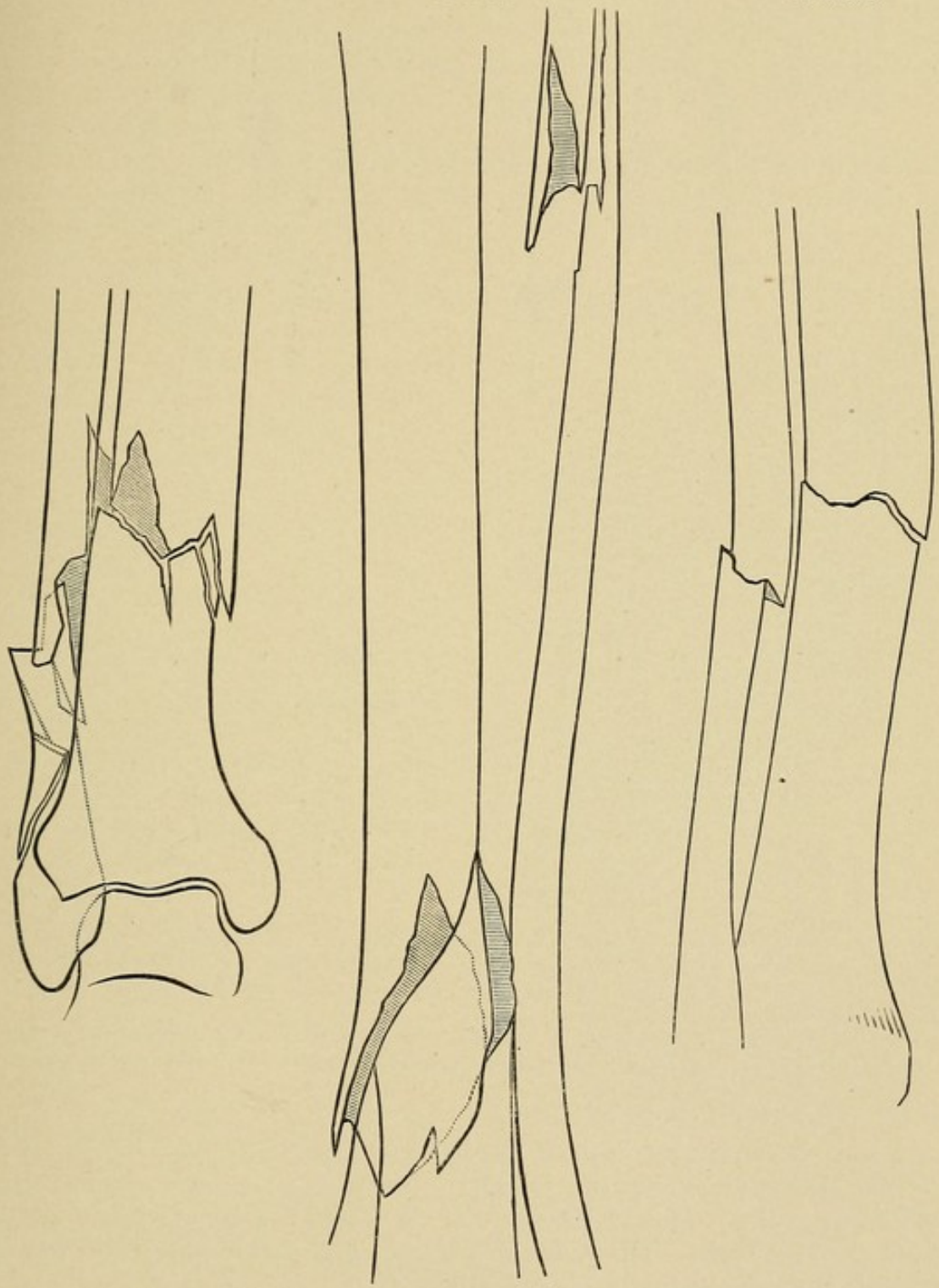


FIG. 396.—Fracture of both bones, comminuted, and at somewhat different levels, tibia, lower and middle fourths, and fibula throughout entire lower fifth. (Adult female.) Anteroposterior view.

FIG. 397.—Fracture of both bones, with extreme degree of difference in levels. Both broken obliquely, tibia in lower fourth of shaft and fibula in its upper fourth. A striking example of the type of fracture resulting from indirect violence. (Male, aged seventy years.) Anteroposterior view.

FIG. 398.—Fracture of both bones at about junction of middle and lower thirds of shafts, transverse, and nearly same level. Unusual cause. (Compare with Fig. 390.) Fracturing force must have been essentially a twisting strain resulting from an attempt to board a rapidly moving car. Left foot was fixed on step, but not caught, and carried forward, while the body and extremity above swung around relatively. (Male, aged twenty-three years.)

Fig. 399 Fig. 400

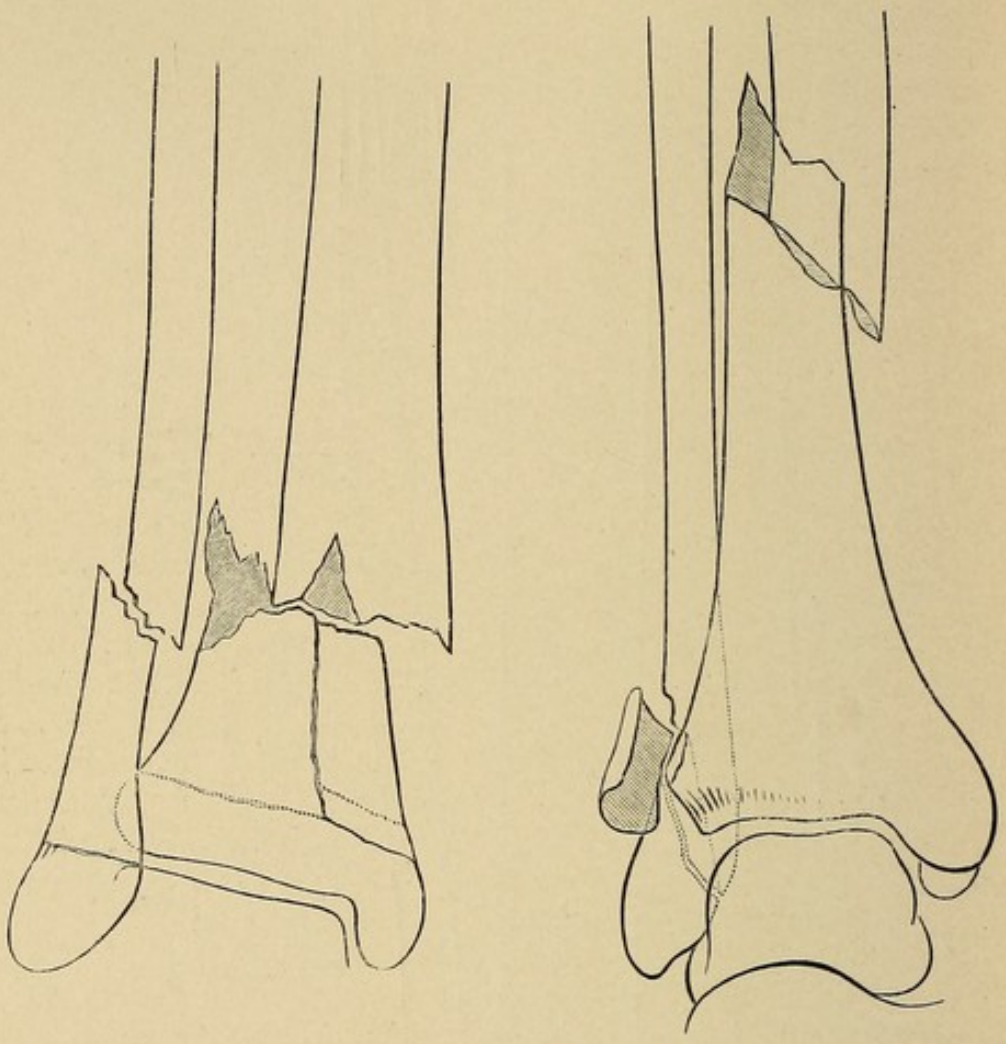


Fig. 399.—Compound fracture of both bones at same level and just above ankle, broken transversely, and in addition a longitudinal fissure through lower tibial fragment extending downward to epiphyseal line, but not through the epiphysis. Injury resulted from direct violence—crushed under a car wheel. (Male, aged eighteen years.)

Fig. 400.—Fracture of both bones at different levels, tibia at junction of lower and middle thirds of shaft obliquely, and fibula comminuted through entire malleolus. (Adult male.)

arthritis. Early recognition of the focus of infection by the *x*-rays may be the means of saving the joint.

Exceptionally it attacks the shaft of the bone, usually as an extension from the epiphysis. The onset is insidious and slowly progressive, and there is a tendency toward fistulization.

When the tuberculous process invades the entire shaft of the bone (rare) it exhibits a more acute onset than is usual with this form of infection, but is thereafter characterized by its slow, steady progression and the ultimate development of characteristic fistulæ and sequestra.

Diagnosis is usually based upon the presence of tuberculous lesions elsewhere, the result of the tuberculin test, the characteristic, thin, cheesy, purulent discharge, microscopic examination, and particularly animal inoculations.

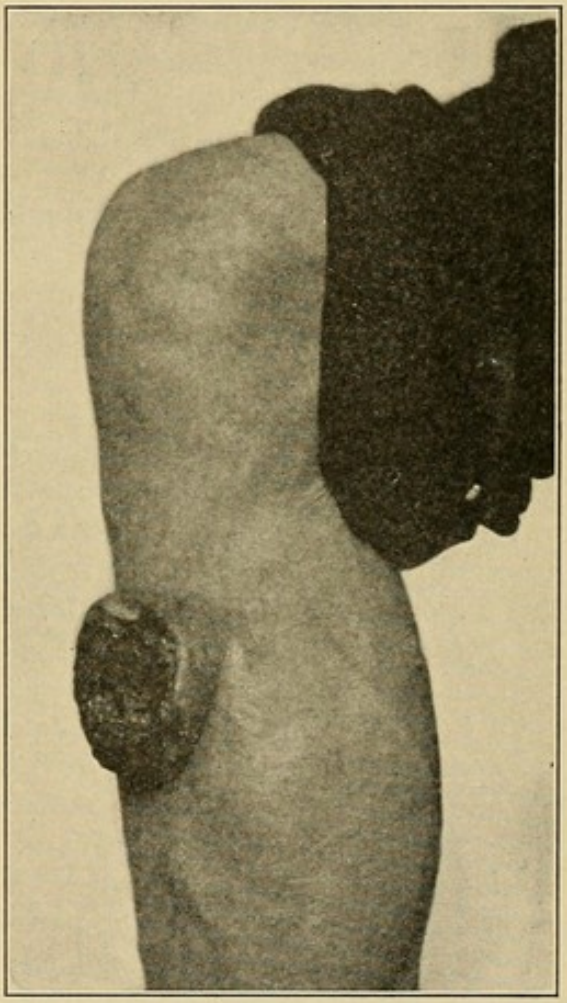
Tumors.—Malignant tumors originating in the soft parts of the leg are not common. A cancerous degeneration of a chronic ulcer has been mentioned. Sarcoma in its beginning cannot be differentiated either from lipoma or fibroma, excepting by excision. This should be the means of diagnosis.

The tibia is the favorite seat of bone sarcoma, both in its periosteal and central form. It is usually placed near the extremity and in its early stages does not differ in symptomatology from a chronic or subacute osteomyelitis. The periosteal sarcoma in its further development forms a palpable tumor, fusiform and not exhibiting either the nodulation or consistency of exostoses or chondromata. The *x*-rays are strongly suggestive; diagnosis should be made by operation.

Persistent deep-seated pain is the usual symptom of central sarcoma. During this stage a probable diagnosis can be made by the *x*-rays. It should be corroborated if gumma can be excluded by immediate operation. The later development of these tumors is usually characterized by rapid growth and the attainment of large dimensions before ulceration or fistulization takes place.

Bone cysts usually give rise to few symptoms other than a slight enlargement of the bone. They are slow in growth and their presence is often first suggested by spontaneous fracture on slight traumatism. The *x*-rays are usually diagnostic.

FIG. 401



Epithelioma. Indolent (years), indurated, infiltrating, fungating lesion growing from a chronic ulcer.

THE KNEE.

The thick, coarse skin, with comparatively little subcutaneous fat, covering the front of the knee-joint, is more redundant and freely movable than that of finer structure, and provided with an abundant panniculus lying at the sides and back of the joint.

The patella, with the leg straight and the quadriceps relaxed, is freely movable from side to side, and readily palpated even in fat subjects.

The condyles of the femur, of which the internal is the more promi-

nent, can be palpated, the adductor tubercle placed at the upper border of the inner condyle forming its most prominent bony projection. The inner and outer tuberosity of the tibia, the latter being more prominent, the end of the fibula, the upper extremity of which is about a finger's width below the line of the joint, the tubercle of the tibia at about the same level, with the patellar ligament inserted into it, are all easily identified.

The tendons of the semitendinosus and semimembranosus forming the inner upper margins of the popliteal space, and of the biceps forming its outer margin, are conspicuous landmarks. The lymphatic glands of this space cannot be felt in normal individuals. They occupy a midline position and drain the superficial area corresponding with the distribution of the short saphenous vein, including a part of the sole and the knee-joint.

To either side of the patella and above it, excepting in fat people, there is a depression, the obliteration of which is characteristic of joint effusion. The depressions at the sides of the ligamentum patellæ, best marked in moderate flexion, are obliterated in fat people by an increase in the fat pad, which, with lateral extensions, normally lies between the ligament and the joint.

The line of the joint is roughly indicated by the lower border of the patella. The synovial membrane reaches a higher point over the front of the inner condyle than it does over the outer. It usually exhibits an anterior pouch extending for a distance of two fingers' breadth above the upper border of the patella. This prolongation may be entirely separate from the joint, or may communicate with it by a narrow opening.

Of the many bursæ placed about the knee-joint, those most frequently involved in surgical affections are: the prepatellar bursæ, of which there may be three, separate or intercommunicating, lying between the various layers of the fibrous investment of the anterior surface of the patella; the infrapatellar bursa, placed between the ligamentum patellæ and the tubercle of the tibia, with the pad of fat naturally lying in this position interposing between it and the joint; the bursa between the gastrocnemius and the semimembranosus tendon, lying to the inner side of the popliteal space and above the line of the joint.

The tibia normally joins the femur in a position of slight varus.

The motions of the knee-joint are flexion, limited by contact of the calf muscles with the flexors of the thigh, extension to the straight position, and, when the leg is moderately flexed on the thigh, rotation; this necessarily implies a slight degree of lateral rocking.

Surgical affections of the knee-joint are characterized by deformity, swelling, pain, tenderness, muscular contraction and atrophy, and limitation or exaggeration of motion.

Deformity, usually obvious to inspection or palpation, may require an *x*-ray examination for its detection. The swelling, if intra-articular, is characterized by a filling out of the normal depressions at the sides of and above the patella, and, if it be due to effusion, by a floating up of

this bone. Extra-articular swelling, if localized, is obvious to inspection and palpation.

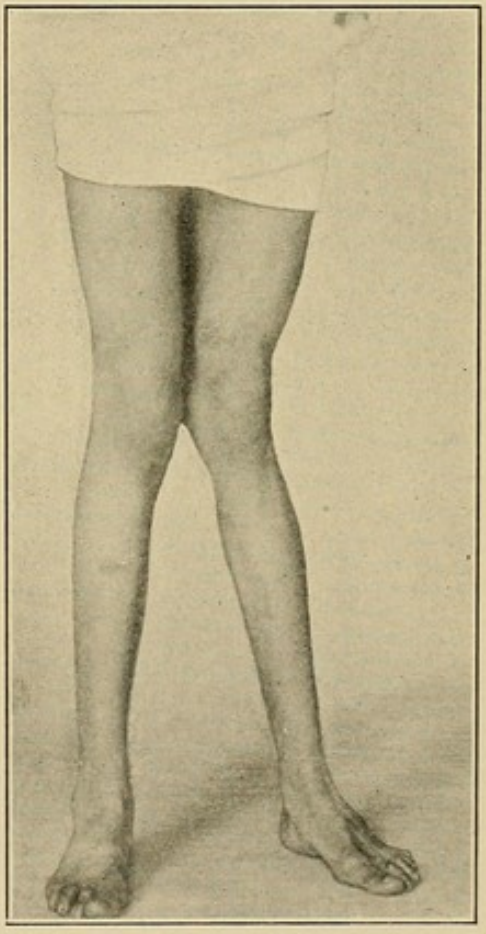
The pain of knee-joint affections, unless this be referred (usually from the hip) or be neuralgic in type, is aggravated by motion, by deep palpation and jarring, and is subject to spasmodic exacerbation incident to muscular contraction.

In localized lesions the seat of pain and tenderness is usually indicative of the seat of lesion.

Muscular atrophy develops most rapidly and is most pronounced in the quadriceps, though all the muscles concerned in the joint movement become involved.

Limitation of motion, if incident to an inflammation, is due in the early course to pain and muscular spasm, later to fibroid changes or bony ankylosis. Exaggerated lateral or antero-posterior movements are characteristic of ligamentous rupture from trauma or of overstretching from failure of muscle support or intra-articular effusion.

FIG. 402



Knock-knee (genu valgum). Knees in apposition. Feet widely separated. Patient in habit of carrying heavy baskets, which he permitted to press against outer side of knees. (Carnett.)

Deformities of the Knee.—Gross congenital deformities such as absence of the patella are obvious on inspection.

Genu Recurvatum.—Genu recurvatum, a term applied to over-extension, may be congenital or acquired.

The congenital form is often accompanied by other deformities, particularly club foot. The popliteal space is prominent, and there may be inability to flex.

The acquired form is commonly due to club foot which places an undue strain upon the knee. Inherent ligamentous relaxation, hip-joint fixation, or direct injury may cause this deformity.

Pain, discomfort, and hyperextension during weight-bearing are the characteristic features. The diagnosis is made by inspection.

Genu Valgum.—Genu valgum, or knock-knee, which usually develops in infancy or childhood, exceptionally about the period of puberty, incident to overuse, is commonly attributed to rickets, though a failure of muscular coördination and habitual faulty attitude may be causative factors. With the knees pressed together and the patient standing, both tibiæ incline downward and outward, and the feet are more or less widely separated. The condition is usually bilateral and is associated with genu recurvatum and flat foot.

Genu Varum.—Genu varum, or bow leg, is usually dependent upon a deformity not of the knee-joint, but of the upper portion of the tibia. It is customarily associated with inward rotation of the tibia producing a pigeon-toe gait. Diagnosis is obvious.

Ankylosis.—Ankylosis of the knee-joint, either bony or fibrous, is the after result of previous inflammation. The diagnosis is obvious and the amount of joint destruction can best be determined by the *x*-rays.

Contractures of the knee-joint, exceptionally congenital, frequently secondary to inflammation in or about the joint, or sequent to infantile palsy, are characterized by partial fixation of the knee in a faulty position, usually more or less pronounced flexion, often combined with outward rotation and subluxation backward.

Trauma of the Knee.—The immediate effects of trauma applied to the knee are wound, contusion, sprain, fracture, or luxation. The usual injuries are contusion and sprain.

Wound.—Wound of the knee is obvious. If it be large the presence or absence of joint penetration is readily determined. Punctured wound or foreign body may cause a synovial effusion even though the joint is not involved. In case of doubt as to the nature of this effusion, aspiration and examination of the exudate are indicated.

Contusion.—Contusion of the knee, if it involves the soft parts alone, is characterized by moderate and ephemeral pain, rapid, often extensive skin discoloration, and, if the prepatellar bursa be involved, a blood effusion into the sac causing a distinctly circumscribed fluctuating or semisolid tumor.

When the joint is contused, usually from force applied to the inner side of the patella when the knee is flexed, there are severe persistent pain, marked disability and rapid intra-articular effusion with prompt discoloration at the seat of impact.

Because of the immediate swelling and the extreme tenderness, associated cartilaginous or bone lesions usually escape detection until their presence is suggested by slow and unsatisfactory convalescence. The exclusion of bone lesion should be accomplished by the *x*-rays.

Sprain.—Sprain of the knee, usually involving the internal lateral ligament, and incident to any force tending to exaggerate the natural slight genu valgum, is characterized by severe pain, local tenderness, discoloration, usually effusion into the joint, and, if the ligament be ruptured, increased lateral mobility, with at times a slight displacement of the tibia upon the femur, the former bone carrying with it the intact semilunar cartilages. This condition, really a recurring subluxation of the tibia, usually due to considerable violence, constitutes one form of dislocation of the semilunar cartilage, and is characterized by a weak joint subject to sudden painful locking, incident to slight force in the direction of rotation while the leg is semiflexed and the muscles are relaxed. These painful lockings are followed by synovial effusion.

Subluxation of the semilunar cartilage, usually the inner and in a forward direction, is due to forcible inward rotation of the femur upon the flexed tibia. It is characterized by severe pain, usually fixation of the

joint in flexion, rapid effusion, tenderness over the semilunar cartilage, and in the case of forward displacement palpable deformity. Since this displacement always implies a ligamentous rupture, there is left a weak joint with tendency to recurrence of acute painful displacement upon slight traumatism.

Rupture of the semilunar cartilage, the usual injury when this structure can be felt projecting externally or when it is driven internally (rare), and its absence can be noted, exhibits the symptomatology described under subluxation.

The after effects of these injuries are recurring attacks of neuralgic pain associated with a joint subject to synovial effusion from overuse or slight strain. In some instances there develops a chronic synovitis with effusion, capsular thickening, creaking, and recurring attacks of sudden fixation.

Rupture of the ligamentum patellæ exhibits the disability of fractured patella with a break in the continuity of the ligament detected by direct examination. Unless the rupture be close to the tibial attachment of the ligament, there will be effusion of blood into the joint.

Rupture of the quadriceps tendon, characterized by severe pain, partial or complete loss of extending power, local tenderness, and a break in the continuity of the tendon, is readily felt by palpation, even though it be obscured by the free subcutaneous hemorrhage common in this injury.

Rupture of the crucial ligaments, incident to either hyperextension or rotation, often associated with a tearing loose of a bony fragment from the femur, is characterized by severe pain and rapid blood effusion into the joint. Preternatural mobility of the tibia on the femur in an antero-posterior direction, usually associated with lateral wobbling, is characteristic, as is also the finding of a loose bony fragment in the joint by the *x*-rays.

Contusion or tear of the alar ligaments, the ligamenta mucosa, or the synovial fringes, incident to trauma not sufficiently severe to cause rupture of the stronger ligaments, is characterized by the tenderness, pain, disability, and joint effusion typical of contusion or sprain. As a sequel to such injury, convalescence is slow and incomplete. Either free or attached bodies are prone to develop; these may be fatty, fibrous, cartilaginous, or even calcareous.

Osteoarthritis of the Knee.—Osteoarthritis of the knee, either in its hypertrophic or atrophic form, may be limited to the joint, but is usually associated with similar lesions of other joints. The atrophic form, usually affecting women of middle age or before it, exhibits the gradual onset, pronounced muscular atrophy, spindle-shaped swelling, and joint creaking characteristic of the affection. The hypertrophic form, occurring frequently at a more advanced age, may attack the knee alone and remain limited to it. Slow progression (years) of symptoms, slight or absent exudation, obvious bony and cartilaginous deformity, and absence of constitutional symptoms are suggestive symptoms. Absolute diagnosis can be made by the *x*-rays.

In its chronic form hemophilia is characterized by recurrent attacks

of intra-articular hemorrhage followed by extensive destruction of joint surfaces, producing ultimately the changes characteristic of advanced osteoarthritis. In the absence of the hemophilic history or aspiration of blood from the joint, the distinction from tuberculosis or osteoarthritis of other origin may be difficult.

Fractures about the Knee.—The break may involve the patella, the epiphyses of the femur or tibia, or their condyles or tuberosities.

Fracture of the patella, an affection of active adult males, is usually incident to a sudden violent pull of the quadriceps tendon and is transverse. When caused by direct violence, the fracture lines are often multiple, running in any direction.

The characteristic symptoms are a sudden and painful loss of the power of extending the leg, following a blow, or a muscular effort in which

FIG. 403[1]

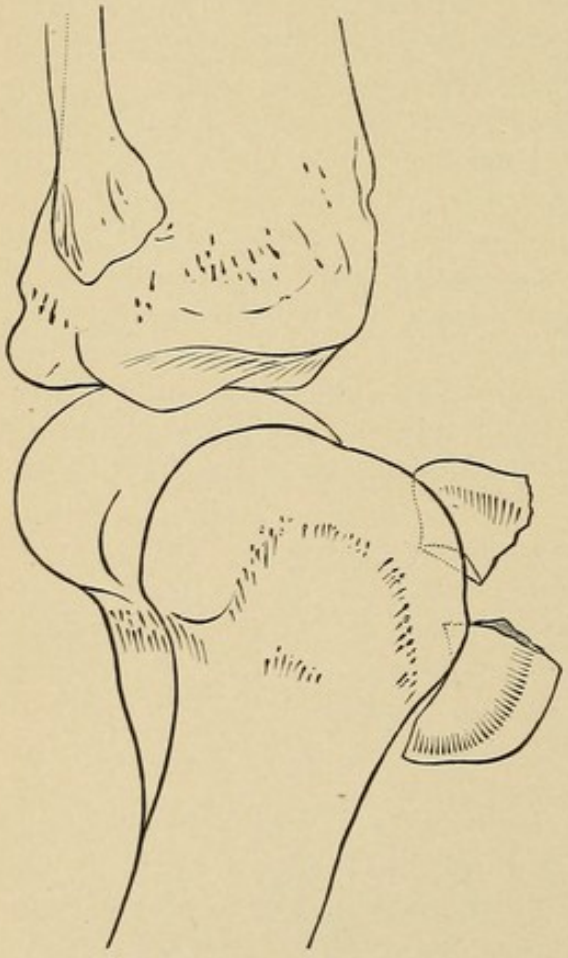


FIG. 404

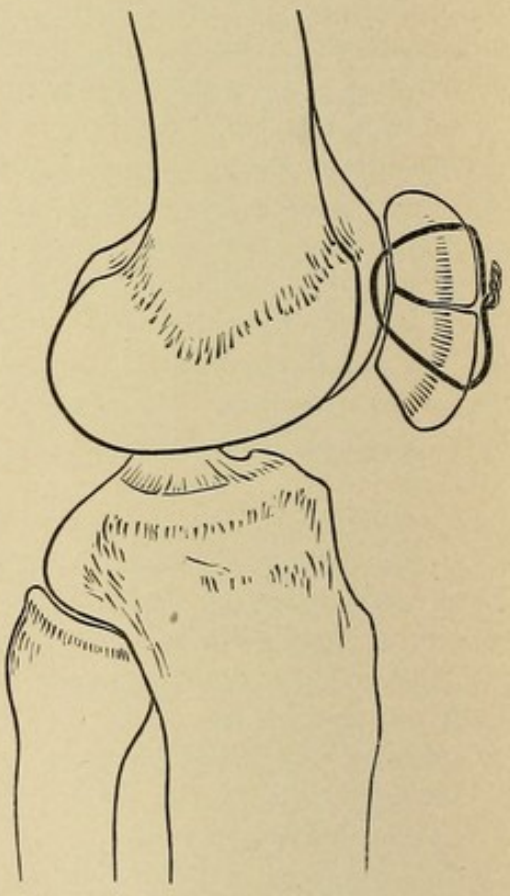


FIG. 403.—Transverse fracture of patella, in adult male, ununited six months after injury. Example of usual type and about average amount of separation of fragments. Note forward and downward tilting of lower fragment in this case.

FIG. 404.—Fracture of patella similar in type to preceding one, in a male, aged twenty-two years, six weeks after open operation and wiring. Radiograph indicates some bony union between deeper portions of fragments.

[1] Figs. 403 to 406. Fractures of the patella. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. Wood, Frazier, and Martin.

Fig. 405

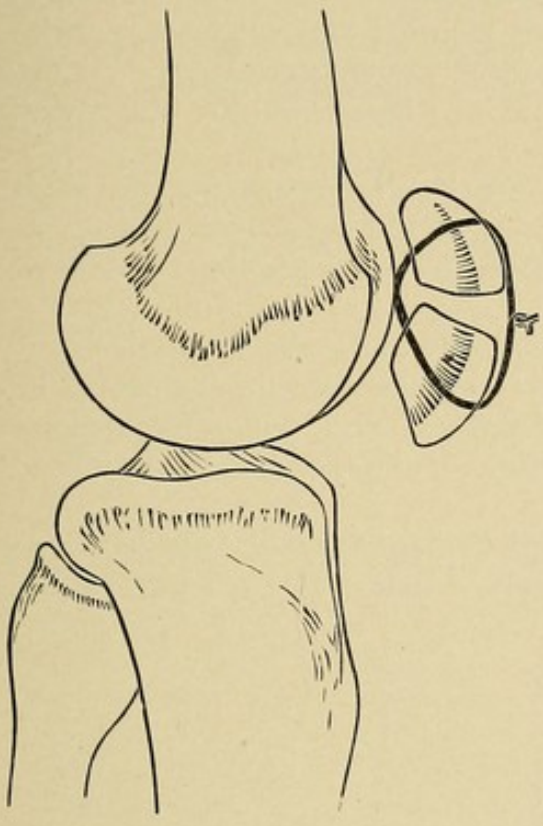


Fig. 406

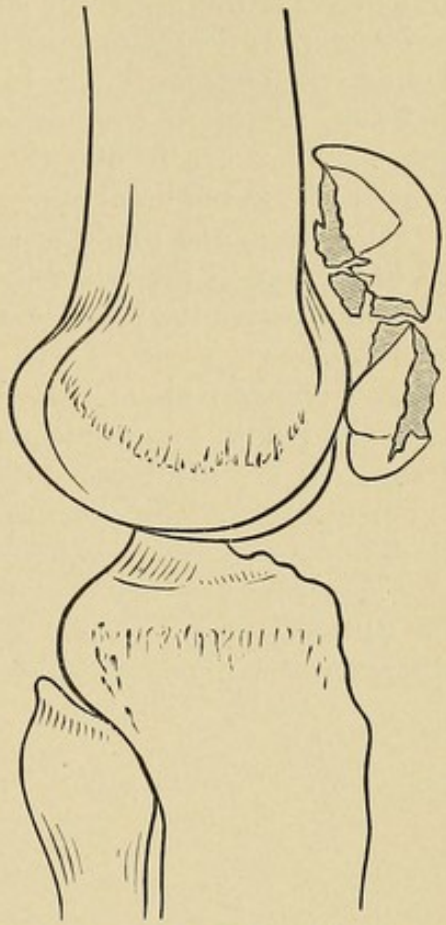


Fig. 405.—Refracture in same case as Fig. 404, resulting from a fall about six weeks later. Radiograph suggests partial untwisting of wire and loop unbroken and still tending to prevent wide displacement. (Open wound rendered fracture compound, and septic arthritis followed.)

Fig. 406.—Comminuted fracture of patella, in adult male, result of direct violence—fall from a ladder, striking on knee. Radiograph three hours after injury. Clinical diagnosis of fracture and variety not difficult, but *x*-rays important to determine amount of comminution and separation before operation, and also advisability of latter.

something is felt to have broken. If the fracture be complete and the fibrous expansion to either side of the patella be torn, there is marked separation of the fragments, and a groove which is widened by flexion can be felt between them. The amount of separation depends upon the extent to which the lateral aponeurosis of the quadriceps muscle is involved. There is an immediate blood effusion into the joint, often also into the prepatellar bursa.

Fractures due to direct violence are evidenced by skin ecchymoses at the point of impact and usually by comminution.

The diagnosis in case of wide separation is readily made. When the separation is slight, owing to preservation of the ligamentous attachments, it may depend upon eliciting preternatural mobility, the patella being grasped from above and below and the parts being pressed alternately from side to side.

Blood effusion into the prepatellar bursa may give the examining finger an area of lessened resistance and a crepitation simulating

fracture. The patella is firm throughout, and flexion of the leg does not increase the apparent space.

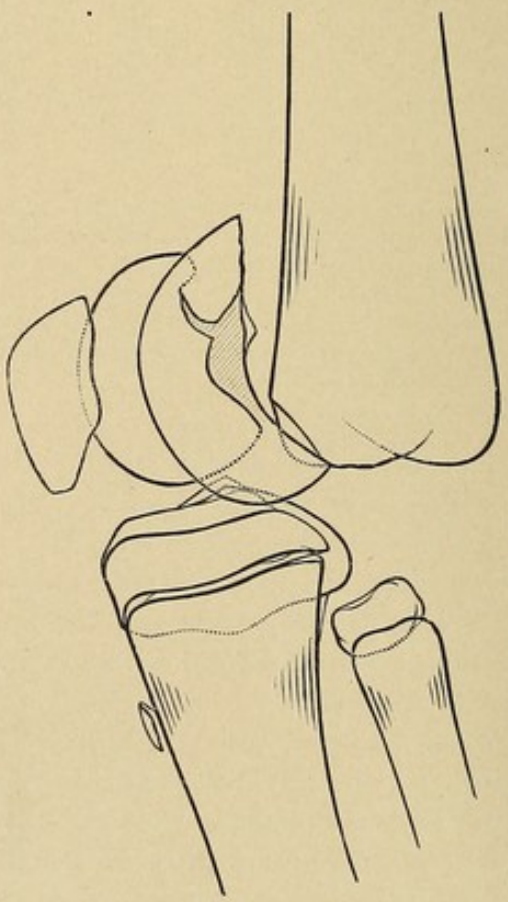
Fracture of the femur near the knee-joint, or involving it, may be condylar or epiphyseal. These fractures are incident to great force, usually indirect, are often compound, and, except the epiphyseal, involve the joint. They are frequently complicated by lesions of the vessels and nerves of the popliteal space.

Fracture of the condyles is due to direct or indirect force, the shaft of the femur in the latter instance acting as a down-driven wedge. It always involves the joint, hence is attended by rapid swelling from blood effusion.

One condyle alone may be involved. Usually the break is intercondyloid and communicates with a transverse fracture above. The fragments are displaced outward and upward, and, unless the swelling be excessive and the tenderness prohibitive, crepitus and preternatural mobility are readily elicited.

The *x*-rays are necessary for a complete diagnosis, since displacement of the articular surfaces may be pronounced, and yet not readily demonstrable by any other means.

FIG. 407[1]



Separation of lower epiphysis of femur, with complete anterior and upward displacement, in a boy, aged eleven years. Caused by foot being caught in spokes of a wagon wheel while "stealing a ride." Lateral view, before reduction.

[1] Fig. 407. Outline drawing from radiograph by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patient referred from service of Dr. Martin.

Fracture of one condyle may be unattended by either undue mobility or deformity, joint effusion, persistent local tenderness, and disability being the only obvious symptoms.

Fracture of the adductor tubercle (rare) is characterized by local persistent tenderness and bony outgrowth. The diagnosis is made by the *x*-rays.

Separation of the lower femoral epiphysis, usually observed before the tenth year, impossible after the twentieth, is characterized by preternatural mobility and a deformity which may strongly suggest luxation. The

FIG. 408[1]

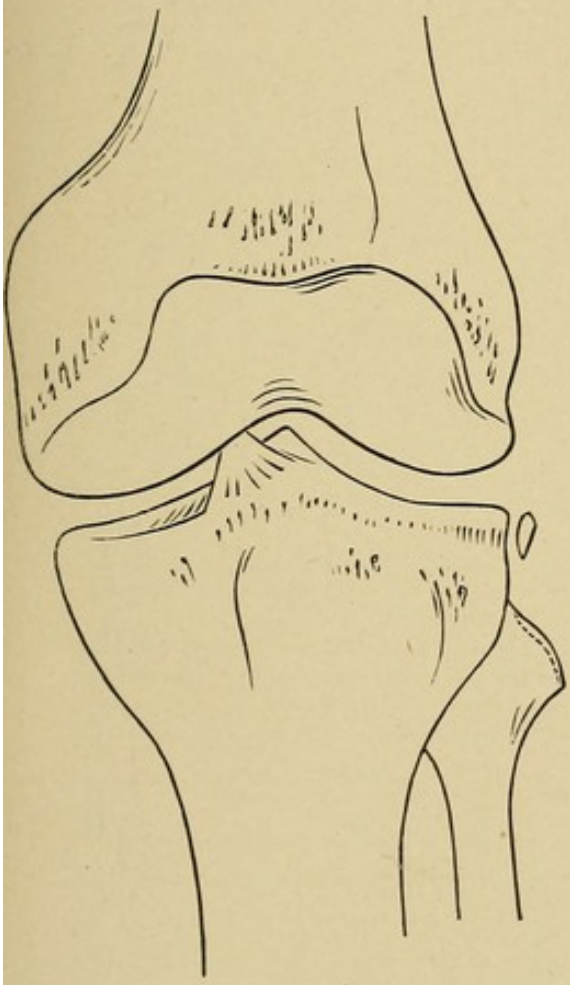


FIG. 409

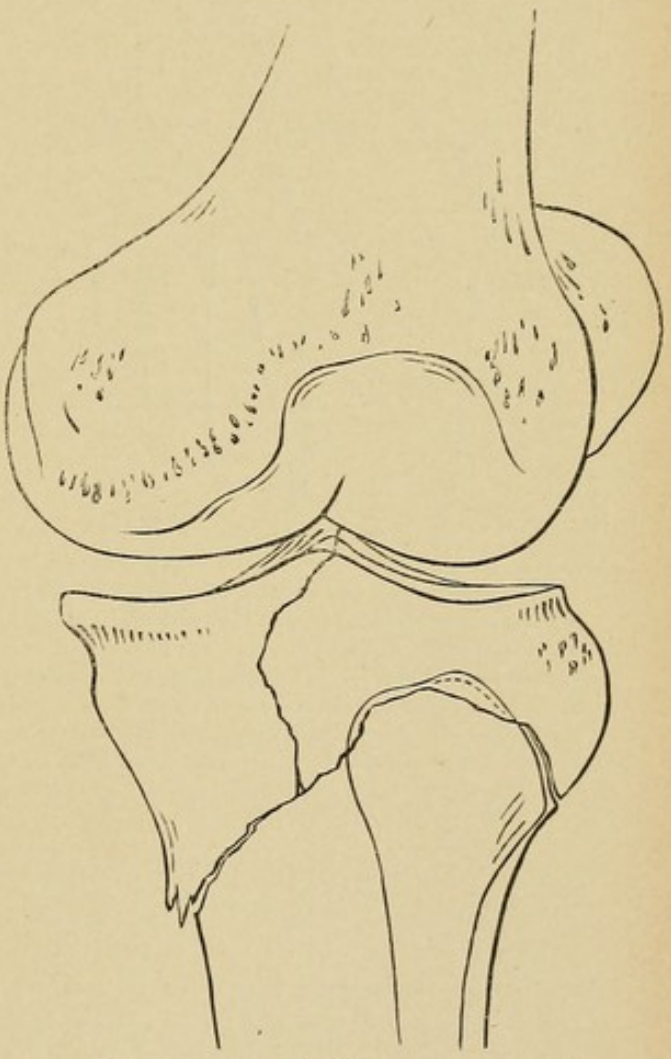


FIG. 408.—Example of a so-called "sprain fracture," in a male, aged thirty-seven years. A small, scale-like fragment has been separated from the outer surface of the head of the tibia, probably representing tearing away of attachment of lateral ligament. Injury caused by wheel of a wagon passing over the region of the patient's knee.

FIG. 409.—Fracture of head of tibia, comparable to a fracture of both tuberosities, or a so-called "T-fracture," but without separation of fragments or widening of joint. Radiograph suggests more or less impaction. Exact clinical diagnosis of such fractures difficult, and *x*-rays of great assistance. View represented nearly but not directly anteroposterior. An important feature is involvement of the joint. Male, aged sixty years.

[1] Figs. 408 to 412. Fractures of the bones of the leg at the knee. Outline drawings from radiographs by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory; patients referred by or from services of Drs. White and Wood.

FIG. 410

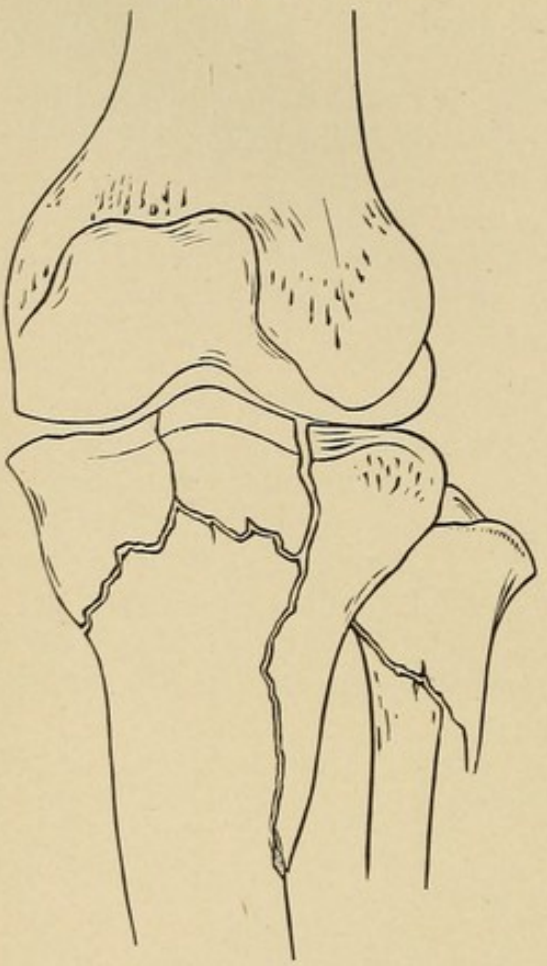


FIG. 411

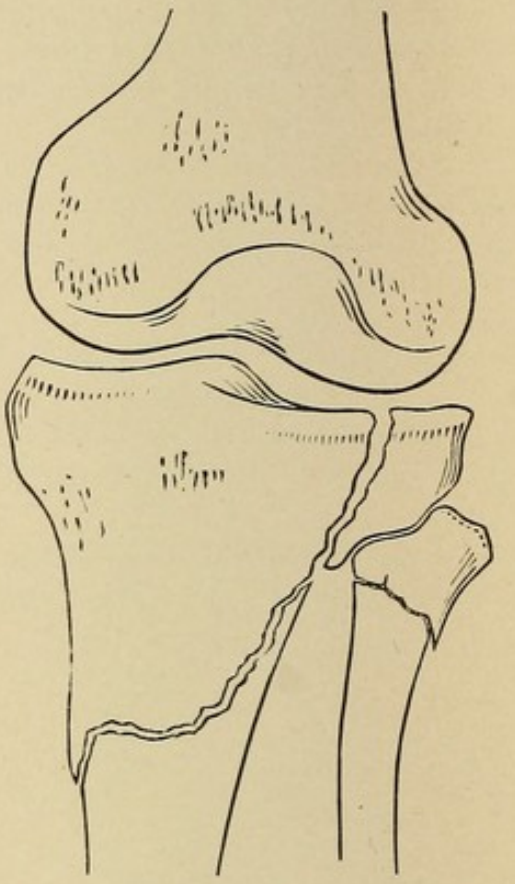


FIG. 410.—Fracture of head of tibia, similar in type to preceding one, but presenting more comminution, appreciable separation, and slight widening of joint. Also an additional fracture through neck of fibula. Patient (female, aged fifty-four years) was struck by a trolley car.

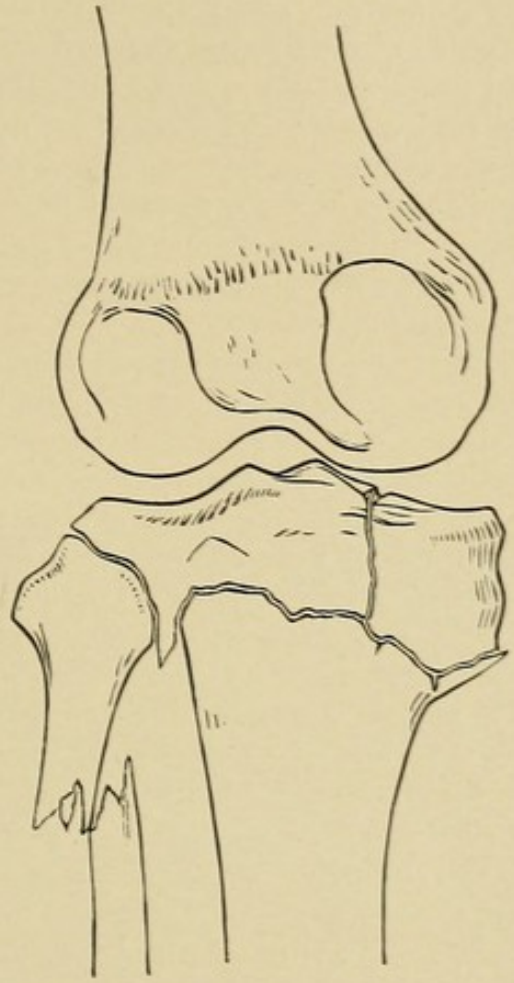
FIG. 411.—Fracture of head of tibia and neck of fibula, in female, aged fifty-eight years. Peculiar type, but presenting some features of preceding case. Not essentially a fracture of both tuberosities, but primarily a separate break through upper portion of shaft, which reaches outer surface of bone, whence the line is practically continuous with that of fracture through middle of outer tuberosity.

lower end of the upper fragment usually projects in the popliteal space, the lower fragment being carried forward and often so rotated that its broken surface is in apposition with the shaft of the diaphysis. The adductor tubercle remains attached to the shaft and the tibia retains its normal relations to the condyles. The age of incidence, the comparatively smooth, broken surface when this can be felt, possibly the moist crepitus, and the *x*-rays establish the diagnosis.

Fracture of the upper end of the tibia, incident to direct violence or jar in the long axis of the bone may be transverse or longitudinal, without involving the joint. Usually the line of fracture runs directly into the joint and results in separation of one or both tuberosities.

In addition to the hemarthrosis, disability, preternatural mobility, and local tenderness exaggerated lateral mobility is highly characteristic, the rocking being most marked in the direction of the fractured tuberosity. Diagnosis should, however, be made by the *x*-rays. This

FIG. 412



Fracture of head of tibia with distinct impaction and some separation of lateral fragment representing tuberosities, causing slight widening of joint. Also a fracture of upper portion of shaft of fibula. Caused by a jump from a second-story window. Female, aged forty-two years.

frequently shows fissures in the absence of the cardinal symptoms of fracture.

Separation of the upper tibial epiphysis (rare), possible up to the twentieth year, is observed mainly in males. It is characterized by displacement of the leg in any direction, except backward, the tuberosities of the bone maintaining their normal relation to the joint. The *x*-rays are diagnostic though the seat of fracture, transverse direction, and moist crepitus may be suggestive.

Diagnosis is based upon the obvious deformity and its seat.

Separation of the tubercle of the tibia incident to muscular action, and observed usually in athletic boys, is characterized by tenderness, pain and swelling in the region of the tubercle, and by the finding of the movable bone fragments if the separation be complete.

In the absence of complete separation, the persistence of tenderness, pain, disability, and bone swelling are suggestive symptoms which may be corroborated by the *x*-rays. As a consequence of partial fracture there may be a bony outgrowth in this region.

Dislocation of the Knee-joint.—*The tibia* may be displaced from the femur in any direction, usually as the result of very great violence, readily recognized by the obvious and palpable deformity.

The patella may be dislocated either outward or inward, or may be rotated on its vertical axis through a quarter or half circle.

The diagnosis is readily made by inspection and palpation. The outward luxation is the commoner form and may occur from muscular action, doubtless predisposed to by congenital formation, the outer lip of the intercondyloid notch being defective.

Weakness of the vastus internus muscle, genu valgum, and chronic arthritis predispose to habitual luxation.

Luxation of the fibula from the tibia (rare), usually forward and outward, is characterized by a depression at the usual site of the fibular head and the presence of this bony prominence in an abnormal position.

Subluxation of the semilunar cartilage, an injury to which vigorous young men are subject, is usually due to violent outward rotation of the leg on the thigh when the limb is in a position of slight flexion. Twists such as occur in running jumping, skating, or even dancing, are common causes. The inner cartilage is the one customarily involved (see p. 598).

Periarticular Inflammation.—The skin of the knee, particularly on its anterior surface, is subject to abrasion, furuncle, abscess, and to the secondary and tertiary lesions of syphilis. These lesions conform to type. Those of acute inflammatory origin not infrequently involve the patellar bursa in a suppurative inflammation followed, in the absence of appropriate treatment, by persistent sinus formation.

Secondary lesions of syphilis are always attended by other corroborative signs of the disease. Dermal and subdermal gummata exhibit a special predilection for the soft parts overlying the patella. Indeed, they not infrequently start in this bone. They are characterized by painless infiltration which slowly (weeks) breaks down into a circular ulcer with a bacon-like base.

Acute inflammation of the popliteal space, unless it be caused by a wound, is usually due to adenitis, secondary to an infection of the foot and leg which may have been so slight as to escape notice, or to a similar condition of the glands incident to subcutaneous hemorrhage or to overuse. Tenderness, pain radiating down the leg, slight sense of fulness in the popliteal space, often the detection of a tender, swollen gland of small size are the symptoms noted. Suppuration is characterized by its usual local and constitutional signs.

In some cases these symptoms are but slightly marked, the pus burrowing from the popliteal space along the course of the bloodvessels and forming collections in the intermuscular septa of both the anterior and the posterior tibial group. The symptoms are expressed in the leg as fluctuating swellings attended with moderate disability, some pain, and a low grade of sepsis.

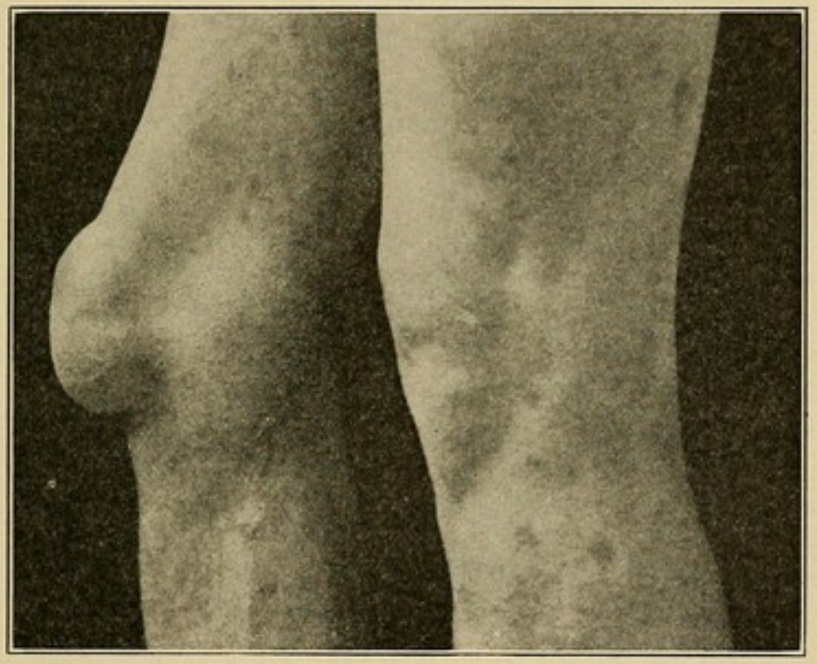
Acute thrombophlebitis, either suppurative or simple, is frequently developed in dilated subcutaneous veins about the knee-joint, particularly those of the long saphenous group overlying the inner condyle.

Induration along the vein is characteristic. In suppurative cases it is shortly obscured by the inflammatory swelling. Because of the movements of the joint, thrombi formed about the knee are particularly likely to be carried into the general circulation.

Thrombosis of the popliteal vein, expressed by tenderness and induration along the course of this vessel, engorgement of the external popliteal vein, edema of the foot and leg, usually by constitutional symptoms of infection, which in the case of septic thrombosis become of high grade and are accompanied by the local features of acute phlegmon.

Bursitis.—Of the many bursæ about the knee-joint the prepatellar is the one most frequently involved in both acute and chronic inflammation. The infrapatellar, the pretibial, and the bursa placed between the gastrocnemius muscle and the semimembranosus tendon are affected

FIG. 413



Chronic prepatellar bursitis. (Housemaid's knee.) Twenty years' duration. Swelling began one week after punctured wound. Knee-joint normal. Swelling situated in front of patella. Fibroid thickening of walls of bursa. Fluctuation present. Skin normal. (Blockley Out-ward.)

next in order of frequency, usually in the form of a chronic inflammation expressed by serous effusion, the dominant symptom being the presence of a fluctuating tumor.

Acute prepatellar bursitis, secondary to trauma, or an overlying suppurating skin lesion, is marked by fluctuating swelling beneath the skin, between it and the anterior surface of the patella.

Blood effusion immediately after trauma often gives a crepitation suggestive of fracture, but distinctly softer. Serous effusion is characterized by the absence of inflammatory symptoms. Purulent involvement exhibits characteristic local and general symptoms of suppuration, with often an edematous swelling so widespread that involvement of the joint is suggested.

A serous exudate into the joint may occur as a complication, but arthritis is readily excluded by free movements and absence of true joint tenderness.

Chronic prepatellar bursitis incident to slight repeated trauma, as from kneeling, or consequent on failure to properly treat an acute inflammation, is characterized mainly by a persistent fluctuating tumor in the position of the bursæ. Greatly thickened walls may simulate a solid tumor.

Tuberculous prepatellar bursitis, occurring independently of patellar involvement, exhibiting more inflammatory thickening and greater sensitiveness than that incident to the non-tuberculous form of involvement, can be diagnosticated in the absence of other tuberculous lesions only by excision and microscopic examination, or the application of the tuberculin test.

Infrapatellar bursitis is marked by a fluctuating swelling appearing to either side of the ligamentum patellæ and by pain during the act of extension. The cushions of fat lying in this region sometimes become hypertrophied and closely simulate a bursitis. Through fluctuation cannot, however, be elicited.

Pretibial bursitis forms a swelling in front of the tibial spine between it and the skin.

Gastrocnemius-semimembranosus bursitis causes a fluctuating swelling in the popliteal space. Normally the U-shaped bursa may be multilocular, and in muscular subjects not infrequently communicates with the joint or with a second bursa, which in turn has a joint communication. An effusion into the bursa secondary to overuse, trauma, or without obvious cause, forms a tumor at first to the inner side of the popliteal space, later filling the greater portion of this space. It is tense and prominent on extension of the knee, is deeply attached to the flexor tendons, fluctuates, becoming soft on flexion, and sometimes exhibits the quality of reducibility into the joint. Occasionally crepitation due to rice-like bodies may be perceived.

Mechanical limitation of flexion, weakness of the knee-joint, and pain are the dominant symptoms. Later there may follow edema from pressure on the bloodvessels. The affection may be bilateral.

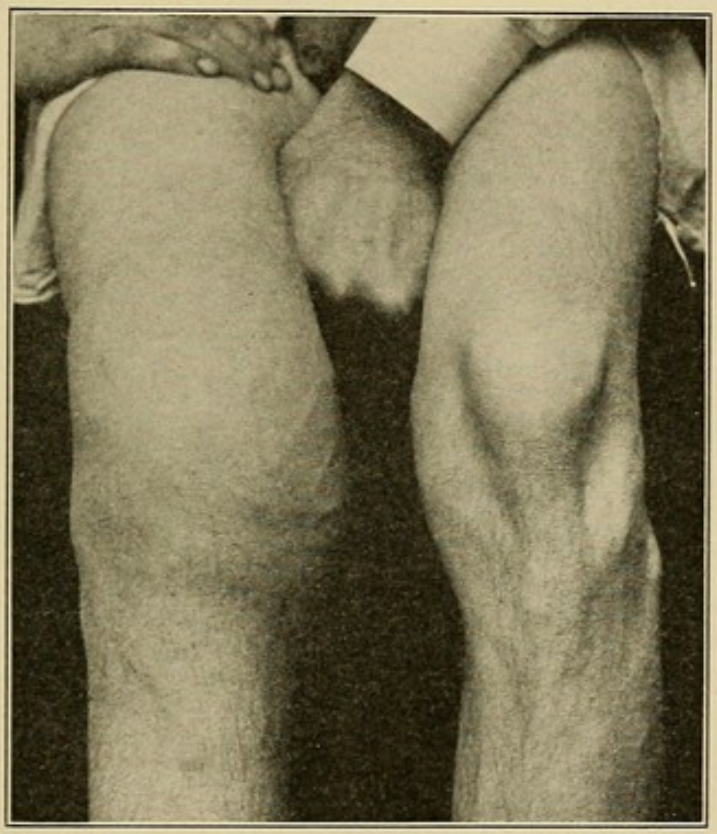
The distinction from cold abscess and from lipoma may be difficult. The former has usually definite joint symptoms of slowly progressive development. Nor is the fluctuating tumor formed by it likely to be so definitely outlined. If of bone origin, which is usual, the *x*-rays should demonstrate osseous lesion. This may be so slight as to show no clear picture, and the abscess may have formed independently of the joint. The differential diagnosis has often been made only at operation.

Biceps Bursitis.—Acute or chronic inflammation of the bursa lying between the biceps tendon and the external lateral ligament, because of the proximity of the peroneal nerve, may be attended by severe pain radiating down the leg. The swelling lies over the head of the tibia, and in its development extends backward toward the popliteal space.

Popliteal bursitis forms a cystic swelling primarily located in the lower outer part of the popliteal space.

Aneurysm of the Popliteal Artery.—Aneurysm of the popliteal artery, a favorite seat, common in hard-working, hard-drinking syphilitics, is usually characterized by some limitation of the joint movement and pain in the popliteal space radiating downward into the leg. Later there develops a tumor usually with an expansile pulsation, bruit, and thrill. The effect upon the size of the tumor of pressure upon the artery above and below is the most characteristic symptom. Acute inflammatory phenomena may develop, the symptoms then closely resembling abscess or bursitis.

FIG. 414



Subacute serofibrinous effusion into the knee-joint. Duration, six weeks; in patient with subacute total gonorrheal urethritis. Fluctuating swelling confined to limits of joint cavity. Obliteration of normal depressions in front of knee. Slight enlargement of superficial veins. Skin normal in color. Pain and disability not pronounced.

Inflammation of the Knee-joint.—Acute Traumatic Arthritis.—Acute traumatic arthritis, incident to contusion, sprain, or fracture, is characterized by a rapid effusion into the joint (minutes or hours, if hemorrhage), evidenced by floating of the patella and fulness about its sides, pain, tenderness, and disability. Under rest the symptoms usually promptly subside. Their continuance or aggravation under use suggest an uncured fracture which may be a fissure without displacement, injury to the semilunar cartilages, thickening of the synovial fringes, or ligamentous or muscular relaxation of such nature and extent as to put the joint to mechanical disadvantage when used. Persistent aggravation of symptoms after slight traumatism adequately treated should in young people suggest the possibility of beginning tuberculosis.

Following fracture of the shaft of the femur, particularly its lower third, there is very commonly observed a synovial effusion into the knee-joint of sufficient extent to float the patella. In young people it subsides promptly.

An acute rapid effusion into the knee-joint from what would usually be inadequate trauma is typical of hemophilia. A suggestive history usually can be elicited. The diagnosis has often not been suspected until aspiration demonstrated a joint cavity filled with blood.

The joint effusion may be serous, serofibrinous, or suppurative, the first attended by practically no constitutional symptoms; the second by those of moderate severity, usually incident to the severe pain characteristic of it; the third by the local and general evidences of profound intoxication.

Gonorrhea and rheumatism are the usual systemic causes of acute inflammation of the knee-joint.

Gonococcal Arthritis.—Gonococcal arthritis in its serous form is attended with rapid and usually painful swelling, not infrequently involving both knees. The patella is usually floated up so wide of the femur that it cannot be tapped against it. Fluctuation is obvious. The diagnosis is based upon the finding elsewhere of a focus of gonorrheal infection and an examination of the joint contents.

This serous exudate may exhibit a tendency to recur incident to slight relighting of long standing, often unrecognized urethral infection. The recurrences are marked mainly by effusion, the patients exhibiting an absence of pain and a functional ability which are considered characteristic of the tabetic joint.

The plastic form of gonorrheal arthritis is attended by slight intra-articular exudate, dense periarticular infiltration, harassing pain, rapid muscle atrophy, constitutional symptoms of moderate severity, and partial or complete ankylosis.

The suppurative form (rare) exhibits the local and general symptoms of pus-formation. Early diagnosis is best made by aspiration or incision into the joint, and examination of its contents.

Acute Rheumatic Arthritis.—Acute rheumatic arthritis is characterized by the rapid onset of a serous exudate. It is usually extremely painful and is attended with other symptoms of rheumatic infection, *i. e.*, migratory character of the joint involvement, moderate fever, rapid pulse, and copious acid sweats. The diagnosis, however, should not be formulated until other causes for acute arthritis have been excluded.

Exanthematous, influenzal, typhoidal, pneumonic, and pyemic inflammations are recognized as such in accordance with their association with the major disease.

Chronic Traumatic Arthritis.—Chronic traumatic arthritis, a sequel of acute traumatism, unless it be definitely associated with the symptoms of loose cartilage, free body, or relaxed ligaments, can be recognized as traumatic only after careful exclusion of infecting causes, a distinct history of adequate trauma, and an estimation as to the curative effects of rest.

Any of the forms of acute infectious arthritis may become chronic, this being particularly true of a gonococcal infection.

The two infections which begin insidiously and are chronic from the first are tuberculosis and syphilis.

Tuberculosis of the Knee.—Tuberculosis of the knee, beginning, as a rule, in the femoral or tibial epiphysis, commonest in children and adolescents, is occasionally seen in young adults, exceptionally at a more advanced age.

FIG. 415

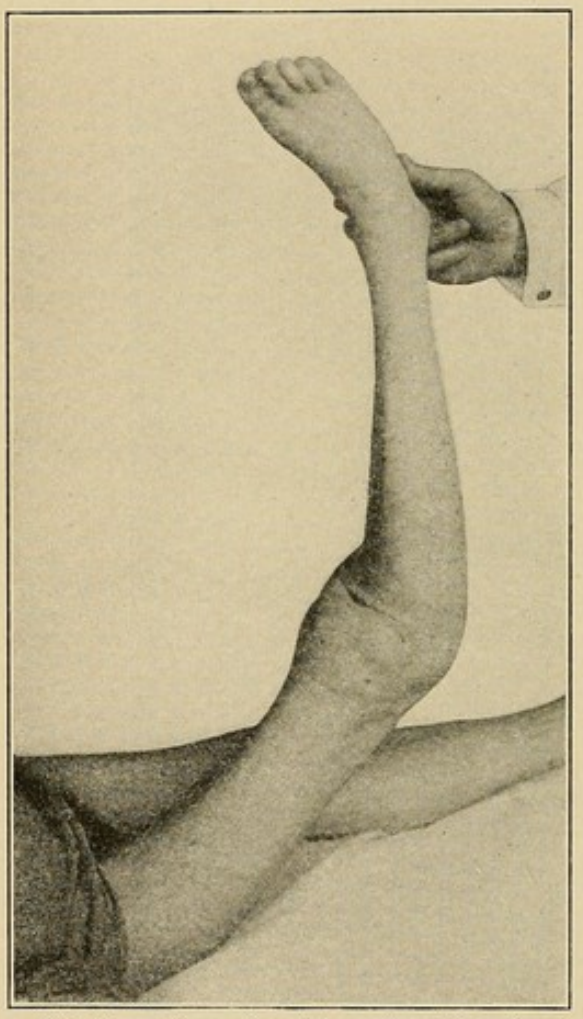
Typical soft, non-adherent, rounded, grouped scars of a tertiary skin syphilide. Duration, years.

It is characterized by apparent causelessness, insidious onset, and slow progression. Intermitting limp is usually the first symptom to attract attention, and is associated with tenderness and limitation of motion due to muscular spasm, neither extreme extension nor complete flexion being possible. Tenderness varies in position in accordance with the seat of primary infection. Swelling is easily demonstrable because of the accessibility of the joint. There is muscular atrophy most marked in the extensor region.

Sometimes there is severe pain which may be paroxysmal or constant. Exceptionally there is a subacute onset which simulates acute infection.

In its further development the affection is characterized by an elastic, at times hard, swelling which obscures the outlines of the joint; muscular atrophy and contracture which may produce a partial backward luxation of the tibia upon the femur, often associated with outward rotation and genu valgum; at times slight lengthening of the bone involved from epiphyseal irritation; usually shortening incident to bone destruction followed by abscess formation.

FIG. 416



Tabetic arthropathy (Charcot's disease) of the knee-joint. Insane patient with locomotor ataxia. Relaxation of ligaments. Effusion and numerous loose bodies in joint. Absorption of articular surfaces. Functionally useless, painless joint. (Carnett.)

Early diagnosis is based upon the persistence and the steady progression of an apparently causeless chronic inflammation in the knee-joint of a child. The exact seat of invasion may be shown by the *x*-rays before the joint is directly involved.

Associated tuberculous lesions elsewhere and the positive results of the tuberculin test are diagnostic aids.

The distinction between a tuberculous knee and one that is contused or sprained is based upon the history of adequate traumatism and the prompt and complete disappearance of symptoms of contusion or sprain under appropriate treatment. Early active and persistent use of a contused knee may result in a condition of chronic synovitis which closely simulates local tuberculosis.

Sarcoma involving the extremity of the femur or tibia is at first characterized chiefly by severe localized pain, which may be referred to the knee. When the tumor appears it is usually characterized by a growth far more rapid than that observed in local tuberculosis. In the case of sarcoma the *x*-rays may be diagnostic.

Persistent pain, unrelieved by treatment appropriate to tuberculous gonitis, with localization of bone lesion by the *x*-rays should suggest a differential diagnosis by early operation.

Syphilitic Arthritis of the Knee.—Syphilitic arthritis of the knee, in its tertiary chronic form, so closely simulates that due to tuberculosis that a diagnosis must depend upon the history, the reaction, the treatment, and the tuberculin test. The syphilitic affection is rare in

children. It usually begins in the femoral epiphysis and is exceedingly painful.

Neuropathic Arthritis of the Knee.—Neuropathic arthritis of the knee, at times preceding other manifestations of ataxia, is characterized by the sudden and painless onset of joint effusion without local or general inflammatory phenomena, aside from edema which may be widespread. There is but little disability. In its complete development the affection is characterized by gross deformity, relaxed ligaments, often subluxation.

The large tumor-like formation with dilated veins suggests in appearance sarcoma. The absence of subjective symptoms, the comparatively slight interference with function, and the associated ataxic manifestations suggest the diagnosis.

Painful Conditions of the Knee without Local Lesion.—The so-called growing pains, common in the knee-joint, often marked after overuse and doubtless incident to transient moderate congestion, are unattended by limp, limitation of motion, joint effusion, or atrophy.

Pain may be referred to the knee as the result of pressure or inflammation of the anterior crural, obturator, or great sciatic nerves. Such pain is not limited to the knee.

Inflammatory affections of the hip-joint are particularly characterized by reference of pain to the knee. To a less marked degree similar reference occurs in affections of the kidney, ureter, bladder, prostate, and uterus. Freedom and painlessness of movement suggest the reflex origin of the pain.

Neuralgia of the knee-joint is characterized by pain and tenderness following inadequate trauma, varying in seat, and out of proportion to the local findings. There may be muscular fixation, increase of surface temperature, skin hypersensibility, and slight swelling. Because of pressure upon the vein, edema of the leg is often marked. Diagnosis is based upon the disagreement of symptoms and signs, the absence of muscular atrophy, the negative findings of the *x*-rays and exclusion by repeated careful examination for the lesions of tuberculosis and syphilis.

Such symptoms occurring in an hysterical subject are usually local manifestations of this condition.

Tumors of the Region of the Knee-joint.—Benign tumors originating in the soft parts are, with the exception of popliteal lipoma, generally recognized as such only because at the time they come under observation they have been present so long and exhibited such slow growth that malignancy can be ruled out. When seen in their early development diagnosis should be made by removal and microscopic examination.

Lipoma placed in the popliteal space beneath the deep fascia forms a rounded, semifluctuating tumor, the distinction of which from bursitis may be possible only by exploratory operation.

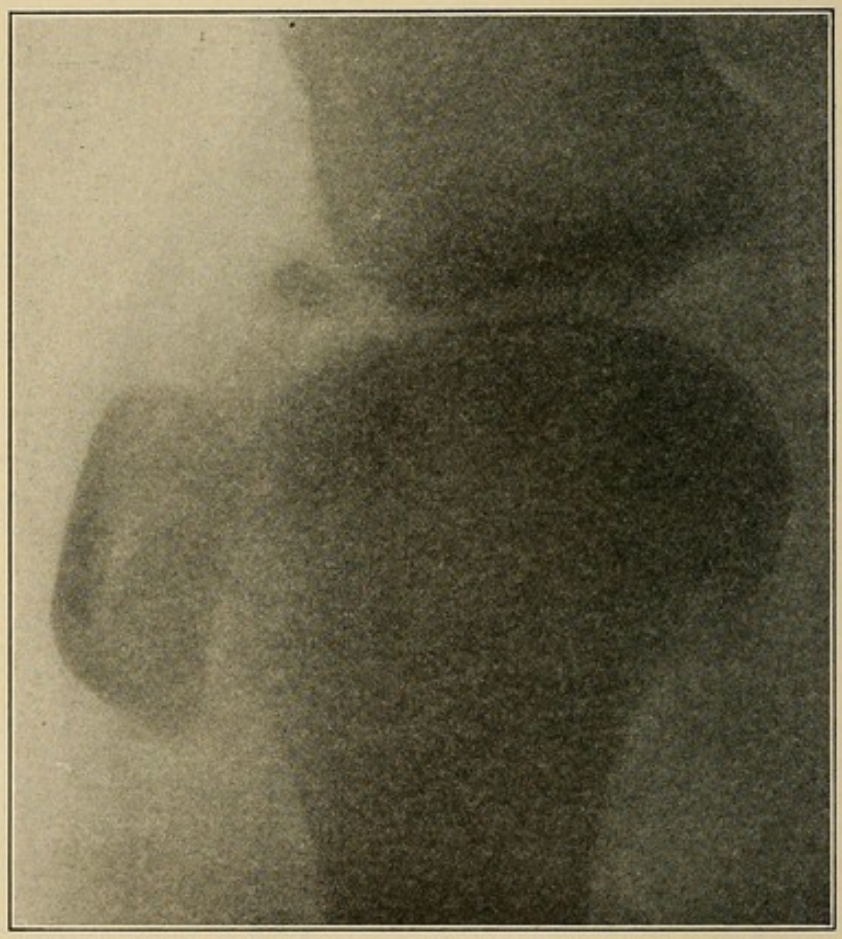
Sarcoma begins precisely as do the benign tumors. A diagnosis should be made by prompt removal before rapidity of growth suggests the nature of the tumor.

Exostoses from the epiphyseal line of the femur or tibia are common.

They develop before puberty, are slow in growth, extending in a spur-like manner away from the joint. They may be hereditary and symmetrical. They are often of traumatic origin. The *x*-rays are diagnostic.

Bone sarcoma, having for its seats of predilection the upper portion of the tibial and the lower portion of the femoral diaphysis, usually sparing the joint cavity, may be central or peripheral in origin, semi-benign, or highly malignant. The early diagnosis is based upon persistent, often intense, sharply localized pain, usually attributed to rheumatism and treated as such, and particularly upon the findings of

FIG. 417



Knee-joint containing two loose bodies, only one of which was demonstrable by *x*-rays. Chronic serous synovitis with repeated mild acute exacerbations. Loose bodies palpably slipping around in joint. (Carnett.)

the *x*-rays. When the tumor becomes manifest to palpation and inspection, its rapid growth is in itself characteristic. The vascular type may give both pulsation and feeble bruit.

Dilatation of the superficial veins and crepitation from the cracking of the thin shell of overlying bone are late symptoms.

The early diagnosis from tuberculosis is suggested by the intensity and persistence of the pain, the futility of rest and extension in relieving this, the negative evidence of the tuberculin test, and particularly by the *x*-ray findings.

Even a clear *x*-ray picture may not satisfactorily distinguish a cyst

or central sarcoma from inflammatory affections, hence, given a lesion which is non-syphilitic, the diagnosis both as to its nature and its relative malignancy should be made promptly by operation, which at times must be supplemented by microscopic examination.

The rapid course and development of tumor and the absence of joint involvement are later characteristic.

Loose Bodies in the Knee-joint.—Unless such bodies can be shown by the *x*-rays, or are so placed that they can be palpated, the diagnosis must be based upon an otherwise causeless chronic synovitis, associated with a recurring partial or complete locking of the joint in the performance of certain motions. Exceptionally joint crepitation, sudden weakness causing falls, and synovial effusion constitute sufficient ground for exploration of the joint, particularly in fat people with well-developed subpatellar fat pads and presumably redundant and fatty alar ligaments.

THE THIGH.

Contusions.—Contusions of the thigh are attended by an abundant, subcutaneous blood effusion which, because of the loose dermal attachment, may form large, fluctuating or semisolid, crepitating tumors. As the result of repeated traumatism there may form a persistent fluctuating subcutaneous tumor, the contents of which closely resemble clear or slightly blood-stained synovia.

Repeated trauma or overuse causes a myositis, characterized by tenderness, induration of the muscles involved, and pain so severe on use as to be crippling. It is a condition frequently noticed in the extensor muscle of football players.

Rupture of the Thigh Muscles.—Rupture of the thigh muscles, involving particularly the adductors and extensors, commonly observed in those who attempt athletic feats without adequate training, is characterized by sudden, severe, crippling pain with local tenderness and palpable break in continuity if the seat of rupture be superficial. Osseous growth may take place at the seat of rupture; this is particularly true of such injuries of the adductors.

Hernia of the muscle is occasionally observed in the thigh (see p. 108).

Of the various dermal lesions furuncle is particularly common in the region of the hip.

Varicosity of either the long saphenous vein or of the lymphatic vessels passing to the glands lying in the saphenous opening may form superficial, soft, lobulated masses in this region which, in the case of vein dilatation, may give impulse on coughing.

Psoas Abscess.—Psoas abscess, or one of pelvic origin, may burrow downward beneath the thick, investing fascia of the thigh, forming a large fluctuating tumor.

As in the leg, extensive intermuscular or subcutaneous pus accumulation may occur without bone lesion or other obvious cause; usually in the cachectic, and characterized by moderate sepsis of the adynamic type

and local inflammatory symptoms so slightly marked that fluctuation first leads to the suspicion of pus.

Aneurysm.—Aneurysm, which may spring from any part of the femoral artery, exhibits some or all of its characteristic features (see p. 99).

Sciatica.—Sciatica, common in middle-aged men, is characterized by pain, usually paroxysmal and increased by all movements which stretch the nerve, and tenderness on deep pressure over its trunk. The points of maximum sensitiveness are just below the border of the gluteus muscle midway between the tuber ischii and the great trochanter and the mid-portion of the popliteal space. There is usually associated muscular weakness with exaggerated reflexes. Bilateral sciatica is usually indicative of spinal lesion.

Pain along the sciatic nerve is a common and early symptom of inflammation of the sacro-iliac joint. It is also characteristic of myositis, follows trauma, and is a common manifestation of pressure from pelvic tumor or inflammation. There is usually in chronic cases a scoliosis with its lumbar convexity toward the affected side.

Fracture of the shaft of the femur, from direct or indirect violence or muscular action, has for its common seat the middle third, and is usually extremely oblique from above downward and forward. The break may be just below the lesser trochanter or above the condyles. There is marked shortening, the lower fragment lies posteriorly, and is usually rotated outward, the foot lying flat on its side.

In the subtrochanteric fracture the upper fragment is pulled forward by the iliopsoas muscle and rotated outward. In the supracondyloid fracture the lower fragment is commonly rotated backward by the gastrocnemius muscle.

Complicating injuries of the bloodvessels, exceptionally the nerves, are not infrequent in these fractures, particularly those above the knee, and should be looked for in the examination

At times the fracture of the shaft is spiral and comminuted, a long, wedge-shaped portion of bone being entirely separated from the two main fragments.

In children the fracture may be transverse and subperiosteal, in which case there may be little or no deformity. Green-stick fracture is also not uncommon in them.

The diagnosis of fracture of the femur, if it be complete, is usually made by inspection. The outward rotation of the leg and the obvious shortening, often angulation, combined with absolute disability indicate the nature of the lesion.

The measurements for shortening are taken on each side from the anterior superior spine of the ilium to the internal malleolus, the legs and thighs occupying the same relative position to the midline of the body in regard to flexion, rotation, and abduction. A second measurement from the top of the trochanter to the external malleolus should be taken and should show the same amount of shortening when this is dependent upon overlapping of the bones of the femur.

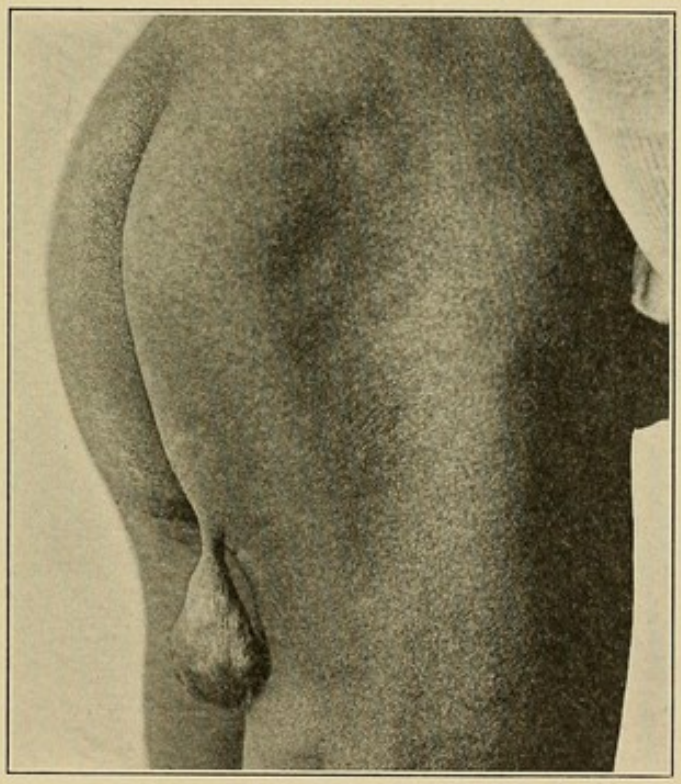
Preternatural mobility is easily elicited, crepitus may be wanting because of interposition of muscular tissue.

Acute osteomyelitis of the femoral shaft, having for its seat of predilection the spongy tissue at either end of the diaphysis, occurring most frequently in boys and often incident to slight trauma or chilling, exhibits characteristic symptoms of hyperacute infection, severe pain, total loss of function, tenderness on deep pressure, and shortly edematous swelling of the entire circumference of the thigh at the seat of involvement. The early diagnosis is made by operation, the *x*-rays not being helpful at this time.

Necrosis, sinus formation, sequestration, are late developments often attended by pronounced permanent deformity.

Chronic osteomyelitis, usually incident to tuberculosis or syphilis, often following an acute attack, sometimes chronic from the first even

FIG. 418



Pedunculated fibrolipoma of thigh. Fifteen years' duration. Surface irregular. Skin normal and slightly movable. Unevenly firm in consistency. (Carnett.)

though incident to staphylococcic infection, is evidenced by deep and persistent pain and tenderness, with moderate disability, slight constitutional symptoms, and bone thickening, first demonstrable by the *x*-rays, later distinctly palpable, and at times involving the entire bone shaft. Sequestration and sinus formation are usual but not invariable sequelæ.

The early distinction from malignant growth is not possible except by the *x*-rays, and, when the inflammatory process is localized, must often be made by operation.

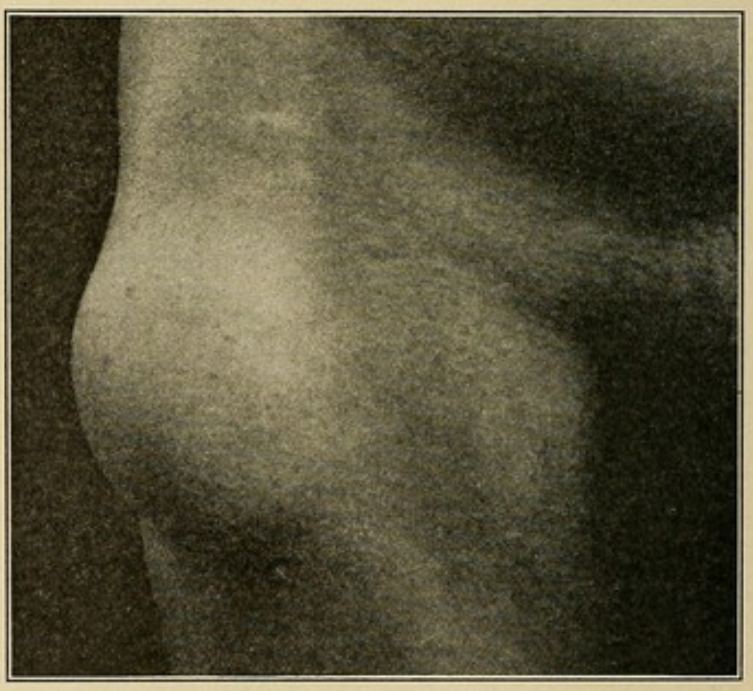
Tumors of the Thigh.—Benign tumors of the bone appear in the form of exostoses and chondromata, growing from the epiphyseal line

of young people. Such exostoses are subject to malignant degeneration, hence when they grow rapidly the diagnosis of their benignancy should be based upon removal and examination.

Lipoma.—Lipoma is occasionally observed in the superficial fascia and corresponds to type, forming a lobulated, rather sharply circumscribed mass, with dimpling of the skin on pinching it up. It may form a diffuse tumor either in the superficial or deep fascia and is not infrequently associated with an angioma, in which case the diagnosis may be suggested by the soft consistency, slow growth, usually congenital origin, and marked change in size incident to elevation and depression.

In the case of deep vascular growths there is often an angiomatous condition of the overlying skin. Exceptionally lipoma beneath the deep

FIG. 419



Fibrolipoma of the thigh. Twelve years' duration. Overlying skin unaltered and non-adherent. Tumor firm in consistency, situated beneath deep fascia, and movable in surrounding tissues. (Carnett.)

fascia may be circumscribed, forming a distinctly hard tumor. The distinction from sarcoma can be formulated only on the much slower growth of the fatty tumor and by operation.

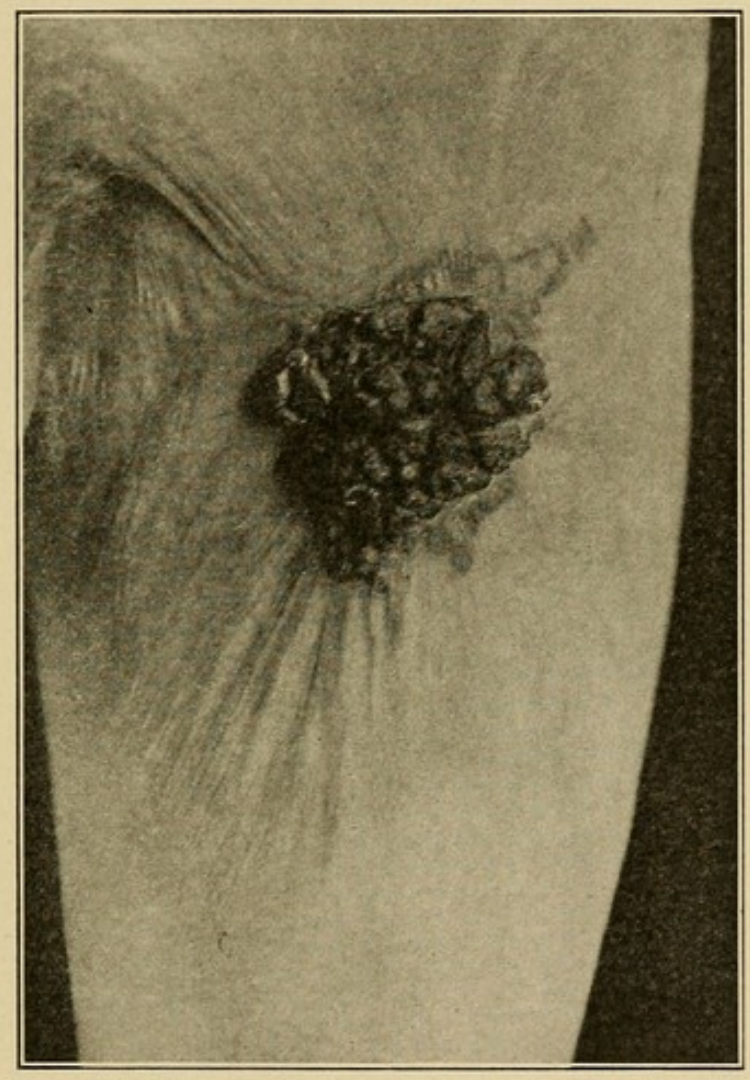
Carcinoma.—Carcinoma, excepting that involving the skin, occurs in the metastatic form and may be the underlying lesion of a spontaneous fracture.

Sarcoma.—Sarcoma originating in the periosteum or soft parts has for its seat of predilection the adductor portion of the thigh. It is characterized by rapidity of growth. Any recent, apparently causeless tumor in this region should suggest the probability of sarcoma.

The thigh is particularly the region of both bone sarcoma and that originating in the connective tissue of the soft parts. The bone

sarcoma is characterized by fixed, harassing pain, later by spontaneous fracture or swelling. Early diagnosis is possible only by the *x*-rays or operation.

FIG. 420



Epithelioma in cicatrix following burn. (Hartzell.)

Bone cyst, being of slow growth, gives few symptoms. Tumor may be first noticed; often fracture from inadequate force is the earliest indication of a lesion. The diagnosis is made by the *x*-rays.

THE HIP.

The coarse skin of the buttock, particularly subject to boils, covers, in addition to the gluteal muscles, much fat and loose connective tissue. Lipomata and extensive blood effusions, from moderate trauma, are common in this region.

About the hip-joint are placed a number of bursæ, the more important of which, surgically, are the trochanteric, the iliopectineal, and the ischial. The trochanteric bursa lies between the deep surface of the

gluteus maximus and the lateral trochanteric surface; there are other smaller bursal sacs lower down between the muscle and the femoral shaft.

The large iliopectineal, called also the iliopsoas bursa, lies in front of the capsule of the hip-joint between this structure and the iliopsoas tendon; a second smaller bursa lies below, nearer the femoral attachment of the muscle.

The ischial bursa lies over the prominence of the ischium, between this structure and the gluteus maximus.

The lymphatics of the buttock empty into the inguinal and the deep pelvic glands.

In the groin, which is limited above by Poupart's ligament and externally by a line drawn from the anterior superior spine to the top of the trochanter, lie two sets of lymphatic glands. The superficial set, in the superficial fascia, containing many single elements, parallels both Poupart's ligament and the long saphenous vein. The deep set, consisting of a few glands, lies to the inner side of the femoral vein. Into these glands drains the lymph of the lower extremity, the buttock, the anus, the perineum, the external genitals, and the lower part of the abdominal parietes.

The strong ball-and-socket hip-joint moves in all directions with a range subject to marked individual variation. Usually the thigh can be flexed until its extensor surface is in contact with the belly wall. With the patient in ventral decubitus and the pelvis held firmly, but slight extension is possible. Abduction, adduction, and the rotation are free within their limits.

In the examination of the hip-joint, the bony landmarks of importance are the anterior superior spine of the ilium, reached by following the crest of the ilium forward, the tuberosity of the ischium, the bony projection on which the weight is borne while sitting, and the trochanter major, indicated by a depression in fat subjects, made more prominent by adduction and internal rotation, with its upper border obscured by the middle gluteal muscle. The posterior superior iliac spine representing the posterior extremity of the iliac crest, and often indicated by a dimple, marks about the centre of the sacro-iliac joint.

The gluteal fold, representing the crease of demarcation between the thigh and buttock, lies above the lower border of the gluteus maximus. With the patient standing upright, heels together, it should be symmetrical on the two sides. It is obscured or obliterated by flexion and by deep or superficial swellings.

A line drawn from the anterior superior iliac spine to the ischial tuberosity, the thigh being slightly flexed, crosses the palpable top of the trochanter (Nélaton's line). From this standard of conformation many normal individuals depart. The line is serviceable mainly in comparing the trochanteric position on the two sides of the body and then only when the person examined is neither overfat nor heavily muscled; and when he can be partially turned on his side and the

trochanter is not obscured by blood effusion or inflammatory swelling.

Bryant's triangle is made by dropping a line vertically from the anterior superior iliac spine to the flat surface on which the patient is lying supine, running a second line from the anterior superior spine to the top of the trochanter, and a third from this point perpendicular to the vertical line first drawn. This last line, called Bryant's line, is shortened as compared to that of the sound side if the trochanter be carried upward as from dislocation, fracture, or deformity of the femoral neck.

The normal angle made by the junction of the axis of the shaft of the femur with that of its neck is in the adult about 130 degrees. Behind the femoral artery, just below the point where it crosses the pelvic brim, lies the head of the femur.

The symptoms of affection of the hip-joint are pain, tenderness, swelling, muscular contraction and atrophy, limitation or exaggeration of motion, deformity, and the local and constitutional manifestations of infection.

The pain of hip-joint affection is aggravated by motion or jarring of the joint. In the early stages of inflammation it may be referred to the knee.

Pain may be referred to the hip as a result of lesion elsewhere; appendicitis, seminal vesiculitis, affections of the prostate, ovaries, tubes, or uterus commonly exhibit this reference. Referred pain is uninfluenced by movements or jarring of the joint, though it exceptionally occasions a limp. The symptoms of the causative lesion are usually pronounced.

Swelling incident to moderate joint effusion is not appreciable to touch. The swelling usually felt is periarticular, representing, in case of joint involvement, bony thickening, infiltration of soft parts, bursal involvement, or abscess formation. The fluctuating swellings of chronic bursitis are characterized by their position.

Muscular contraction, usually first expressed in the iliopsoas, limiting extension, is an early symptom of joint inflammation. The atrophy is earliest demonstrable in the gluteal region unless there be inflammatory swelling here, though all the thigh muscles participate.

Malformations of the Hip-joint.—**Congenital Dislocation,** exhibiting a predilection for girl babies, usually unilateral and due to developmental defect, exceptionally traumatic, is often not detected in fat children until they begin to walk; this is especially the case when the deformity is bilateral.

When the affection is unilateral, shortening of the leg, elevation and undue prominence of the trochanter, and flattening of the buttock are suggestive symptoms, the diagnostic one being the palpation of the abnormally mobile head in its wrong position, facilitated by adducting and rotating the thigh and pulling and pushing upon it. The ability to cause the trochanter to move up and down by alternately pushing and pulling the leg is highly characteristic.

Bilateral luxation is characterized by the symptoms of the unilateral affection, except that, since both legs are shortened, there is no standard for comparing measurements.

When the walking age is reached the limp in the unilateral involvement, with compensatory lordosis and scoliosis, the waddling gait in bilateral involvement, with compensatory lordosis and prominent buttocks and belly, associated with the symptoms already given, is characteristic. The *x*-rays give the easiest and surest means of making a diagnosis.

Coxa Vara.—Coxa vara is a deformity of late childhood and puberty, commonest in boys, characterized usually by downward and backward bending of the neck of the femur and consequent lessening of the angle formed by its long axis with that of the shaft. It is an affection of gradual development, sometimes secondary to fracture of the neck, epiphyseal separation, rickets, or tuberculosis. It is usually independent of such causes.

Coxa vara is characterized by limp, weakness, and pain in the hip region moderate in degree and aggravated by use, outward rotation of the thigh, and prominence and upward displacement of the trochanter.

Examination shows limitation of abduction and also to some extent of inward rotation and flexion. Actual shortening of the limb is readily demonstrated; this is rendered apparently greater by the tilting of the pelvis toward the sound side to compensate for the limited abduction.

The distinction from tuberculous coxitis is based upon the obvious deformity which precedes crippling disability, and by the freedom of extension which is characteristic of coxa vara. In tuberculous coxitis limitation of extension is one of the earliest and most characteristic signs.

In congenital luxation of the hip-joint the head of the bone may be felt in its abnormal position. Shortening can be lessened by traction and can be increased by pushing the femur upward. The exact seat of deformity can be determined only by the *x*-rays.

Coxa Valga.—Coxa valga, a condition in which the angle made by the neck of the femur with its shaft is increased, occurs in flabby adolescents, causing pain in the hip, lameness, and stiffness of the joint, often intermittent at first, and usually an outward rotation of the femur, with abduction, limitation of flexion, and stiffness of the joint due to spasmodic contraction of the muscle. There is necessarily an increase in the length of the limb. Diagnosis is based upon *x*-ray findings. There is associated anterior bowing of the neck of the femur, the trochanter minor pointing directly inward instead of backward and inward.

Contracture and ankylosis of the hip-joint are usually caused by a preceding joint inflammation.

A flexion contracture incident to psoas involvement secondary to spinal caries is distinguished by the absence of tenderness in the hip-joint, its free motions within the limits imposed by the involved muscle, and the symptoms of Pott's disease.

Rheumatic contraction affecting children and marked by rapid onset and severe pain on motion, the joint being fixed in moderate flexion with either adduction or abduction, can be distinguished from beginning tuberculous coxitis only by the prompt curative effect of appropriate treatment. In its mild form it is characterized by recurring transitory limp. Pain is the dominant symptom.

Habit contracture incident to long maintenance of flexed position is less common in the hip than in the knee-joint.

The contracture, partial fixation, and deformity incident to senile arthritis deformans, have the associated joint symptoms and the *x*-ray picture of the affection.

The gross deformity of tabetic arthropathy is painless and is accompanied by other characteristic symptoms of the disease.

Paralytic contractures usually associated with dislocation backward if the abductors and external rotators are involved, forward if the paralysis has crippled the adductors, is characterized by muscular atrophy and elastic fixation in either flexion, adduction and internal rotation, or abduction and outward rotation, and the finding of the head of the bone in its abnormal position.

Ankylosis incident to a previous inflammation is compensated for by increased mobility of the spine and the sacro-iliac articulation. It is a common sequel of gonococcal and rheumatic inflammation.

Tuberculous inflammation is more prone to result in extensive destruction of the head and neck of the bone and upward displacement of the trochanter. Coxitis of typhoid origin is frequently complicated by backward luxation.

The determination of bony fixation, because of the mobility of the pelvis, is difficult, and is best determined by the *x*-rays.

Trauma of the Hip.—**Contusion of the Soft Parts.**—Contusion of the soft parts exhibits extensive blood effusion which is slowly absorbed. Either the iliopsoas or the ischiatic bursa may, as a result of blood effusion, form a prominent, fluctuating or semisolid, crepitating, circumscribed tumor lying in the bursal region and persisting after the subcutaneous blood effusion has been absorbed. The diagnosis is based upon the history of trauma and the seat of tumor. Such traumatized bursæ may subsequently become the seat of hygromata.

Contusion of the Hip-joint.—Contusion of the hip-joint is evidenced by local pain, and the signs of bruising, often associated with the complete disability, extreme tenderness, and outward rotation which are characteristic of fracture. Since the latter, if intracapsular, may be attended with none of the well-marked signs of this condition, the differential diagnosis may be impossible without the help of the *x*-rays.

An injury to the hip sufficiently severe to cause complete disability is usually a fracture, the patient rarely having the power, when the leg is broken and non-impacted, of flexing the thigh even to a slight degree on the pelvis.

Contusions of the joint attended with much less marked symptoms may in young people produce epiphyseal separation or incomplete

fracture of the neck suggested by slow and incomplete convalescence and ultimate deformity. The *x*-rays afford the only means of making an early diagnosis.

Fractures in and about the Hip-joint.—The fracture may involve the trochanters, the neck of the femur or its head, or the acetabulum. Usually they are of the femoral neck.

Fractures of the Neck of the Femur.—The injury may be an epiphyseal separation of the head, a fracture of the junction of the head and neck, which may be incomplete or impacted, a fracture of any portion of the neck, or a fracture of the junction of the neck and trochanter, often impacted and both intracapsular and extracapsular.

In children traumatic separation of the head of the femur at the epiphyseal line or fracture of the neck of the bone may be partial or complete. The complete fracture is usually impacted with downward bending of the neck. It is due to a heavy fall upon the hip, resulting in local pain and swelling, and disability characteristic in its extent of that of bruise rather than of fracture. Recovery is, however, neither rapid nor complete. There is continual lameness and discomfort.

The diagnosis is based upon a careful examination which shows elevation of the trochanter of the affected side (one-half to one inch), and usually limited abduction, flexion, and inward rotation. The positive diagnosis of these injuries should be made by the *x*-rays.

In the adult the seats of fracture are at the junction of the head and neck and the junction of the neck and shaft. In the former position the break is always intracapsular and is exceptionally impacted. It results from application of force in the long axis of the femur, as from unexpectedly slipping down a stair, or falling upon the knee, or from trifling violence.

Fracture at the junction of the neck and shaft is usually comminuted and intracapsular in front and extracapsular behind, or entirely extracapsular, and is frequently impacted, this impaction being more marked posteriorly. It results from a fall upon the hip, which, except in the aged or those subject to fracture, must be heavy.

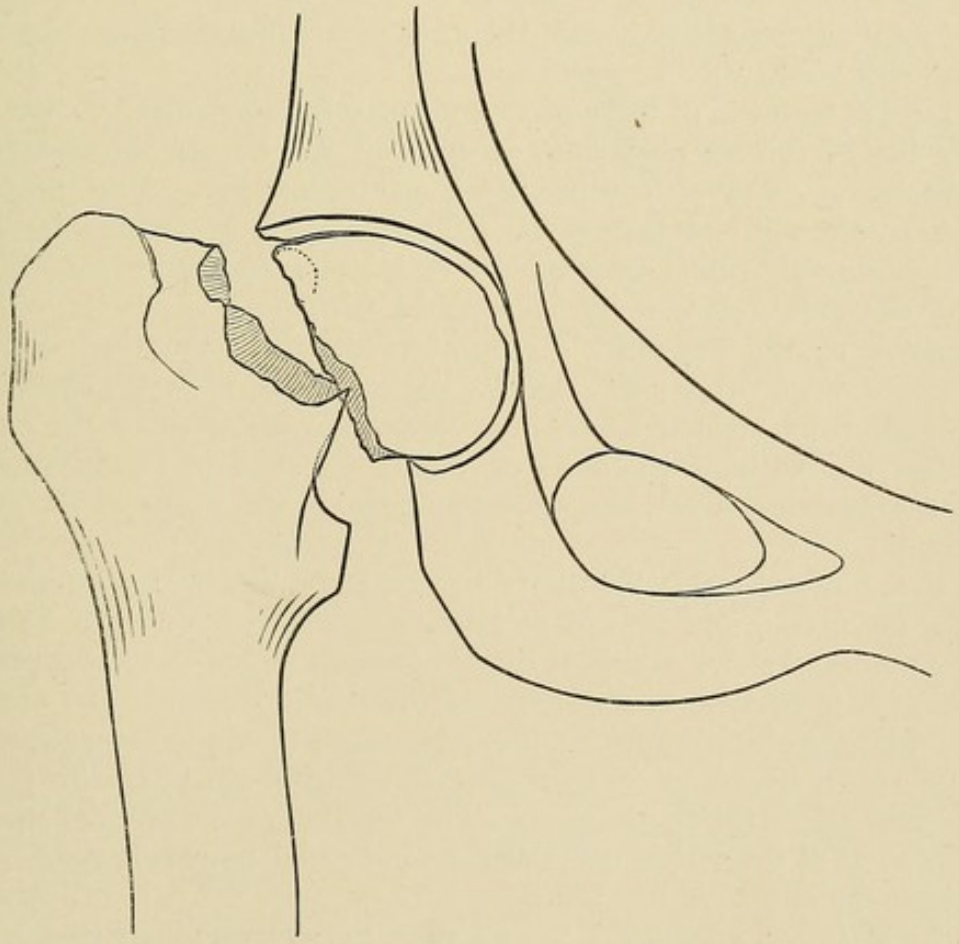
Fractures of the neck of the femur are characterized by disability which may be only partial in impacted fractures; by shortening, as shown by measurement from the anterior superior spinous process of the ilium to the internal malleolus, the interspinous line being at right angles to the long axis of the body and the legs of the two sides being held in similar position both in their relation to this line and in regard to their degree of flexion and rotation; by elevation of the trochanter to the extent of the shortening as determined by Bryant's line; by lack of parallelism between two lines, one of which connects the two anterior superior iliac spines, the other the tips of the trochanters; by outward rotation, the back of the heel of the injured side lying in contact with the tendo Achillis on the sound side when the legs are brought together; by lessened resistance in the space between the top of the trochanter and the crest of the ilium; by crepitus, in free fractures, elicited by

pressure upon the trochanter, supplemented by traction and movements of the joint; by rotation of the trochanter about the arc of a circle with a less diameter than that of the sound side. There is, moreover, swelling, most rapid and pronounced when the fracture is extracapsular, pain greatly aggravated by motion, and tenderness on palpation most marked at the seat of injury.

When the shortening and external rotation are slight, the disability not complete, the swelling pronounced and rapid, the pain severe, the trochanter obviously widened to the examining hand, blood effusion and skin discoloration prompt and widespread, and the injury is due to direct violence to the trochanter, it is probable the fracture is extracapsular and impacted. Under such circumstances, unless there be great deformity, no effort should be made to elicit crepitus or undue mobility.

When the injury is trifling and not directly applied to the trochanter, even though there be but slight shortening of Bryant's line, if absolute

FIG. 421[1]



Fracture through small part of neck of femur, in female, aged fifty-four years. Ununited (with shortening) eight weeks after injury. Injury neither diagnosticated nor treated as a fracture.

[1] Fig. 421. Outline drawing from radiograph by Dr. H. K. Pancoast in collection of University Hospital *x*-ray Laboratory. (Referred by Dr. Willard.)

disability is associated with pronounced outward rotation, it is probable the fracture is intracapsular and non-impacted.

Contusion of the thigh does not cause shortening, but, since in fracture the latter may be so slight as to be difficult of demonstration, the differential diagnosis must be made by the *x*-rays.

Fracture of the great trochanter due to direct violence, rare except as a complication of fracture of the neck, then usually comminuted, can be detected in the absence of mobility or displacement only by the *x*-rays, or by severe and persistent bone pain and tenderness and the elimination of other lesions.

The distinction between fracture, the common injury, and luxation, which is comparatively rare, is based upon the characteristic and elastically fixed position of the thigh and leg in backward luxation and the obvious displacement of the head of the bone and the trochanter in those rare dislocations characterized by outward rotation and abduction.

Fracture of the acetabulum, usually a chipping off of a portion of its brim and constituting a complication of luxation, may be suggested by deep crepitus on manipulation, easy reduction of a partial luxation and a tendency toward recurrence of deformity on removal of extending force. An assured diagnosis of this condition is rarely possible without the use of the *x*-rays.

Extensive fracture of the acetabulum may be suggested by shortening of the leg of the affected side, absence of the normal prominence of the trochanter, and by comparatively easy reduction of the deformity by extension with its recurrence on removal of the extending force. Rectal examination has sometimes revealed crepitus and blood effusion. Diagnosis should be made by the *x*-rays.

Luxation of the Hip-joint.—Traumatic dislocation of the hip-joint, commonest in vigorous adult males, is characterized by an elastic fixation of the thigh, which varies in accordance with whether the head of the bone lies without (behind) or within (in front of) a line passing from the anterior superior spinous process of the ilium to the ischial tuberosity.

Outward or posterior luxation (iliac or ischiatic) is characterized by flexion, adduction and inward rotation incident to the pull of an intact Y-ligament, and shortening. If the Y-ligament be ruptured, the position will depart from type. The head of the displaced bone can often be felt beneath the gluteus muscles, and its absence from the normal position will be shown by loss of deep resistance on pressure upon the femoral artery just below the pubic bone. The trochanter is displaced upward. Involvement of the sciatic nerve will be indicated by severe pain radiating along the course of this trunk.

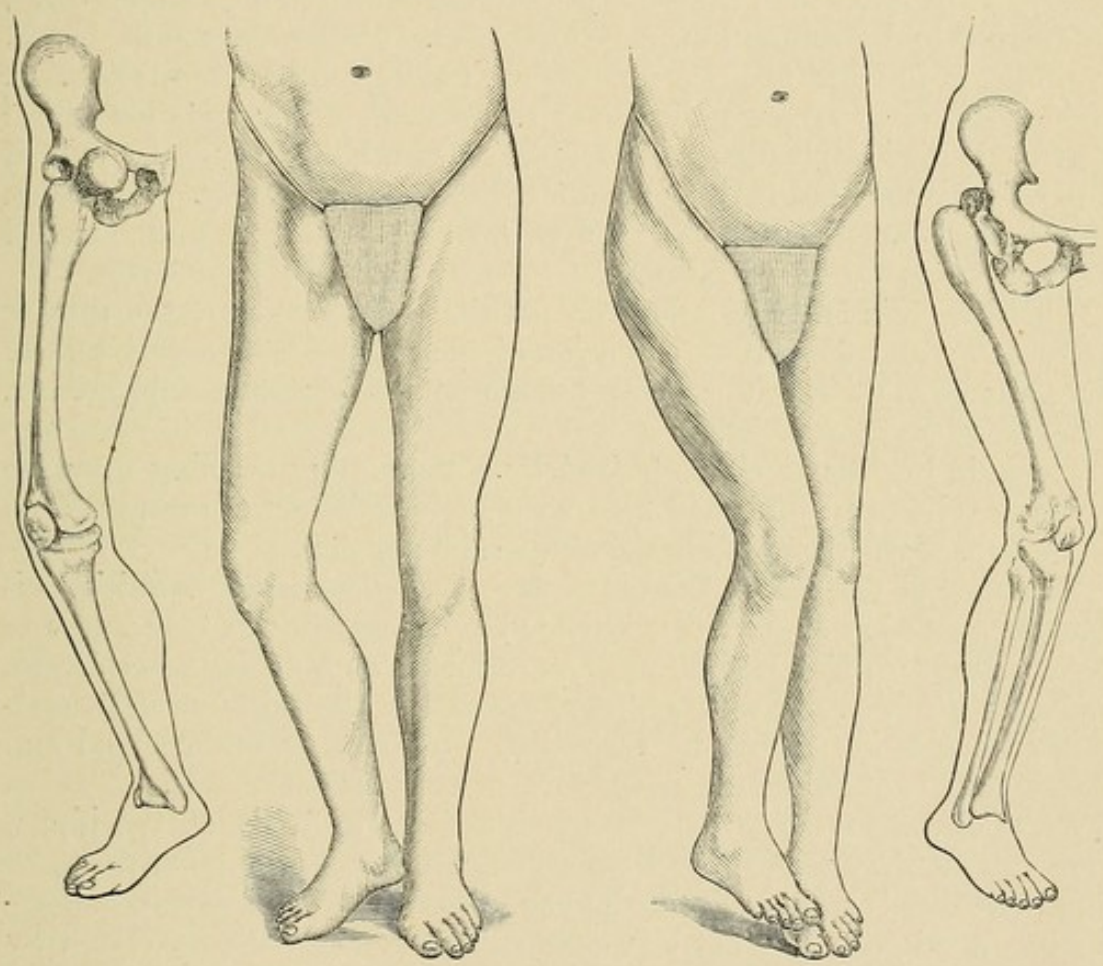
Complicating acetabular fracture may be suggested by crepitus on manipulation and ease in reduction. The diagnosis of the presence or absence of associated bone lesions should be made by the *x*-rays.

The determination as to whether the luxation is iliac or ischiatic is dependent rather upon palpating the head of the bone in its abnormal position than upon the greater degree of adduction and inversion as

compared to flexion and shortening, since the individual case gives no standard for such comparison.

Internal (anterior) luxation, thyroid or pubic, in accordance with the position of the head of the bone, is characterized by abduction and outward rotation of the flexed thigh. Shortening is trifling or absent in the obturator form. The head of the femur is felt in its abnormal position, the trochanteric prominence is lessened.

FIG. 422 FIG. 423



Dislocation of hip. (Park.)

The pubic luxation is characterized by marked shortening, obvious groin tumor formed by the femoral head, usually slight or absent flexion. If the head of the femur be pushed beneath Poupart's ligament, there may be inward rotation.

Pathological dislocation incident to previous disease of the bone or joint is characterized by marked shortening of sudden development, without obvious traumatic cause, occurring in the course of a hip affection. This in itself is diagnostic, fracture being excluded by the *x*-rays. Such a luxation may occur in consequence of a typhoid arthritis unnoticed at the time of its occurrence, because of the adynamic condition of the patient, and not detected until convalescence.

Affections of the Bursæ about the Hip-joint.—Inflammation of the deep trochanteric bursa, if acute, is commonly traumatic or secondary to direct or systemic infection; if chronic, is usually tuberculous. It is characterized by a tender, fluctuating swelling, at times bilocular, placed above and behind the trochanter and exhibiting fairly sharp outlines. The thigh is held in abduction, outward rotation, and slight flexion. The motions of the hip-joint which do not increase the tension of the bursa are free and painless.

Diagnosis is based upon the position of the tumor, its fluctuating character, and its indolence; should it present the consistency of solid growth, by excision and examination, since sarcoma may be primary in the bursa.

Iliopsoas bursitis forms a fluctuating, tender tumor, often bilocular, and occasioning severe pain along the course of the anterior crural nerve. It may reach the size of a child's head, filling the upper part of Scarpa's triangle and making prominent the femoral artery. Extension of the thigh on the pelvis is painful, flexion, abduction, and outward rotation being the usual position.

The diagnosis is based upon the position of the tumor, the greater prominence and tension on extension of the thigh on the pelvis, and, if the walls be so thick as to obscure fluctuation and simulate solid growth, by excision and examination.

Ischiatic bursitis is characterized by a fluctuating swelling over the ischiatic tuberosity. It may become acutely inflamed, forming a deep phlegmon. The diagnosis is based upon its position.

Arthritis of the Hip.—**Traumatic Arthritis.**—Traumatic arthritis incident to contusion or sprain is attended by characteristic tenderness to deep pressure, pain, limitation of movement, and, in its severe form, muscular atrophy. If recovery be not complete and fairly prompt, associated bone lesion should be suspected. Trauma in middle-aged and elderly men is often the apparent cause of arthritis deformans.

Acute Infectious Arthritis.—*Acute infectious arthritis* of the hip, a localization of systemic infection, usually rheumatic or gonorrheal, at times typhoidal, influenzal, pneumonic, diphtheritic, scarlatinal, or incident to a number of other less common infections, is characterized by pain, aggravated by motion, tenderness, fixation, swelling which, because of the deep position of the joint, is not immediately demonstrable, and, if the infection is actively proliferating and producing extensive destruction of tissue as typified by the staphylococcus and streptococcus, the symptoms of profound sepsis.

Gonococcal arthritis is characterized by extreme pain. In the hip-joint it is usually of the plastic type resulting in ankylosis. Children are not immune against this form of coxitis.

Rheumatic arthritis, usually polyarticular and migratory, if monarticular, is diagnosticated as such on the basis of constitutional symptoms and on the absence of other recognized infecting causes.

Typhoidal arthritis is characterized by large joint effusion, with other symptoms but slightly marked. Occurring as it does at the period of maximum illness, it is often overlooked until luxation calls attention to it.

Osteomyelitic arthritis is commonly observed in infants and children. There is profound sepsis. Joint tenderness and fixation are characteristic, edematous periarticular swelling develops rapidly, followed shortly by softening and fluctuation. There is often epiphyseal separation, or necrosis of the head and the neck of the bone. The joint is not always involved in trochanteric osteomyelitis.

Pneumococcal arthritis also occurs at or shortly after the period of maximum illness. The effusion is commonly suppurative and the symptoms acute.

Traumatic arthritis or any of the acute infections may become chronic. Other forms of arthritis begin insidiously and are chronic from the start. Tuberculous arthritis is the most conspicuous example of this class.

Tuberculosis of the Hip-joint.—Tuberculosis of the hip-joint, commonest in children after the second and before the tenth year, rare in infants and adults; usually begins in or near the epiphyseal line of the femoral head; it may be synovial or acetabular in onset.

Tuberculous heredity or disease in other parts of the body is a predisposing factor. It may develop in children who apparently are perfectly well. The first symptom is usually an intermitting limp, usually attributed to slight trauma. Pain, which is also intermittent, is often referred to the knee, and as the disease progresses it is marked by recurring brief nocturnal paroxysms causing the typical night cries.

Examination in the early stage shows limitation in the joint movements due to muscular spasm, tenderness, muscular atrophy, and possibly trochanteric thickening.

Limitation of movement is the most important single diagnostic sign of arthritis. Slight motions may be free and unimpeded, but the full movement of the joint is always arrested, and usually in all directions, though the limitation is most pronounced in the direction of extension.

Atrophy is evidenced in both the thigh and gluteal muscles; at times it can be demonstrated by measurement before it is obvious to inspection. Partly because of this atrophy, but mainly on account of the slight flexion in which the joint is customarily held, the gluteal fold is less marked than on the sound side.

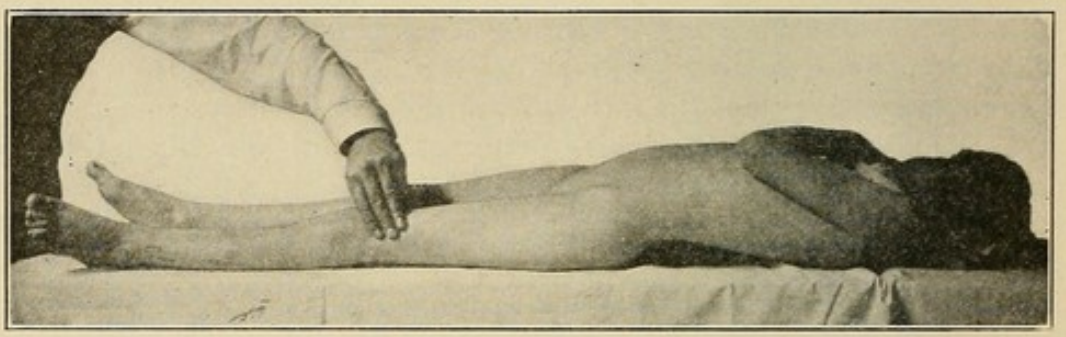
In the early stages the thigh is slightly flexed, rotated outward and abducted, and while walking during the limp periods the ankle of the affected side is extended and the knee flexed to save the joint from jar.

Direct examination in the early stages has for its end the detection of limited motion, of tenderness, of muscular atrophy, and trochanteric thickening. The garments must therefore be so arranged that the lower part of the body, the pelvis, and the lower extremities can be seen and the two sides compared. With the patient in dorsal decubitus, the legs are brought together, as nearly as possible parallel with the long axis of the body; if one thigh be fixed in abduction, this is only possible by lateral tilt of the pelvis, hence a line drawn from one anterior iliac spine to the other will not make a right angle with the midline of the trunk.

The limb of the sound side is grasped by the ankle, and with the other hand resting upon the ilium to detect any movement in it, the knee is

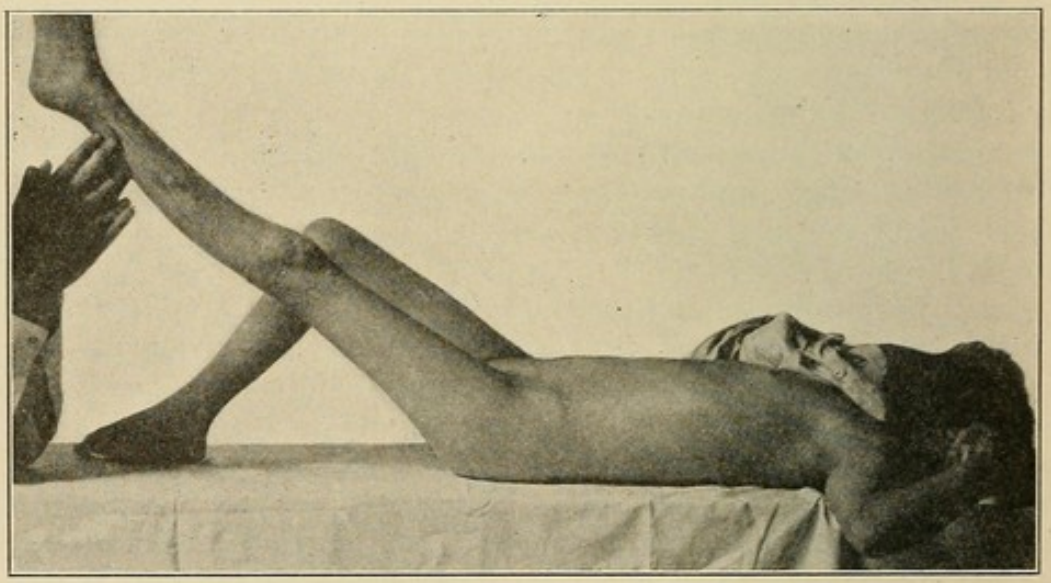
flexed upon the thigh, and the thigh upon the pelvis to the fullest extent; thereafter motions of abduction, adduction, and rotation are practised. A similar examination is then conducted with the leg and thigh of the affected side, the hand on the ilium noting the moment when this bone participates in the thigh movements. The motion is usually limited by an elastic resistance (muscular) in all directions, but particularly in extension and adduction and internal rotation.

FIG. 424



Subacute coxitis Hip-joint held in position of flexion, eversion, and abduction. Eversion is indicated by the outward rotation of the foot and flexion by the lordosis in the lumbar spine during full extension of the thigh. Compare with Fig. 425. (Carnett.)

FIG. 425



Subacute coxitis. Same patient as in Fig. 424. The degree of flexion deformity at the hip-joint from spasm of the iliopsoas is indicated by the extent to which the thigh must be flexed to abolish the lumbar lordosis. (Carnett.)

To detect the slight flexion, an invariable early symptom of coxitis, with the patient in dorsal decubitus, the sound limb is flexed until the knee touches the chest. If no flexion exists, the popliteal space upon the affected side can be made to touch the table. Both thighs are flexed until the small of the back lies flat on the table. The thigh and knee of the sound side are then extended until the popliteal space is in contact with the table surface. An effort to place the affected limb in the same position is immediately followed by arching of the lumbar spine.

The test for limited extension is applied by placing the patient in ventral decubitus and lifting the straight legs from the table, the pelvis being held down. In a healthy child the hip-joint can be hyperextended until it makes an angle of about 10 degrees with the surface on which the child lies.

The circumference of both thighs is measured for muscular atrophy at the same point, usually just below the gluteal fold, the limbs being held in exactly the same position for this measurement.

Tenderness is elicited by palpation anteriorly and posteriorly, by jarring the trochanter, by flexing the leg at the knee and jarring the end of the femur with the ball of the hand. This sign usually has been sufficiently demonstrated beforehand in the examination for limitation of motion.

Trochanteric thickening is detected by palpation and comparison with the trochanter on the unaffected side.

These symptoms, if present, simply prove that the hip-joint is inflamed.

The tuberculous nature of this inflammation is suggested by the age of the patient, the absence of adequate cause, and particularly by the slow but progressive evolution. The tuberculin test is corroborative and the *x*-ray findings are at times, in themselves, diagnostic, both as to the nature of the affection and its seat.

Sprain or contusion of the hip-joint, or sprain or rheumatic myositis of the iliopsoas muscle, exhibit similar symptoms. There is usually an adequate cause, and recovery is prompt and complete under appropriate treatment.

The joint irritation incident to an unrecognized epiphyseal separation or partial fracture of the neck of the bone, in the absence of shortening sufficient to be demonstrated by measurement, can be distinguished from tuberculous arthritis following trauma only by the *x*-rays.

In lumbar Pott's disease, among other symptoms, there will be pain, limp, and muscular fixation of the leg in much the position characteristic of coxalgia. Fixation is, however, only against extension, other movements being free, the hip-joint is not tender, and the spinal seat of the trouble is readily determined if search be made for it. The two conditions are sometimes associated.

From coxa vara, the distinction is suggested by the different age incidence, the slower progression of symptoms, the elevation of the greater trochanter in the absence of the evidence of extensive bone or joint involvement, and the findings of the *x*-rays.

Acute epiphysitis of infancy and childhood is characterized by violent onset, rapid course, and early and free pus formation.

In sacro-iliac disease the thigh and leg are carried straight, there is tenderness over the sacro-iliac joint, and all hip motions are free, except those which throw a strain directly upon the sacro-iliac joint.

Hysterical joint is marked by an incoördination and irregularity of symptoms, with pain dominant, and is associated with other signs of hysteria. Moreover, the age incidence is different.

In cases of referred pain the joint movements are free.

Chronic arthritis, secondary to subacute or chronic osteomyelitis in its development and progress, closely simulates tuberculous arthritis. Recovery may take place without suppuration, but with both deformity and disability. Usually abscesses form, discharging for months or years. Healing is followed by recurrence of inflammation. The differential diagnosis is dependent upon bacterial examination, including animal inoculation and the tuberculin test.

Arthritis Deformans.—Arthritis deformans, exceptionally observed in young people and then secondary to trauma, usually developing spontaneously in persons past forty, is characterized by pain usually attributed to sciatica, limp most marked after rest, limitation of motion, muscular atrophy, joint crepitus, cartilaginous erosion, bony outgrowth demonstrable by the *x*-rays long before they can be palpated externally, and elevation of the trochanter of the affected side. Early diagnosis is suggested by limited abduction and abnormal elevation of the trochanter, and is confirmed by the *x*-rays.

Tabetic Arthropathy.—Tabetic arthropathy of the hip-joint, at times an early symptom of tabes, is characterized by pronounced swelling of rapid development due to sudden effusion into the joint, without pain, markedly increased disability, or other symptoms of inflammation. Later there is destruction of joint surfaces, at times spontaneous luxation.

Syringomyelia produces similar changes.

Tumors of the Hip.—These, with the exception of the superficial lipomata and the exostoses and chondromata, which may grow from either the pelvic bones or the femur, should be regarded as malignant unless they have been existent and stationary for such a long period as to make the assumption improbable.

The early diagnosis should be made by the *x*-rays. These should be employed when there is complaint of persistent, deep-seated, localized bone pain in the absence of joint involvement. In case of doubt, with the seat of lesion indicated by the *x*-rays, the diagnosis should be by operation.

Huge tumor, rapid growth, dilated superficial veins, and eggshell crackling are symptoms highly characteristic, but too late, as a rule, to be of service to the patient.

Thick-walled bursæ and subaponeurotic lipomata should be diagnosticated as such by removal.

Hysterical Joint.—Hysterical joint may closely simulate organic disease, since pain, tenderness, swelling, heat, and muscular contraction may all be present. Pain and tenderness are out of proportion to the findings. There is a lack of consistency in the symptoms, and contractions disappear under etherization. Moreover, there is a history of other hysterical seizures and other unmistakable symptoms of this condition. The contraction usually involves the adductors and internal rotators. It may be entirely involuntary.

Snapping hip, by which is meant the power of partly displacing the hip upon the upper border of the acetabulum, may become habitual.

THE BUTTOCKS.

Either wound or contusion of the buttocks may be followed by a deep extravasation of blood incident to partial or complete rupture of the gluteal, the pudic, or the sciatic artery. This may result in the formation of a progressive, fluctuating, painful tumor which, even though it present neither thrill nor bruit, is necessarily due to hemorrhage because of its rapid (hours) development.

When the blood extravasation is more gradual and more efficiently limited by inflammatory reaction of the surrounding soft parts, the resultant traumatic aneurysm may exhibit the tenderness, pain, and rate of growth which would be characteristic of a deep infected thrombus. Pronounced constitutional symptoms are absent, and thrill and bruit have usually been present, together with severe pain incident to nerve pressure. In the absence of characteristic aneurysm symptoms, a previous history of trauma should suggest the possibility of aneurysm.

The distinction from cold abscess pointing backward, or from gluteal hernia, may be impossible without direct exploration. Both the traumatic and idiopathic gluteal aneurysm may be first suggested by severe sciatic pain before the development of a palpable pulsating tumor.

Gluteal Hernia.—Gluteal hernia (rare) forms a tumor which may be partly or wholly reducible, and may be resonant. It is rarely detected until it projects beneath the gluteus maximus into the perineum or until symptoms of strangulation or incarceration are accompanied by pain and tenderness in the region of the sciatic notch, with possibly pressure pain radiating down the leg.

Abscess.—Abscess centring in the gluteal region may originate from iliac or sacro-iliac osteomyelitis or from postperitoneal or purulent collections, or those of spinal origin. The diagnosis is usually based upon the symptoms of the original infection. In the absence of these it may be difficult.

Sarcoma.—Sarcoma originating in the soft parts of the buttocks is rare. Diagnosis should be formulated by the immediate removal of a tumor not obviously benign.

Sacrococcygeal Tumors of Congenital Origin.—A hernial protrusion of the dura may occur at the coccygeal junction, often associated with lymphangiomatous or teratomatous growth. The latter are common in this region as are also dermoids which may be simple or compound implantation cysts, and sarcomata.

The congenital tumors of the coccyx grow downward rather than upward, lymphangioma and teratoma complicating meningocele on the dorsal surface of the coccyx; whereas teratomata, congenital lipomata, and cystic lymphangiomata are found in front of the coccyx, lying between this bone and the rectum, and exhibiting no dural connection (Steinthal).

The diagnosis of these tumors is based mainly on their congenital origin.

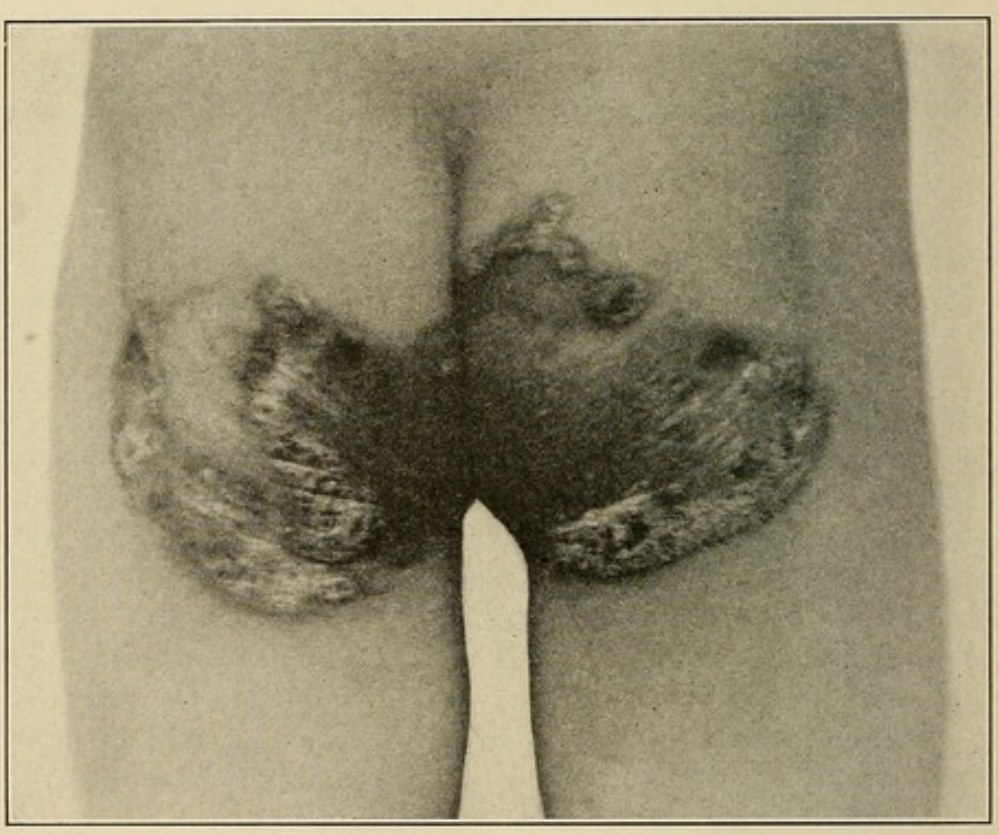
The dermoid placed over the coccyx or lower portion of the sacrum

in the midline is fairly common. It usually excites no attention until it becomes inflamed. Suppuration is followed by a persistent midline sinus, usually mistaken for rectal fistula. Diagnosis is made by probe, often by the finding of hair in the discharge.

Anterior sacral meningocele (rare), forming a tumor detected by rectal palpation, may be recognized by the bony defect shown by the *x*-rays, and by aspiration and examination of the fluid.

Dermoids in the pelvic connective tissue are usually not recognized as such until operation. They may remain latent until adult life.

FIG. 426



Syphilodermic tubercle. Closely resembling lupus vulgaris.

Coccygodynia is a term applied to pain greatly aggravated by movements of the coccyx such as are incident to sitting down, defecating or coughing, and reaching its maximum intensity incident to direct palpation. It may be due to an arthritis, a neuritis, a chronic osteomyelitis, or be without assignable cause. It frequently follows traumatism. It is often simulated by the hysterical.

The pubic joint may be congenitally absent, the pubic bones being widely separated from each other. This is a common complication of exstrophy of the bladder. The motion of this joint is a vertical sliding one. The strong iliosacral joint allows the ilium to tilt slightly.

Disjunction of the pubic symphysis, necessarily accompanied by sprain or fracture of the sacro-iliac joint, is characterized by local pain, tenderness, mobility, tumor from blood effusion, frequently urethral tear, indicated by bleeding from the meatus, and retention of urine. There

is usually history of adequate trauma. Urinary retention is an almost constant accompaniment of severe pelvic injury in the absence of urethral rupture or bladder lesion.

Strain of the sacro-iliac joint incident to sudden violence, either muscular or jarring, is characterized by local pain, exaggerated by lateral pressure upon the pelvis, direct palpation, or standing, jarring on the heels, and motions of the thigh which impart motion to the joint, as does flexion of the thigh with straight legs. Recovery is usually prompt. Symptoms incident to inadequate treatment may become chronic, a condition of traumatic arthritis developing.

Fractures of the Pelvis.—By direct impact the crest of the ilium or either of the anterior spines may be broken, the latter possibly by muscular force. The diagnosis in the absence of preternatural mobility and crepitus is suggested by persistent deep tenderness, and is corroborated by the *x*-rays.

Deep fractures, incident to crushing force, acting either anteroposteriorly or laterally, usually involve the pubic bone, the break passing through both the upper and the lower ramus and from above downward and inward; sometimes extending into the acetabulum. This fracture may be comminuted, bilateral, may be complicated by a fracture of the ilium passing from its crest to the sciatic notch or one at its junction with the sacro-iliac articulation, or more frequently by a fracture of the sacrum paralleling the articulations.

The diagnosis is made by palpation, since obvious deformity is usually absent. Mobility and crepitus may often be detected by external palpation of the accessible surfaces, supplemented by lateral pressure upon the iliac crests from without inward and by separating them by force exerted upon the anterior superior spines in the outward direction. This manipulation in case of fracture always occasions pain, often referred in its greatest intensity to the sacro-iliac joint, which is necessarily sprained even though there be no fracture near it.

External examination should be supplemented by rectal palpation, by means of which the posterior portion of the pubic bone and its rami can be felt.

As a result of break in the continuity of the pelvic girdle there is complete disability, always persistently localized tenderness aggravated by motion, frequently rupture of the urethra and bladder, characterized by either the inability to pass water or the passage of bloody urine and late discoloration, which if it appear above Poupart's ligament is regarded by Rose as of diagnostic importance in distinguishing between intracapsular fracture of the neck of the femur and fracture of the acetabulum.

When diagnosis of fracture of the pubic bone is established, the integrity of the urethra and bladder should be assured by catheterization, unless the patient be able to void urine unstained by blood.

Osteomyelitis of the Pelvis.—Osteomyelitis of the pelvis may occur in the acute or chronic form, may be diffuse or circumscribed.

Acute diffuse osteomyelitis of the ilium commonly involves both the hip and the sacro-iliac joints, and is attended with symptoms of violent sepsis.

In its circumscribed form the affection is often subacute or chronic, and invades the acetabular region in young children, the region of the crest and spine in older ones.

Acute osteomyelitis of the sacrum usually spares the sacro-iliac joint.

The sudden onset of symptoms of virulent constitutional infection associated with deep pain, often referred to the hip-joint, and tenderness are in themselves suggestive. Edematous swelling and abscess formation are the signs on which diagnosis usually is based. If the process be not diffuse, there may be a subsidence of constitutional and local symptoms followed (weeks or months) by the appearance of a fluctuating, non-inflammatory tumor due to pus. Such cold abscesses may form as a sequel of osteomyelitis chronic from the first and unattended with marked constitutional or local symptoms.

The abscess of iliac, sacro-iliac, or acetabular origin, if it gravitates anteriorly, forms a palpable, often fluctuating tumor closely attached to the bone and partly filling the iliac fossa. It points either just beneath the outer part of Poupart's ligament or lower down the thigh, to either side of the sartorius muscle. Posterior pointing may be in the gluteal, anal, perineal, or upper posterior thigh region.

Subperitoneal abscesses usually secondary to lesions of the cecum, appendix, bladder, prostate, or seminal vesicles point usually above the inner third of Poupart's ligament or through the saphenous opening. Psoas abscess points below Poupart's ligament and to the outer side of the bloodvessels.

Traumatic inflammation of the sacro-iliac joint, characterized by pain, often referred to as a backache, located in the sacral region, and sequent on slight injuries or overuse, or long maintenance of a position which renders the ligaments tense, is diagnosticated by tenderness in the joint elicited by hyperextension of the thigh on the pelvis, by attempting to extend the leg on the flexed thigh, by directing the patient to bend forward with the knees straight, by all motions which render tense the muscles of the ham, and thus tilt the ilium.

Sacro-iliac inflammation, usually tuberculous in nature, and resulting in abscess formation, is rarely observed in children, nor is it common at any age. Its characteristic initial symptom is pain referred to or near the joint, radiating over the buttock and down the back and inner part of the thigh to the knee, so greatly aggravated by movement as to be crippling in intensity, accompanied by a sense of weakness about the joint, with a distinct limp on walking; the body being inclined to the sound side, with apparent elongation of the affected leg incident to the lowering of the pelvis on that side.

The diagnosis is based upon direct examination. With the patient in dorsal decubitus, squeezing the pelvic brims together or separating them may give pain. In ventral decubitus the joint is tender to deep pressure, hyperextension of the thigh on the pelvis is limited and painful, the leg cannot be straightened on the flexed thigh, and bending forward is painful.

Swelling and abscess formation ultimately develop and may be

detected either externally over the joint or by rectal palpation, though the pus may burrow forward beneath the sheath of the iliacus muscle and point in front without being accessible to the rectal touch. When the abscess breaks into the rectum or opens into the rectal fossa its track can usually be traced either by probing or by the injection of iodoform or bismuth and making a picture with the *x*-rays.

The diagnosis of the tuberculous nature of the affection depends upon the results of the tuberculin test and laboratory examinations of the discharge when sinuses have formed.

The distinction from disease of the hip-joint is made by noting that when the pelvis is fixed all motions of the hip-joint are free except such as put some strain on the sacro-iliac articulation.

In the early stages the elimination of low Pott's disease is difficult. The latter condition is the usual one in children.

A chronically inflamed appendix may produce precisely the referred and local pains of sacro-iliac disease, the differential diagnosis being based upon the absence of distinct tenderness over the joint, the presence of appendix tenderness, and the associated gastro-intestinal symptoms of appendicitis.

From sciatica the affection is distinguished by the existence of local tenderness in the joint.

Rheumatism, gonorrhea, syphilis, and other forms of infection may manifest their presence by chronic inflammation in or near the sacro-iliac joint.

Exostoses originating in the pelvic bones are usually found about the sacro-iliac articulation, and exhibit their characteristic slow growth. They occasionally develop on the outer extremity of the acetabulum, in which case they may interfere with motion, and if traumatized may undergo sarcomatous degeneration. The diagnosis is by palpation, by pressure symptoms, expressed particularly in the form of sciatica, and by the *x*-rays.

Chondromata (rare), noted about the iliosacral joint and the pubic and sciatic rami, are symptomless except for their bulk and the pressure symptoms they may produce. The diagnosis is based upon the detection of a dense, distinctly nodular tumor which gives no *x*-ray shadow. It is corroborated by removal.

Sarcoma, either of the periosteal or central type, is usually found in the ilium to the outer side of the vessels, and is characterized by its rapid growth, early development of pressure symptoms, often by pulsation. Diagnosis should be made by the *x*-rays and by prompt removal. Huge tumor, venous obstruction, eggshell crackling are late signs.

Pressure symptoms are usually first manifested in the form of pain, which may be sudden in onset, relieved by position, and becomes progressively worse with the growth of the tumor. Since there may be associated with a rapidly growing tumor a distinct fever with pronounced anemia, the disease may closely simulate a subacute or chronic osteomyelitis. The distinction can usually be made by the *x*-rays.

THE INGUINAL REGION AND GROIN.

The surgical affections peculiar to this region are displaced testicle and affections of the spermatic cord or the round ligament.

Affections common in this region are hernia, inflammatory and neoplastic glandular enlargements, varicosities of the lymphatics or bloodvessels, aneurysm, and tumors or cysts.

Undescended or misplaced testicle forms an oval, smooth, usually movable, tender nodule. Its nature is suggested by the absence of the gland from its normal position. It is subject to recurring inflammation and malignant degeneration, and is often complicated by hernia (see p. 504).

Hydrocele of the cord, an affection of infants, forms a fluctuating non-inflammatory, non-sensitive, translucent tumor, moved by traction on the testicle. It may be partly or wholly reducible. The distinction from lipoma (rare) or non-reducible epiplocele may be difficult, since the latter in infants exhibits a moderate degree of translucency.

Hydrocele of the round ligament exhibits a slightly mobile tumor in the inguinal canal, partly reducible, presenting, if large, through the external ring. It may be partly reducible. It is occasionally so closely simulated by a cold abscess originating from the pubic bone that differential diagnosis is made only on operation.

Hernia is the usual cause of inguinal swelling. Its complete reducibility and the palpation of an empty inguinal or femoral canal thereafter constitute the chief diagnostic features.

Obturator hernia, an affection of old women, if it gives diagnostic symptoms, will be characterized by a swelling to the inner side of the bloodvessels, and pain radiating along the course of the obturator nerve and involving both the hip and the knee. Careful palpation is needful to make the distinction from femoral hernia.

Gravitation abscesses are reducible and exhibit impulse on coughing. These may be of spinal, sacro-iliac, pelvic, or prostatic origin.

Cold abscesses of spinal origin form a fluctuating tumor to the outer side of the bloodvessels below Poupart's ligament. By abdominal palpation the tumor can be traced upward along the course of the psoas muscle, and through fluctuation can be elicited.

Cold abscess of sacro-iliac or iliac origin usually points in the outer part of the groin below Poupart's ligament.

An abscess forming as a result of subacute or chronic osteomyelitis of the pubis may readily simulate in position and symptomatology an omental hernia.

Postperitoneal cysts, extravasations, or inflammatory collections (see p. 492), if large, may point on the inguinal region or groin, as does a psoas abscess.

Inflammation of the lymphatic glands of the groin, if there be no demonstrable focus on the skin surface drained by them, should suggest anal and urethral examination. The inflammation incident to ordinary

infection may be hyperplastic or suppurative, and is readily recognized. That incident to chancre exhibits characteristic bilateral polyglandular, painless enlargement (see p. 643).

Chancroidal adenitis frequently suppurates and leaves persistent burrowing sinuses incident to reactionary inflammation against the necrotic gland substance.

Tuberculous adenitis, by no means uncommon in this region, exhibits the chronic course and progressive involvement of the entire superficial group with deep extension, tendency to softening and to sinus formation, and ultimate generalization characteristic of the infection in general.

The diagnosis is based upon the tuberculin test and animal inoculation.

Carcinoma involving the inguinal glands is always secondary.

Lymphosarcoma is marked by rapid and apparently causeless growth, without inflammatory symptoms and exhibiting a tendency to become adherent to neighboring structures. The diagnosis should be made by immediate removal.

The enlargements noted in Hodgkin's disease are associated with similar growths elsewhere.

The cystic tumor of the lymphatic gland due to the filaria develops in the superficial inguinal group. The diagnosis is based upon associated dilatation of the afferent lymphatic vessels and the finding of the parasite in the blood.

Lymphangioma may be difficult to distinguish from lipoma unless individual varices can be felt. It is usually indefinite in outline, somewhat nodular, and often congenital.

Hemangioma is usually associated with dilated skin vessels which suggest the diagnosis. Its size variation incident to position is characteristic.

Aneurysm is usually unmistakable. Even when inflamed, and with a sac so extremely laminated that expansile pulsation is not present, a careful examination and a study of the history of the case usually enables a correct diagnosis to be formulated.

Tumor of the soft parts which is not surely recognized as benign should be diagnosticated as to nature by immediate operation.

Exostoses of pelvic origin may become palpable in the groin. Dense consistence and slow growth suggest the diagnosis which is corroborated by the *x*-rays.

Sarcoma of the pelvic bones may first become manifest by groin tumor, less dense in structure than either chondroma or osteoma, and more rapid in growth. Diagnosis is made as by the *x*-rays.

CHAPTER XVIII.

THE GENITO-URINARY ORGANS.

The symptoms of surgical affections of the genito-urinary organs are visible or palpable alteration in position, size, or conformation, one or all; disturbance of function; pain either localized or referred; and blood or purulent discharge or both, appearing externally from a sore or sinus, discharging from the urethra when the anterior part of the mucous passage is involved or found in the urine when the lesion involves any portion of the urinary tract in or behind the membranous urethra. In addition there may be constitutional symptoms incident to deficient elimination or septic absorption.

THE PENIS.

Congenital Malformations.—This organ may be absent, in which case the urethra opens into or near the anus, concealed, but discoverable by palpation. It may be minute, even of quill size, gigantic, double, twisted, or adherent. These rare deformities are obvious. The common deformities are those associated with urethral defects (see p. 666).

The prepuce may be deformed, absent, adherent, or redundant; exceptionally with an orifice so small as to constitute a source of urinary obstruction. It is usually redundant and adherent at birth. The frenum may be so short as to interfere with erection.

Trauma of the Penis.—Contusion is characterized by rapid swelling and discoloration. Blood from the urinary meatus indicates partial or complete rupture of the urethra.

Wounds.—Wounds are of importance in accordance with whether the urethra and the erectile tissue are or are not involved.

Fracture.—Fracture of the penis due to traumatism exerted upon the erect organ is due to a tearing of the fibrous investment of the erectile tissue. It is attended by severe pain, rapid swelling, and subsidence of erection. Prognosis as to function without operation must be guarded.

Dislocation of the Penis.—As the result of great force the penis may be squeezed from its skin investment as a grape from its skin. The sheath of the penis is filled with blood clot closely simulating the flaccid organ.

This rare injury is usually complicated by rupture of the urethra. If it be suspected the foreskin should be retracted until the head of the penis is brought clearly in view. This is always necessary after severe trauma of the penis to determine the presence or absence of urethral rupture.

Inflammatory Affections of the Penis.—**Diffuse Inflammations.**—The envelopes of the penis are, aside from distinctly venereal disorders, subject to diffuse inflammations observed in other parts of the body, such as dermatitis, particularly that from rhus poisoning, eczema, pruritus, urticaria, erythema intertrigo, stings of insects, erysipelas, lymphangitis, diffuse cellular inflammation, and gangrene.

Rhus dermatitis is suggested by the history of exposure and sudden and rapid spread of the vesicular eruption.

Eczema is a rebellious affection usually involving both the scrotum and the penis; gradual in onset, spreading slowly, and exceedingly persistent.

Pruritus and *erythema intertrigo* more commonly attack the scrotum.

Urticaria.—In the absence of previous lesion a pronounced, rapidly formed (hours), edematous swelling, involving the skin and subcutaneous tissues, not interfering with the function of urination except by edematous phimosis, and not spreading peripherally, is likely to be urticarial (acute rheumatism, gastro-intestinal disturbances).

Erysipelas.—If an acute swelling has been preceded by surface lesions such as those of balanoposthitis, and it exhibits a tendency to spread from the root of the penis over the abdomen and thighs, particularly if it is associated with the constitutional symptoms of septic absorption, has raised borders, and is accompanied by enlargement of the inguinal glands, the affection is probably erysipelas.

Cellulitis.—If the swelling has been preceded by difficulty in micturition and induration along the course of the urethra, and in its progression involves the penis, the scrotum, and thence spreads directly upward on the abdominal walls, sparing the anal perineum and upper part of the thighs, urinary extravasation should be suspected and examined for.

Cavernitis.—If the swelling is associated with marked deep induration and profound constitutional symptoms of septic absorption, involvement of the erectile tissue should be suspected, usually secondary to extravasation. When the inflammation has proceeded to gangrene the diagnosis is sufficiently obvious.

Lymphangitis in its acute form is always secondary to an infected lesion, and is characterized by an edematous swelling of the skin of the penis and the presence of an indurated tender cord in the position of the dorsal lymphatic vessels, movable with the skin over the deeper parts. The inguinal glands are enlarged. Small dorsal abscesses may form.

Phlebitis (rare) is attended with symptoms characteristic of lymphangitis, except that the induration is more deeply placed and the inguinal lymphatic glands are not necessarily enlarged.

Circumscribed inflammation of the penis may be non-ulcerating or ulcerating.

The non-ulcerating inflammatory circumscribed lesions of the penis are itch, papular syphilitic eruptions, exceptionally chancre, and paraphimosis. With the exception of the chancre, lesions of a similar nature on other parts of the body suggest the diagnosis, though itch may occur only on the penis. The detection of the burrow under a magnifying glass and

the finding of the insect or the effect of sulphur treatment would be conclusive.

When chancre appears as a papule which does not ulcerate, a history of exposure to infection not less than twelve days before the appearance of the lesion, the development of induration (five days), inguinal adenopathy, and resistance to treatment should suggest a diagnosis which could be formulated by excision and microscopic examination of the papule.

Paraphimosis, characterized by edematous swelling of the foreskin beyond the ring of constriction formed by a tight preputial orifice drawn behind the glandular corona is usually obvious on inspection. Exceptionally the prepuce, in place of turning back as the sleeve of a coat, and causing edema of its mucous surface, slips directly over the corona and causes rapid swelling of the glans. In such a case the ring of constriction may be picked up by a grooved director passed from before backward in the sulcus. When the prepuce is rolled back the constriction ring must be picked up by the director passed from behind forward.

Eroded or ulcerating circumscribed inflammatory lesions of the penis include balanoposthitis, simple hair cuts or abrasions, herpes, chancre, secondary and tertiary lesions of syphilis, chancroid, tuberculous ulceration, and epithelioma.

The commonest of these lesions are those of balanoposthitis and simple infection from slight trauma. In private practice chancroid is less frequent than are the syphilitic lesions. Tuberculous lesions are exceedingly rare.

Paraphimosis in its advanced stage may be attended with deep ulceration at the point of constriction or even extensive gangrene of the glans and foreskin.

Balanoposthitis, predisposed to by a long, tight prepuce, the gouty or rheumatic diathesis, and abnormal conditions of the urine, often excited by a urethral discharge or one from an ulcerating lesion of the glans or prepuce, is characterized by itching, heat, swelling, and an offensive, irritating discharge. The slightly edematous prepuce, being stripped back, shows areas of denudation covered with a thick, creamy discharge. There may even be distinct excoriations and superficial ulcers. These lesions may be the starting point of lymphangitis, phlebitis, or cellulitis. They often precede the development of condylomata.

This is a common inflammation in children and in adults who do not keep the preputial sac clean.

The inflammation may be a manifestation of secondary syphilis, in which case there will be other signs of the constitutional disease, nor will cleansing treatment avail.

Chancroid may begin as a balanoposthitis. The diagnosis can be made only by the further development of the latter lesion. The distinction from herpes is dependent upon the beginning of the latter in the form of discrete vesicles which become confluent with circinate borders. These lesions may be, however, quickly complicated, often completely obscured, by balanoposthitis.

In the presence of phimosis the diagnosis of simple balanoposthitis may be extremely difficult. The absence of the gonococcus excludes gonorrhea; of induration probably, but not certainly, chancre; prompt yielding to cleansing treatment, chancroid.

If the inflammatory symptoms are persistent or progressive, incision will be needful for the framing of a diagnosis.

Cracks, fissures, hair cuts, and *abrasions* contaminated by the ordinary pus organisms represent the commonest form of genital sores. These become obvious within twenty-four hours of the time of infection. Symptoms of local inflammation increase for two or at most three days and then rapidly subside under ordinary cleansing treatment. On this point the early diagnosis from chancroid and chancre must be made.

From herpes these simple infections are distinguished by the fact that they do not appear first as vesicles or superficial round sores. They conform in shape to the original lesion, usually a scratch or hair cut or an irregular abrasion.

Herpes is characterized by the somewhat sudden appearance of vesicles with erythematous bases situated on the mucous or skin surfaces of the penis. They are attended with itching and burning and are prone to recur. They are commonly found about the coronary sulcus, involving both the glans and foreskin. The vesicles are quickly macerated, leaving round or irregular erosions tending to become rapidly confluent. There is associated surrounding balanoposthitis. At times there is intense pain, which may be accompanied by urethral discharge because of similar lesions in the urethra.

Herpes is characterized by its tendency to recur, sudden appearance in clusters of vesicles, usually in the absence of obvious cause, absence of induration, superficial nature of the eruption, circinate border of the confluent lesion, and rapid healing of the outbreak under cleansing treatment, though fresh crops may appear. There is often bilateral, polyglandular, inguinal induration.

Exceptionally chancre begins as herpes. The diagnosis must be based upon the persistence of the original lesions, the tendency to induration, and microscopic examination.

Chancre.—Chancre forms, usually one, often two or more, indolent, indurated erosions or ulcerations. Any macule, slight, painless excoriation, or scratch, which persists in spite of careful local treatment, which slowly spreads without marked inflammatory symptoms, which becomes distinctly hard peripherally and at the base as though there were a dense, cellular infiltrate, and which gives a thin, scanty discharge, showing a tendency to crust or to form a pseudomembranous deposit covering the excoriated surface, is almost certainly a chancre.

The diagnosis is further strengthened by proof of exposure, an incubation period of two to five weeks, progressive hardening of the dorsal lymphatic vessels, and induration of one or more of the inguinal lymphatic glands, usually two or three on each side. From mixed infection these glands may suppurate. This is exceptional.

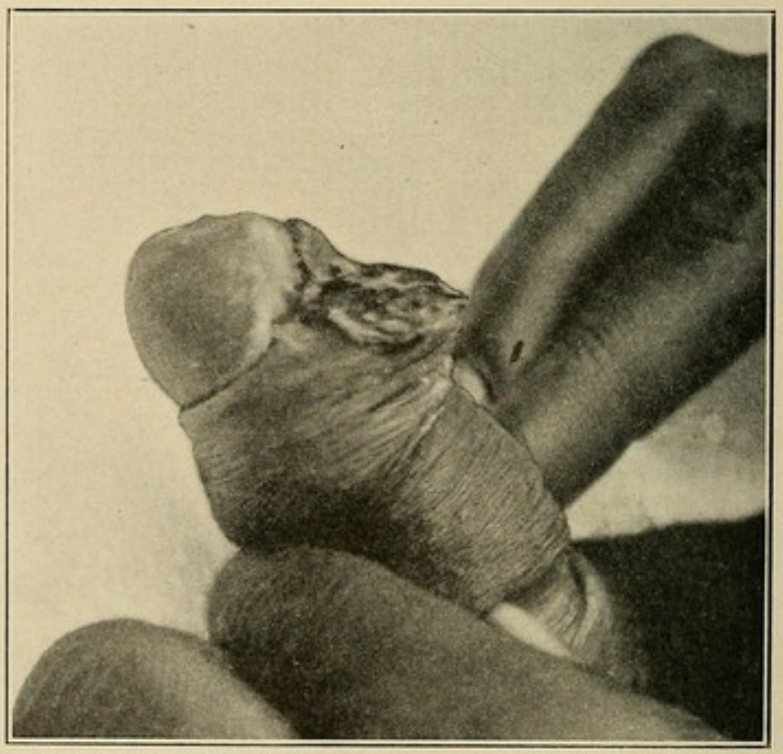
Long incubation, persistent induration, and progressive inguinal

adenopathy are more characteristic than the form of the lesion, which is usually oval or round, but may begin as a balanoposthitis and continue as such except for hardening of the foreskin.

FIG. 427

Meatal chancre. Incubation, three weeks. Duration, four weeks. Ulcerating surface covered by pseudomembrane within the meatus. Inguinal glands typically enlarged. Urination obstructed, and occasionally bleeding from the meatus.

FIG. 428



Chancre of the glans sulcus and inner preputial surface. The typical induration causes it to project in place of lying flat when the foreskin is retracted. Incubation, three weeks. Duration, three weeks. A flat, superficial, indolent, rounded sore. Wire-like induration of the dorsal lymphatics of the penis. Glands in each groin painlessly enlarged.

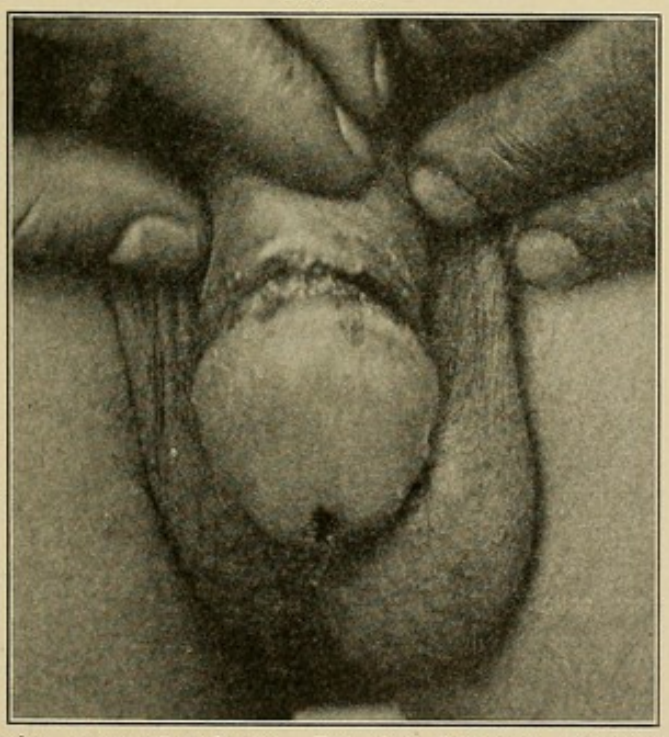
The induration may be simulated by the inflammatory infiltration incident to cauterization of a non-specific sore, or by that of a slowly forming furuncle or a folliculitis. A gumma, or so-called relapsing chancre, may so closely simulate a primary lesion that differential diagnosis must be based upon the history, since both induration and inguinal adenopathy may be absent from chancre (exceptional).

The finding of the spirocheta in the scrapings of an excised sore constitutes the only absolutely conclusive early diagnostic sign of chancre.

Secondary and Tertiary Lesions of Syphilis.—The secondary eruption of syphilis, particularly in the form of mucous patch, is common on the penis and foreskin. It is usually associated with a recent history of syphilis and other unmistakable lesions of the disease.

Gumma is prone to develop at or near the seat of a former chancre; it begins as an induration which softens and discharges, forming a hard, indolent, deep ulcer, often mistaken for chancre. The inguinal glands are not characteristically enlarged nor do secondary eruptions develop.

FIG. 429



Chancroids. Incubation, twenty-four hours. Duration, five days Multiple acutely inflammatory, freely suppurating, punched-out destructive lesions.

Chancroid.—Chancroid usually begins exactly as a simple abrasion or hair cut, hence is without incubation, but may not become sufficiently obvious to attract attention for three to five days after exposure. The lesion may be single and so remain throughout. It is usually multiple and successively so, *i. e.*, fresh sores break out in crops. Chancroids progress rapidly, forming ragged, punched-out, often undermined, non-indurated ulcers, irregular in shape, discharging freely, inflammatory in type, covered with a gray, pus-soaked slough or concealed by a thick, moist scab. They produce similar lesions on surfaces with which they

come into contact. Their discharge can be inoculated on any portion of the surface of the body. In the later stage of their course (three weeks) auto-inoculation fails.

Exceptionally chancroids exhibit induration, particularly those which have been cauterized.

A chancroid may become gangrenous if it be complicated by phimosis or paraphimosis, or if it be mechanically or chemically irritated.

The distinction from simple infection and balanoposthitis is impossible if the chancroid be seen at its very beginning. Later it is based upon the ulcerating, rapidly extending type of inflammation and the finding of the Ducrey bacillus.

Ulcerating gummata ultimately produce lesions indistinguishable in appearance from chancroid. Induration precedes destruction, and this process is a matter of weeks or months.

Tuberculous ulcers are extremely slow, associated with tuberculous lesions elsewhere, may exhibit peripherally semitransparent, grayish, miliary tubercles, and scrapings show the bacilli microscopically.

Epitheliomatous ulcer is a common malignant infiltration of the penis, usually beginning as a wart in a middle-aged or elderly man, at times before the thirtieth year. The mere presence of a persistently (weeks) ulcerating wart, not obviously syphilitic, calls for immediate excision and microscopic examination. Thus only can the diagnosis be made at a time when it is serviceable.

The well-developed, ulcerating, and fungating epithelioma is unmistakable. Glandular involvement and widespread infiltration of tissue will sufficiently distinguish it from broken-down gumma.

Tuberculous ulcers are rare. They are associated with obvious tuberculous lesions elsewhere, are exceedingly chronic in course, and may exhibit about their periphery characteristic miliary tubercles. Finding the tubercle bacillus would be diagnostic.

Abscess of the Penis.—This exceptionally takes the form of an ordinary boil.

Usually it is due to a folliculitis in turn secondary to urethritis. Along the course of the urethra can be felt one or more hard, tender, pea-sized nodules which usually discharge into the urethra. If the duct leading thereto be blocked, the swelling becomes red and soft, and there is an external discharge of pus. These abscesses are commonest along the course of the bulbous urethra and near the meatus, on one or both sides of the frenum. Exceptionally, they give rise to urinary extravasation; or opening both internally and externally, form fistulæ. In the latter case the course of the tract is often indirect, and the urethral opening may be in the roof of this canal.

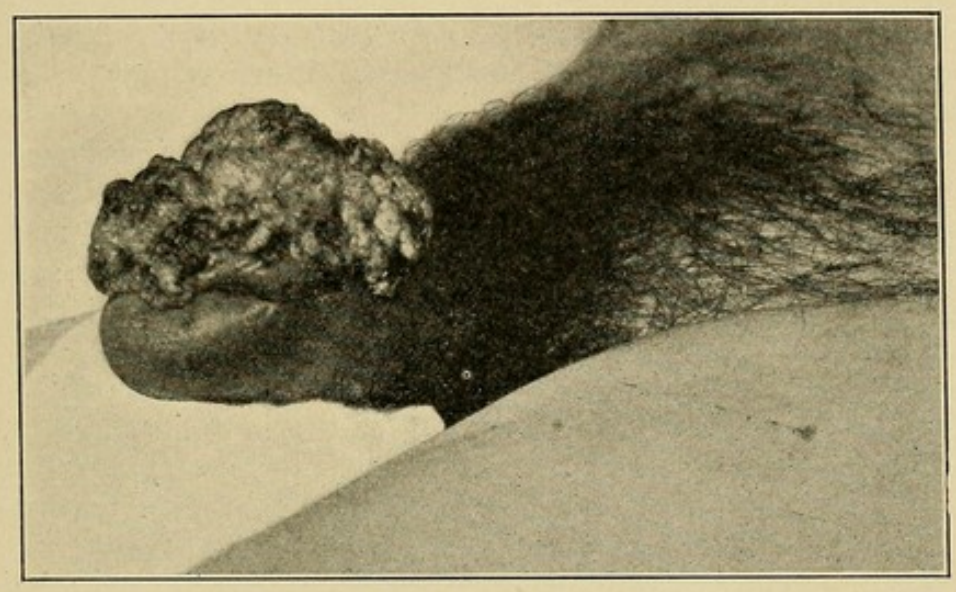
Tumors of the Penis.—Papilloma.—Papilloma is the commonest tumor of the penis. It may be single or multiple, confluent or discrete, moist or dry.

Commonly it springs from the coronary sulcus, posterior border of the glans penis, margin of the prepuce, the region of the frenum, and the orifice of the urethra, and is frequently sequent to urethral discharge

or balanoposthitis. Redundant or phimotic foreskin is the usual predisposing factor.

With the condyloma latum, or mucous patch, a wart may readily be confounded. The former represents a papillary outgrowth due to irritation of the spirocheta or its products. Diagnosis will be based upon the history of the case and concomitant lesions. Moreover, the syphilitic lesion never attains the enormous outgrowth characteristic of the wart.

FIG. 430



Epithelioma of penis. Cauliflower (fungating) mass involving glans and prepuce. One year's duration. Edema of dependent portion of prepuce. Bilateral enlargement of inguinal lymph glands. (Carnett.)

Epithelioma.—Epithelioma, beginning as an ulcerating papilloma, is diagnosticated by excision and microscopic examination.

Among rare tumors of the penis may be mentioned sarcoma; dermoid, sebaceous, blood, and mucous cysts; horny growths; fibroma; adenoma; lymphangioma. These tumors coincide in development and appearance with similar lesions placed elsewhere. Cysts of Tyson's glands may be multiple and reach a large size.

Distressing bladder reflexes have been noted in connection with angiomata.

Sarcoma.—Sarcoma, at times melanotic, when originating from the glans appears as a rounded nodule, growing from the erectile tissue or its sheath, elastic, clearly outlined, increasing rapidly in size, and markedly interfering with erection. If gumma can be excluded and the small growth from its position cannot possibly be an expression of chronic folliculitis, the diagnosis should be made at once by excision and microscopic examination.

Lymphangioma, or elephantiasis, which occurs about the external genitals, involves both the penis and scrotum. In this country it is usually secondary to disease or removal of the inguinal lymphatics.

Dermoid cysts, congenital in origin, usually placed in the raphe, form non-inflammatory tumors, which after years of indolence may grow rapidly. They are diagnosticated by removal and examination.

Induration of the Cavernous Bodies.—On the dorsum of the penis of middle-aged men may rarely be found on palpation one or more irregularly shaped, indurated areas, cartilaginous in hardness, usually neither tender nor painful, and causing marked distortion on erection. There is no visible tumor, and the overlying skin is freely movable. This condition is associated with the gouty and rheumatic diathesis, and is distinguished from gumma by its chronicity, its occurrence in the absence of signs of syphilis, and the fact that it never breaks down.

Functional Disturbances of the Penis.—Erection may be absent, partial, complete, or persistent.

Absence of erections may be due to developmental failure, exceptionally of the penis, more commonly of the testicles. It is a sequel of degeneration or removal of the testes, prolonged priapism, and may follow complete prostatectomy. It is a constant, often an early, symptom of degenerations of the cord, particularly that of which locomotor ataxia is an expression.

Absent or feeble erections are usually due to a lumbar cord neurasthenia incident to chronic inflammation of the posterior urethra, prolonged, ungratified sexual excitement, sexual excess, or general neurasthenia. The diagnosis is incident to the history and a urethral and neurological examination.

Priapism, or prolonged erection, unaccompanied by sexual desire, often painful, may be intermittent or persistent.

In its intermittent form it is sometimes an early sign of spinal degeneration. Usually it indicates a source of irritation about the urethra, penis, or anus. At times it follows venereal excess. Exceptionally it is apparently idiopathic, coming on at night, and giving rise to but little inconvenience aside from the psychical effect it produces. It is little influenced by treatment, nor do these cases ultimately develop symptoms that would suggest that this recurring priapism is of evil portent.

Persistent priapism is a common symptom of leukemia, a rare one of locomotor axaxia and syphilis of the cord, and a very exceptional sequel of perineal trauma.

The etiology is at times undiscoverable. It may last weeks or months. Turgescence is limited to the cavernous bodies, urination is likely to be somewhat difficult, and the ultimate result is sclerosis of the erectile tissue and incurable impotence.

THE SCROTUM.

Congenital deformities are unknown, except in association with other lesions of the external genitalia. In hypospadia and hermaphrodism there is cleft scrotum. The penis and scrotum may be grown together. In the case of undescended testicle the scrotum remains infantile or undeveloped.

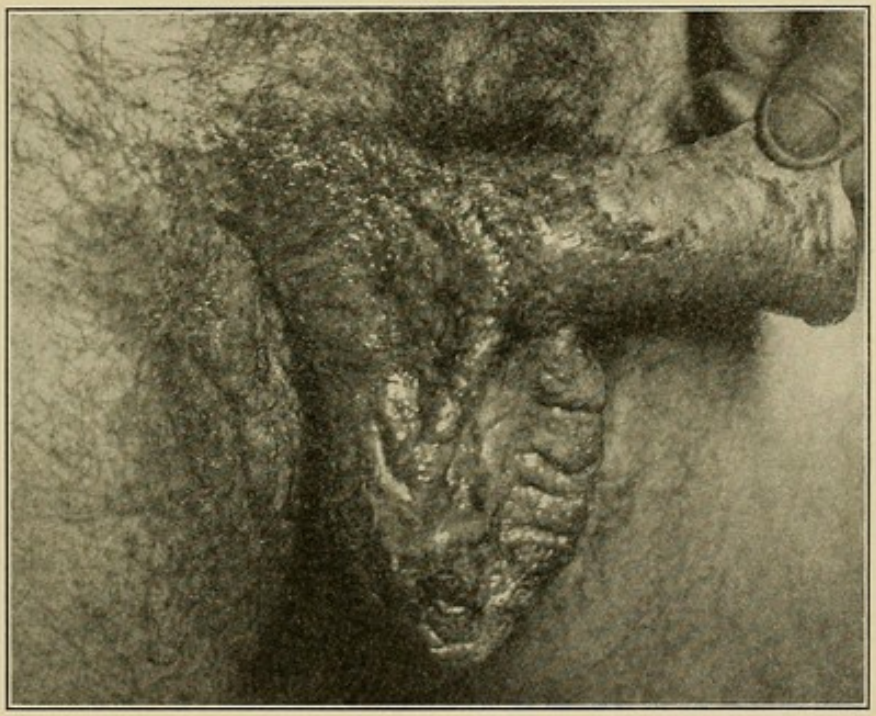
Contusions.—Contusions are followed by rapid swelling and intense discoloration.

Edema.—Edema is a common expression of either general vascular failure or local inflammation. In the former case it is associated with a similar condition elsewhere, and the symptoms of local inflammation are absent. Its presence, when not traumatic, or secondary to surface lesion, should suggest extravasation of urine.

Emphysema.—Emphysema, if not artificially produced, is indicative of extravasation and extensive sloughing.

Cutaneous Affections.—These exhibit the characteristics of such lesions when placed in other parts of the body. Those of inflammatory nature common on the scrotum are erythema intertrigo and eczema; of parasitic nature, pediculosis; of cystic nature, molluscum contagiosum and sebaceous cysts.

FIG. 431



Eczema rubrum of the scrotum. (Hartzell.)

Circumscribed erosions or ulcers of the scrotum, if not traumatic, are chancre, chancroid, or the lesions of secondary or tertiary syphilis.

Abscesses and sinuses are secondary to urethral extravasation or simple infection, or tuberculous, syphilitic, or malignant degeneration of the testicle.

Cellulitis may be secondary to a wound or granulating surface. It is usually an expression of urinary extravasation or abscess rupturing into the scrotal tissue.

Erythema intertrigo is frequent in children and in fat, flabby men, especially those who are rheumatic or uncleanly, or both, or who readily chafe.

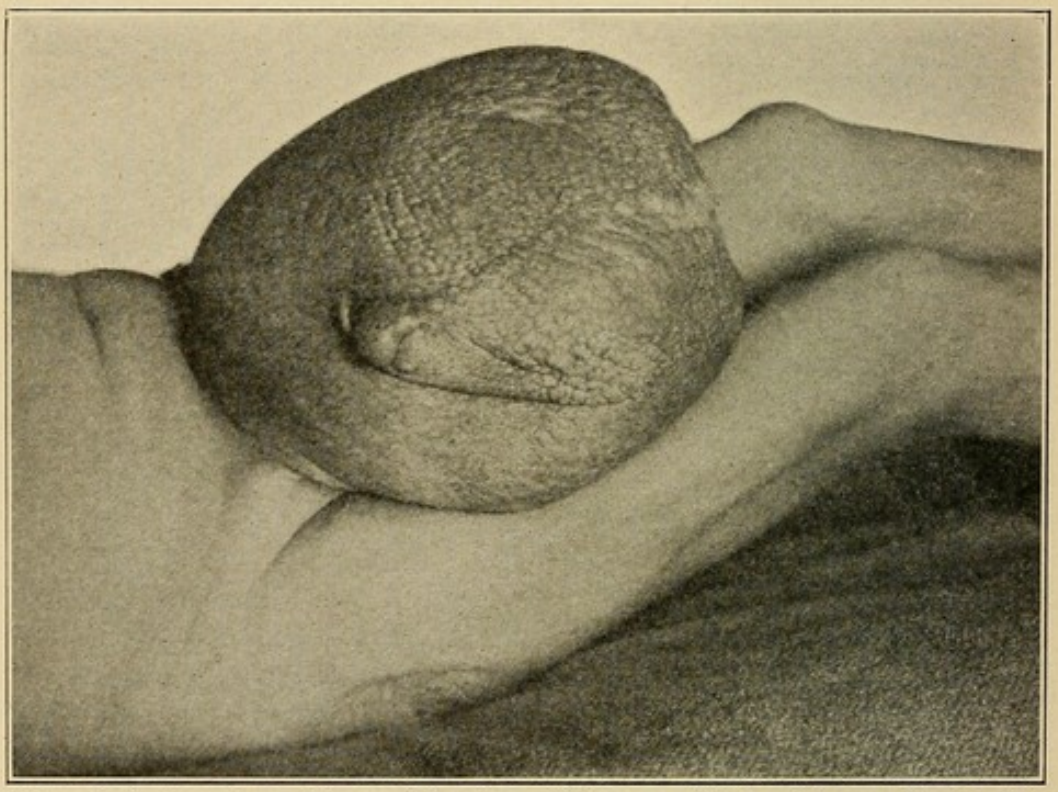
Eczema is commonly associated with gout, rheumatism, and diabetes. It may occur in any of its forms, causing great itching, burning, and when persistent a marked thickening of the scrotal tissues.

Pruritus, most frequently noted in the rheumatic, may develop independently of any local lesion and reach maddening intensity. The only symptom is itching, which may produce so great a yearning to scratch, pull, and knead the scrotum that decorum, even decency, is forgotten.

Pediculosis is the usual cause of itching unassociated with pronounced skin lesions.

Diagnosis is made by finding the lice which resemble small skin scabs and are most abundant at the root of the penis. The ova, looking like flakes of dandruff, but rounded and intimately adherent to the hair, can readily be found if search be made for them.

FIG. 432



Elephantiasis of scrotum. Ten years' duration. Filaria sanguinis hominis never found. Characteristic thickening and corrugation of the skin. Hyperplasia of the subcutaneous tissues. Preputial orifice near middle of tumefaction. (Carnett.)

Molluscum contagiosum is usually seen in children. Small, waxy, almost spherical tumors or cysts are found in the superficial layers of the skin, mostly sessile, sometimes pedunculated, later they become umbilicated, showing a small, black spot in the centre indicating the opening into the follicle. They are painless.

Sebaceous cysts are usually single, forming soft, doughy, rounded tumors in the skin. In the adult they may reach the size of an egg and are prone to break down and suppurate.

Chancre, chancroid, mucous patch, gumma, and epithelioma of the scrotum exhibit no departure from type.

Abscess of the Scrotum.—Abscess of the scrotum presents characteristic features, the edematous swelling being particularly well marked and fluctuation occurring early. Except those from a breaking down hema-

toma or suppurating sebaceous cyst, such abscesses are of urethral, testicular, or rectal origin, hence, after discharge, sinuses remain which may be multiple or greatly infiltrated.

Cellulitis of the Scrotum.—This, exceptionally traumatic, occasionally due to extension of skin infection, is usually a sign and symptom of urinary extravasation. The edema is deep and infiltrating, there are constitutional signs of infection (exceptionally none), and the preceding and accompanying symptoms of urethral obstruction.

Tumors of the Scrotum.—These, if sebaceous cyst be excepted, are rare.

Epithelioma begins as an indurated wart, which becomes ulcerated, scabs on its surface, and is characterized by hard, raised edges, uneven surface, and the exudation of ichorous pus. The distinction from syphilitic lesion, when this is in doubt, should be made by excision and microscopic examination.

Lipoma sometimes develops. It may be infiltrating or globular, usually the former. Diagnosis is based upon the consistency. Distinction from omental hernia may be extremely difficult, indeed quite impossible if the tumor has infiltrated along the course of the cord.

Lymphangioma or lymphedema, usually secondary to inflammation or removal of the inguinal lymphatics, and characterized by a brawny induration and enormous thickening, may reach huge proportions. The diagnosis is obvious.

Gummata, enchondromata, osteomata, and fibromata are occasionally observed.

THE TESTICLE AND EPIDIDYMIS.

Congenital Anomalies.—The testicle may be absent, fused, enlarged, inverted, arrested in development, imperfectly descended, or displaced from its normal position or its track of descent.

The testicle may be absent on one or both sides. In the latter case the diagnosis is based upon impotence and asexuality; hence, it is a matter of time. Complete absence of the testes is exceedingly rare.

The testicle may be arrested at any point in its transit.

Abdominal Retention.—Abdominal retention may be unilateral or bilateral, the testicle may be found close to the posterior abdominal wall, below the kidney, may be provided with a long mesorchium, allowing it to move freely in the abdominal cavity, or it may be placed in the iliac fossa close to the internal ring.

Inguinal Retention.—The testicle may be arrested at the internal ring, in the inguinal canal, or at the external ring, and is usually extremely mobile, unless it becomes fixed by attacks of inflammation.

Cruroscrotal Retention.—In incomplete scrotal descent the testicle lies outside of the inguinal canal, but fails to descend completely, being found in the fold between the scrotum and the thigh, at a varying distance from the ring.

If the testicle takes an aberrant course, it may be found beneath the skin of the abdominal wall at a variable distance from the external

abdominal ring, in the crural region behind the femoral vessels, or in the perineum.

Incomplete transit is most commonly manifested in the form of inguinal retention; the aberrant transit, in the form of perineal ectopy.

Diagnosis of misplaced testicle is based upon the absence of the gland from its normal position and, excepting in abdominal ectopy, the finding of it elsewhere. The scrotum is atrophic on the side of the displacement. In children the testis is extremely small and very movable, and to the unpractised finger not always readily found. The testis which is not descended by the sixth year will usually remain in its faulty position unless subjected to surgical treatment.

A testis abnormally placed does not reach full size, nevertheless it may secrete healthy spermatozoa unless it be subject to repeated inflammation.

Misplaced testicle is often complicated by hernia of the congenital or funicular type exhibiting the characteristic symptoms of hernia.

Orchi-epididymitis, particularly the traumatic and urethral form, is a common complication, exhibiting symptoms which depart from type only in their location. Such an affection in the case of abdominal or inguinal ectopy might closely simulate internal strangulation of hernia and be mistaken for such if absence of the testis were unsuspected, since tympany and vomiting are common reflexes of testicular inflammation.

Torsion is an accident to which the undescended testis seems peculiarly subject. The symptoms are those of a hyperacute orchi-epididymitis. Nor can the diagnosis be made with absolute certainty without incision.

Hydrocele and hematocele exhibit symptoms elsewhere described but for their unusual position. The congenital hydrocele, slowly reducible into the abdominal cavity, must be distinguished from omental hernia by marked translucence, slow and gradual reduction, equally slow return, and finally by incision.

Malignant degeneration exhibits a solid tumor in the inguinal region, steadily, often rapidly progressive, accompanied by persistent pain. The diagnosis must be made through an incision, since, when it is obvious from nodulation, great size, and adherence of the tumor, operation is of no avail.

Inversion of the Testicle.—Though it may descend to the bottom of the scrotum, the testicle may exhibit anterior, horizontal, or lateral displacement, or may be completely rotated, the epididymis lying in front, the free border to the rear. The possibility of this displacement must be considered in tapping for hydrocele.

Affections of the Testicle and Epididymis Characterized by Acute Inflammatory Phenomena.—**Torsion of the testicle** may be either to the right or to the left, and, in accordance with its extent and the degree of constriction to which the vessels are subject, the symptoms are slight or severe. In slight cases the epididymis alone becomes infiltrated. In severe cases the entire gland with the epididymis becomes gangrenous.

The symptoms of torsion are those of orchi-epididymitis of a hyper-

acute type appearing suddenly and causelessly during active muscular exertion. Attacking an undescended testis, the symptoms are akin to those of internal strangulation. In any case the diagnosis can be made only by incision.

Contusion of the Testicle.—Acute traumatic orchi-epididymitis is characterized by sickening pain so severe as to cause syncope, sometimes death. The testicle is retracted and there is rapid swelling. The pain, at first overwhelming, is followed by a constant ache aggravated by standing, coughing, or straining, and so wearing as to enjoin anodynes and rest in bed; subsiding in three to five days, and leaving a testis prone to atrophy.

Acute epididymoörchitis from strain properly belongs to contusion, since the injury inflicted on the testicle is incident to the sudden jerk on the part of the cremaster muscle, or to blood effusion incident to the venous congestion of abdominal strain.

A descending infection often follows hard upon a strain. The onset is not sudden, and such cases usually assume the type of the ordinary epididymitis and are not followed by atrophy.

When, after a comparatively slight trauma, testicular lesions persist and progress, it may be suspected that there was a latent tuberculosis, syphilis, or malignant infiltration before the injury.

Luxation of the testicle may be due to trauma or muscular action. The usual cause is sudden, violent contraction of the cremaster muscle, which may fix the testis in the groin external to the ring from tonic spasm, may lodge it in the inguinal canal, or may draw it within the abdominal cavity. The testis is usually found within the inguinal canal acutely inflamed, because of the violence to which it has been subjected, and exhibiting tenderness and tumor sufficiently characteristic.

Urethral epididymitis is an expression of inflammation carried along the vas. It is a common sequel of gonorrheal and of instrumental urethritis; it occasionally complicates gouty urethritis.

The diagnostic symptoms are a tender edematous swelling at the back of the testis as large as this gland or even larger; tenderness and swelling along the cord; severe pain in the testis and back aggravated by standing, walking, or straining; shortly an effusion into the tunica vaginalis constituting an acute hydrocele, and simulating a swollen testicle; often tender, swollen ampulla and seminal vesicle detected on rectal examination; fever and mental depression. The urethral origin of the infection is established by the presence of a purulent discharge from the meatus, or of pus of posturethral origin in the urine (see p. 675).

Tympany and vomiting, and tenderness, pain, and rigidity in the right iliac fossa may be prodromal symptoms due to peritoneal extension from the inflamed seminal vesicle. The symptoms reach their height in about five days.

In some cases the onset is insidious, the progress non-crippling, provided proper support be worn, and the sole symptom, aside from urethral pus, an enlarged epididymis, which may almost completely surround the testis.

Gonorrheal epididymitis rarely suppurates, and, as a rule, undergoes almost complete resolution, leaving a permanent induration in the tail of the epididymis, which, exceptionally, completely and permanently blocks the channel against the passage of spermatozoa.

Urethral epididymitis of catheter origin (mixed infection) often gives rise to destructive abscess formation, characterized by softening, the discharge of pus, and at times the formation of multiple sinuses burrowing through enormously thickened scrotal tissues. Such abscesses may terminate in complete sloughing of both the epididymis and the testis.

As a result of abscess, fungus may develop characterized by exuberant granulations usually from the scrotal tissue. If from the testicle or epididymis, the discharge will contain the glandular or tubular structure of these organs.

Tuberculous epididymitis exceptionally begins precisely as does an acute gonorrheal epididymitis; the diagnosis must at first be based upon the absence of gonococci or catheter infection as causative agents, and the usual association of tuberculous lesions elsewhere, particularly in the genito-urinary tract. The subsequent course of the affection will later suggest the diagnosis.

Acute orchi-epididymitis may occur in the course of mumps, malaria, tonsillitis, typhoid, scarlatina, influenza, and gout. The symptoms are those of urethral epididymitis, except that there is no urethral infection, but slight hydrocele, and the testicle is the structure most seriously affected; hence it forms the bulk of the swelling, maintaining, however, its characteristic form.

This inflammation is sometimes the sole expression of mumps. Diagnosis will then be based upon the absence of other causes of inflammation and the history of exposure to mumps. Mumps orchitis is often followed by atrophy.

Typhoid and tonsillitis orchitis is like that secondary to mumps.

Malarial orchitis is characterized by regular recurrence of attacks independent of other reason and the finding of the malarial organism.

Gouty orchitis is recurrent and alternates with other gouty symptoms, disappearing when arthritis develops and reappearing as the latter subsides. It occurs in sudden seizures.

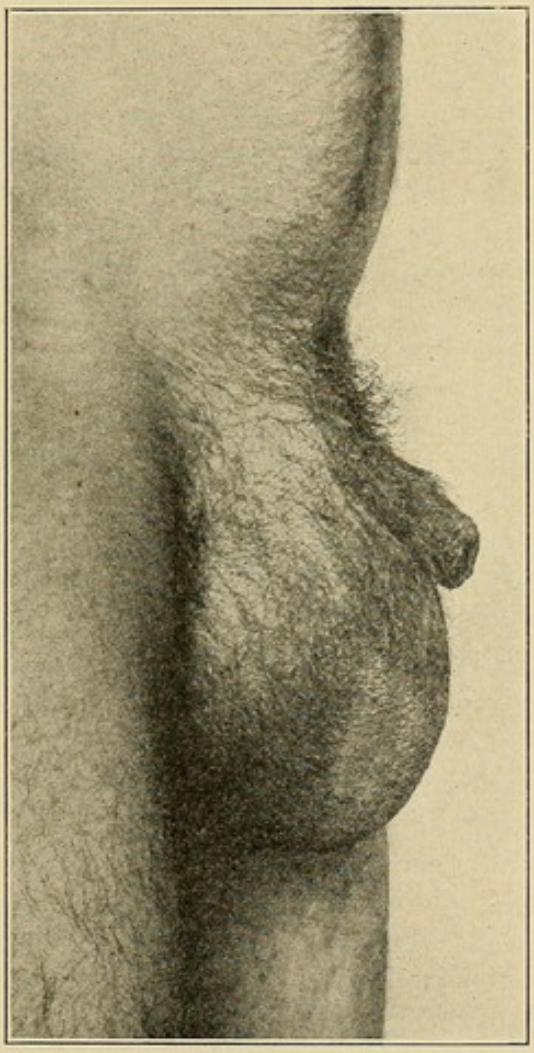
Swellings of the Testicles and Epididymis without Symptoms of Acute Inflammation.—The fluid swellings are hydrocele, cysts of the epididymis or testis, and hematocele, the latter often giving the impression of a solid tumor.

The solid swellings are tuberculous, syphilitic, or malignant. Exceptionally benign tumors develop.

Hydrocele.—Hydrocele, the commonest scrotal tumor, is essentially an affection of infancy and old age. It is characterized in the adult by the development of a slowly growing (years), painless, smooth, tense, heavy, elastic, fluctuating, pyriform tumor, over which the skin is freely movable. The cord is not enlarged. Fluctuation is best elicited by holding the tumor firmly in one hand and lightly percussing with a finger of the other.

Translucency is the most convincing single sign aside from aspiration. This test is best conducted in a dark room and by means of a small electric light placed sufficiently deep within a small metal cup to allow the opening of the latter to be pressed closely against the scrotal skin, thus shutting in all rays except those which pass through the scrotum. In the absence of an electric light, translucency may be elicited by a candle held close to the tumor, over which the scrotal skin has been tensely stretched. The surgeon inspects from the side

FIG. 433



Tense hydrocele. Showing projection into groin. Dull on percussion. Irreducible. No impulse. Fluctuation present. Translucent.

opposite the candle, shielding his eyes from the direct rays of the light by the open hand placed with its ulnar border on the convexity of the tense tumor. This inspection can be made through a tube—a cylindrical proctoscope answers well—or a thick paper rolled into a cylinder and so held to the examining eye that light is excluded except that which passes through the hydrocele.

To be diagnostic, the translucency should be clear and unmistakable, since lipoma may give this symptom faintly.

The final diagnosis is made by the aspiration of a fluid which may be clear, or turbid from admixture with cholesterin, blood, or spermatozoa (encysted hydrocele).

The position of the testicle in regard to the fluid can usually be determined by digital pressure, the latter eliciting the typical tenderness. Moreover, where the testicle lies there will be diminished translucency. When fluctuation, translucency, and testicular sensation cannot be elicited, diagnosis should be made by incision.

Hydrocele of the tunica vaginalis may be bilocular or multilocular, and may occur in the acute form, in which case it is usually secondary to epididymitis.

Chronic hydrocele usually distends the closed sac of the tunica vaginalis alone; it may also involve its funicular process (infantile hydrocele), or if a communication between that and the peritoneum still exists, it may communicate with the general abdominal cavity (congenital hydrocele). If the testis be in the inguinal region, the hydrocele will, of course, develop here.

A huge hydrocele extending up into the inguinal canal may be difficult to distinguish from irreducible omental hernia, or the latter may be a complicating factor. The history of the case, when this can be elicited, is conclusive, hernia beginning from above and the hydrocele from below. Moreover, hernia is usually, in its early development, an intermittent tumor dependent upon abdominal strain for its recurrence.

The distinction between hydrocele and hernia of the undescended testis will be based upon the distinct fluctuation of hydrocele, its persistence, and the absence of the usual attributes of hernia. At times the differential diagnosis is not possible. This is particularly the case in the congenital form of hydrocele. The inguinal hydrocele is often bilocular.

Cysts of the Epididymis and Testicle.—These cysts usually grow from the head of the epididymis, forming an elastic, rounded, or multilocular tumor just above the testicle, of varying size but rarely larger than the gland itself, giving rise to no symptoms, and stationary or exceedingly slow in growth. Such cysts usually contain spermatozoa, hence the translucence is not as marked as in the case of hydrocele. Diagnosis is based upon the absolute indolence of the affection and, if tuberculosis be suspected, exploratory incision. Because of the tension of the fluid in these cysts they are often mistaken for solid tumors.

Encysted hydrocele of the testicle arises from the substance of the latter and forms a tense, circumscribed, elastic tumor covered by the visceral layer of the tunica vaginalis. It usually contains a fluid turbid with spermatozoa.

Loose bodies in the tunica vaginalis are usually discovered accidentally. They present a smooth surface, move freely, and are accompanied by a slight degree of hydrocele. The trouble caused by these bodies is usually psychic rather than physical.

Hematocele.—Hematocele may be acute or chronic in its development. In the former case, incident to trauma or violent muscular strain, it forms a fluctuating tumor, non-translucent, entirely enveloping the testis, and corresponding to its shape. There is usually an accompanying ecchymosis of the scrotum.

There may be complete resolution, or the condition may degenerate into a chronic one.

Chronic hematocele is characterized by a thickening of the vaginal tunic, often of such degree as to simulate a solid tumor. The testicle proper commonly lies in the posterior wall of this thickened mass, and ultimately undergoes pressure atrophy. It is an affection of early old age, exhibits a smooth, rounded, unbossed tumor, beginning with a strain, trauma, or preëxisting hydrocele, growing slowly (years), and with periods of acute exacerbation, attended with moderate inflammatory symptoms, due to fresh hemorrhages into the sac.

The diagnosis, unless the time limit (years) excludes malignant growth, should be made by incision, since aspiration is not sufficiently conclusive.

Intratesticular hematocele would be suggested by severe, crippling, persistent (weeks) testicular pain following trauma.

Tuberculosis.—Tuberculosis attacks the epididymis by preference, usually its head, forming one or more nodules which soften and discharge (months or years). Exceptionally the outbreak is acute, simulating the gonorrheal form of epididymitis, followed by persistence of infiltrations and nodulations, involving not merely the tail of the epididymis, but the whole of its substance.

The usual form is characterized by the painless development of one or more nodules, usually discovered accidentally. Sometimes accompanied by a slight sense of weight and dragging, which leads the patient to make an examination. There is very commonly a preceding and associated slight mucopurulent urethral discharge, together with evidences of tuberculosis elsewhere, particularly in the genito-urinary tract.

The characteristic features of the affection are the inadequacy of a cause other than tuberculosis to produce usually in young adults an indolent, painless, nodular, often bilateral swelling of the epididymis, which ultimately tends to an almost painless breaking down, leaving one or more sinuses which discharge cheesy pus. Exceptionally, the tuberculous foci become permanently encysted. The cord is usually thickened and finely nodular.

The tuberculin test, microscopic examination of the wound discharge, injection of accompanying hydrocele fluid into guinea-pigs, are all means of diagnostic corroboration.

The affection is usually bilateral, nor will prompt removal of the affected testis prevent a secondary involvement of the remaining apparently healthy one.

In infants, tuberculosis affects by preference the body of the testis; it may have a subacute onset, appearing first as a hydrocele or as a tender, swollen testis, with reddening of the overlying scrotum. Persistence of

inflammatory symptoms and early softening and sinus formation are characteristic features. If syphilis be excluded as a cause of the nodular infiltration, distinction from neoplasm should be made by operation.

Cysts of the epididymis are more elastic and sharply rounded than tuberculous infiltrates, the body and tail of the epididymis remain perfectly normal to palpation, and there is no tendency to sinus formation.

Gumma usually involves the testicle first, and is characterized by a history of syphilis, the presence or traces of other specific lesions, and absence of tuberculous stigmata.

Syphilis of the Testicle.—Syphilis of the testicle is usually expressed in the form of sometimes symmetrical, usually bosselated or ridged, painless, densely hard, often bilateral enlargement, associated with a moderate degree of hydrocele; persisting for months with slow increment. The cord is not enlarged. On reaching the size of a fist, the infiltrate undergoes resolution, leaving an atrophied and distorted testis, or breaks down, discharging gummy pus. Exceptionally the onset is characterized by the symptoms of a mild or acute orchitis.

The diagnosis is based upon the history and associated symptoms of syphilis, the absence of inflammatory phenomena, the at first rapid (weeks) then slow (months) progress, and the therapeutic test. When the onset is subacute, the diagnosis must be by exclusion, and must depend upon the history of the case and the therapeutic test.

From tuberculosis the distinction may be made, in the adult, by the fact that the latter nearly always attacks the epididymis first and exhibits lesions elsewhere.

From malignant infiltration, a timely diagnosis must depend upon the history of the case, a therapeutic test, and incision and microscopic examination.

Malignant Tumor of the Testicle.—Malignant tumor of the testicle, usually in the form of soft carcinoma, at times mixed sarcoma, and commonly enough beginning with trauma or inflammation, usually develops before middle age; occasionally in children. It is characterized by a comparatively painless, usually symmetrical, rapid (weeks or months) enlargement of the testis. The postperitoneal glands are quickly invaded.

The diagnosis based upon the presence of a rapidly increasing enlargement in the absence of adequate cause other than malignancy should be made by incision and microscopic examination, since, when the features of the case are such as to be entirely characteristic, *i. e.*, large tumor, dilated veins, and involved lymphatics, operative treatment is futile.

Neuralgia of the Testicle.—Neuralgia of the testicle, by which is meant intense, persistently recurring pain, without demonstrable lesion, is sufficiently often dependent upon either varicocele, encysted hematocele, or a beginning tuberculous or malignant infiltration to justify exploratory operation.

THE SPERMATIC CORD.

The vas may be absent on one or both sides without other obvious defect.

Trauma or muscular strain may cause hemorrhage characterized by the rapid formation of a doughy, sausage-shaped tumor, occupying the position of the cord, simulating hernia of sudden formation.

Acute funiculitis is a common accompaniment of urethral epididymitis and is characterized by pain, tenderness, and thickening.

In the course of tuberculous epididymitis the vas is very commonly finely nodular and infiltrated, and the whole cord is thickened.

In malignant infiltration the cord is often enormously thickened.

Varicocele is the commonest affection of the cord. It is characterized by a soft mass of thickened, dilated, and tortuous veins occupying the position of the cord, not only palpable, but often obvious to inspection. In its extreme development it gives impulse on coughing, and partially disappears on taking the recumbent posture. Exceptionally it is attended with atrophy of the testis. It occasions psychic rather than physical disturbance, but occasionally neuralgic pain and sexual neurasthenia are distinctly referable to it.

It is an affection of youth, appearing after maturity without obvious cause. It is suggestive of venous obstruction of postperitoneal origin, particularly of hypernephroma.

The distinction from omental hernia is made from the peculiar worm-like feeling characteristic of the dilated, tortuous, and often thickened veins, the fact that the tumor began in the lower part of the scrotum, that it can be partly reduced by the recumbent posture, and pressure over the internal or the external ring on resumption of the erect position does not prevent its slowly growing large from below upward.

From discrete lipoma, diagnosis will be made with difficulty. There is no alteration in the size of lipoma dependent upon position or intra-abdominal strain. Moreover, this affection is extremely rare.

Hydrocele of the cord, usually seen in infants, forms a soft, fluctuating, translucent tumor occupying the position of the cord; beneath it the testicle can be felt. It may be acute in development, in which case it is rather an edema than an effusion into a patulous funicular portion of the vaginal tunic.

The encysted hydrocele of the cord is (patulous, funicular portion of the vaginal tunic) insidious in development, chronic in course, unilocular or multilocular, common in children, but noted in the adult, and often complicated by hernia. It appears as a smooth, tense, ovoid swelling in some portion of the spermatic cord. Beneath this the testis can usually be recognized. It is usually mistaken for hernia, and can often be pressed back into the inguinal canal, but cannot be really reduced. Moreover, translucency is present, nor are the characteristic features of hernia to be found unless this condition be associated with congenital hydrocele.

Lipoma of the cord (rare) forms a slow (years), soft, painless, ill-defined growth in the course of the cord, between the structures of which it may intimately infiltrate. The tumor grows from below upward. When it has traversed the inguinal canal, the distinction between it and irreducible omental hernia can be made only on the history of the case and examination through an incision.

THE SEMINAL VESICLES.

The seminal vesicles form two lobulated pouches inclosed in dense fascia, passing from the walls of the bladder to the posterior border of the prostate. They vary greatly in size within normal limits, averaging about two and one-half inches in length and one-half inch in breadth, and terminating in a duct which unites with the vas just before the latter enters the substance of the prostate. The upper extremities of the seminal vesicles are in close relation to the peritoneum of the rectovesical pouch. The function of the vesicles is entirely secretory.

Malformations.—One or both seminal vesicles may be absent, usually associated with other malformations of the sexual organs. They may be fused, multiple, or atrophic. Or they may communicate with the ureter.

The ejaculatory duct, formed by the fusion of the vas and duct of the seminal vesicle, normally pierces the prostatic isthmus, opening at the sides of the prostatic utricle. This duct may be absent, partially wanting, or fused, or it may be continued forward, forming a canal which opens at some point on the glans penis, suggesting a double urethra.

Acute Vesiculitis.—Acute vesiculitis, or spermatocystitis, is due to extension of inflammation, usually gonococcal, from the posterior urethra into the seminal vesicle. The symptoms are those of aggravated posterior urethritis (see p. 667), except that the pain radiations are characteristic, being referred not only to the perineum, anus, and hypogastric region, but also to the hip-joint of the affected side and the outer surface of the leg. Frequent erection and painful nocturnal emissions of blood-stained purulent semen are common.

Exceptionally seminal vesiculitis is ushered in with the vomiting, tympany, and symptoms of acute local peritonitis, even including rigidity and tenderness on deep pressure in the iliac fossa corresponding to the seminal vesicle involved. If this be the right one, a diagnostic error may readily be made.

The diagnosis is based upon rectal examination. If practicable the patient should have a fairly full bladder and should lean forward supporting himself by the hands placed upon a table or chair, with the legs slightly separated. Lying above the prostate and extending obliquely upward and outward from it will be found a tender mass, usually about the size of the thumb. When both vesicles are inflamed there is felt above the prostate a hot, broad, tender infiltration suggesting on palpation an enormously enlarged prostate. This is lacking in the density

of true prostatic swelling and on careful palpation the prostate can be distinctly outlined below the mass.

A distinction between seminal vesiculitis and inflammation of the ampulla of the vas cannot be made.

Chronic Vesiculitis.—Chronic vesiculitis is the usual termination of an acute attack. It may, however, develop with symptoms so slight as to attract little attention. It is practically always complicated by posterior urethritis and is a common cause for the continuance of this condition.

It is characterized by sexual neurasthenia, slight anemia of the toxic type, usually a persistent gleet, and recurring attacks of subacute or acute urethritis from inadequate cause. Monoarticular or polyarticular rheumatism is a not infrequent expression of systemic infection, even in the absence of marked local symptoms. Pus in the urine is constant; anterior discharge appears during the subacute or acute attacks.

These symptoms do not differ from those of a chronic posterior urethritis kept up by persistent infection of glands or follicles, hence the diagnosis can be made only by rectal examination, which demonstrates a swollen, usually softly bossed, sometimes nodular vesicle, from which can be expressed pus and blood. For the collection of this the patient passes a small part of his urine. The prostate is then massaged, and he urinates again, but does not empty the bladder. The vesicles are next massaged and the urine remaining in the bladder is passed. In this last portion will be found the pus expressed from the vasal ampullæ and the seminal vesicles.

Tuberculous Vesiculitis.—Tuberculous vesiculitis is usually associated with other tuberculous lesions, particularly with nephritis, cystitis, and epididymitis.

If the bladder be free from invasion, the symptoms are slight or wanting. When present, they are those of chronic posterior urethritis. Sexual erythism, bloody semen, and pain during and after ejaculation are frequently noted.

The diagnosis is based upon the finding by rectal examination of an irregular, nodular, non-sensitive growth occupying the position of the seminal vesicle; not explainable from a history of a preceding gonococcal or infectious urethritis, slowly and obstinately progressive, made worse by ordinary treatment applicable to chronic seminal vesiculitis, and associated with the evidences of tuberculous invasion elsewhere.

Absolute diagnosis is made by finding tubercle bacilli in the urine or in the expressed discharge.

Cysts of the seminal vesicles, due to obstruction of the ejaculatory ducts, are characterized by pressure symptoms. Diagnosis is based upon rectal palpation and the position of the cysts. These can be differentiated from dermoid cysts similarly placed only by operation. *Concretions* sometimes form in the seminal vesicle and become of surgical interest only when they produce blocking of the ejaculatory duct.

Painful emissions and the symptoms of chronic vesiculitis suggest a rectal examination which shows the presence of one or more bodies of stone-like hardness lying between the bladder wall and the rectum.

Malignant infiltration of the seminal vesicle is always secondary to that of the prostate. It is characterized by a stony induration confluent with an equally dense prostate.

THE PROSTATE.

The average normal adult prostate is about one and one-half inches wide, one and one-quarter inches long, and three-quarters of an inch thick, weighing about five drams; it is made up of glandular tissue and smooth muscular fibers. In shape it resembles somewhat a chestnut, but is subject to marked variations in both shape and size. On rectal examination it is distinctly bilobed, the two halves being connected by an isthmus which sometimes forms a distinct projection called the third lobe. This isthmus lies just below the vesical orifice of the urethra and above and behind the ejaculatory ducts, discharging its secretion into that portion of the urethra which lies nearest the bladder.

The prostate is situated behind and slightly below the symphysis pubis, lying between the posterior layer of the triangular ligament and the neck of the bladder, which is surrounded by its base. It is separated from the rectum by a thin, rectovesical fascia and by the prostatic sheath. The latter completely invests the gland, forming a tough, connective-tissue covering in which are found the large veins of the prostatic plexus.

The symptoms common to surgical affections of the prostate are enlargement or deformity, detected by rectal, urethral, or cystoscopic examination, interference with the function of micturition, and pain.

Inflammatory Affections of the Prostate.—**Acute Prostatitis** is usually due to extension of gonorrheal or catheter urethritis. The symptoms are pus in the urine from the originating urethral infection, a feeling of weight in the perineum, pain greatly increased by urination and defecation, frequency in urination, possible difficulty in starting the stream, failure to experience complete relief after the bladder is apparently emptied, and either circumscribed or diffuse prostatic tenderness and swelling detected by rectal examination.

If inflammation goes on to abscess formation there are the local and constitutional signs of this affection, *i. e.*, increase of pain which becomes throbbing, burning, and almost unendurable in its intensity, added difficulty in urination, and constitutional symptoms of deep pus. Fluctuation may be detected by rectal palpation.

Complete retention is common, and because of associated pelvic congestion, hemorrhoids are a frequent complication.

The symptoms are so like those of a posterior urethritis that diagnosis must be based upon rectal palpation which reveals a hot, tender tumor occupying the position of the prostate.

If the abscess be confined to one or more prostatic follicles, these commonly open into the urethra, giving prompt relief, with increase of the discharge, often with some blood admixture. This is the usual termination. If the abscess has burst its glandular environment, involving

a part or the whole of the substance of the prostate, rupture may still take place into the urethra or rectum, or the pus may burrow through the pelvis, forming multiple fistulæ opening in regions remote from the prostate, and exceedingly difficult to heal.

Exceptionally a huge pelvic abscess of prostatic origin may develop, with almost no symptoms, the diagnosis being formulated on symptoms of profound sepsis and the findings by rectal examination.

Chronic prostatitis is predisposed to by congestion, such as that incident to prolonged ungratified sexual excitement, excessive coitus, masturbation, habitual constipation, urethral stricture, or irritating conditions of the urine. It is directly caused by infection.

It is characterized by increased frequency of urination and often burning pain during and after the act, deep perineal pains radiating to the rectum and down the thighs, made worse by exertion, slight perineal tenderness, induration, possibly nodulation, of the prostate, pus in the urine at times. There are frequently intercurrent subacute attacks of inflammation, the general symptoms of mild septic absorption, such as headache, backache, myalgia, and indigestion, sexual neurasthenia, and a slight toxic anemia. On rectal examination the prostate may be unduly sensitive at some portion of its surface, this tenderness being nearly always localized. The urine passed after milking the prostate contains a considerable quantity of pus.

Chronic prostatitis may persist for years with no symptoms other than pus in the urine, detected only by careful examination.

Calculi of the Prostate.—Prostatic calculi, usually due to deposits of lime salts in suppurating prostatic follicles or abscess cavities, exceptionally to concretions formed about the corpora amylacea, are found in the region of the verumontanum. They may give no symptoms. Usually they are characterized by those of posterior urethritis.

The diagnosis is made by rectal palpation and urethral examination. If the calculi are large, they can usually be felt by the finger introduced into the rectum. They may also be detected by the passage of metal instruments, which will give a click, or by the introduction of the urethroscope. The *x*-rays give a characteristic shadow.

The distinction from vesical calculi will be made by the fixed position of the stones, determined by passing a metal instrument with the finger in the rectum.

Enlargement of the Prostate.—This is an affection of middle and old age. It is characterized solely by obstructive symptoms, to which, when infection occurs, are added those of inflammation.

The typical obstructive symptoms are increased frequency of micturition most marked during the night or early in the morning, delay in starting the stream, loss of force, interruptions during the passage of the stream, and dribbling at the completion of the act. Later, when the bladder becomes distended, there may be incontinence due to the overflow of urine from an atonic and greatly dilated bladder.

There is usually polyuria due to back pressure and slight albuminuria with hyaline casts.

When inflammation is added to obstruction, urgency, pain, and pyuria further complicate the picture.

The diagnosis is based upon rectal palpation, measurement of urethral length, cystoscopic or instrumental examination of the posterior urethra and its vesical orifice, and the detection of residual urine.

Hypersecretion of urine may occasion frequency, but without the other symptoms of enlarged prostate.

Sclerosis and contracture of the internal vesical sphincter will produce all the symptoms of prostatic hypertrophy, with the exception of enlargement felt through the rectum and increased urethral length.

Stricture will produce all the symptoms, but the history of a preceding trauma or inflammation (usually years before) and the passage of a urethral instrument will clear the diagnosis. Moreover, the prostate is not found unduly enlarged on rectal examination.

To determine the extent to which the urethra is lengthened, a soft elbowed catheter is employed. This is first passed down to the membranous urethra. The anterior urethra is then thoroughly flushed out with a mild antiseptic solution. The catheter is pushed on until the urine begins to flow. A point on the shaft corresponding to the meatus is marked and after the bladder has been emptied the catheter is withdrawn and the distance from this mark to the eye of the instrument is taken. This measurement represents roughly the urethral length. If it be more than eight to eight and one-half inches, this suggests prostatic enlargement.

The thickness of the isthmus, the so-called median lobe, can be determined by introducing a sound into the bladder and palpating on this through the rectum. Moreover, by means of this sound, if it be provided with a sharp curve such as is common in stone sounds, the size, and the direction of intravesical projections can be roughly determined. This can be more accurately done by the use of the cystoscope.

The amount of residual urine is estimated by directing the patient to empty the bladder, then introducing the soft catheter and drawing off all that remains. Normally not more than a few drops of urine should be drawn.

Unusually severe pain and tenesmus, especially if associated with blood and pus in the urine, should suggest vesical stone as a complication of the enlarged prostate.

Contracture or sclerosis of the internal vesical sphincter is characterized by the symptoms of prostatic obstruction. The retention is even more complete and the suffering incident to catheter infection more marked. The diagnosis can be made only by rectal examination, which shows often a small, hard prostate, and by the passage of instruments which demonstrate a short posterior urethra, no intravesical prostatic projections, no lateral deviation of the sound, and obstruction to the introduction of the instrument only at the vesical neck.

Malignant tumor of the prostate is characterized by precisely the symptoms of prostatic enlargement, differing from these only in the fact that

the tumor is of stony hardness. As a rule, the growth is small, progresses slowly, and begins in the posterior portion of the lateral lobes. Metastases to the bones, particularly those of the lumbar vertebræ, may occur before the local symptoms are sufficiently severe to lead to examination. The growth exhibits a tendency to extend upward along the course of the seminal vesicles, which are promptly invaded.

The diagnosis can be made at a time when this is serviceable to the patient only by excision. In its late development hemorrhage, pain, and extensive induration, with involvement of the rectum and bladder, make the diagnosis unmistakable.

THE URETHRA.

The urethra, a mucous canal, abundantly supplied with glands and follicles, is about eight inches long in the adult. It is narrowest at the meatus and in its membranous portion. Just behind the meatus and in its prostatic and bulbous portions are areas of physiological dilatation. It should normally take a 32 sound, except for the natural meatal narrowing, which may be so small that a 22 cannot be passed without traumatism.

A congenital narrowing, persisting until puberty below this gauge, usually gives rise to some bladder irritability and favors the development of urethral discharge.

Normally there should be no discharge from the urethra except a slight transparent mucus following prolonged erection, nor should there be dribbling of urine following micturition beyond two or three drops, readily shaken off.

The anterior urethra, six inches in length, is surrounded by the erectile tissue of the spongy body.

The posterior urethra in its first three-quarters of an inch lies between the anterior and posterior layers of the triangular ligament, surrounded by the compressor urethræ muscle. The prostatic portion of the posterior urethra, one and one-quarter inches long, runs through the upper portion of the prostate gland.

Inflammation of the anterior urethra is characterized by discharge from the meatus, pain aggravated by the act of urination and by erection which may be painful.

Obstruction to the free passage of the urine is characterized by slight urethral discharge, alteration in the force and volume of the stream passed, dribbling at the end of urination, and undue frequency of the act.

Inflammation of the posterior urethra is characterized by pus found both in the first and the second portions of urine if this be passed from a full bladder in two parts. This, together with backache in the sacral region and sexual neurasthenia, may be the only symptom if the affection be chronic.

In acute cases there is pain, usually referred to the meatus or just behind it and felt in the perineum, anus, and down the inner surfaces of the

thighs, severe aching in the same region, frequent urgent painful urination, with, in hyperacute cases, a few drops of blood at the end of the act. Frequently there are recurring erections and painful emissions.

Malformations of the Urethra.—The urethra may be absent, obliterated, congenitally strictured, sacculated, or deficient as to its floor or its roof.

Atresia or obstruction of an otherwise well-formed urethra, is likely to be observed near the meatus.

Hypospadia.—Hypospadia, or deficiency of the floor to the urethra, is comparatively common. The urethra may terminate at the base of the glans (balanic), between the glans and the penoscrotal junction (penile), or in the scrotal cleft or perineum (perineal). The balanic form is the usual one. It is commonly associated with a normally placed meatus which opens into a blind pouch.

Epispadia.—Epispadia, or deficiency of the urethral roof, is a rare deformity, likely to be complicated by exstrophy of the bladder or other malformations. Though it may appear simply in the balanic form, the abnormal opening will usually be found just in front of the pubic symphysis, or the position this should occupy, since it may be congenitally absent.

Narrowings of the urethra, whether congenital or acquired, are characterized by frequent, difficult urination.

Congenital pouches, due to a deficiency of the spongy body, are marked by obvious distention at the time of urination and subsequent dribbling as the pouch is gradually emptied.

Traumatic subcutaneous rupture of the urethra is characterized by pain, urethral hemorrhage, the immediate formation of a circumscribed tumor at the seat of injury, and difficulty in passing urine, or complete retention.

When this rupture has been accomplished by rough instrumentation, immediate free bleeding and severe pain followed by a mucopurulent discharge may be the only symptoms immediate or remote. Exceptionally it is followed by extravasations of urine.

When the rupture is due to force from without, the external swelling increases and becomes diffuse and is shortly (days) followed by brawny, widespread edema, due to urinary extravasation. This edema in the case of the anterior urethra is confined to the scrotum, the penis, and later the anterior belly wall.

If the fibrous envelope of the spongy body has not been torn through, the extravasation may not involve the tissues of the scrotum, but may travel forward, producing cellulitis and gangrene of the spongy body and the glans. More commonly it forms a circumscribed abscess.

When the rupture involves the posterior urethra (membranous and prostatic part) there is neither bleeding from the meatus nor any external sign of blood tumor. There is pain and complete retention or the straining passage of bloody urine. The urinary extravasation may pass forward taking the course of that incident to rupture of the anterior urethra, or may infiltrate the pelvis, giving no signs other than the constitutional

ones of an extensive cellulitis and perhaps a boggy swelling detected by rectal examination.

The posterior urethra is particularly likely to be torn by falling astride of a narrow surface, such as the edge of a plank, or by forces which disrupt the pelvis. The bleeding then takes place into the surrounding cellular tissue and the blood flows back into the bladder.

The absolute diagnosis of urethral rupture is made by instrumental examination. A soft instrument will be arrested at the seat of tear if this be complete. If it be partial, there will be a sense of obstruction which, on yielding, allows the instrument to pass into the bladder. From this clear urine will be drawn in the case of tears of the anterior urethra; bloody urine, if the posterior urethra be torn. A further diagnosis may be made by direct inspection through a cystoscopic tube.

Diagnosis of extravasation will be based upon the rapid extension of brawny edema in the case of rupture of the anterior urethra, possibly by the detection of pelvic edema on rectal examination if the posterior urethra be involved, associated in either case with the constitutional symptoms of septic cellulitis.

Foreign bodies in the urethra give rise to pain and obstruction to urination. If the body be lodged in the anterior urethra for more than twenty-four hours, there will be a blood-stained, mucopurulent discharge. If of sufficient size, it can usually be detected by external palpation. If the foreign body be a calculus, there will be a sudden arrest of urine, often accompanied by sharp pain, frequently preceded by a history of renal colic. The sound and the urethroscope will not only prove the presence of the foreign body, but usually show its nature.

Inflammatory Affection of the Urethra.—Urethritis.—The only constant symptom of urethritis is pus either escaping from the meatus or found in the urine. Inflammation of the anterior urethra always causes a urethral discharge unless the secretion of pus be so slight that it is washed away by each act of micturition before a sufficient quantity accumulates to become obvious at the meatus.

Discharge from the posterior urethra usually flows back into the bladder, hence may be profuse without appearing at the meatus.

In determining from what part of the urethra the pus comes the patient is directed to hold his urine for from four to eight hours; this is conveniently done during the night, the test being made at the time of his first urination on waking up. He is directed to pass his urine into two glasses, the first part in one, the last part in another. If he is suffering from a free urethral discharge involving both the anterior and posterior urethra, both portions of urine will show the presence of pus, but usually there will be much less in the last portion. If the posterior urethra is free from inflammation, the second portion of urine passed will fail to show pus.

Symptoms of urethritis other than pus are present or absent in accordance with the severity of the inflammation, and bear no necessary relation to the particular form of infection

Aside from urorrhea, characterized by a moderate mucous discharge containing few leukocytes, much epithelium and the bacteria customarily found in the normal healthy urethra, and developing in the relaxed and cachectic, all discharges indicate the presence of inflammation.

Acute traumatic urethritis, i. e., incident to instrumentation, irritating injections (common), exceptionally to external traumatism, is characterized by a blood-stained, purulent discharge which usually disappears in three to seven days. The discharge following strong bichloride injections may, however, be quite as persistent as that due to gonococcal infection. The diagnosis is made from the history of the case and by excluding the gonococcus (microscopic examination).

Acute urethritis due to irritating conditions of the urine (rare). A mucopurulent discharge, with slight inflammatory symptoms, is sometimes due to the ingestion of drugs or certain articles of food, such as turpentine, cubebs, copaiba, cantharides, alcohol, arsenic, iodides, asparagus, rhubarb, strawberries, and fish. Or the irritating quality of the urine may be due to high fever, to rheumatism, oxaluria, or phosphaturia. The gonococcus must always be excluded before the diagnosis of this form of urethritis can be formulated.

Eruptive Urethritis (rare).—During the course of the acute exanthemata a slight urethral discharge is at times observed. Exceptionally this is an expression of urethral herpes, in which case it is likely to be accompanied by severe pain and the presence of herpetic lesions elsewhere.

Simple infectious urethritis, at times called abortive gonorrhea, follows much the early course of gonorrhea, and is usually due to a similar form of exposure. It runs a short course, unattended with complications. Exceptionally it is as prolonged and complicated as the most obstinate infection. Gonococci are not found.

Gonococcic Urethritis.—This, the commonest form of urethral inflammation, is characterized by an acute urethral inflammation which comes on in from one to twelve, usually three, days after exposure. It becomes total within the first week. The diagnosis depends upon finding the gonococcus.

Urethral and periurethral abscess, common complications of both gonococcal and instrumental urethritis, are characterized by nodulation or induration along the urethral course and chordee, followed by softening and discharge either internally, externally, or in both directions, exceptionally leading to urinary fistula or extravasation, and always followed by stricture.

Cowperitis.—Suppuration of Cowper's gland, situated as it is between the two layers of the triangular ligament below the urethra, is attended by severe perineal pain, aggravated by defecation, and especially so by the terminal act of micturition, perineal tenderness so great as to make sitting or walking difficult, and the presence of a swelling behind the bulb, most readily detected by a finger passed just within the external sphincter and pressed upward and forward. The tumor is found to one side of the median line unless both glands are involved, and lies in front of the prostate—this is diagnostic.

The increased swelling incident to suppuration causes complete retention of urine and marked aggravation of all symptoms. The abscess usually ruptures externally. Exceptionally into the urethra. It is not complicated by urinary extravasation. When the gland is not destroyed by abscess formation the inflammation may become chronic, indefinitely prolonging the urethritis.

Pneumococcic and *diphtheritic urethritis* (rare) are overshadowed by the constitutional symptoms of the major disease. The diagnosis must be made by the finding of the specific organisms in the discharge.

Syphilitic urethritis may be due to either primary, secondary, or tertiary syphilis. In its acute or subacute form it is always due to chancre, which is usually placed not deeper than half an inch from the meatus. There is moderate discharge, swelling about the frenum, and some obstruction to urination. Though there may be frequency because of obstruction, other posterior symptoms do not develop. Inguinal adenopathy or general eruption usually appears before the true nature of the affection is recognized.

The long incubation (never less than two weeks), the chronic, nonprogressive nature of the affection, and particularly bilateral, polyglandular, painless enlargement of the inguinal glands should suggest an examination with the meatoscope or urethroscope, which would establish the diagnosis by showing the presence of a rounded, indolent ulcer. At times the mucopurulent discharge and obstructive swelling are not sufficient to excite attention, in which case secondary symptoms may occur without suspicion upon the part of the patient as to the true seat of infection.

Chancroidal urethritis is always accompanied by an ulceration at or near the meatus, exhibiting the characteristics of a chancroid.

The inflammation is limited to the region of the meatus, there are no symptoms of posterior urethritis, and no gonococci are found.

Chronic Urethritis.—The causes of chronic urethritis are stricture, persistence of infection in glands and follicles, tuberculosis, syphilis, and urethral polypi.

Stricture, even though it be of large caliber, is the commonest cause of chronic urethral discharge. It is best detected by square-shouldered metal bougies. An inflammation once started, a narrow meatus acts as a stricture. If the meatus be once passed, an unstrictured urethra should take a 32 F. bulbous bougie; this will be resisted by the accelerator urinæ muscle and stopped by the compressor urethræ. On withdrawal it should not at any point give a distinct jump, such as comes when it is made to clear an obstruction.

Next in order of frequency as a cause of chronic urethral discharge comes persistent infection of the glands and follicles. These act as foci for recurring subacute outbreaks. The diagnosis must be made by direct examination. After irrigation of the anterior urethra a bulbous bougie of full caliber is passed to the membranous urethra and withdrawn with a gentle swabbing motion; this milks the pus from the inflamed follicles, bringing it out on the shoulder of the bulb.

From the posterior urethra after partial micturition massage of the prostate will usually bring an abundant supply of pus. A direct urethroscopic examination may be essential for an absolute diagnosis.

Tuberculous urethritis is characterized by apparently causeless, slight, persistent urethral discharge, which is not bettered by local treatment. Diagnosis is sometimes made by the finding of the tubercle bacillus, usually by the discovery of tuberculous lesions in other situations, particularly in the seminal vesicles or epididymis. With this discharge there is usually associated frequency of urination; later, tenesmus, pain and slight hematuria.

Syphilitic urethritis as a manifestation of the urethral localization of the secondary eruption of syphilis (rare) is chronic, indolent, and practically without symptoms except for the discharge. The history, exclusion of other causes, and association with other more characteristic lesions of the infection will lead to a correct diagnosis.

Urethral Polyps.—Urethral polyps (rare) are characterized by persistent moderate discharge; the diagnosis must be made by means of the urethroscope.

THE BLADDER.

The bladder, when healthy, has no absorbing power. It holds with comfort about twelve ounces; with slight distress, a pint. It is provided with two sphincters. The internal vesical sphincter is in a condition of tonic contraction until the viscus contains from four to six ounces when it dilates, making the prostatic urethra a portion of the bladder cavity; the urine is then retained by the external sphincter, *i. e.*, the compressor urethræ muscle.

The vesical mucous membrane is made up of flat epithelium placed on a layer of cylindrical cells. It is of a yellowish color, and, because of the distensibility of the organ, exhibits many plications. The ureteral orifices of the bladder are protected against regurgitation by valves which become increasingly competent in proportion to intravesical tension.

Most men empty the bladder on rising in the morning, after breakfast, during defecation, at noon, late in the afternoon, and on going to bed, passing from six to twelve ounces at each act of urination.

Transitory undue frequency of urination in the absence of vesical or renal lesions follows the excessive ingestion of fluid, the use of diuretic drugs and articles of food, anxiety or any vivid emotion, or change from warm to cold weather.

Persistent undue frequency of urination may be an expression of hypersecretion, as in diabetes or chronic nephritis. Unassociated with hypersecretion, it may be due to irritating qualities of the urine, producing congestion and hence exaggerated reflexes. This symptom is common when the urine contains blood, phosphates, or oxalates, or is highly concentrated as the result of fever or indigestion.

Incontinence of urine, unattended by vesical or renal lesions, is

characterized by the painless escape of urine with or without the consciousness of the individual.

In its accidental form the affection is often called a weak bladder. The discharge is explosive, and comes from a sudden abdominal strain, which takes the sphincters off their guard, as in the act of laughing or coughing. In its transient form incontinence follows anesthesia, drunkenness, sometimes prolonged involuntary retention.

Persistent incontinence, independent of bladder lesion, is physiological in children up to the age of one or two years. In those of older growth the incontinence may be due to habit or degeneracy; if it be both diurnal and nocturnal, it is probably dependent upon an organic lesion.

Nocturnal incontinence occurring in an adolescent or adult without local inflammatory or reflex cause is strongly suggestive of epilepsy or beginning ataxia. Visceral crises limited to the urinary organs occur in tabes.

Attacks of profuse hematuria without other symptoms may be due to vesical varices, to aneurysm of the renal arteries, or to an essential renal hemorrhage. These conditions are all extremely rare. The usual cause is a bladder tumor, nor is the freedom of bleeding an index to the size of the tumor.

Bacteriuria.—The urine may be swarming with bacteria without pus admixture.

The organism usually causative of simple bacteriuria is the Bacillus coli communis. It gains entrance from the intestine in cases of chronic constipation, acute enteritis, dysentery, or typhoid fever.

Typhoid bacteriuria exists in from 20 per cent. to 30 per cent. of cases of typhoid fever, usually in pure culture, appearing generally in the second to the third week of the disease, often associated with albuminuria, without pus, and rarely producing the morbid changes of cystitis, even though it persist for years.

With the exception of hypersecretion of mucus and slight albuminuria, simple bacteriuria is unattended with inflammatory symptoms. Under local favoring conditions it may become converted into pyuric bacteriuria. Microscopic examination will at once determine the presence or absence of pus in quantity.

The local symptoms when present are generally slight—frequency of micturition, mild ardor urinæ, occasionally incontinence, and, in children, nervous disturbances. There may be a slight urethral discharge. So long as the epithelium of the urinary tract remains healthy there is no absorption of the bacterial toxins. If from imperfect drainage the bladder epithelium loses its vitality, absorption occurs and mild fever, lassitude, and digestive and nervous disturbances appear.

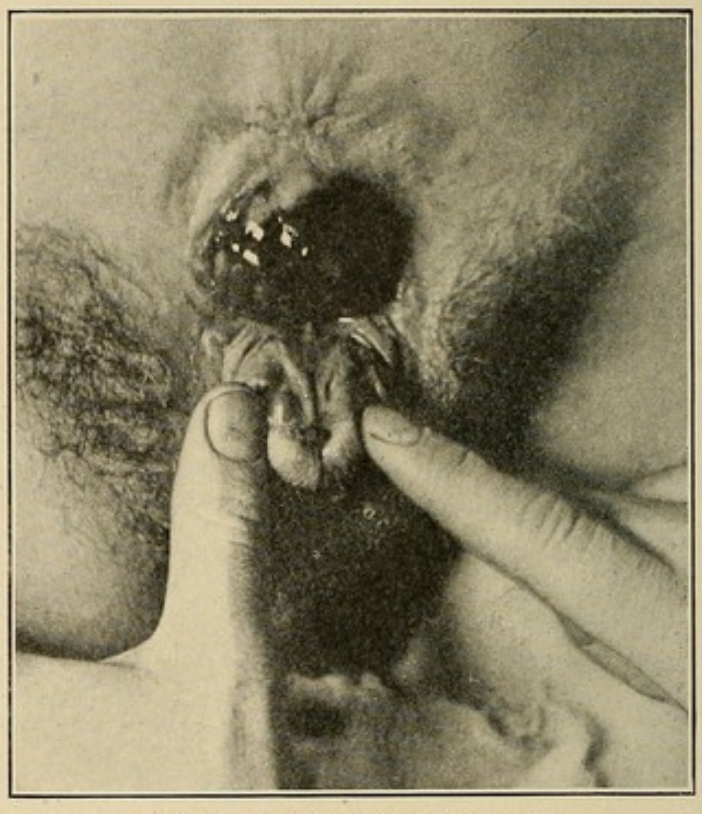
Pyuria always implies an area of suppuration in some part of the genito-urinary tract, and is generally associated with symptoms referable to its location.

Malformations and Malpositions of the Bladder.—The bladder may be absent, the ureters opening into the urethra, the vagina, the rectum, or the umbilicus. It may be multiple, single, with a central septum

dividing it into two portions, which may or may not communicate with each other, or sacculated.

The usual malformation is *exstrophy*, or absence of a portion of the bladder wall, usually the anterior one. It is most often observed in male children, and is due to failure of the lateral portions of the urogenital cleft to unite; hence the deficiency is not only of the bladder, but also of the musculocutaneous abdominal parietes and the pelvic girdle, the pubes not meeting in the middle line to form the symphysis.

FIG. 434



Exstrophy of bladder and epispadia.

This deformity is associated with epispadia in the male and split clitoris in the female. There is also commonly associated with it complete double inguinal hernia, rudimentary prostate, and ectopic testes.

The diagnosis is obvious, the bulging, dark red surface of intensely inflamed mucous membrane surrounded by an area of cicatrix-like tissue uniting its borders to the skin being sufficiently characteristic. Projections marking the ureteral orifice can usually be found by the escape of urine which comes from them in jets.

Occasionally, as a congenital defect, the urachus remains patent, the urine escaping through the umbilicus. In this mucous channel urinary concretions and suppurating pouches may form and may persist after closure of the communication with the bladder.

Hernia of the Bladder.—Hernia implies a protrusion of the bladder wall along the track usually taken by intestinal hernia. The inguinal cystocele is the common form, though there are instances of obturator, crural, and perineal vesical hernia. The herniated portion of the bladder usually

presents thin walls and is often surrounded by considerable fat. Sometimes it appears as a diverticulum with an extremely small opening into the general vesical cavity. Because of stagnation of urine in these diverticula calculi may form.

These hernia are caused by the peritoneal pull of a preceding intestinal hernia, and are characterized by a dull, fluctuating tumor in the inguinal region, varying in size with the quantity of urine contained in the bladder. Where the communication between the herniated portion and the general cavity is small there may be no immediate change in the size of the herniated portion on micturition. If, however, the patient lies down and subjects the mass to gentle manipulation it markedly diminishes in size, and almost immediately he can pass a further quantity of urine. Furthermore, the flaccid and inconspicuous swelling becomes tense and full when fluid is forced into the bladder.

As a rule, the herniated portion of the bladder is small and offers no symptoms other than those associated with an irreducible omental hernia. It is usually unexpectedly encountered during hernia operations. Its presence should be suspected when in the effort to close the hernial orifice an undue amount of fat is brought into sight. These vesical hernias are rarely invested with a complete layer of peritoneum.

Traumatisms.—Wounds of the bladder, if large and open, are characterized by the escape of urine through them. If small, by the passage of bloody urine, and by the results of cystoscopic examination, together with a consideration of the nature of the vulnerating body and its direction of travel. Usually there is temporary retention of urine.

The complications of these wounds are peritonitis, pelvic cellulitis, fistulæ, and calculi; the latter from the lodgement of a foreign body in the bladder too large to be passed per urethram. If there be free bleeding from the bladder, this in itself is indicative of wound and would justify an exploratory operation.

Contusion of the bladder is characterized by retention, tenesmus, pain, tenderness, and the passage of blood-stained urine and clots following traumatism. Shock is usually wanting. It is possible that in a previously diseased bladder hemorrhage may have been severe and continued. Contusion with such symptoms is extremely rare.

The diagnosis must be made from rupture. Theoretically, this can be done by injecting a measured quantity of fluid into the bladder and withdrawing it. If all that has been injected flows through the catheter, it is obvious there can be no large rent in the wall.

Rupture of the Bladder.—Rupture of the bladder is particularly common in drunkards. Probably because they are frequently subjected to trauma and often have overfull bladders. It is observed as a result of fracture of the pelvis and kicks in the belly. Occasionally it is caused by muscular action, such as defecation, urination, or heavy lifting. It has occurred at times from moderate distention of a bladder lifted forward by an inflated bag in the rectum, with the idea of facilitating a suprapubic cystotomy. The rupture may be intraperitoneal or extraperitoneal, usually the former.

The characteristic symptoms are a sense of something having ruptured, agonizing hypogastric pain, constant desire to urinate, with either the loss of power to do so or the passage of blood-stained urine, and severe shock. In the course of hours, sometimes days, there will follow either the symptoms of general peritonitis or of pelvic cellulitis, dependent upon the seat of rupture.

There may be no immediate symptoms other than temporary inability to urinate, and later the passage of bloody urine. Nor does the extravasation of a small amount of sterile urine inevitably cause peritonitis or septic cellulitis.

Diagnosis is founded upon the symptoms and the results of direct examination.

After flushing the anterior urethra with an antiseptic solution a sterile silver catheter of as large size as can be passed is introduced into the bladder. If this draws off bloody urine and clot, the probability of rupture is strong. If, on manipulation of the shaft, so that the tip is made to traverse the inner surface of the bladder, this tip repeatedly catches at one point, and apparently can be passed through the bladder wall, so that it can be felt immediately beneath the skin in the hypogastric region or close to the rectal mucous membrane, there can be no doubt as to the presence of rupture. Through the silver catheter, after it has drained the bladder of its contents, a measured quantity of sterile salt solution can be injected. If there be no rupture, this should all flow out again. This test is not infallible. Doubt should be resolved by suprapubic cystotomy. The cystoscope will be most serviceable in disproving the existence of rupture, since for its successful use the bladder must hold four ounces of a clear fluid.

Cystitis.—Cystitis, or inflammation of the bladder, is due to infection. It is extremely difficult to infect the normal, properly vascularized mucous membrane of the bladder. When this becomes greatly congested, as from retention of urine, infection is made easy.

As it appears clinically, cystitis may be acute or chronic, and in accordance with the depth of the structures involved it may be catarrhal or interstitial.

The causes of vesical congestion are retention of urine, trauma, whether this be due to external injury, passage of an instrument, or presence of a stone or tumor, surface chilling, frequently repeated and straining micturition, abnormal conditions of the urine, constipation, prolonged sexual excitement or excess, cardiac weakness, or lesion of the central nervous system.

The exciting cause of cystitis is local infection, usually due to catheter infection or urethritis; exceptionally to pericystic suppurating foci, or carried by the blood or lymph vessels. Infection by way of the urine may take place secondary to involvement of the kidneys, although healthy kidneys may eliminate pyogenic organisms.

The colon bacillus is the usual infecting agent; less frequently the pyogenic staphylococci and streptococci and the Bacillus proteus vulgaris. Excepting for the trigonum, the vesical mucosa is to an extent immune to the gonococcus.

All the pyogenic germs and many others found in the urine of cystitis produce ammoniacal fermentation, providing the urine is retained more than a few hours in the bladder. This increases the irritating effect of retained urine upon the already inflamed vesical mucous membrane. Ammoniacal urine is diagnostic of infection and of at least partial retention, though this may occur in the renal pelvis.

The symptoms of cystitis are those of posterior urethritis, except that in acute cases there is marked suprapubic tenderness.

The frequent painful passage of purulent urine constitutes the major symptom. In chronic cases pyuria may be the only symptom.

With the pus there is often found blood and always an excess of mucus and bladder epithelium.

When, together with pain, frequency, urgency, and pyuria the bladder is tender on suprapubic and rectal palpation, when the urine passed in three portions shows greatest pus turbidity in the last, when the flat bladder epithelium is very abundant, when intravesical injections show that the bladder is hypersensitive to tension, and when the urine at the time of being passed is ropy and ammoniacal, the diagnosis of cystitis can be safely made. A large amount of mucopus in the urine (settling out $\frac{1}{8}$ on standing) in the absence of pyelitis is diagnostic of cystitis. Examination with the cystoscope is conclusive. When this is impracticable there may be introduced into the bladder a self-retaining catheter, so stretched over a carrier that its flange is obliterated. On withdrawing the carrier the elasticity of the rubber causes the flange to resume its shape. The catheter is then drawn out until the flange catches against the internal vesical sphincter, and is secured in place by a small weight attached to its free end. The bladder is thoroughly washed out with normal salt solution, and the catheter is left in place for an hour, the urine which flows through it being collected. Pus in quantity found in this urine must come from the bladder, ureters, or kidneys.

If the kidneys are neither tender nor obviously enlarged, the bladder origin of the pus is probable. The infecting organism must be determined by microscopic examination of the pus.

The essential point in the diagnosis of cystitis is to determine its cause. Cystitis once started in a bladder subject to retention because of urethral obstruction (enlarged prostate, sclerosed internal vesical sphincter, stricture) persists until the obstruction is relieved. So long as a bladder contains tumor, calculus, or foreign body there is no tendency toward cure. In the absence of these causes of chronic congestion or urethral obstruction, cystitis has no natural tendency to persist; hence, if after removal of the apparently predisposing factor the infection remains obstinate to treatment, this in itself constitutes a good reason for suspecting tuberculosis.

Vesical Calculus.—The large majority of calculi are formed of uric acid and the urates, the phosphatic and mixed calculi come next in order of frequency, and last come the oxalates and rarer forms.

Vesical calculi are found from fetal life to old age. They are commonest in poor male children and rich old men, and are at times preceded by

a history of gravel, oxaluria, heavy deposits in the urine, hematuria, or renal colic.

The symptoms characteristic of calculus of the bladder are identical with those of posterior urethritis or cystitis. Indeed, the latter is often the lesion which causes the pain. Frequent urination is most marked in the daytime, is aggravated by motion, and relieved by rest. In the case of small, freely movable stones urination may be accompanied by so much tenesmus as to produce prolapse of the bowel, or there may be sudden stoppage of the urine during the passage of a full-sized stream, which may be obviated by having the patient assume the dorsal decubitus during urination. This symptom is suggestive, though not diagnostic, since inflammation in itself may produce reflex spasm causing the same symptom.

The pain of vesical calculus, usually referred to the end of the penis, or more accurately to the lower urethral surface, about an inch behind the glans, is also common to posterior urethritis. This symptom is not observed in old prostatics suffering from stone, because the backward projection of the prostate prevents the calculus from coming in contact with the vesical neck. It is especially marked in children and induces in them that characteristic pulling on the penis which, when associated with rectal prolapse, crying during urination, frequency of the act, and pus and blood in the urine, is diagnostic of stone.

The pain of stone is usually terminal, as is the hematuria, which is slight. The pain may be referred to the perineum, hypogastric region, the small of the back, the outer surfaces of the thighs, the lower leg, or the foot.

The congestion incident to stone predisposes to infection, which is usually produced by instrumentation.

The diagnosis is based upon physical examination, since stone may exist in the absence of all these symptoms, even blood not being found on microscopic examination of the urine.

The examination is conducted by bimanual palpation The patient having passed his urine, is directed to lean well forward with the elbows on a table or the hands resting on a chair, with the legs moderately separated and the abdominal muscles relaxed. Thereafter he is placed upon his back with the shoulders and the thighs flexed. In each position the index finger of one hand is passed into the rectum, the fingers of the other press above the pubis. In children a stone of moderate size can be felt. A large stone can nearly always be detected in adults unless there is an associated prostatic hypertrophy.

Instrumental examination is inaugurated by an antiseptic irrigation of the anterior urethra. Thereafter a stone searcher, fully 10 inches long, with a short curve near the tip, is introduced. This searcher should be hollow, to permit of evacuation of the bladder contents. When the searcher is first passed the bladder should be well distended; as the examination proceeds the urine should be allowed slowly to flow out. When using this instrument the patient is placed in the flat dorsal position. When the prostate is greatly enlarged and the bladder not greatly

distended, he is put in the Trendelenburg posture. The introduction of the curve of the instrument within the bladder is usually painful and requires that its shaft should be depressed well below the horizontal plane of the body. The searcher has not satisfactorily entered the bladder until at least eight inches of its shaft have passed within the meatus and it can be rotated almost completely about its long axis without the slightest sense of resistance.

The bladder having been entered, the sound is pushed backward and drawn forward again with comparatively rapid motions, the handle being elevated and depressed and carried first to one side, then the other. It is at no time sufficiently withdrawn to engage the curve of the instrument in the prostatic urethra. Failing thus to detect the stone, the sound is introduced to its full extent, and its tip is flicked from side to side by a rapid rotary motion of the handle. This motion, begun with the inner end of the sound at the bas-fond, is continued while the sound is gently drawn outward until the curve reaches the vesical neck. If the stone is not found in this manner, the tip is again introduced as far as it will go, is turned gently toward the floor of the bladder and rotated quickly from side to side, while the instrument is gradually withdrawn until its curve catches the vesical neck. The anterior wall of the bladder may be explored by pressing it down by suprapubic pressure until the tip of the instrument can reach its surface. When there is an enlarged prostate and the base of the bladder is depressed, it is well to elevate this portion of the viscus by a finger introduced into the rectum, while the exploration with the sound is continued.

If these manipulations fail to detect the stone, the urine should be gradually withdrawn and they should be repeated as the bladder contracts. A sharp click denotes the presence of a stone. It is both felt and heard.

This examination may fail to detect the stone because it is small, encysted, lies in a diverticulum, is fixed by adhesions to the anterior wall of the bladder, is covered with lymph or blood clot, or is lodged in a pocket or sinus lying between the vesical mucosa and the prostate.

The click may be simulated by incrustation of a tumor with lime salts, by a fasciculated and incrusted condition of the bladder.

If there is reason to suppose the calculus is a small one, as when a recent ureteral colic shows it has not been long in the bladder, the examination should be conducted with the small tube of an evacuating lithotrite. The bladder is distended, in the case of an adult with four to six ounces of fluid, the evacuator of the lithotrite is filled with protargol solution, 1 to 2000, the tube is introduced into the bladder, connected with an evacuator, and the stopcock is turned on. Then by squeezing the bulb of the evacuator one or two ounces of fluid is injected into the bladder; on relaxing the pressure a similar quantity is rapidly sucked out. This will draw a small stone into the eye of the evacuator, making a sharp click. The eye of the evacuator should be carried systematically into various portions of the bladder in making this examination.

Cystoscopic examination conducted by an expert in the use of the instrument is to the surgeon the most satisfactory way of making a

diagnosis. To the patient the *x*-ray is the easiest way and is fairly reliable in its results.

Foreign Bodies in the Bladder.—Foreign bodies in the bladder may cause no symptom until they become complicated by cystitis, when incrustation with urinary salts promptly occurs. The symptoms are those of stone, from which a differentiation can be made only by the *x*-rays or cystoscopic examination. Often the history is diagnostic.

Tuberculosis of the Bladder.—Nearly always secondary to infection of the kidneys, it may be unsuspected until microscopic examination of the urine shows the presence of blood and mucus, with an excess of leukocytes greatly deformed and free from bacteria. Usually there is a nocturnal and diurnal frequency not sufficiently pronounced to excite attention. At times there is slight terminal hematuria obvious to the patient.

With the onset of cystitis, which almost inevitably develops and is frequently incident to the first catheterization practised for diagnosis of the cause of frequency, there is pain, greatly aggravated by the act of micturition, urgency, pyuria, and either microscopic or macroscopic blood. The pain of tuberculous cystitis is more harassing, persistent, and obstinate to treatment than that from any other cause, with the exception of calculus. It is due in great part to spasm. The coincident loss of weight and deterioration of physical condition are partly incident to pain, but mainly to the accompanying tuberculous nephritis.

Diagnosis is based upon finding the tubercle bacilli, often a difficult matter, elimination of other causes, and cystoscopic examination. This may show disseminated or grouped tubercles or ragged, irregular punched-out ulcers. Usually in the trigonum in the neighborhood of the ureter. Characteristic family history and tuberculous involvement elsewhere are suggestive evidence.

In the absence of direct bladder examination, apparently causeless and persistent bladder irritability or cystitis is in itself strongly suggestive.

Tumors of the Bladder.—Tumors of the bladder, usually observed in middle-aged men, may be benign or malignant.

Benign tumors are usually papillomata. Next in order of frequency come the myxomata, or polypi. Adenomata, fibromata, and cysts are reported.

The malignant growths include sarcomata, carcinomata, and mixed tumors.

Carcinoma.—Carcinoma is the commonest of all bladder tumors, including both the benign and malignant. The tumor is usually placed in or about the trigonum, though it may be found in any portion of the bladder surface. Sometimes it is pedunculated, usually sessile, and is infiltrating.

The characteristic symptom is sudden, causeless, profuse hemorrhage stopping as quickly as it started. If the last part of the urine passed contains more blood than the first part, and if instrumental examination of the bladder always occasions free bleeding and demonstrates that the tip of the instrument is arrested at some point in its sweep, the diagnosis

of vesical tumor is well assured. Absolutely so if with the blood clots fragments of the growth of sufficient size for microscopic examination are passed. Pain, frequency, and urgency are usually not noted until the bladder tumor is complicated by cystitis, and are then symptoms of the latter condition and not of the tumor.

If a cystoscope can be passed without occasioning obscuring bleeding, it will usually afford a view of the lesion sufficiently clear to be diagnostic both as to nature and position.

A recurring vesical bleeding so free and so easily excited as to prevent the use of the cystoscope calls for diagnosis by suprapubic cystotomy, since the only hope of cure lies in early operation. The passage of irregularly shaped clots, superabundance of bladder epithelial cells, absence of fragmentation in the blood corpuscles, and absence of kidney albumin are all indicative of the vesical origin of hemorrhage. The most severe and frequently recurring hemorrhage may come from a small papilloma.

Benign tumors untreated may lead to a fatal termination, either from an exhausting hemorrhage or ascending pyelonephritis. The course of these cases is extremely slow (many years).

Malignant tumors are also slow (years) both in growth and metastasis.

THE URETERS.

The ureters are musculomucous canals about twelve inches long, passing behind the peritoneum from the renal pelvis to the bladder. The normal points of narrowing are about two inches below the pelvis of the kidney, at the crossing of the iliac artery and near the vesical orifice. The ureters are capable of enormous dilatation as the result of chronic blocking. Even though not dilated, they can be stretched to 16 F. without tearing. The vesical portion of the ureter runs obliquely inward and forward for half an inch through the muscular layer of the bladder wall, opening by a slit-like orifice, the upper wall of which is devoid of muscular fibers, and so thin that intravesical tension produces a valvular closure.

Anomalies of the Ureter.—These channels may be absent or multiple; in the latter case either fusing or passing separately into the bladder. The double ureter is commonly associated with a kidney with two pelves. The ureters may pursue an aberrant course, opening at the external urinary meatus into the vagina or at the umbilicus.

Valve formation is a common cause of hydronephrosis. The ureter may pass from the pelvis of the kidney at an acute angle or may run for some distance in the wall of this reservoir in place of escaping from the funnel-shaped orifice at its lowest portion.

Rupture of the ureter is characterized by extravasation of urine. If the urine is sterile, this need not lead to cellulitis. Small effusions will be absorbed. If the extravasation be continuous, a large fluctuating tumor may develop. Rupture of the ureter is ultimately followed by stricture and hydronephrosis.

The diagnosis is made by the history of trauma of such nature as to expose the ureter to injury, followed by the formation of a fluctuating tumor in the lumbar region unattended with the symptoms of internal hemorrhage. If this on aspiration is found to be urine the diagnosis is assured. When the rupture is not sufficiently extensive to cause a demonstrable urinary extravasation the later development of a hydronephrosis will prove the existence of a previous ureteral injury.

Wound of the Ureter.—Wound of the ureter during a surgical operation is usually recognized both by the escape of urine and because the thick-walled white cord is readily recognized. Ligation of the ureter is followed in rare instances by signs of mild renal colic. As a rule, symptoms are wanting unless both ureters are ligated, in which case there is anuria. Diagnosis in any suspected case is made by the cystoscope failing to show escape of urine from the ureteral orifice and by the ureteral catheter encountering the obstruction.

Ureteritis, predisposed to by congestion, such as would be caused by traumatism, lodgement or passage of a calculus or clot, the passage of irritating urine or distention from any obstruction, is caused by infection which may ascend from the bladder or descend from the kidney. Exceptionally it comes from without, as in the case of an inflamed appendix adherent to the peritoneum overlying the ureter. The symptoms are indefinite, and are usually obscured by the accompanying pyelitis or cystitis.

The diagnosis may be suggested by urethral tenderness on palpation. This tenderness will be found by making deep pressure at the point of intersection of a line joining the anterior superior iliac spines with a vertical line running upward from the junction of the inner and middle thirds of Poupart's ligament. Such tenderness is not, however, pathognomonic of ureteritis.

Stricture of the ureter may be congenital or acquired. The symptoms are those of back pressure, *i. e.*, hydronephrosis and dilatation of the ureter above the seat of narrowing.

The diagnosis may be made by ureteral catheterization, a point of narrowing being found which, after having been passed by the ureteral catheter, will yield a free flow of urine.

The presence of hydronephrosis not due to stone, movable kidney, or the pressure of a pelvic tumor, or to chronically distended bladder, is suggestive of ureteral stricture.

Calculus of the Ureter.—The majority of calculi, having once entered the ureter, pass into the bladder without symptoms. When the stone is of such size or shape that it cannot immediately pass, it is arrested at one of the points of narrowing, usually just above the bladder or in the intravesical portion of the ureter.

Ureteral calculus is usually single, at times multiple, exceptionally bilateral. The immediate symptoms of an arrested or slowly progressing ureteral calculus are those of renal colic. The remote symptoms, if the arrest be continuous, are hydro- or pyonephrosis. Exceptionally hydronephrosis incident to renal calculus develops without history of preceding

acute pain. During the attack of colic the urine will contain no blood unless the obstruction is incomplete. With the subsidence of severe pain blood appears in the urine, often only microscopically.

Typical renal colic, which will be caused by any sudden ureteral obstruction and consequent renal tension, is characterized by the sudden onset of agonizing pain, located in the lumbar and hypochondriac regions and radiating therefrom along the course of the ureter, to the end of the penis, to the testicle of the affected side, to the inner surface of the thigh. The pain is sufficiently severe to cause marked shock, at times collapse. It is attended with abdominal tympany, vomiting, and tenderness, urgent desire to micturate, with loss of power to do so, and tenderness, elicited by deep pressure in the angle made by the last rib and the erector spinæ muscles, or from before backward just below the tenth costochondral junction.

Exceptionally the pain may radiate to the chest or shoulders or be referred to the unaffected kidney.

The distinction from acute fulminating peritonitis must be made by the absence of rigidity, the seat of tenderness on pressure, the finding of blood in the urine, radiations of pain to the penis and testicle, and interference with bladder function when the stone is lodged in the pelvic portion of the ureter.

When anuria develops, this is evidence of bilateral renal disease, probably but not necessarily calculous.

After the subsidence of an acute renal colic, or in the absence of this, a stone lodged in the intravesical portion of the ureter will cause frequent, urgent, painful micturition and usually pus in the urine, *i. e.*, the symptoms of posterior urethritis.

The diagnosis, unless it be suggested by a history of repeated renal colics followed by the development of a hydronephrosis or pyonephrosis, must be made by cystoscopic examination, showing an inflamed patulous ureteral opening from which the stone may project as a tumor. Ureteral sounding will demonstrate the presence of obstruction, and, if a bougie with a wax end should be used, it will possibly show markings incident to impact against the calculus.

The *x*-rays, on which from a diagnostic standpoint the main reliance must often be placed, may be misleading, since phleboliths and caseating glands give pictures much like those of ureteral stone. Multiple shadows should always be distrusted, and this is particularly so if they are not placed strictly in the line of the ureter or if the patient examined be suffering from genito-urinary tuberculosis.

The persistent lodgement of a stone in the ureter or the pelvis of the kidney, unattended with hydronephrosis or pyelonephrosis of such extent as to be palpable, has been mistaken for chronic appendicitis and cholecystitis.

The presence of blood and pus in the urine and the downward radiations of pain during the acute attacks are characteristic.

Ureteral fistulæ are characterized by a steady or irregular flow of urine. They are kept up by stricture and show little tendency toward

spontaneous cure. Cystoscopic examination and ureteral catheterization may be needful to exclude the vesical origin of such fistulæ.

Tuberculosis of the ureter can be diagnosticated only by the development of obstructive symptoms. It is masked by the associated tuberculosis of the bladder and kidney.

The ureteral papilla is the most frequent seat of cancer. This can be diagnosticated only by cystoscopic examination. The first symptom of growths situated elsewhere in the ureter would probably be those of obstruction, though unusually free bleeding from the passage of a ureteral instrument might suggest papilloma.

THE KIDNEYS.

The kidneys are placed in the upper back part of the abdomen, behind the peritoneum, and, if normal in size and position, cannot be felt. In people of relaxed fiber, particularly women who have lost much fat, the right kidney is, as a rule, distinctly palpable on deep expiration.

The lower poles of both kidneys lie above the umbilicus. A vertical line carried up from the middle of Poupart's ligament to the costal arch should cross the kidney at about the junction of the middle and inner thirds.

Surgical diseases of the kidney are characterized by displacement, pain, tumor, pus, blood, and renal elements in the urine, lessened permeability, and the systemic manifestations of toxemia or infection.

The simplest and most satisfactory proof of renal permeability is the passage of an adequate quantity of urine containing a normal percentage of urea.

Since surgical intervention is usually directed to one kidney, it is of cardinal importance if the nature of the malady be such as to require nephrectomy (malignant growth, tuberculosis, pyonephrosis), that there be a functionally competent kidney on the other side.

The existence of two kidneys may be determined by *x*-rays, and almost certainly, except when the kidneys are fused, by ureteral catheterization.

Permeability, *i. e.*, functional activity of each organ, can be absolutely assured only by ureteral catheterization and examination of the secretion thus obtained from each kidney. When one kidney is obviously extensively diseased and renal excretion is satisfactorily maintained, it is probable that the remaining and apparently healthy kidney is adequate to its function.

The phloridzin test is based upon the power of the normal kidney to eliminate sugar within a certain time after the subcutaneous administration of phloridzin. In renal disease the appearance of sugar in the urine is delayed and the elimination is feeble, prolonged, or absent.

Cryoscopy, or determination of the freezing point of the urine, is an elaborate procedure, requiring from 10 to 20 c.c. of this fluid. Its compensating value is questionable.

The passage of the ureteral catheter will sometimes inhibit the flow of urine for from ten to thirty minutes.

Anomalies.—The kidneys may depart from the normal in number, shape, size, position, attachment, and mobility.

The absence of one kidney has been noted with sufficient frequency to warrant the surgeon in assuring himself of the presence of both kidneys before performing nephrectomy. This defect is more common on the left than on the right side. A single kidney is large. Fused kidney may assume the shape of a horseshoe or may be fused along the whole inner surface, forming one large oval or rounded organ, with bloodvessels and excretory ducts attached to its centre or possibly to one side. It may reach enormous size, simulating abdominal tumor.

The kidney may be displaced from its normal position in any direction except posteriorly. The displacement is usually downward, the kidney lying in the region of the sacroiliac articulation. It may be tilted, rotated, or turned on its own axis.

A displaced kidney, often fixed in its false position, usually causes no symptom.

Floating kidney is a congenital anomaly in which the organ is loosely attached to the posterior abdominal wall by a mesonephron. The diagnosis can be suspected from the free mobility, but can be assured only by operation.

Movable Kidney.—The kidney is normally movable, falling and rising with each respiratory act.

It may be capable of excursions much greater than those recognized as normal or may lie permanently below its proper level without exhibiting symptoms. This condition is common in thin, long-bodied neurasthenic women with an obsession for doctors.

Movable kidney, when it becomes a surgical affection, is characterized by renal colic sudden in onset, recurrent, with associated gastro-intestinal symptoms. This colic is sometimes relieved by position, is associated with albumin, hyaline casts, and sometimes blood in the urine, with palpable tenderness of the kidneys, and is followed by hypersecretion of urine. Hepatic colic, dilatation of the stomach, and gastric catarrh have been attributed to the drag of the right kidney, while intestinal indigestion has been attributed to movable left kidney through partial blocking of the descending colon.

The diagnosis of movable kidney is made by direct palpation. The patient is placed in the dorsal decubitus, with the thighs flexed, head and shoulders elevated, and the trunk slightly inclined toward the side to be examined by a thin pillow placed under the opposite loin. The fingers of one hand are placed posteriorly just below the twelfth rib, those of the other hand in front below the costal margin, over the lower pole of the kidney. The patient is directed to breathe deeply. By gradually increasing the bimanual pressure the examining fingers are sunk deeply down until the kidney is felt in its inspiratory descent. In women, particularly those who are emaciated, the normal kidney can often be felt on the right side. When, however, the kidney descends so far during

inspiration that its expiratory ascent can be prevented by firmly pressing above it with the examining fingers, the mobility is abnormal. The gravity of the affection, however, is dependent, not upon the freedom of mobility, but upon the presence of symptoms produced by it.

In distinguishing the kidney from other tumors its characteristic shape and the completeness with which it can be pressed back into the normal position are highly characteristic.

From omental growths and tumors of the colon, movable kidney can be distinguished by the fact that it lies behind these.

Dilatation of the gall-bladder presents the greatest diagnostic difficulty. The tumor is, however, obviously anterior and continuous with the liver, cannot be made to recede into the loin, and, if subject to attacks of colic, is tender to superficial anterior pressure and does not give downward pain radiation attended or followed by blood in the urine. Nor can it be made distinctly more prominent and accessible by pressure in the loin. When palpation leaves the examiner in doubt, the affection is usually one of the kidney.

Contusion of the Kidney.—Contusion of the kidney may be caused by direct or indirect violence, as from kicks, blows, pressure or contortion, flexions of the trunk, or by violent jarring from a fall.

Direct violence is usually inflicted by a narrow vulnerating body, since the kidney is protected against broad pressure. The lesion, usually complicated by trauma of neighboring organs, varies from subcapsular ecchymoses and intrarenal blood extravasation to extensive rupture. Intrarenal bleeding is rarely profuse. Extrarenal hemorrhage may be fatal. The symptoms are hematuria, and usually shock and severe sickening pain, followed by the formation of lumbar tumor if there be extrarenal bleeding.

Hematuria may be absent if the ureter be ruptured, slight if the hemorrhage be mainly extracapsular or parenchymatous, or profuse. Hemorrhage so severe as to threaten life is usually intraperitoneal or perinephric. The urine often contains worm-like clots moulded into this shape by the ureter, and, because of the blocking caused by these clots, attacks of renal colic may supervene. Recurrent hemorrhage is not uncommon.

The characteristic sickening renal pain is more marked in contusions characterized by slight ecchymosis than in extensive lacerations, nor is immediate shock a reliable index as to the extent of renal lesion.

Lumbar tumor developing in a few hours is due to blood. If it increases from day to day without inflammatory symptoms other than those normal to a clean wound reaction, it is probably due to urine which may be retained in the renal pelvis or may be extravasated into the perirenal tissue, forming a false hydronephrosis.

Renal Calculus.—Renal calculus may be single or multiple. It is usually irregular in shape and of uric acid. Next in order of frequency are the oxalates. Both these stones are deposited from acid urine. Calculi made up of phosphate or carbonate of lime are deposited from alkaline, usually infected, urine.

Calculus is usually found in the renal pelvis or its branches. Excep-

tionally it is placed in the substance of the kidney. In the absence of infection the calculus is generally adherent, taking the shape of the portion of the pelvis in which it is placed; at times bifurcating or branching like a piece of coral, representing a mould of the pelvis and its subdivisions. In about 15 per cent. of cases both kidneys are affected.

The uric acid, the oxalate or the phosphatic diathesis and local infection are predisposing factors. They favor coagulation necrosis of cells, thus furnishing the organic framework essential to calculus formation.

The affection may be without symptoms. Usually it is characterized by pain in the back just below the twelfth rib and in front over the position of the kidney, attacks of renal colic, renal tenderness, testicular or ovarian hyperesthesia of the affected side (Bittorf), hematuria, renal albumin, hyaline casts, and gastro-enteric disturbances.

The characteristic pain is an ache, aggravated by bodily activity and repeated jarring. Subject to acute exacerbations, which may occur at night, waking the patient. These exacerbations may take the form of acute renal colic attended by vomiting, tympany, and collapse, exhibiting downward radiations along the course of the ureter and into the genitals. Exceptionally the pain is referred to the healthy kidney.

During the periods of exacerbation, often at all times, there is renal tenderness elicited by deep palpation.

Hematuria is usually detected only on microscopic examination, is intermittent, and is markedly increased by jarring or bodily activity. Exceptionally it is transitorily profuse, apparently causeless, and is subject to recurrence at long intervals. Frequent urination is a common reflex, though it is more essentially a symptom of calculus lodged in the ureter. Passage of gravel or fragments of calculi are symptoms of great diagnostic value.

Temporary suppression of urine may occur during attacks of renal colic. This, when it persists for several days, is indicative of bilateral disease.

The gastro-intestinal disturbances, *i. e.*, distaste for food, tardy stomach digestion, flatulence, constipation, and diarrhea, may be reflex. They are usually, however, expressions of toxic absorption.

When stone in the kidney becomes complicated by infection, this is indicated by pus in the urine and marked aggravation of all the symptoms, especially those of gastro-intestinal disturbance. Pyelitis is suggestive of stone simply because it is such a common sequel of this condition.

Of these symptoms, pain and hematuria are the two most constant and, with the exception of the passage of calculus fragments, the most characteristic.

The absolute diagnosis is made by the *x*-rays, or, this failing, by exploratory incision.

The *x*-rays afford the most trustworthy means of making the diagnosis. The picture must be clear and unmistakable, and repetitions must show a correspondence in the shadow or shadows in at least two pictures taken at different times. In the case of uric acid calculi the *x*-rays may

fail. Hence, if symptoms are persistent, with signs of progressing renal degeneration or infection, the diagnosis must be made by direct incision.

The symptoms of renal calculus may be closely simulated by nephralgia, crises of locomotor ataxia, oxaluria, phosphaturia, chronic interstitial nephritis or tuberculosis of the kidney, movable kidney, cholecystitis, or appendicitis.

Nephralgia, oxaluria, phosphaturia, and strongly acid urine may all be characterized by renal tenderness, blood in the urine, and pain with paroxysmal exacerbations radiating downward. Nephralgia occurs in neurasthenic females, is worse at the time of the catamenia, is characterized by the passage of large quantities of urine of low specific gravity, and very exceptionally the urine contains a few blood corpuscles.

The dull pain and slight hematuria of oxaluria or phosphaturia are transitory in nature, and disappear completely under appropriate treatment. These conditions are, however, often associated with calculus.

Crises of locomotor ataxia, which may exactly simulate renal colic, are suggested by the history of the case and other symptoms of cord degeneration, nor is there blood found in the urine either during or after the attack.

Tuberculosis may exhibit precisely the symptoms of stone. The finding of the tubercle bacillus will be diagnostic. It ultimately becomes complicated by tuberculosis of the bladder, but the diagnosis should be formed before this develops. Tuberculous lesions elsewhere would be suggestive. Mixed infection develops earlier than is the case with calculus, hence an apparently causeless pyelitis in the absence of preceding symptoms of long standing (months or years) is suggestive of renal tuberculosis.

Movable kidney must be distinguished by the detection of this condition by direct examination. Aside from the mobility the symptoms may be identical.

Gallstone colic gives upward and backward radiation. Tenderness is marked on superficial pressure over the region of the gall-bladder, there is an abundant secretion of urine not containing blood and there is no difficulty in passing urine. The preceding history is often characteristic.

Appendicitis may simulate renal colic. In the acute attack the location of the point of greatest tenderness is characteristic and muscular rigidity is not found in renal colic, though this may be simulated by the voluntary resistance of the patient during examination. If the appendix be adherent to the ureter or point downward, involving the bladder, the vesical symptoms may exactly simulate those of renal or ureteral irritation. The blood will, however, be absent from the urine. Nor can renal tenderness be elicited by deep dorsal pressure beneath the last rib.

The distinction between ureteral and renal calculus may be suggested by tenderness along the course of the ureter and marked vesical symptoms. It can be made positively only by the *x*-rays and by exploration of the ureter at the time of operation. This should always be done when the kidney is opened, particularly if the ureter is dilated.

Suppurative Diseases of the Kidney.—Predisposition is offered by renal congestion, the ordinary cause of which is back pressure from obstruction in any part of the urinary tract. Exposure to cold; traumatism; drug irritation, such as that incident to irritating diuretics, antiseptics, balsams, and ethereal oils; chronic interstitial nephritis; gastroenteritis; gout; pregnancy; the mechanical irritation of gravel or calculus; irritation of elimination in acute infectious diseases, and tuberculosis are common predisposing factors to infection.

The usual microörganisms of renal suppuration are the Bacterium coli communis, the Staphylococcus aureus, the Streptococcus pyogenes, and the Proteus hauseri. Exceptionally the gonococcus, the typhoid bacillus, the pneumonia diplococcus are the caustive agents.

Infection may reach the kidney through the blood in the course of elimination. This is the common route when suppurative inflammation occurs in the course of infective fever. It may extend to the kidney from inflammation of adjacent structures. It is usually secondary to infection of the bladder, ascending by way of the ureter.

The infection may take the form of a pyelitis, which, if complicated by obstruction, becomes a pyelonephrosis, the inflammation reaching its maximum in the pelvis of the kidney. When both the pelvis and the renal parenchyma are extensively involved the affection is called pyelonephritis. This is the form usually taken by an ascending infection. Suppuration of the renal substance secondary to systemic infection, and entering by the blood channnels, may be without characteristic symptoms until the rupture of an abscess into the renal pelvis or the perirenal tissue causes a sudden pyuria or a perinephric abscess.

The characteristic symptoms of renal infection are pain in the lumbodorsal region, fever which may be exceedingly high and accompanied by chills and sweats, renal tenderness on deep palpation, and pus of renal origin in the urine. This point may be determined by ureteral catheterization or inspection of the urinary jet as it escapes from the ureter.

Pyelitis.—Usually bilateral, it is even in its acute outbreak often obscured by the symptoms of an antecedent disease, such as gastroenteritis, typhoid, pneumonia, or la grippe infections, or by those of acute or chronic cystitis.

In its acute form it is characterized by severe pain in the region of the kidney, tenderness on palpation, frequent urination, with decrease in the total quantity, and often vomiting, fever, chills, and sweat. The urine is usually acid, contains a trace of albumin, degenerated epithelium, hyaline casts, mucus, pus, and often blood.

Chronic pyelitis may be attended with no symptoms other than pus in the urine and is often overlooked, particularly in children. Diagnosis depends upon the examination of the urine secured by ureteral catheterization. Usually there is kidney ache, some slight local tenderness on deep pressure, and general impairment of health and slight toxic anemia. The urine, usually acid, contains polynuclear leukocytes, nucleo-albumin (from the pus and blood), and is increased in amount. The casts are of the hyaline variety. There are frequently recurring subacute attacks.

Intermittent pyuria, *i. e.*, pus disappearing from the urine for some hours and then recurring, shows that the inflammation is confined to one side, and that pyonephrosis is developing on that side.

In the absence of acute obstruction and its attendant renal colic, polyuria and pyuria are the most diagnostic features. Nocturnal frequency is regarded by Bazy as highly characteristic.

Pyonephrosis.—Pyonephrosis is a sequel of pyelitis and back pressure, or is caused by infection of a hydronephrosis. In the former case there is usually a history of renal infection associated with recurring attacks of renal colic, often the presence of a palpable, tender tumor, with the fever and sweats of either acute or chronic sepsis.

The tumor, if present, lies behind the colon, can be felt by bimanual palpation, is freely movable, but slightly tender, except during attacks of colic, exceptionally distinctly fluctuating, and varies in size from time to time. This, together with intermittent pyuria, or, more commonly, marked variations in the quantity of pus, is a highly characteristic feature.

Exceptionally a pyonephrosis develops with almost no symptoms other than those of impaired health and toxic anemia. The distinction from hydronephrosis is made by urinary examination and by the absence of constitutional symptoms in cases of simple urinary retention.

Pyelonephritis.—Pyelonephritis is the usual sequel of pyonephrosis, the suppuration involving and destroying the kidney parenchyma. The acute form of infection is characterized by lumbar pain and violent septic symptoms, *i. e.*, prolonged chills, high fever, and drenching sweats, associated with an irritable condition of the stomach, characterized by persistent vomiting and hiccough. The associated symptoms of intoxication are those of sepsis and uremia. The prognosis, though extremely bad, is not absolutely so, there being a possibility of the pus collections draining through the ureter.

Chronic pyelonephritis is characterized by pus in the urine, and a toxic condition exhibited by complete anorexia, dry tongue, scanty secretion of saliva, tympany, constipation, often uncontrollable diarrhea. Intercurrent acute febrile attacks develop. There may be no pain or other local symptoms, the diagnosis of the affection being entirely dependent upon the examination of the urine. There is usually polyuria, except in the terminal stage, and constant pyuria subject to marked quantitative variations. At times necrotic fragments of renal substance are passed, often preceded by renal colic from temporary blocking of the ureter. Frequently repeated severe attacks of renal colic suggest the complication of renal calculus.

The distinction between cystitis and pyelonephritis is made by ureteral catheterization, though chronic cystitis produces very little systemic effect.

When the underlying lesion of a pyelonephritis is tuberculous, this may be suggested by tuberculous lesion elsewhere. If the bacillus can be recovered from the urine, this will be diagnostic. Mere per-

sistence of the infection in the absence of obstruction or calculus is strongly suggestive.

Acute hematogenous nephritis, usually unilateral, is characterized by the rapid development of septic symptoms. Chills, fever, and sweats, with rapid and at first sthenic pulse, abdominal tympany and tenderness, but without rigidity, and tenderness on deep pressure at the costo-vertebral angle. The urine at first may show only a trace of albumin and a few red blood cells. Later, if the patient survives, when abscesses form and break into the pelvis, there will be pus in quantity. The swollen kidney can sometimes be felt. Early diagnosis is based upon violent septic symptoms and the seat of local tenderness. Occurring on the right side the affection strongly suggests appendicitis.

Perinephric Suppuration.—Perinephric suppuration, which may be traumatic in origin or secondary to renal suppuration or infection of neighboring organs, particularly the appendix, is commonest in middle-aged men.

The pus usually discharges in the lumbar region or passes upward toward the pleural cavity, causing, first, a serous effusion, later an empyema. It may burrow into the pelvis behind the peritoneum, may pass down within the sheath of the psoas muscle, or may rupture into the ureter, kidney, colon, duodenum, or stomach.

The affection is characterized by pain, tenderness, and fever, and a fixed, vaguely outlined, rapidly progressing tumor in the lumbar region. When the affection is not masked by a preceding causative lesion, such as appendicitis, pyelonephrosis, or lumbar osteomyelitis, the diagnosis is readily formulated. The pain is aggravated by motion of the thigh of the affected side and the body is curved toward this side. The thigh is sometimes flexed and adducted, and there is marked polymorphonuclear leukocytosis, except when the abscess is purely tuberculous secondary to bone involvement. Frequently there is tympany and vomiting.

Spinal tuberculosis will usually be noted by its slow onset and by associated symptoms. A neoplasm fixed in position can be differentiated from pure perinephric abscess only by its comparatively slow and progressive growth and by the absence of septic symptoms and pyuria.

Hydronephrosis.—Hydronephrosis, due to obstruction to the flow of urine through any portion of the urinary tract, may be congenital or acquired. It may be persistent or intermittent, unilateral or bilateral, partial or total. Partial hydronephrosis involves one or more calices, but not the whole pelvis.

Bilateral hydronephrosis is incident to obstruction low down in the urinary tract. Enlarged prostate, hypertrophy of the bladder from urethral obstruction, and tumors of the pelvic organs compressing the ureters are common causes.

The usual causes of unilateral hydronephrosis are calculus and movable kidney. Valve formation and irregular implantation of the ureter into the renal pelvis are unusual causes. Even postmortem examination has at times failed to detect a cause.

The secreting substance of the kidney ultimately disappears from pressure atrophy and interstitial nephritis incident to interference with the circulation.

The diagnosis of hydronephrosis is based upon the finding of a smooth, rounded, movable, fluctuating tumor placed behind the colon, unattended with fever, pain, or tenderness.

The intermittent form of the disease is characterized by the recurring development of a tumor, accompanied usually by renal colic and by the rapid diminution in size or disappearance of this tumor attended with polyuria. After attacks of renal colic, the urine may contain blood, albumin, and hyaline casts.

When the hydronephrosis is well developed (containing many gallons), distinction from cystic growths, particularly those of ovarian origin, can be made only by the history of the case. The presence of urinary salts usually proves the origin of the fluid. These may be absent when the renal parenchyma has atrophied.

Tuberculosis of the Kidney.—Tuberculosis of the kidney may appear in its acute form as a part of general miliary tuberculosis. The symptoms are then masked by the general systemic invasion.

Chronic renal tuberculosis may appear as the sole evidence of tuberculous invasion, or may be secondary to lesions of the lungs, bones, or other parts of the body. It is commonest in early manhood, and in its beginning is unilateral. The second kidney is ultimately involved by the infection which first invades the bladder, then blocks the ureter of the healthy side, and finally reaches this kidney predisposed to infection by the congestion incident to blocking and prolonged elimination of toxic substances.

The diagnosis in the early stage of the affection is based upon a constant or intermitting ache in the renal region, deterioration in general health, polyuria and frequent urination not otherwise explicable, slight (usually microscopic) transitory, apparently causeless, hematuria, and demonstration of tubercle bacilli in the urine.

The existence of lesions obviously tuberculous in other parts of the body, particularly in the genito-urinary tract, and tuberculous family history are sufficiently common to be of diagnostic value. The tuberculin test may be serviceable.

When the disease is fairly well advanced and involves the pelvis of the kidney, hyaline and granular casts appear and the descending infection involves the ureter, the renal orifice of which becomes edematous, hyperemic, and sometimes eroded.

On the advent of mixed infection, which develops earlier than is the case with stone, the symptoms of pyelitis and pyelonephritis or pyelonephrosis develop. This, in the absence of other causative lesion, is suggestive of tuberculosis. As the affection progresses perinephric abscess is a common complication.

The determination as to whether one or both kidneys is affected usually depends upon ureteral catheterization and the injection of the urine drawn from each kidney into susceptible animals.

Syphilis of the Kidney.—Syphilis of the kidney may manifest itself in the form of a congestion, shortly (weeks) following the chancre, characterized by a slight, transitory, intermittent albuminuria, with possibly hyaline casts.

In the secondary period (the first two years of the disease) acute parenchymatous nephritis may develop, dependent upon the syphilitic virus or its toxins, exhibiting the symptoms of this condition when it is due to other causes and cured by specific treatment.

In the later stages of the disease (after two years) interstitial nephritis may develop.

Aneurysm of the Renal Arteries.—Aneurysm of the renal arteries is characterized by the formation of a postperitoneal tumor, following traumatism; either exhibiting no symptoms or characterized by profuse bleeding into the pelvis of the kidney or into the peritoneal cavity.

The diagnosis is made by surgical operation or autopsy, since the tumor is so deeply placed that neither thrill, bruit, nor pulsation can be detected. The possibility that a renal tumor which shortly follows traumatism and is accompanied by profuse hematuria may be an aneurysm should be considered.

Tumors of the Kidney.—Tumors of the kidney are commonest in children under five years of age, usually sarcomatous, are characterized by profuse, intermittent, and apparently causeless hematuria (at times associated with transitory colic from ureteral blocking by clots), a sense of weight or pain in the lumbar region, and the formation of a rapidly growing postperitoneal tumor, always prominent in the loin, though its direction of growth may be either upward, forward, or both.

The tumor is usually fixed, hard, bossed, and, if small, lies behind the colon. If it attains large size, this viscus may be pushed completely to one side.

Hypernephroma, constituting the large majority of renal tumors observed in the adult, exhibits the clinical features of sarcoma; recurring, apparently causeless, often profuse bleeding, and the development of tumor. The favorite seats of metastasis are the long bones, the liver, and the lungs.

In the late stages of malignant disease of the kidney the huge size of the growth, its rapid progression, dilated veins of the abdomen, and profound cachexia make the nature of the affection unmistakable. Diagnosis should be based upon the results of operation performed when free bleeding without obvious cause first suggests the probability of neoplasm.

The lateral position of the tumor and the lumbar bulge usually enable a distinction to be made from retroperitoneal sarcoma. The diagnosis from renal calculus and from renal tuberculosis will be suggested by the slight bleeding characteristic of the latter conditions.

Papilloma.—Papilloma of the renal pelvis (rare) is characterized by hematuria or, if it becomes obstructive, pain. It is diagnosticated only by surgical operation.

Cystic disease of the kidneys (congenital) is characterized by bilateral enlargement of slow growth (years) unattended with hematuria. There

is usually associated moderate hydronephrosis. Such kidneys are subject to nephrolithiasis and pyelitis.

The diagnosis is based upon the slow enlargement, this distinguishing it from sarcoma. The bosselated surface of the tumor, its failure to be distinctly outlined by the *x*-rays, and the symptoms of a progressive renal incompetency are characteristic features. The diagnosis is usually made post mortem.

Hydatid cyst may be distinguished from hydronephrosis only by direct examination, excepting in the case of rupture into the pelvis or ureter, when the examination of the urine should be diagnostic.

The Adrenal Glands.—The adrenal glands, if diseased bilaterally and extensively (tuberculosis), are attended with emaciation, anemia, adynamia, vomiting of blood, melena, and often bronzing of the skin (Addison's disease).

Tumor of the suprarenal capsule usually cannot be diagnosticated from similar conditions involving the kidney excepting by the absence of blood from the urine. Even this may be present incident to pressure, congestion, or direct renal involvement. The adrenal tumor in its growth displaces the kidney downward, and may be first felt in the epigastric region to the right or the left of the middle line. General and pronounced outgrowth of hair and hypertrophy of the genitalia have been noted. Metastasis to the orbital region is characteristic of one form of sarcoma.

Cysts of the suprarenal gland (rare), of slow growth (years), and probably secondary to embolus or hemorrhage, form thoraco-abdominal tumors, the origin of which even operation has at times failed to demonstrate.

CHAPTER XIX.

GYNECOLOGICAL DIAGNOSIS.

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Gynecological diagnosis depends upon the history, the symptoms, and the physical examination. To correctly determine each of them, one must be familiar with the normal anatomy of the reproductive organs, with the various gynecological diseases, and with both the subjective and the objective manifestations of pelvic disorders.

The Anatomy of the Reproductive Organs.—The genital organs may be divided for the purpose of description into the external, the intermediate, and the internal genitalia. The external genital organs, collectively known as the vulva, are bounded by the labia majora, the pubes, and the perineal body. The vulva comprises the labia majora, the labia minora, the clitoris, the external urinary meatus, the vestibule, the hymen, the ostium vaginæ, and the fourchette. It is covered with a modified skin which is thinner than the general cutaneous covering, and contains sebaceous and sudoriferous glands.

The vulvovaginal glands are two distinct bodies, each about the size of a bean, embedded in the lower part of the labia majora, on either side of the introitus vaginæ. The ducts open upon the vulvar surface about the middle of the vaginal orifice and just in front of the hymen. The secretion is mucous. The perineal body lies between the vaginal introitus and the anus. It is the musculofibrous intersection of the transversus perinei, the bulbus cavernosum, the levator ani, and the sphincter ani muscles. At the external urinary meatus are two invaginations of the urethral mucosa known as Skene's tubules. They are each about $\frac{5}{8}$ of an inch in length and open on the urethral surface just within the meatus. In the multiparous women the orifices are visible as small openings of sufficient size to admit a bristle.

The vagina extends from the vulva to the cervix, which it surrounds and to which it is attached. The ballooned-out upper part of the vagina into which the cervix projects is known as the vaginal fornix. The vaginal walls in the normal nulliparous woman are in contact, except at the introitus and at the vaginal fornix. The posterior wall is held against the anterior wall by the support it receives from the levator ani and the other muscles and fasciæ of the pelvic floor. The anterior border of the levator ani muscle can be felt in the normal woman just within the vaginal orifice, on either side, its fibers forming a band about one-half inch in thickness. The vagina is lined by a modified skin very much like that of the vulva and containing no glands. It is moistened by the so-called vaginal secretion which consists of the

discharge from the cervix and the uterus, desquamated epithelium, and transuded blood serum.

The cervix projects into the vaginal fornix. It is covered by a reflection of the vaginal mucosa as far as the external os, where the mucosa of the cervical canal begins. It has a smooth, grayish red appearance. The external os is usually plugged with clear, thick mucus. The cervix points toward the coccyx and its axis is nearly at right angles to that of the vagina.

The body of the uterus is flexed gently forward upon the cervix and lies within the cavity of the true pelvis. Its anterior surface is in relation with the superior surface of the bladder. As the bladder fills with urine, the fundus of the uterus is pushed upward and backward.

The pelvic peritoneum covers the anterior and the posterior surface of the uterus, dipping down between the body of the uterus in front to about the level of the internal os, and then being reflected forward upon the bladder. Posteriorly the peritoneum covers the entire surface of the uterus and thence is reflected to the pelvic wall, partially surrounding the rectum. The peritoneal space thus formed between the uterus and the rectum is known as Douglas' pouch.

The tubes and ovaries lie at the side of and posterior to the uterus. They are held in position by the broad ligaments which run from the lateral borders of the uterus to the pelvic wall, and by the uteroövarian and the infundibulopelvic ligaments. The outer extremities of the tubes are open and communicate with the peritoneal surface of the pelvis. The ovary is not covered by the peritoneum, but projects from the posterior peritoneal surface of the broad ligament.

The uterine ligaments consist of the broad, the uterosacral, the uterovesical, and the round ligaments. All of these but the last mentioned are formed by foldings of the pelvic peritoneum, enclosing between them fatty connective tissue, a few muscle fibers, bloodvessels, and nerves. The round ligaments are distinct fibromuscular structures which pass from the cornua of the uterus through the inguinal canals to the pubes.

The body of the uterus is lined by a mucous membrane known as the endometrium. It is continuous with the mucosa of the cervical canal at the internal os and with that of the tubes at the uterine cornua. Within the tube the mucosa is thrown into folds and at the outer extremity projects into the peritoneal cavity as a fringe-like formation, spoken of as the fimbria.

GENERAL CONSIDERATION OF THE HISTORY AND OF THE SYMPTOMS.

The age and the social position of the patient may direct the physician to a certain extent in collecting the data for a diagnosis.

Diseases Occurring before the Age of Puberty.—Only a few gynecological diseases are found before the age of puberty. Gonorrheal vulvovaginitis, malignant tumor (cystic or solid) of the ovary, grape-like sarcoma of the cervix, and tuberculous salpingitis and peritonitis are

those most often encountered. Sometimes a catarrhal inflammation of the tube occurs during the course of one of the acute exanthematous diseases; ovaritis may complicate mumps, scarlet fever, or smallpox. These complications produce abdominal pain which is usually misinterpreted and the disease escapes attention. At some time subsequently, however, the result of the pelvic inflammation may become manifest in hydrosalpinx, adherent adnexa, or adherent retroposition of the uterus; sterility may be caused by light velamentous adhesions covering the tubal ostia. Congenital malformations, except gross deformities of the external genitalia, do not become noticeable, as a rule, until puberty.

Diseases Occurring after Puberty and during Adolescence.—Affections which manifest themselves at puberty are either the result of a malformation of some part of the genital apparatus or an evidence of general ill-health. Thus, a tumor arising from any of the forms of gynatresia (hematocolpos, hematometra, hematosalpinx), or subjective evidence of functional or anatomical insufficiency of the genitalia (amenorrhea, dysmenorrhea) may appear. Malignant tumor (cystic and solid) of the ovary, grape-like sarcoma of the cervix, and tuberculosis of the tubes and of the pelvic peritoneum are more frequent than before puberty.

As adult life is approached, gonorrhea and pregnancy are encountered in the married and in the non-virginal.

Diseases Occurring between the Ages of Twenty-one and Forty in the Unmarried and Virginal.—The various lesions due to gonorrheal infection and to pregnancy and childbirth may be excluded. Dysmenorrhea of the neuralgic type, the result of a lowered general body tone, may develop in those who lead an unhygienic life.

Neurasthenia and the various neuroses will be met, the subjects frequently having a fixed and erroneous idea concerning their pelvic organs. A congenital or a traumatic displacement of the uterus may become manifest. Endometritis or some general affection may be indicated by leucorrhea or menorrhagia. Fibroid tumor and endometrial polyp are not uncommon.

Diseases Occurring between the Ages of Twenty-one and Forty in the Married and in the Non-virginal.—The whole gamut of disorders caused by the gonococcus is found in this class. Pregnancy, normal and pathological, and its results are encountered. Pelvic inflammatory disease, displacements of the uterus, lacerations of the cervix and of the pelvic floor are common. Fibroid tumors occur, especially in those who have been sterile or who give the history of repeated miscarriages.

Diseases Occurring between the Ages of Forty and Sixty.—The diseases associated with the menopause and with old age include ovarian cysts, carcinoma of the cervix, carcinoma of the fundus, extreme degrees of displacement of the uterus, laceration and hypertrophy of the cervix, cystocele, and rectocele. Carcinoma of the cervix almost never occurs in those who have borne no children. Carcinoma of the body of the uterus frequently occurs in sterile women and in combination with fibroid tumors of the uterus.

The Time of Onset of the Symptoms.—The time of the onset of the symptoms may furnish a clue to the diagnosis. Thus, developmental anomalies are first detected at the time of puberty or after marriage. Gonorrheal infection and all of its sequelæ date from suspicious intercourse or from marriage. Gonorrheal endometritis or peritonitis in a woman already infected frequently begins at or about the time of the menstrual period. The onset of the symptoms of displacement of the uterus, laceration of the cervix, and relaxation of the pelvic floor will customarily be referred to childbirth.

GYNECOLOGICAL SYMPTOMS IN DETAIL.

Pain.—Pain varies in character, location, and time of occurrence.

Character.—Pain may be dull, sharp, neuralgic, or cramp-like. Dull pain is most common in displacements of the uterus and in relaxations of the pelvic floor. It may arise also as a result of pressure from a pelvic tumor. Dull pain is sometimes associated with a dragging sensation in cases of relaxation of the pelvic floor and in displacements of the uterus.

Sharp, lancinating pain is usually found in inflammatory affections of the pelvic peritoneum and the adnexa. The pain at the time of rupture of a tubal pregnancy is often spoken of as lancinating.

Neuralgic pain is found in diseases which produce compression or infiltration of nerve sheaths. The most familiar examples of neuralgic pains are found in carcinoma of the cervix (infiltration and compression), tumors which block the pelvis (compression), and dense inflammatory masses (compression and infiltration).

Cramp-like pain, or the pain associated with muscular contractions, occurs from the efforts of the uterus to expel a foreign body, as, for example, a piece of placenta, a pedunculated submucous fibroid tumor, or an endometrial polyp. Cramp-like pains also occur from tubal contractions in tubal pregnancy preceding tubal abortion or rupture.

Burning pain accompanies acute inflammation of the vulva, vagina, and bladder. It is also found in urethral caruncle.

A sensation of loss of support is complained of in relaxation of the pelvic floor.

Location.—*External Genitalia.*—Pain from inflammatory and other affections of the vulva or the vagina is usually felt in the external genitalia, perineum, and groin.

Bladder.—A burning pain with frequency of urination may be found in inflammatory affections of the urethra and the bladder, in relaxation of the pelvic floor, in prolapsus of the uterus with cystocele, in retroposition of the uterus, in fibroid tumor (pressure on the bladder), and in pelvic inflammatory diseases of all types when the bladder is involved. Frequent and painful urination which is due to displacement of the uterus or relaxation of the pelvic floor disappears when the organs are replaced and maintained in good position.

Pain in the Rectum.—A feeling of pressure and pain in the rectum is found in cases of rectocele, especially during attempts at defecation. In extreme degrees of retroposition, when the body of the uterus presses against the bowel, the patient may complain of a sensation as if a foreign body were in the rectum. An intense desire to defecate is often associated with pelvic hematocele. Pain during defecation is sometimes observed in prolapsus of the ovary.

Pain in the lower abdomen in the median line is found in relaxation of the pelvic floor, in pathological anteflexion, retroposition, and prolapse of the uterus, and in uterine fibroids, especially of the intramural or the submucous type.

Pain in the lower abdomen at the sides is found in pelvic inflammatory disease and in tubal and ovarian affections such as extra-uterine pregnancy, cystic ovary, prolapsed ovary, and ovarian cyst.

Backache in the sacral region, vertical headache, and pain along the front or the back of the thighs are referred sensations, and may be present in a variety of gynecological diseases. Backache is especially prone to be associated with relaxation of the pelvic floor and displacement of the uterus. The same may be said of vertical headache. Pains which are referred to the thighs are the result of pressure on the sciatic, the obturator, or the crural nerves, and may be produced by any tumor or inflammatory affection.

The Time of the Occurrence of Pain.—Pain due to a relaxation of the pelvic floor and to a displacement of the pelvic organs is less when the patient is in bed; it gradually increases when the patient gets up and goes about or works. The pain is always relieved by assuming a recumbent position.

Rheumatic pain in the back and limbs is worse on arising from bed, and becomes less as the muscles of the back and thighs are called into use.

Inflammatory pain is but little influenced by rest, unless it keeps inflamed surfaces apart or reduces muscular tension over inflamed areas.

Menstrual Symptoms.—The menstrual symptoms which are met in gynecological diseases are amenorrhea, scanty menstruation, acute suppression of the menstrual flow, menorrhagia, metrorrhagia, and dysmenorrhea.

Amenorrhea is an absence of menstruation. This term does not apply to the absence of menstruation during pregnancy. Nor can it be truly used in cases of retention of the menstrual flow because of an imperforate hymen or in any form of gynatresia (hematocolpos, hematometra, hematosalpinx). In such instances the flow occurs, but is not visible for obvious reasons.

Amenorrhea may depend upon an anatomical lesion of the uterus or of the ovaries which renders menstruation impossible, *e. g.*, hyperinvolution of the uterus; ovaritis complicating parotitis, scarlet fever, or smallpox; bilateral sarcoma or carcinoma or atrophy of the ovary or fatty degeneration of the ovary associated with general obesity.

Amenorrhea may be the result of diseases which affect the general health, such as chlorosis, typhoid fever, tuberculosis, myxedema, Basedow's disease, diabetes, carcinoma outside of the genital tract, gastric catarrh, leukemia, acromegaly, or Addison's disease.

Amenorrhea may have a psychical cause, such as the fear of impregnation, the desire for impregnation, terrible fright, altered social relations, or a change of climate.

Scanty menstruation is etiologically similar to amenorrhea. The cause is less active in the case of scanty menstruation.

Suppression of the Menstrual Flow.—A sudden cessation of the menstrual flow occurs as the result of wet feet or of insufficient clothing for the lower extremities. Sea-bathing, the use of a cold douche, and psychic influences will also produce it. The menstrual flow sometimes ceases abruptly during an attack of gonorrheal endometritis or peritonitis.

Menorrhagia is an increase in the amount or the duration of the menstrual flow.

Metrorrhagia is a uterine hemorrhage which occurs between the menstrual periods. It is to a large extent dependent upon the same causes as menorrhagia. Metrorrhagia represents the extreme effect of a cause which may have first produced menorrhagia. The causes of menorrhagia and metrorrhagia are general and local.

The general causes are: Cardiac incompetency, cirrhosis of the liver, interstitial nephritis, the hemorrhagic diathesis, scurvy, typhoid fever, cholera, variola, scarlatina, influenza, acute articular rheumatism, and syphilis, secondary or tertiary.

The local causes are: Endometritis, endometrial polyp, subinvolution of the uterus, relaxation of the uterine muscle, retrodisplacement of the uterus, fibroid tumor, carcinoma or sarcoma of the uterus, tubal pregnancy, cystic degeneration of the ovary, and carcinomatous ovarian tumors.

The source and the cause of menorrhagia and metrorrhagia should be investigated in every instance. It should be remembered that *metrorrhagia is usually the first symptom of cancer.* This symptom in a woman past forty years of age should always arouse the greatest anxiety until malignant disorders are excluded.

Dysmenorrhea is a word used to designate pain of varying type and location which is definitely associated with the menstrual flow. Dysmenorrhea usually signifies sharp, cramp-like pain in the lower abdomen. But severe headache and backache and dull pain in the hips and ovarian regions also constitute a form of dysmenorrhea.

Dysmenorrhea may be due to congenital defects such as infantile type of uterus, ill-developed fundus, long, conical or short, knob-like cervix, or sharp anteflexion or stenosis of the cervix. Congenital defects of the nervous mechanism may also be responsible for the neuralgic type of dysmenorrhea.

Dysmenorrhea may be symptomatic of almost any of the acquired pelvic lesions, *e. g.*, endometritis, retroposition of the uterus, fibroid tumor of the uterus, uterine polyp, inflammatory diseases of the adnexa, ovarian tumors, etc.

Dysmenorrhea, the result of obstruction to the cervical canal, anteflexion, stenosis, etc., commonly consists of cramp-like pain in the lower abdomen which precedes the menstrual discharge from twenty-four to thirty-six hours and is relieved as soon as the flow is well established. In dysmenorrhea associated with fibroid tumor, endometrial polyp, endometritis, or retroposition of the uterus, the pain starts with the flow and continues throughout the period.

Dysmenorrhea from chronic pelvic inflammatory disease or cystic degeneration of the ovaries takes the form of a dull, heavy ache in the lower abdomen and hips which precedes the appearance of the menstrual flow and then gradually subsides. The neuralgic form of dysmenorrhea may simulate any of these. Usually it partly simulates that due to obstruction, viz., the cramp-like pains begin prior to the establishment of the menstrual flow, but, unlike the obstructive type, they continue throughout the period, not being relieved by the escape of the menstrual blood. The neuralgic form sometimes consists of a dull, heavy sensation in the lower abdomen, the ovarian regions, and the thighs, preceding the period, and frightful headache and backache during the flow.

Leucorrhea.—Leucorrhea is a symptom of numerous gynecological disorders. It may be mucous, mucopurulent, purulent, or putrid in type.

Mucous leucorrhea results from catarrh of the vulvovaginal glands and the cervix. Cervical mucus is extremely thick and tenacious.

Mucopurulent leucorrhea results from an infection of the vulvovaginal and the cervical glands. As the disease progresses the discharge may become purulent.

Purulent leucorrhea originates from vulvitis, urethritis, vaginitis, ulcerative diseases of the vulva and the vagina, and acute endometritis.

Serous leucorrhea, a thin watery leucorrhea, is noted in chronic endometritis, in the early stage of some cases of carcinoma of the corpus uteri, in fibroid tumor, in early sarcoma of the uterus, in chronic pelvic congestion, and in constitutional debility.

Putrid leucorrhea is noted in carcinoma and sarcoma of any part of the genital tract, the peculiar odor occurring as soon as infection and necrosis of the newgrowth takes place. A sloughing, or necrotic, fibroid tumor or endometrial polyp, retained and putrefying secundines, or decidual tissue produces the same result.

Constipation.—Chronic constipation is noted in retrodisplacements of the uterus, in fibroid tumors of the uterus, or in other pelvic tumors which encroach upon the rectum. Constipation is also noted in pelvic inflammatory diseases, both in the acute and in the chronic stage.

Pruritus Vulvæ.—Pruritus vulvæ is often indicative of an irritating discharge, but it may be a symptom of many disorders. In the severest form it is accompanied by local lesions. It is discussed under diseases of the vulva on page 708.

Fever.—Most of the inflammatory diseases are accompanied by fever. In acute gonorrhea of the urethra, vulvovaginal glands, and the cervix it is usually slight. Abscess of the vulvovaginal glands, acute endome-

tritis, acute pelvic peritonitis, and acute salpingitis and ovaritis are accompanied by a considerable degree of pyrexia. In tubal pregnancy (before rupture) there is often some rise of temperature.

Sterility.—A woman is said to be sterile when conception does not occur within three years after marriage. This is an arbitrary statement, and is, of course, modified by the condition of the husband and by any means which have been used to prevent conception. *Relative sterility* —"one child sterility"—is the common result of an ascending gonorrheal infection occurring in the first and only puerperium. Sterility on the part of the woman may be due to imperfect development, inflammatory disease and its result, or to some functional or mechanical difficulty which renders the sexual act faulty or keeps the spermatic particles from meeting the ovum.

Developmental Sterility.—The following defects may prevent impregnation: Hyperplasia of the ovaries (few and imperfectly formed ova), fetal type of Fallopian tube (the tube is long and very much twisted), diverticula of the tubal canal (ovum is caught in a blind passage and arrested in its progress toward the uterus), infantile or fetal type of uterus (the fertilized ovum is badly embedded and perishes), stenosis of the cervix (spermatic particles cannot enter the uterus), elongation of the cervix and flattening of the vaginal fornices (the semen is expelled from or runs out of the vaginal vault almost directly after it is deposited there), malformation of the vagina or the external genitalia (normal intercourse or the entrance of the spermatic particle is difficult or impossible).

Sterility Depending on Pelvic Inflammatory Diseases.—Any inflammatory disease which closes the abdominal ostia of the tubes or produces kinking and contraction of the lumen of the tube may lead to sterility. Dense adhesions of the ovary prevent rupture of the Graafian follicles, cervical gonorrhea destroys the spermatozoön or prevents its ingress; endometritis renders difficult the embedment of the ovum after it has been fertilized.

Salpingitis and ovaritis complicating the exanthemata in early life may result in thin velamentous adhesions about the tubal ostia.

Mechanical impediments to the ingress of the spermatic particles, such as acute anteflexion or retroflexion, fibroid tumor, or adenomatous polyp, may account for sterility; a lacerated or an everted cervix may prevent conception because of the displacement of the external os.

Functional sterility may be due to vaginismus or to incompatibility between the male and the female.

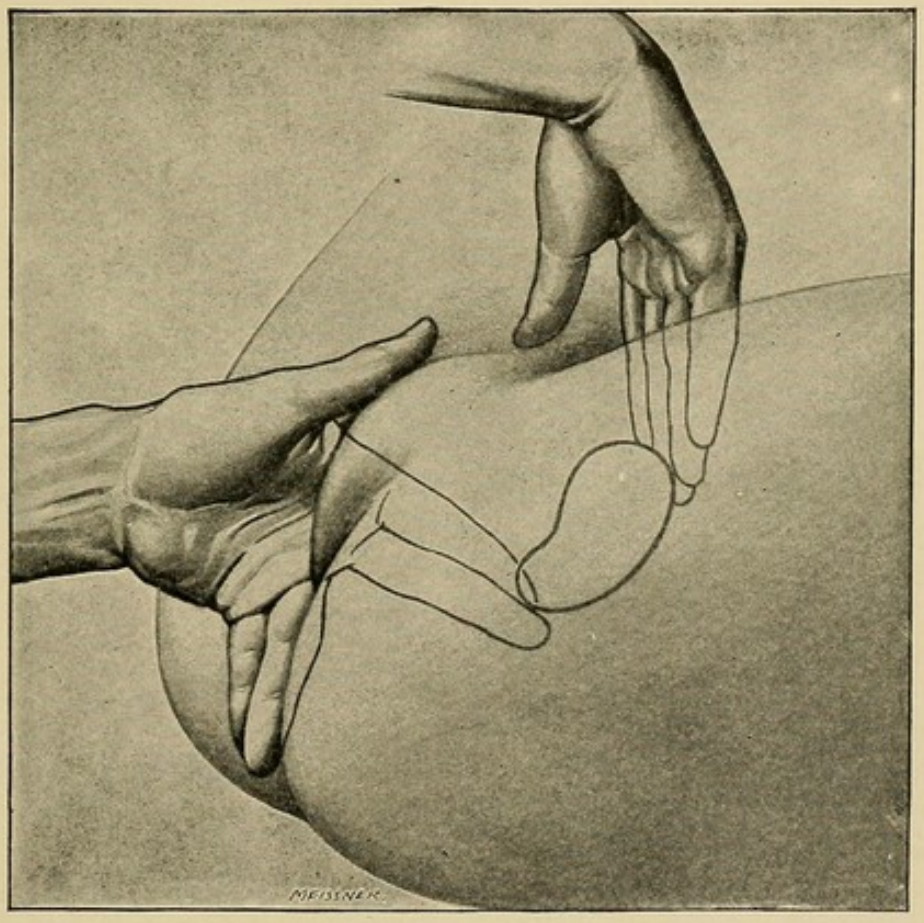
METHODS OF EXAMINATION.

The same methods of examination which are employed for physical diagnosis in general are used in gynecology. On account of the anatomy of the parts, certain positions are required in order to satisfactorily conduct the examination, and certain instruments or devices are

of service. While the physical examination includes inspection, palpation, percussion, and auscultation, the most valuable are inspection and palpation. Percussion is useful in the diagnosis of pelvic tumors which encroach upon the abdominal cavity. Auscultation is scarcely ever used except in the diagnosis of pregnancy. Palpation is the sine qua non of gynecological examinations. Inspection is a valuable aid and should precede the others.

Position of the Patient.—For a routine examination the *dorsal position* is the best. The patient lies upon her back with the thighs well flexed upon the abdomen and the knees widely separated. The legs are flexed

FIG. 435



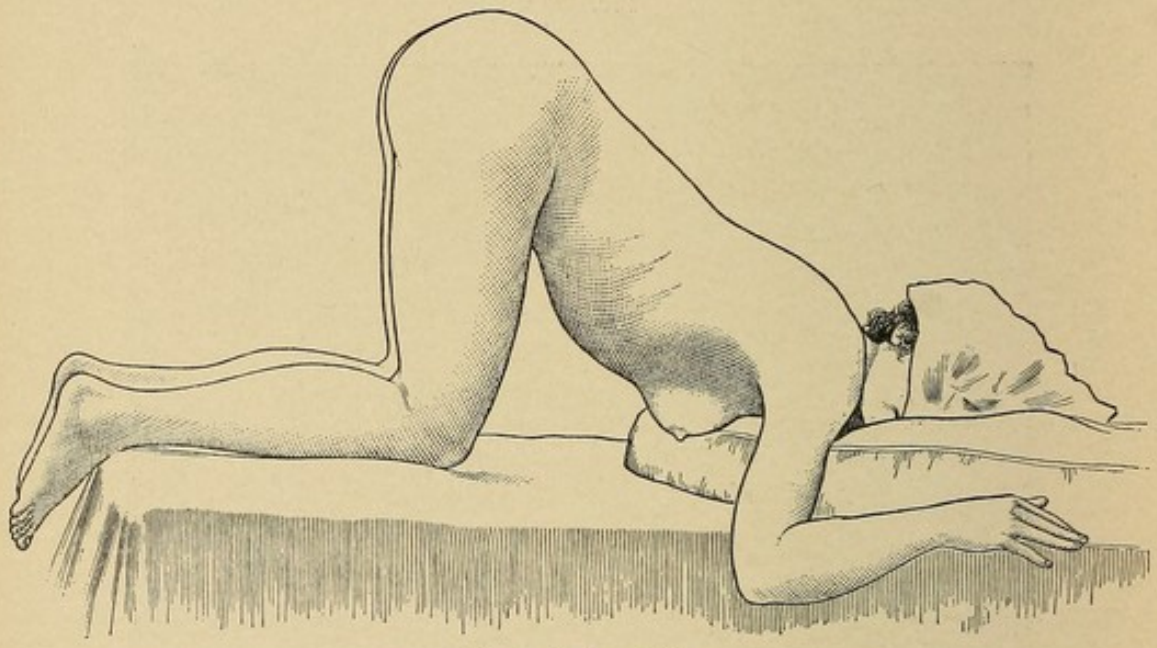
Dorsal position. Bimanual or abdominovaginal examination.

on the thighs and the feet are held either by stirrups suspended from upright rods, or by foot-rests at the end of the examining table. The buttocks should project slightly over the edge of the table. If necessary, the patient can be examined in bed. She should lie across it with her buttocks resting on the edge, the shoulders and head elevated by a pillow, the knees widely separated, drawn upward, and supported by assistants.

Sims' Position; Knee-chest Position—The Sims position or the knee-chest position is advisable when inspection of the vaginal vault or of

the anterior vaginal wall is desired. These positions are also of value in cystoscopic or in proctoscopic examinations. In Sims' position, the patient lies on the left side with the left arm behind her; the trunk is rotated so that the front of the chest lies in contact with the table; the thighs are flexed at right angles to the abdomen and the legs at right angles to the thighs; the right thigh is flexed more than the left, so that the right knee lies above the left. A small, firm pillow placed beneath the hips will increase the efficiency of this position by securing greater inclination of the pelvis. In assuming the knee-chest position,

FIG. 436



Knee-chest position.

the patient kneels upon the edge of the table, sinking the chest to the surface and spreading the arms to either side, the elbows being flexed; the face is turned to one side. The thighs must be vertical, the chest must rest upon the table, the spinal column must be relaxed, and the lumbar curve exaggerated.

Position for Abdominal Examination.—When pelvic disease causes distention of the abdomen, or in any case of abdominal enlargement when pelvic disease is suspected, an examination of the abdomen should follow the pelvic examination. For this purpose the patient should lie flat on her back with the knees and the shoulders slightly elevated by pillows.

Preparation of the Patient for an Examination.—The sigmoid flexure and the rectum should be thoroughly evacuated. The bladder should be emptied voluntarily or by catheterization, except in a case where it is especially desirable to observe the presence, the nature, and the amount of a leucorrheal discharge. Under such circumstances a preliminary inspection should be made several hours after urination or defecation. A douche should never be given previous to the first gyne-

cological examination. The clothing about the waist should be loosened. Constricting bands should be unfastened.

Armamentarium.—Lubricant.—A very satisfactory lubricant for the fingers in pelvic examinations is composed of

Gum tragacanth	ʒv to gr. xlviij
Carbolic acid	♏ xxxij
Glycerin	ʒiij
Water	ʒxxxij

Petroleum jelly or oil may be used; it protects the fingers more than a watery paste, but is harder to wash off and is more objectionable to the patient. Whatever lubricant is chosen, it should be expressed from a collapsible tube or poured upon the fingers.

Rubber Gloves.—The hand should be protected by a rubber glove whenever infection of any sort is probable in a vaginal examination, and always in digital palpation of the rectum. The transference of infection from the vagina to the rectum or vice versa should be carefully avoided.

Specula.—Howard's or Graves' bivalve, or Nott's trivalve speculum, is used in the dorsal position. In the Sims or in the knee-chest position the Sims speculum is required. Every speculum should be well lubricated before it is inserted. It should be introduced with its greater diameter in the oblique axis of the vagina and then turned to the desired position. The bivalve and the tribladed specula hold the vaginal walls apart, exposing the cervix and that part of the vaginal surface which lies between the blades. The Sims speculum retracts the posterior vaginal wall and favors atmospheric distention of the vagina, the patient being in the knee-chest or the Sims position; in this way the entire anterior vaginal wall, the cervix, and the vaginal vault are exposed.

As a rule, examination of virginal women should be made under the influence of an anesthetic. Palpation should be made per rectum. If inspection of the cervix is necessary, a large-sized Kelly cystoscope or the smallest trivalve speculum may be used.

Pelvic Examination.—Inspection of the external genitalia should be the first step in a pelvic examination. The existence of a leucorrheal discharge and the presence of venereal sores or any other lesions of the vulva may be detected in this way. Inspection will often give at once certain valuable information. For example, a virginal introitus will exclude the diseases due to pregnancy and childbirth; a reddening of the orifices of Skene's tubules and of the ducts of the vulvovaginal glands will suggest gonorrheal infection. An imperforate hymen will explain an absence of the menstrual flow. Extensive lacerations of the perineum, cystocele, rectocele, etc., are often revealed at a glance.

The cervix and the vaginal fornices are exposed by means of a speculum. The state of the vaginal mucosa, whether bathed in leucorrheal discharge or bereft of its natural moisture, and the presence of erosions or inflammation can be observed immediately. The contour of the cervix the amount and the character of the cervical discharge, and any gross

lesions may be detected. Inspection of the cervix aside from the mere question of cervical diseases gives evidence concerning the parity of the woman and the probability of a chronic gonorrheal infection.

Palpation.—Evidence of gonorrheal infection may be shown by "milking" Skene's tubules and the vulvovaginal glands. The friability and the induration of a cancerous growth, the peculiar disk-like hardness of a chancre, the fluctuation of a vulvovaginal cyst, or the tenderness and induration of an inflammatory affection may be noted. The condition of the perineal floor, the presence of cystocele and rectocele, and the spastic contraction encountered in cases of vaginismus may be detected. The friability of a cervical outgrowth, softening or induration of the cervix, or an abnormality in the diameter of the cervical canal—all may be quickly ascertained.

Palpation of the vaginal vault yields further information. In front of the cervix the sharp kink of an anteflexion may be recognized; the body of the uterus may be felt through the posterior vaginal fornix in well-marked cases of retroposition and often also an angle of flexion between the cervix and the body. An ovary prolapsed into Douglas' pouch is at once detected.

While this simple digital examination gives a considerable amount of information, no examination is complete without bimanual palpation. By this means the pelvic organs are picked up between the palpating hands one after the other, and an estimate is made of their size, mobility, consistency, and sensitiveness. The feasibility of a satisfactory bimanual palpation in a given case will depend upon the degree of relaxation of the abdominal muscles which the patient is able to induce voluntarily, and upon the amount of adipose tissue in the abdominal walls. Rigid or thick abdominal parietes render bimanual examination difficult or unsatisfactory unless an anesthetic is employed.

In bimanual palpation the palmar surface of one hand is placed upon the abdominal wall and one or two fingers of the other hand are introduced into the vagina or into the rectum. Palpation is made first with the organs in the position in which they are found. Afterward, except in acute or subacute pelvic inflammatory disease, if it is desirable, bimanual palpation may be made with a finger in the rectum while the uterus is drawn downward by means of a tenaculum. This maneuver brings the entire posterior surface of the uterus within reach of the examining finger and permits a minute examination of the posterior surface of the broad ligaments and of the pouch of Douglas.

In bimanual palpation the cervix is located with the vaginal finger and the direction of its axis in relation to that of the vagina is noted. Normally it is almost at a right angle and points toward the coccyx. If it is found in the axis of the vagina it is quite likely that the uterus is retroposed or that the patient is suffering from an acute anteflexion of the cervix. The body of the uterus is the next objective point. If it is in normal position—anteversion and anteflexion—it may be palpated between the vaginal finger placed upon the anterior vaginal wall just in front of the cervix, and the abdominal hand pressed downward

and toward the pelvic outlet in the median line above the symphysis. If the fundus is not found by this maneuver, it is evidently out of position. The vaginal finger is now carried back of the cervix along the posterior vaginal vault while the abdominal hand is sunk downward below the sacral promontory. In case of well-marked retroposition, the posterior surface of the body of the uterus will be felt inclining backward toward the sacrum, and, if retroflexion is present, the angle between the cervix and the body can be made out easily. Besides the position, the size, consistency, mobility, shape, and sensitiveness of the uterus may be determined.

To palpate the left adnexa, the vaginal finger is carried to the extreme left lateral part of the vaginal fornix, and pressed upward along the pelvic wall as far as possible while the abdominal hand is gently sunk downward and forward over the brim of the true pelvis to the left of the sacral promontory. The finger in the vagina and the fingers of the abdominal hand are approximated at the highest lateral and posterior position feasible and then drawn gently forward. By this means the normal ovary and tube are brought between the fingers. The normal ovary feels like a smooth, elliptical body, about the size of an almond, which slips or jumps away and is freely movable. The normal tube is difficult to palpate, giving the impression of a very soft rubber tube about the diameter of a lead pencil. The examiner can be sure only in very exceptional cases that the tube is felt. Muscular strands in the abdominal wall, or the round ligament, will often be mistaken for a normal tube. The right adnexa may be palpated by similar maneuvers on the opposite side.

In the case of an adherent ovary the organ will be immovable and somewhat enlarged, and will feel as if it were stuck to the pelvic wall or floor. If the tube and the ovary are enlarged and adherent, they form an irregular, retort-shaped mass in which it is difficult to distinguish one organ from the other.

It is to be remembered that the position of the uterus will influence the position of the ovary. Thus, if the uterus is retroposed or in descensus, the ovary will be nearer the median line and lower; when the uterus is in the normal position, it is higher and more laterally placed. When the ovary is prolapsed, it may be felt by turning the palmar surface of the finger backward and palpating Douglas' cul-de-sac by pushing backward and outward. The ovary will be recognized as a smooth, elliptical body which slips away from the examining finger. A scybalous mass in the rectum gives a sensation to the finger very like a prolapsed ovary, but it may be excluded by noting that it pits on pressure or by making an examination per rectum.

Bimanual rectal palpation, with the uterus drawn downward by means of a tenaculum, is a most valuable means of diagnosis in affections of the tubes and ovaries. The finger is inserted into the rectum and pushed backward and downward until it passes between the utero-sacral ligaments; it is then turned upward upon the posterior surface of the uterus and to either side upon the posterior surface of the broad ligaments.

In the case of inflammatory affections of the ovaries and tubes irregular masses will be felt back of the uterus on one or on both sides, displacing it forward. When an inflammatory affection involves the cellular tissue of the broad ligaments, the induration felt at the vaginal vault is very dense and board-like and extends all the way to the pelvic wall and fuses with it.

Pelvic masses, without induration of the vaginal fornices or the bases of the broad ligaments, are usually uterine or ovarian in origin—uterine, if they are in connection or move with the uterus; ovarian, if they are distinctly separate from the uterus and independently movable. Induration of the broad ligaments or the vaginal fornices with immobility or partial fixation of the uterus, is suggestive of inflammatory disease involving the tubes and the pelvic peritoneum, possibly also of carcinoma with extension to the broad ligament, or of cellulitis. Pelvic enlargements rising slightly above the pelvic brim and decidedly lateral in position are apt to be inflammatory in type. Those which have a more or less median position and extend well into the abdominal cavity are usually newgrowths of the uterus or of the ovaries.

Abdominal Examination.—**Inspection.**—The color of the skin, the presence of dilated veins, the contour of the abdomen, the lineæ albicantes, and the linea nigra are determined by inspection. The abdominal respiratory wave and the presence of any abdominal enlargement are noted. The abdomen should be inspected from the side, from the feet, and from the head of the patient. In the presence of an abdominal tumor it should be observed whether the enlargement involves the entire abdomen or is confined to the lower part; whether the enlargement has a median or a lateral position, and whether its surface is even or irregular.

Palpation.—Palpation verifies inspection as to the shape and the contour of the abdomen. It also confirms the situation as well as the regularity of surface of any abdominal enlargement which has been observed. Palpation also in addition discovers rigidity and tenderness and, combined with percussion, the physical sign of fluctuation. The tonicity of the abdominal wall may be determined by palpation. Diastasis of the recti muscles may be estimated by sinking the fingers between them while the patient tries to raise herself into a sitting position. By palpation it can be ascertained whether an abdominal tumor is of pelvic origin. If the fingers can be dipped down between the tumor and the symphysis pubis, the tumor is probably not pelvic. In pelvic growths this maneuver meets with firm resistance.

In making palpation the hands should be thoroughly warmed, the palmar surface should be pressed gently against the abdominal wall, making deeper pressure with the fingers as the patient's confidence is gained and the abdominal wall relaxes. In eliciting fluctuation it may be advantageous to have an assistant place the ulnar border of the hand in the median line of the abdomen or somewhere at least on the surface between the palpating and the percussing hand. In this way the spurious fluctuation due to an accumulation of fat in the abdominal parietes may be eliminated.

Information concerning the consistency of an abdominal enlargement, whether it is hard or soft, elastic or doughy, may also be gained by palpation.

Percussion.—All tumors of the abdomen originating in the pelvis are dull on percussion. The area of dulness begins below at the pelvic brim and is most pronounced over the greater bulge or convexity of the tumor. Surrounding it above and at the sides there is resonance or tympany (coronal resonance). The percussion note changes with the the position of the patient when there is a free intraperitoneal collection of fluid. The percussion note over a tumor or over an encysted collection of fluid is little affected by position.

Auscultation.—Auscultation is of service almost solely in distinguishing the fetal heart sounds and the placental bruit.

THE VULVA.

Malformation.—Malformations of the vulva include:

Atresia of the *urethra* or the *vagina.*

Persistent Cloaca.—The anus opens into the vestibule; there is no perineum.

Hypospadias.—A congenital vesicovaginal fistula.

Epispadias.—Usually accompanied by fissure of the clitoris, and sometimes also of the symphysis and the entire anterior vesical wall.

Infantile Vulva.—General absence of development of the labia majora and minora.

Hermaphrodism.

Imperforate hymen.

Rigidity and thickness of the hymen.

Inflammations.—**Vulvitis.**—*Causes.*—Vulvitis is caused in the young by epidemic gonorrheal infection as seen in children's homes and hospitals, or by gonorrheal infection from the mother or the nurse, or through the medium of napkins, towels, etc. Thread-worms and uncleanliness may be factors in the vulvitis of children. In the adult, repeated gonorrheal infection from more or less constant bathing of the part with gonorrheal pus, irritating discharge from a vesical fistula, or an ulcerating carcinoma, diabetic urine, too frequent sexual intercourse, or masturbation may produce it. Streptococcus or diphtheritic infection of the vulva may occur in puerperal women. The rectal discharge in typhus fever and in dysentery may excite vulvitis.

Symptoms.—Pain, which varies between a sense of discomfort or itching and a severe burning; difficulty in walking; leucorrhea.

Examination.—The vulva is covered with a mucopurulent or purulent discharge. After this has been wiped or washed away, the vulvar mucosa is seen to be swollen, reddened, and edematous. In the gonorrheal vulvitis of children the vagina is usually coincidently affected. In adults, the urethra and the vulvovaginal glands, and often the cervix, are involved. The sebaceous glands of the labia majora and the labia minora may be inflamed, the lesions resembling those of acne (follicular

vulvitis), and the vulvar mucosa between the follicles appearing normal, or at most but slightly reddened. To determine the type of infection smears and cultures should be made, in cases of vulvitis, from the discharge covering the surface of the vulva, the vulvovaginal glands, and Skene's tubules. In the adult, simultaneous infection of Skene's tubules, the vulvovaginal glands, and the cervix is almost always gonorrheal.

Pruritus Vulvæ.—*Causes.*—Pruritus vulvæ is either a pure neurosis or a symptom produced by the irritation of substances circulating in the blood (bile, uric acid, urea, sugar, morphine, alcohol, or iodine); congestion or venous stasis of the vulva (heart disease, pregnancy, retroposition of the uterus, or uterine tumors); skin diseases (erythema, urticaria, herpes, eczema); carcinoma of the vulva (early symptom); irritating discharges (hyperidrosis, diabetic urine, ammoniacal urine, leucorrhea from gonorrheal infection of the cervix or the uterus, carcinoma or decomposing fibroid tumor); rectal discharge (purulent and catarrhal inflammation of the rectum); parasites, animal (pediculi, oxyuris vermicularis) and vegetable (leptothrix, leptomitus, oidium albicans); heat (pruritus estivalis) and cold (pruritus hiemalis), or by masturbation.

Symptoms.—Intense itching of the vulva, worse at night and under the influence of warmth and exercise; worse also during pregnancy and during the menstrual periods. Because of an uncontrollable desire to scratch, the patient avoids society and becomes depressed and nervous. Relief may be sought in drugs.

Examination.—The vulvar surface usually shows one of the local conditions noted above. The presence of scratch marks is noted upon the skin. In old cases there is considerable thickening of the vulvar skin which becomes leathery and has a dead white surface broken here and there by the excoriations made by the patient's finger nails. Urinalysis may discover sugar, bile, or an excess of uric acid. In every case of pruritus it is very important to determine the underlying lesion. In the few instances where none of the causes already mentioned are found the disease may be regarded as a pure neurosis.

Kraurosis Vulvæ.—A very rare condition characterized by an atrophy and a shrinkage of the vulvar parts.

Adhesions of the prepuce to the glans clitoris is a common condition which produces irritation only when an accumulation of smegma occurs behind them.

Elephantiasis of the Vulva.—*Cause.*—Syphilis is the usual cause in this country. Symptoms are due to mechanical irritation, and there is inconvenience in walking or in sexual intercourse.

Examination.—There is hypertrophy of the labia majora and minora; the parts are indurated and sometimes edematous. Excoriations or warty outgrowths may appear upon the surface.

Venereal Sores.—The venereal lesions in the female differ slightly from those in the male. Neither the chancre nor the chancroid is so constant in form. The appearance of each is modified by the personal cleanliness of the woman, by her habits, by bruising of the vulvar parts

at the time when infection occurs, and by the chemical and mechanical irritation of strong disinfecting solutions which are sometimes used before a physician is consulted. For this reason, edema and induration of the labia majora are not infrequent in association with venereal lesions.

Chancre.—For a description of the chancre see p. 643. It is not so often observed in the female. The lesion occurs upon the vulva or the cervix and commonly takes the form of the indurated papule. It is said to be multiple sometimes. The diagnosis is confirmed by indentification of the treponema (spirocheta) pallidum in suitably stained preparations.

Chancroid.—Chancroid in the female resembles the same sore in the male (see p. 645).

Herpes Vulvæ.—Herpes vulvæ resembles herpes preputialis (see p. 643).

Secondary syphilitic lesions of the vulva occur quite frequently. A papular syphilide developing upon the vulva often has an abraded and secreting surface, and is partly or completely covered by a gray, adherent, offensive pseudomembrane. This is a mucous patch. Sometimes the moist papule takes on a distinct papillary overgrowth (condyloma). Condylomata appear as raised, flat, raw surfaces; the cellular infiltration is so abundant that the papillary nature of the growth is but imperfectly marked and may be observed only after careful inspection. When the mucous patch preceding the condyloma has developed from a large papular syphilide, the elevated surface varies in size from a shirt button to a penny.

Tertiary syphilitic lesions of the vulva are rare. Gumma of the labia majora is the usual lesion; it shows a tendency to break down and suppurate.

Venereal Warts.—*Causes.*—Venereal warts result from the irritation of uncleanliness or from the irritation of gonorrheal pus. They are also associated at times with secondary syphilitic lesions.

Symptoms.—Their symptoms vary between actual discomfort and pain. Usually they simply interfere mechanically with walking or intercourse. When inflamed, they are painful. They sometimes have a thin and highly irritating discharge.

Examination.—Venereal warts appear as papillary excrescences, either in a single discrete group or in a coalescent cauliflower-like mass. They may occur on the vulva, mons veneris, perineum, or anus. They are also occasionally found on the vagina and upon the cervix. They usually have a purplish red color; the surface is moist and divided into small projections which have pointed ends (condyloma acuminatum).

Enlargements and Tumors of the Vulva.—Varicose Veins of the Vulva.—*Causes.*—Pregnancy, pelvic exudates, pelvic tumors, retroposition of the uterus with adhesions, straining at stool, prolonged standing, and heavy work are causes. They are usually found in the labia majora; the other parts and the vagina may be involved.

Symptoms.—Itching and burning, or a sense of discomfort or of weight.

Examination.—An elongated, knotty, bluish enlargement is found made up of dilated and tortuous veins. Upon palpation they resemble

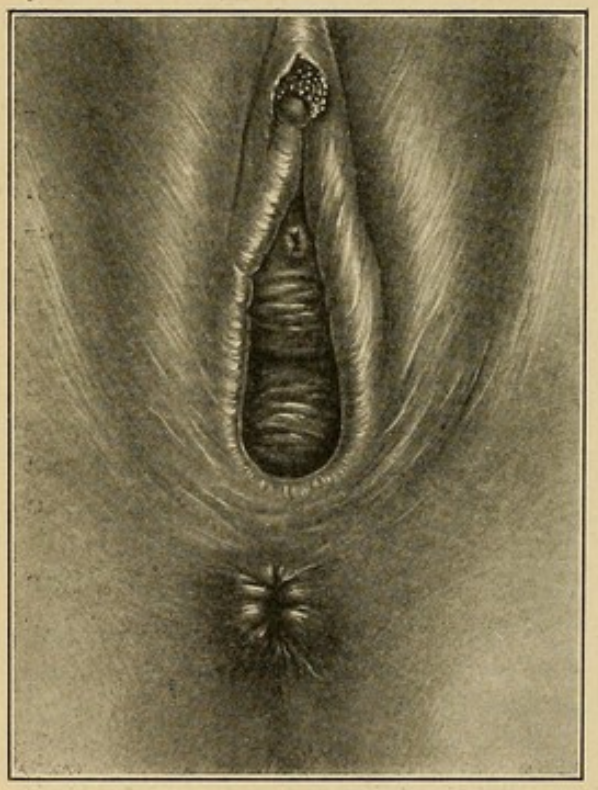
a bundle of earth-worms. The condition varies from a slight distention of the vulvar veins to a tumor as large as the fetal head.

Hematoma of the vulva is caused by the subcutaneous rupture of varicose veins during pregnancy or labor, or as the result of a fall or of a blow.

Symptoms.—Sudden pain in the affected part, with rectal or vesical tenesmus. Later there is also a feeling of fulness, and, if suppuration occurs, the signs of abscess.

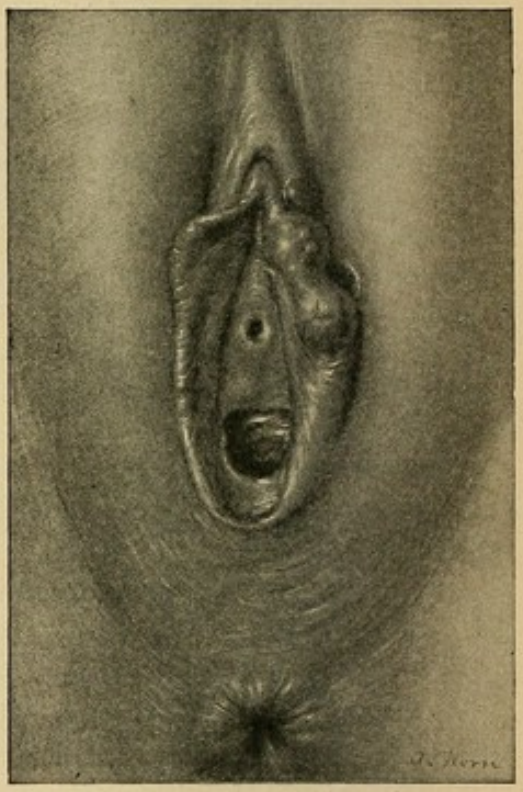
Examination shows a purplish globular tumor which may be as large as the fetal head. It is tense and elastic at first, but later doughy.

FIG. 437



Early carcinoma of the vulva, confined to the clitoris.

FIG. 438



Early adenocarcinoma of the vulva, limited to the left lesser labium. (Hurdon).

Carcinoma of the Vulva.—*Causes.*—Primary carcinoma is usually of the squamous type (epithelioma), and may be preceded by psoriasis, papillomata, or some trauma. There may be no preceding lesion. Secondary carcinoma results from carcinoma higher in the genital tract, and may be of the cylinder-cell variety (adenocarcinoma). The growth begins in the sulcus between the labium majus and the nympha, or upon the clitoris or in the urethra. It occurs in subjects between the ages of forty and sixty years, rarely in the young (one case aged twenty-three).

Symptoms.—Pruritus is the most common early symptom, but is not characteristic. There may be no early subjective symptoms. Later, when ulceration has occurred, pain is more or less constant and severe. The inguinal glands on the affected side become enlarged. There is a

foul-smelling discharge and slight hemorrhage. General ill-health and cachexia supervene.

Examination.—The affection first appears as a small, indurated, elevated nodule. Later, ulceration occurs. The edge of the ulcer is elevated, hard, and bluish red. The surface is granular and is covered by a semi-opaque putrid secretion. Little "maggot-like" bodies can often be pressed out of the floor of the ulcer. They are epithelial pearls, or nests, and are highly diagnostic of squamous carcinoma or epithelioma. The labium surrounding the carcinomatous ulcer becomes

FIG. 439

Epithelioma of the vulva (labium majus). Indurated fungoid ulcer. Slight trauma causes free bloody oozing. Enlarged right inguinal lymphatic glands. Diagnosis made by microscope. (Carnett).

thickened and indurated. The opposing surfaces of the vulva may develop a carcinomatous growth from contact.

Differential Diagnosis.—It is important to diagnose the condition in its *earliest stage.* To this end *any suspected lesion* should be *immediately excised* and submitted to microscopic examination.

Lupus appears at a younger age. The affection progresses very slowly and there is little pain. Instead of single hard nodules, there are multiple soft nodules. The discharge is not putrid. The ulceration tends to undergo cicatrization. Healthy skin is frequently found between neighboring lesions. The inguinal glands are not involved, as a rule.

Chancre.—There is a history of infection and a period of incubation. The sore develops rapidly, is not painful, and does not spread; there is a thin, scanty, sanious discharge. The inguinal glands enlarge early and constitutional symptoms appear.

Chancroids.—There is a history of contagion and a short period of incubation. The lesions are multiple and inflammatory; they spread rapidly and are auto-inoculable. Inguinal enlargement is early and perhaps unilateral.

Venereal Warts.—Unless the diagnosis is plain, the growths should be excised and examined microscopically. It should be remembered that papillomata may become cancerous.

Sarcoma of the vulva usually affects the labia majora. It begins as a hard, round nodule, brown or black in color. It grows rapidly; ulceration occurs late. The inguinal glands are involved late. The disease is usually fatal. Death occurs from metastasis through the veins.

Lupus of the vulva is rare. The lesion is produced by the tubercle bacillus, and consists early of nodules varying in size from a pinhead to a bean, embedded rather deeply in the skin; the nodules have a reddish, brownish, or a yellowish red color. Later, these become larger and undergo cheesy or colloid degeneration. Ulceration finally takes place. The ulcers are soft and usually superficial; they may be deep, causing a fistulous communication between the vagina and the surrounding parts. The ulcerations have bright red granulations, they bleed easily, and are covered with pus which does not have a bad odor. Cicatrization occurs irregularly and may produce stricture or stenosis of the urethra, vagina, or rectum. There is a general increase of connective tissue in the affected parts, sometimes resembling elephantiasis. There is little pain and the growth is very slow.

Fibromyoma of the vulva affects the labia majora principally and has the same structural features as fibromyoma elsewhere. The symptoms are the result of mechanical interference. The condition is very rare.

Lipoma of the vulva affects the labia majora or the mons veneris and resembles lipomatous tumors found in other parts.

THE VULVOVAGINAL GLANDS.

Inflammation of the ducts of the vulvovaginal glands is usually the result of gonorrhea. Other infections extending from the surface may cause it. In gonorrheal inflammation of the duct the orifice is surrounded by a red, slightly elevated spot, known as the gonorrheal macule. Pressure over the course of the duct will express a drop of pus. Inflammation of the ducts of the vulvovaginal glands may lead to a retention cyst or to an extension of the infection to the gland substance with the production of an abscess.

Abscess of the vulvovaginal gland is evidenced by severe pain and marked swelling and edema of the surrounding parts. The swelling may extend even to the anus. Fluctuation appears first upon the inner

surface of the labium, and, if the pus is not evacuated by an incision, it finally finds exit through several fistulous openings below the orifice of the duct. These may keep on discharging indefinitely.

Cyst of the vulvovaginal glands results either from an occlusion of the duct by an inflammatory process or from thickening of the glandular secretion. The symptoms produced by vulvovaginal cysts are usually the result of mechanical interference with sitting, walking, or sexual congress.

Examination.—Vulvovaginal cysts vary in size from that of a walnut to a tumor as large as a child's head. When as large as an egg or over, the mucosa to the inner side of the labium, overlying the surface of the cyst, is considerably thinned. The cyst contents are clear and colorless, or yellow, or a turbid, chocolate color from admixture with blood. Vulvovaginal cysts must be distinguished from inguinal hernia, hydrocele of the canal of Nuck, and cysts of old hernial sacs. In them the enlargement is more to the upper and outer part of the labium majus, and is connected with the external inguinal ring.

THE VAGINA.

Malformations of the Vagina.—Vaginal Septa.—Vaginal septa usually extend upward from the vulva and divide the vagina into two passages, seldom of equal size. Both of the divisions may communicate with the uterus or one of them may end blindly. Various malformations of the uterus may be associated with vaginal septa.

Hematocolpos.—The hymen is imperforate and the vagina is distended with an accumulation of the menstrual fluid. The condition does not arise until after the onset of puberty. The menstrual molimina develop, but the flow does not appear.

Atresia of the vagina may be the result of adhesive inflammations occurring before birth (congenital atresia) or during early life.

Complete absence of the vagina is a very rare condition and is usually associated with an absence or a defective development of the uterus, tubes, and ovaries.

Inflammations.—Vaginitis.—Vaginitis is usually subacute or chronic, except in children. It depends in the adult upon repeated infection plus a mechanical irritation or injury, or upon some general condition which lowers the vitality of the vaginal mucosa. Predisposing causes are venous stasis, the hyperemia incident to pregnancy, small abrasions of the mucosa, and the irritation of foreign bodies. An irritating gonorrheal discharge from the cervix is the most frequent cause. Vaginitis occurs in connection with vesicovaginal fistula and sometimes also with the exanthemata. Dysenteric discharges, caustic solutions, the streptococcus and the diphtheria bacillus may produce it.

Examination.—In *acute vaginitis* the vaginal walls are red, swollen, hot, and very tender. They are covered with a mucopurulent or a purulent discharge. The entire extent of the vagina is not involved usually except

in children. The vulva is bathed in the discharge, which becomes highly offensive.

In *subacute* or in *chronic vaginitis* the vaginal surface shows numerous small red spots; these are caused by inflammatory infiltration of the papillæ in the vaginal mucosa. The overlying epithelium subsequently desquamates and small eroded areas are formed. In old persons such areas, when they are apposed, may adhere. The vaginal walls are covered with a thinner and a less purulent discharge than in the acute form. In old chronic cases the lesion may be confined to eroded patches in the vaginal vault. In children the local examination should be confined to an inspection of the vaginal orifice or to the introduction of a small Kelly cystoscope into the vagina. The examination of the vagina in the adult is preferably made by means of a Sims speculum, with the patient in the Sims or the knee-chest position.

Tumors.—Vaginal Cysts.—Vaginal cysts are the most frequent of the vaginal tumors, but, even so, they are rare. They result from the distention of aberrant vaginal glands, inclusion of epithelium following operations, hematoma, dilatation of a lymph vessel, and the echinococcus. Dermoid cysts are found rarely. Cysts may also arise from rests of the Wolffian duct in the upper part of the vaginal vault. Such cysts are often multiple and occur in a row. Vaginal cysts are hemispherical or ovoid and project more or less into the vagina. Rarely they may be pedunculated. The overlying mucosa is thinned out. The contents of a cyst may be clear, thin, and watery, or gluey and opalescent, or chocolate colored.

The *symptoms* are *nil* when the tumor is small. When large, there is interference with urination and defecation. The tumor may form an obstruction to intercourse or to labor. There may be a fetid leucorrhea if the passage of the menstrual fluid is obstructed and an accumulation occurs above the tumor. The condition must be distinguished from cystocele, rectocele, and suburethral abscess.

Fibromyoma of the vagina is an infrequent form of vaginal tumor. It has the same peculiarities as fibromyoma elsewhere.

Sarcoma of the vagina is very rare. In adults it forms a diffuse growth which may be situated in any part of the canal. In young children it is polypoid or grape-like in form and springs from the anterior vaginal wall.

Carcinoma of the Vagina.—Primary cancer is very rare. Cancer of the vagina is usually secondary to a growth higher in the genital tract.

Rectovaginal fistula in the upper part of the vagina is usually produced by carcinoma; in the lower part by ulcerative processes of a tuberculous or a syphilitic nature or by the failure of operation for a complete tear.

THE PELVIC FLOOR.

Recent tears of the perineum belong to the subject of obstetrics and will not be discussed here.

Relaxation of the pelvic floor is the result of an injury to the levator ani and other muscles incurred during childbirth. The symptoms of a

relaxed pelvic floor are a feeling of loss of support, dragging and bearing-down sensations in the lower abdomen, and backache. All of the symptoms are increased by exertion and are relieved by the recumbent position.

Examination should be made with the patient in the dorsal position. Scars may be seen in one or both vaginal sulci, indicating the position of previous tears. The perineal body may appear cleft in the median line, or to one side. If the lacerations have been subcutaneous, no evidence of a previous tear of the mucous membranes will be observed. Upon further inspection, it will be found that the anal cleft is shallow, the anus is prominent, the distance from the external urinary meatus to the anus is increased, the perineal body is low, the vaginal orifice is gaping, the anterior and the posterior walls are either not in contact or they show the presence of cystocele and rectocele. If the woman is directed to "bear down," the anterior and the posterior vaginal walls protrude. If the vulva is pricked, the woman draws herself away; no reflex muscular action closing the vagina and drawing up the anus is observed. A relaxed pelvic floor may be complicated by cystocele and rectocele, laceration of the cervix, and descensus, retro-position, or prolapsus of the uterus.

Rectocele.—A rectocele is a protrusion of the rectovaginal septum in the direction of the vaginal outlet. The patient may be unaware of its presence, or she may feel the protrusion at stool and imagine she has falling of the womb. She may also experience difficulty in defecation, and may only partially succeed until the rectocele is pushed backward and upward with the finger. The condition may be diagnosticated by introducing a finger into the rectum and directing it upward, when it will enter the most prominent part of the rectocele.

Cystocele.—A cystocele is a protrusion of the vesicovaginal septum in the direction of the vaginal outlet. It causes difficulty in thorough evacuation of the bladder; there is usually, in bad cases, a certain amount of residual urine which is apt to decompose and produce cystitis. The tip of a sound introduced into the bladder and turned downward will enter the most prominent part of the cystocele.

THE CERVIX.

Malformations.—Double Cervix.—Two completely formed cervices may occur with a double uterus and a double vagina.

Septate cervix may exist alone or in connection with a septate uterus or with a uterus bicornis.

Infantile Cervix.—The cervix is long and conical with a very small external os; this condition is apt to be associated with a poorly developed vaginal vault and a sharply anteflexed cervix.

Pathological Anteflexion of the Cervix.—While the cervix is normally anteflexed upon the uterus, sometimes the condition is exaggerated, and it may be associated also with a conical, infantile cervix and a stenosed cervical canal. Under these circumstances the condition

produces symptoms and the anteflexion is spoken of as pathological. The symptoms are dysmenorrhea, in which the pain precedes and subsides with the establishment of the flow, and, in married women, sterility. The diagnosis is made from the typical dysmenorrhea, and the physical findings as elicited by inspection of the cervix, bimanual palpation, and the introduction of a uterine sound.

Laceration of the Cervix and its Complications.—Cervical Lacerations.—Lacerations of the cervix result from childbirth. They may be unilateral, bilateral, anterior, posterior, or stellate. A lateral laceration is usually worse on the left side.

Symptoms.—A cervical laceration does not, as a rule, give rise to symptoms unless the laceration is complicated by eversion, cystic degeneration, or hypertrophy of the cervical lips, endometritis, or subinvolution of the uterus. In the case of an extensive tear into the paracervical connective tissue, pelvic pain may be referred to the scar.

The diagnosis of a cervical laceration is made by inspection and by simple digital palpation.

Eversion of the cervical lips is the result of bilateral laceration of the cervix. The bright red cervical mucosa is exposed to view. Because of mechanical irritation, the glands of the exposed mucosa secrete an excess of cervical mucus. The most prominent symptom is a profuse, thick, ropy discharge. Sterility may ensue because of the leucorrhea and the displacement of the external os. When the cervix is actually inflamed, pelvic pain may be present, the result of a complicating para-uterine lymphangitis or lymphadenitis. Other symptoms may be present if endometritis or subinvolution of the uterus exist.

Examination.—The anteroposterior diameter of the cervix is increased. The scars of the lacerations may be felt as well as the slightly irregular velvety surface of the cervical mucosa; the sensation imparted to the finger by the latter is quite different from the smooth, firm surface of the normal cervix. Inspection should be made with the patient in the Sims or in the knee-chest position. The cervix appears bright red and granular; the folds of the cervical mucosa and the lacerations can be plainly seen. There is an abundant secretion of mucus. By catching each cervical lip with a tenaculum at the border between the exposed cervical mucosa and the vaginal surface of the cervix and approximating them, the normal relation of the cervical lips will be restored, the everted mucosa will disappear, and the cervix will approach its normal appearance.

Cystic Degeneration of the Cervix.—Nabothian cysts are produced by an occlusion of the ducts of the cervical glands. This results from inflammatory processes following laceration, eversion, or infection of the cervix. The small cysts, varying in size from a pinhead to a large pea or bean, extend peripherally and appear on the vaginal surface of the cervix. The entire cervix may be riddled with them, the connective tissue of the cervix undergoing considerable hypertrophy.

Symptoms.—There are no distinctive symptoms. The condition is usually combined with the causal factors already mentioned. Upon examination, the cervix is found to be hard and the small cysts feel

like shot embedded in the cervical tissue. Puncture of a cyst leads to the escape of a thick, glairy mucus.

Inflammation of the Cervix.—**Catarrh of the cervix** is caused by gonorrhea and by infection from unclean instruments. It may be secondary also to laceration and eversion of the cervix, to the use of cold douches, to imperfect involution of the cervix after labor, miscarriage or abortion, or to malposition of the uterus. The only symptom referable directly to the catarrh itself is a thick, tenacious discharge which is mucous or mucopurulent and may prevent conception. Other symptoms depend upon complicating or causative lesions, and are: sensation of a dull, heavy weight and dragging in the pelvis, burning in the vagina, backache, vertical headache, menorrhagia, etc.

Examination.—Inspection shows the cervix slightly enlarged and congested. The external os is open and filled with a thick, tenacious secretion. Upon wiping this away the mucosa of the cervical canal is seen to be prolapsed slightly beyond the external os, giving an appearance resembling but at once distinguishable from eversion. Surrounding the prolapsed mucosa there may be an area of true superficial erosion of the mucosa of the vaginal cervix. Nabothian cysts may be present, also some increase of the connective tissue and hypertrophy.

Newgrowths.—**Cervical Polyp.**—A cervical polyp is produced by an outgrowth from the cervical mucous membrane which finally becomes pedunculated. Polyps vary in shape and in size; they may be elongated or pyriform, depending upon whether they lie within the cervical canal or project from the external os; they vary in size from a pea to a walnut.

The *symptoms* are leucorrhea, from an overproduction of cervical mucus, menorrhagia, and dysmenorrhea. Metrorrhagia may occur after sexual intercourse or some unusual trauma. Inspection shows a pedunculated, spongy, or velvety tumor lying in or projecting from the cervical canal. The external os is patulous; the tumor is usually bright red in color, and in external cases its pedicle can be detected passing into the cervical canal. Adenomatous polyps are to be distinguished from small pedunculated fibroid tumors of the cervix.

Pedunculated fibroid tumors of the cervix feel smooth and hard; they are usually of considerably greater size than polyps and have a pinkish white color, unless necrotic changes have occurred, when they appear gangrenous and there is a fetid discharge. Pedunculated fibromyomata of the cervix also cause greater menorrhagia and more often metrorrhagia than do polyps.

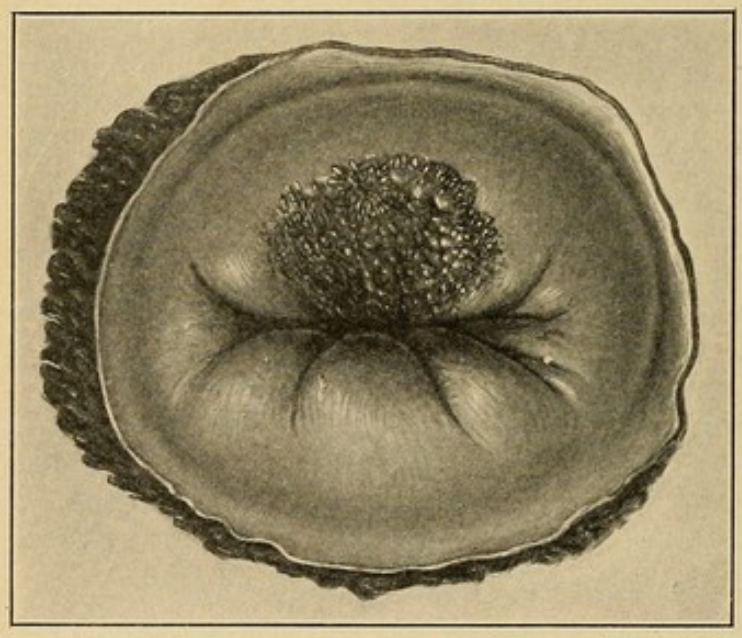
Venereal Warts of the Cervix.—Papillary, or warty, outgrowths of the cervical mucosa are rare. They are not as indurated and do not bleed as readily on palpation as carcinoma. In all cases, however, as the condition is suggestive of malignancy, the entire growth should be excised at once and the diagnosis made microscopically.

Cancer of the Cervix.—Cancer of the cervix occurs usually between the ages of thirty and fifty years; most frequently at about the time of the menopause. It may occur in early adult life. Almost invariably it

affects the childbearing woman and especially those who have had repeated pregnancies. A badly lacerated cervix predisposes to cancer. The disease begins either upon the vaginal aspect of the cervix or within the cervical canal.

Symptoms.—There are no symptoms pathognomonic of cancer. The earliest symptom is usually hemorrhage between the regular menstrual periods—bleeding from the uterus after exertion, sexual intercourse, or straining at stool. Hemorrhage from a cancer which develops after the menopause has often been taken for a return of the menstrual flow. The first symptoms may be an inoffensive leucorrheal discharge. Late in the disease, when the carcinoma begins to undergo disintegration and is spreading widely, there are frequent and exhausting hemorrhages, profuse fetid discharge, pain, and cachexia. The discharge at this time is purulent, bloody, and mixed with pieces and shreds of putrefying cancerous tissue. The pain is either dull and gnawing or sharp and lancinating. It is referred to the sacrum, crest of the ilium, ovarian region, or along the sciatic nerve. If the cervical canal is blocked and the uterus becomes distended with blood, pus, or gas (hemato-, pyo-, or physometra), the patient may complain of colicky pain or intense bearing-down sensations. The anemia and the cachexia of cancer are due to the loss of blood and the absorption of toxins from necrotic cancerous tissue.

FIG. 440



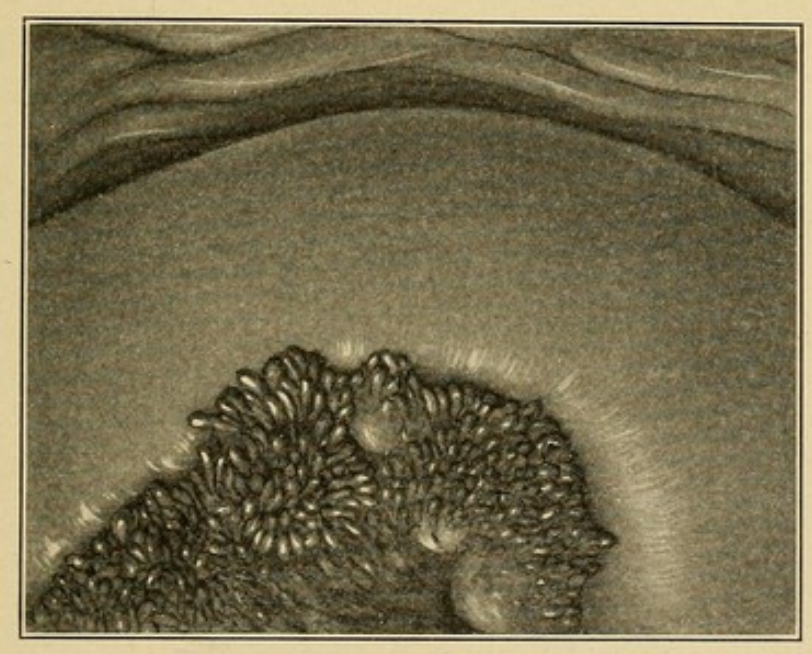
Early carcinoma of the anterior cervical lip.

Examination.—Unless the diagnosis is made early, the case is hopeless. Carcinoma beginning upon the vaginal aspect of the cervix is easier to diagnosticate early than carcinoma which originates in the cervical canal. In the early stage of either form the cervix feels thickened and hard, and hemorrhage is apt to follow palpation. Upon exposure of the cervix in the external form, numerous large and small bosses are seen on the mucosa which have a glazed, bluish white appearance, as though the tissue were very tense and ready to burst. On careful study at several points masses of teat-like or branching papillæ are seen which are very friable and bleed readily. Often the papillæ are held together in masses by ropy mucus, and may be easily overlooked (Cullen). Later they grow rapidly and form cauliflower-like projections.

Carcinoma may appear early also as an ulceration. True ulceration of the cervix, that is, actual loss of tissue, except it be very superficial, is almost always cancerous. The cancerous ulcer bleeds readily, is indurated, and has friable edges. When carcinoma begins in the cervical canal low down, the os is dilated and the growth may be seen through the cervical canal. When it starts high up in the canal, the growth may be far advanced before it becomes visible. The only evidence in these cases is from the hard nodular state of the cervix and the tendency to hemorrhage after palpation. In advanced cases there are cauliflower masses projecting from the cervix or a deep ulcer of the cervix. In the final stage of any form of cancer, the cervix is destroyed and the cancerous excavation extends to the surrounding tissues and organs.

As already stated, a diagnosis of carcinoma of the cervix, except in the *early* stages, is useless, so far as a cure of the disease is concerned.

FIG. 441



Same case as Fig. 440, a part of the cancerous area magnified, showing the finger-like projections.

Early carcinoma of the cervix must be distinguished from an eversion of the cervical lips, prolapse of the cervical mucosa and cervical catarrh, cystic degeneration of the cervix, venereal warts, chancre, tuberculosis, small interstitial myomata, sloughing submucous myomata, and cervical polyps. *In any suspicious case,* when the diagnosis is *not certain,* curettage of the uterus and amputation of the cervix, or trachelorrhaphy should be performed *at once* and the excised tissue and the curettings should be submitted to expert microscopic examination.

Sarcoma of the Cervix.—Sarcoma of the cervix is much less frequent than carcinoma. There are certain cases of sarcoma (grape-like) in which the tumor consists of outgrowths which appear cystic and resemble the hydatidiform mole. These growths usually occur in persons

under the age of twenty and are rather characteristic in appearance. Other varieties of sarcoma of the cervix are difficult to differentiate from cancer except by a microscopic examination.

THE UTERUS.

Malformations.—**Infantile uterus** varies from a uterus smaller than normal to one represented simply by a fibrous cord.

Double Uterus.—Two complete uteri lying side by side—each has one round ligament, one tube, and one ovary.

Bicornate Uterus.—The union of the Müllerian ducts has occurred at a lower point than normal, giving the uterus a "Y" shape.

Uterus Septus.—The uterus has a normal appearance externally, but the endometrial cavity is divided into two by a median septum; each of these cavities communicates with the tube on its corresponding side.

In either the bicornate or the septate uterus pregnancy may occur on one side; or one horn or one division may be imperforate, resulting in hematometra.

Uterine Displacements.—**Retroposition of the uterus** is usually caused by childbirth, being preceded or accompanied by relaxation of the pelvic floor, abdominal wall, and the uterine ligaments, and by subinvolution of the uterus. Constant coughing or straining (hard work) predispose to retroposition. Pelvic inflammatory disease may complicate retroposition of the uterus. In such a case the uterus is bound down by adhesions. Falls, violent contortion of the body, or a sudden effort to lift, may cause retroposition in the young. Retroposition may also be congenital. It always precedes, to a certain degree, descensus or prolapse.

Retroflexion is a bending of the fundus backward on the cervix, and is commonly associated with retroposition. The symptoms include vertical or occipital headache, sacral backache, and a feeling of weight and dragging in the pelvis which extends into the thighs. Irritability of the bladder and constipation frequently arise. The symptoms are relieved by the recumbent posture. Dysmenorrhea, menorrhagia, and leucorrhea may be present if there are congestion and chronic inflammation of the endometrium.

Diagnosis.—The body of the uterus is not felt in its normal anteposition; the cervix is not directed toward the coccyx, as in the normal position, but lies in the axis of the vagina. The body of the uterus is felt through the posterior vaginal fornix; it is directed backward toward the sacrum. There is an angle of retroflexion between the cervix and the body. By sinking the abdominal hand deeply into the pelvis, below the promontory of the sacrum, the fundus can be palpated between the two hands.

Descensus and Prolapsus Uteri.—Descensus is the first stage of prolapsus; when the uterus falls slightly below its normal level it is said to be in descensus. Retroversion is nearly always present before descensus or prolapsus occurs. There are various degrees of prolapsus best de-

scribed by the position of the cervix: (1) What may be called descensus, when the cervix has descended into the vagina to an appreciable degree; (2) when the cervix presents at the vulvar outlet; (3) when the entire uterus is outside the body, spoken of also as procidentia.

Exceptionally prolapse takes place as the result of a violent muscular effort. Usually it is the final result of relaxation of the pelvic floor, abdominal walls, and uterine ligaments. As the organ descends into the vagina, the latter is inverted; the bladder wall and the rectal wall may or may not come down with the vagina. In case the prolapse is mainly caused by traction on the cervix from a relaxed pelvic floor, and the fundus of the uterus is held in fair position by its ligaments and the retentive power of the abdomen, there occurs an elongation and a thinning of the supravaginal cervix. The symptoms are those of a relaxed pelvic floor, depending in severity upon the degree of the prolapsus. Bladder and rectal symptoms as described under cystocele and rectocele are present. In complete prolapsus there may be considerable interference with walking; pressure ulcers of the vaginal mucosa may develop, accompanied by a foul-smelling discharge. The symptoms vary in intensity in different individuals, and sometimes bear no relation to the extent of the displacement.

Examination.—Procidentia is readily recognized. The pear-shaped tumor projecting from the vulva with the cervical canal at its apex can hardly be mistaken for anything else. Inversion of the uterus and a pedunculated fibroid may bear some resemblance. Any doubt is dispelled by putting the patient in the knee-chest position, when in the case of prolapsus the tumor is readily reduced. In minor degrees the uterus may go back more or less completely when the woman is in the dorsal position, even though it projects from the vagina when she is erect. The degree of descensus can be determined by having the patient "bear down" or by pulling on the cervix with a tenaculum. When there is supravaginal elongation of the cervix the fundus is not correspondingly prolapsed and the endometrial cavity is lengthened.

Inflammations.—**Acute endometritis** is due to gonorrhea or to septic infection. The symptoms in the gonorrheal form begin during or after a menstrual period; if during a period, the flow suddenly stops; if after a period, there is a diminution in the cervical leucorrhea, the attack is marked by pain in the back and lower abdomen, vesical irritability, and tenesmus, constipation, headache, rise of temperature (101°) and pulse. Within a few days a profuse purulent discharge appears.

Examination of the excretion from the vulvovaginal glands or from Skene's tubules will often reveal the gonococcus. Gonorrheal endometritis readily passes into gonorrheal salpingitis, and it is usually hard to say where one ends and the other begins.

In the septic form the symptoms follow the introduction of septic material into the endometrial cavity, either by an instrument or by the finger. The uterus may be puerperal or not. If puerperal the condition is a form of puerperal sepsis and more serious than when the uterus has not been pregnant. The symptoms in general resemble those of acute

gonorrheal endometritis, but are more severe; the temperature and the pulse are higher; chills or chilly sensations are more frequent, and the evidences of a toxemia are more likely to appear. The local symptoms depend upon whether the uterus is puerperal and upon the nature of the infecting organism. If the infection is of a virulent type, there may be little local reaction; in this case the disease rapidly advances beyond the endometrium, toxemia or bacteremia develop, and the patient dies with few structural changes in the pelvis. With less dangerous infection in a puerperal case there is at first a diminution, and later an increase in the lochial discharge. In case placental or decidual tissue has been retained within the uterus, the lochia has a foul odor. In non-puerperal cases, there is a puriform discharge streaked with blood.

Examination.—Bimanual palpation of the uterus reveals enlargement, tenderness, and perhaps edema. The os is usually patulous. It is difficult to differentiate acute endometritis from acute metritis or mild inflammatory lesions of the appendages.

Chronic endometritis usually occurs in association with some other pelvic lesion, such as retroposition of the uterus, fibroid tumor, or inflammatory disease of the appendages. It may exist alone. Leucorrhea is the most common *symptom*. The discharge is thin unless the cervix is coincidently the seat of catarrh; dysmenorrhea, profuse menstruation, and in exceptional cases metrorrhagia may be caused by chronic endometritis. As an independent lesion it has little significance.

Acute metritis is customarily associated with endometritis of the septic type and other inflammatory pelvic lesions. Its *symptoms* vary between those of septic endometritis and pelvic peritonitis, from which it is difficult and unimportant to differentiate.

Chronic metritis is the residuum of an acute infection or the result of long-continued subinvolution of the uterus. It is frequently associated with chronic endometritis and displacement. The *symptoms* are backache and dragging sensations in the lower abdomen, profuse menstruation, and an irritating leucorrhea. The uterus is symmetrically enlarged. The *diagnosis* is made by excluding fibroid tumor and cancer.

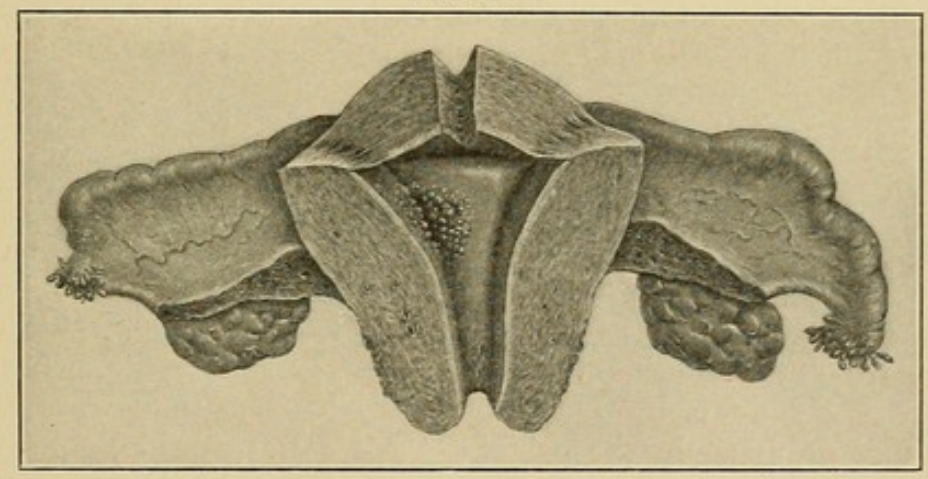
Newgrowths.—Cancer of the body of the uterus occurs somewhat later in life than cancer of the cervix; usually between the ages of fifty and sixty. It is often found in single or nulliparous women. Fibroid tumor seems to predispose to carcinoma.

Symptoms.—The earliest symptom usually is metrorrhagia. Menorrhagia may be the first indication of the disease. Sometimes more or less periodical hemorrhage occurs after the menopause and is taken by the patient for a return of menstruation. Metrorrhagia may follow coitus, straining at stool, or any pronounced exertion. The onset of leucorrhea or the exaggeration of a chronic discharge may be the first symptom. The discharge is commonly serous; it may have a disagreeable odor and cause irritation of the external genitalia; it may be streaked with blood. There is little or no pain in the earlier stages. After the disease is advanced, hemorrhage increases in amount and is more or less constant. There is a profuse, purulent, dirty brown discharge,

which has a putrid odor, and contains disintegrated blood clots and shreds of necrotic cancer tissue. Pain is constant or intermittent, being described as shooting, burning, or colicky. It is felt in the lower abdomen, lumbosacral region, thighs, and along the crest of the ilium.

Examination in the Early Stage.—The uterus is normal in size or slightly and symmetrically enlarged. It may be a little softer than normal; the cervical canal is patulous, or easily dilatable. Hemorrhage may follow bimanual palpation. Such symptoms in a woman between forty-five and sixty years should be considered indicative of malignant disease until proved otherwise. In the late stages the uterus is enlarged, sometimes irregularly. The finger may be pushed through the external os with ease and friable, necrotic material felt within the endometrial cavity. *Early*, the condition must be diagnosticated from chronic endometritis, mucous polyp, small submucous fibroid, and beginning sarcoma. *Later*, from sloughing submucous fibroid and retained and

FIG. 442



Early cancer of the body of the uterus. The small area involved shows the importance of curettement in making an early diagnosis. It also emphasizes the fact that the operator should reach every part of the endometrium and furnish the pathologist with all of the tissue removed.

putrefying placental tissue and advanced sarcoma. *In any case where doubt exists*, and this is frequent in early cases, *the uterine cavity should be curetted* and the scrapings should be submitted to a pathologist for diagnosis. It is *important to curette the uterus thoroughly and reach every part of the endometrium*, and to have every particle of the scrapings examined (Fig. 442). The curettings should be mounted and cut in celloidin or paraffin, and examined in the usual way. This can be accomplished within thirty-six hours. If malignant trouble is found, a second operation can then be undertaken immediately. It is unwise to depend upon frozen sections of the endometrium in making a histological diagnosis.

Sarcoma of the Uterus.—Primary sarcoma of the uterus is rare. Sarcomatous degeneration occurs in about 1 per cent. of fibroid tumors, most often in the submucous variety. There is almost nothing symptomatic to distinguish between primary sarcoma of the uterine body

and carcinoma. The clinical significance of each is the same. The microscope only can decide between them positively. The following facts in regard to a fibroid tumor may be indicative of sarcomatous degeneration: the patient is advanced in years; the tumor is submucous in position; there is a sudden increase in the size of the tumor and a coincident increase of hemorrhage and discharge.

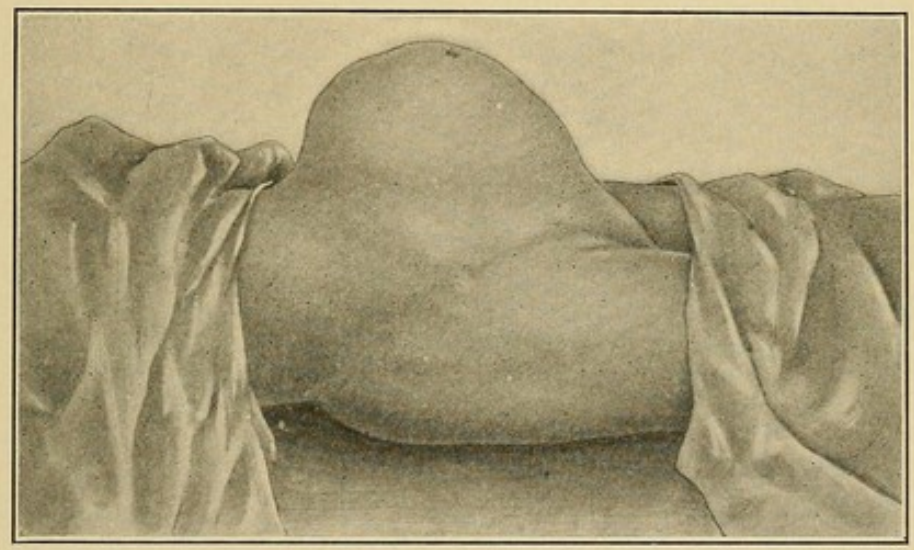
Fibroid Tumor of the Uterus.—Fibroid tumor is the commonest neoplasm of the uterus. It occurs during the period of menstrual activity, from the thirtieth to the forty-fifth year. It is more frequent in sterile or single women and in the colored race. Fibroid tumors may affect any part of the uterus, but they are much less likely to occur in the cervix. From their position in the uterine wall, fibroid nodules are spoken of as subperitoneal, intramural, or submucous.

Symptoms.—The chief symptom is hemorrhage. This is manifested at first as an increase in the amount or the duration of the menstrual flow. As a rule, the symptom grows worse gradually, and finally bleeding occurs between the periods. In some cases there is little hemorrhage. Hemorrhage is most severe in the submucous variety. In such a case the blood may be retained for a time inside the uterus, and may then come away in clots and be partly decomposed. Leucorrhea may be present and is at first thin and watery; later the amount of leucorrhea is obscured by the more or less constant hemorrhage. In necrotic submucous fibroids the discharge is putrid. Pain depends upon the position and the size of the tumor. Severe dysmenorrhea may be produced even by small tumors situated in the wall of the uterus. A submucous tumor may cause labor-like pains from uterine contractions made in an effort to expel it. There is also pain from the pressure which a tumor may exert upon the surrounding structures. Sciatic or crural neuralgia, backache, and a feeling of weight and dragging in the pelvis are not at all unusual. Frequent, painful, and difficult micturition or incontinence of urine may occur. Constipation is frequently observed. There are very often circulatory symptoms in cases of fibroid tumor. They result from impoverishment of the blood and from obstruction to the pelvic circulation. The cardiovascular symptoms are manifested by palpitation of the heart, shortness of breath, hemic murmurs, edema, and varicosities of the lower extremities. The anemia in fibroid tumor depends, in uncomplicated cases, largely upon the amount of blood lost. The skin is yellowish white, and the woman does not have a cachectic appearance. On the contrary, many patients grow fat.

Diagnosis.—Abdominal Examination.—A fibroid tumor may be of sufficient size to rise above the pelvic brim and produce an enlargement of the abdomen. Such an abdominal enlargement must be differentiated from pregnancy and from an ovarian cyst. On inspection the distention of the abdomen produced by a fibroid is apt to be found asymmetrical; it is more prominent on one side than on the other, or it occurs entirely to one side of the median line. The surface of the abdominal wall above the tumor drops suddenly to its normal level. On palpation inspection is confirmed. The fibroid tumor is hard and some-

what resilient. The surface of the growth is frequently knobby and small tumors on the surface of larger ones may sometimes be felt. If it can be determined by palpation that these smaller tumors are pedunculated, the diagnosis is all but positive. Percussion of a fibroid tumor distending the abdomen gives dulness over the prominence of the tumor and resonance surrounding it, except toward the pelvic brim. There are no auscultatory indications of a fibroid. If the fibroid is intramural and distends the uterus symmetrically, it may be impossible to distinguish it from early pregnancy. In such cases it is advisable to keep the patient under observation until fetal movements and fetal heart sounds would have become manifest if the woman were pregnant. It should be remembered also that pregnancy and fibroid tumor may co-exist.

FIG. 443



Fibroid tumor of the uterus distending the abdomen. Note the slightly irregular outline and the abrupt fall of the surface line from the upper pole of the mass to the epigastrium. The abdominal wall is pushed out by the hard, unyielding mass within.

Bimanual Palpation.—Submucous Tumors.—The uterus is enlarged and more or less symmetrical. It is harder than the pregnant uterus. If the tumor is pedunculated it sometimes dilates the cervix and presents itself in the cervical canal, or it may be extruded from the canal and hang by its pedicle in the vagina. In the case of small submucous tumors a positive diagnosis can be made only after dilatation of the cervix and intra-uterine exploration by means of the finger, sound, or curette. *Interstitial tumors:* The cervix fuses directly with the enlarged fundus. It sometimes projects from the surface of the latter like a nipple from the breast. The uterus is usually somewhat irregular and of increased density. The uterine body cannot be outlined distinctly from the mass. This form of tumor is most difficult to distinguish from pregnancy. *Subperitoneal tumors:* The uterus is studded with hard, knob-like protuberances. If they are pedunculated, the diagnosis is clear. When the growths are confined to one side of the uterus or to the fundus the uterus can be outlined as a distinct but attached body. When the tumor is single and pedunculated

an ovarian growth must be excluded; an attempt should be made to isolate the ovary upon the affected side. If a subperitoneal fibroid, which rises out of the pelvis and distends the abdomen, is pushed upward by the external hand, the uterus will immediately follow. If the tumor is held in that position and the uterus is drawn downward, the pedicle of the tumor may be felt at its attachment to the uterus by rectal palpation.

Tuberculosis of the uterus is usually complicated by tuberculosis of the tubes and of the pelvic peritoneum. The symptoms of the uterine trouble itself may resemble those of carcinoma. There may be a profuse leucorrheal discharge containing cheesy particles. The body of the uterus may be considerably hypertrophied. A positive diagnosis can be made only by the microscopic examination of curettings.

Inversion of the uterus dates from labor or the expulsion of a submucous pedunculated fibroid. The diagnosis rests upon the recognition of a pear-shaped tumor filling the vagina and covered with endometrium; the tubal ostia may be distinguishable. The cervix surrounds the pedicle of the tumor and the endometrial cavity is turned inside out. There is a cup-shaped depression at the fundus.

Chorio-epithelioma of the uterus is an epithelial newgrowth arising from the chorion epithelium. Half of the cases are preceded by hydatidiform mole. The *symptoms* develop after abortion or labor and include a rapid enlargement of the uterus, hemorrhage, and a foul-smelling discharge. The growth rapidly extends locally, and metastases to the lungs and to other organs may occur very soon. The *diagnosis* depends chiefly upon a microscopic examination of pieces of the tumor secured by curettement. It is important to recognize the lesion without delay.

Hematometra is a distention of the uterus with blood. It is usually associated with atresia of the vagina and hematocolpos. The uterus may be distended alone, the condition then resulting from an atresia of the cervix. Under these circumstances the uterus is frequently septate or bicornate, and the atresia and the hematometra affect one side. There are periodic colicky pains associated with menstrual molimina and a globular tumor in the lower abdomen.

Pyometra and physometra exist when the uterus is distended with pus and gas respectively. They are almost invariably associated with carcinoma or sarcoma. The patient is septic and complains of colicky pains. The uterus is enlarged and sensitive.

THE TUBES AND THE OVARIES.

Malformations.—Hematosalpinx.—The tube is distended with blood; the condition may exist alone or in connection with hematometra or with hematometra and hematocolpos, as a consequence of some form of gynatresia.

Elongation and twisting of the tube or a persistence of its fetal type favor tubal pregnancy and sterility.

Rudimentary or ill-developed ovaries have imperfectly formed follicles or none at all and are an occasional cause of sterility.

Inflammations.—Acute salpingitis usually results from gonorrheal infection. Gonorrhea of the endometrium frequently extends to the tubes and from these in turn the infection progresses toward and involves the pelvic peritoneum. Acute gonorrheal salpingitis is usually associated with gonorrheal pelvic peritonitis. Its symptoms, diagnosis, etc., are found under that subject on page 728.

Pyosalpinx is a distention of the tube with pus. It results from a suppurative inflammation of the mucosa with a coincident closure of the abdominal and the uterine ostia. The symptoms during the formative stage of the lesion are those of acute gonorrheal pelvic peritonitis (see p. 728). After full development and the subsidence of active inflammatory processes, the symptoms, examination, etc., are those described under chronic pelvic peritonitis (see p. 729).

Abscess of the ovary usually results from puerperal infection which reaches the ovary by way of the lymph channels. It may also be produced by the extension of infection from an acute gonorrheal salpingitis to a Graafian follicle or a corpus luteum, or it may be formed by the bursting of a pyosalpinx into an adherent Graafian follicle or a cystic corpus luteum. The symptoms during the formative stage are those described under puerperal pelvic peritonitis, with which it is commonly associated (see p. 728). They are less apt to subside spontaneously than in gonorrheal salpingitis. If the inflammatory process becomes quiescent the symptoms resemble those of chronic pelvic inflammatory disease.

Pelvic Inflammatory Disease.—Inflammatory affections of the tubes, the ovaries, and the pelvic peritoneum are so closely related and so frequently combined that they may be considered together. It is very often impossible to say, in a given case, which of the three is principally involved. A comparison of the conditions found at operation with the cause of the inflammation has shown that certain forms of infection affect particularly certain organs. Thus, it is known that gonorrhea frequently produces pyosalpinx in pelvic inflammatory disease, and that sepsis following labor or instrumentation of the uterus does not, as a rule, produce pyosalpinx. It is shown further that the last-mentioned form of infection is more apt to result in an ovarian abscess or in an inflammation of the cellular tissue of the broad ligaments. The pelvic peritoneum is usually involved in all forms of pelvic inflammation. With this explanation the various inflammatory affections of the tubes, the ovaries, and the pelvic peritoneum will be considered under the term pelvic peritonitis.

Acute Pelvic Peritonitis.—Acute pelvic peritonitis may result from gonorrhea, from septic infection following abortion or labor, and from infection incident either to an operation upon the uterovaginal canal or to some instrumentation of the uterus.

Gonorrheal Pelvic Peritonitis.—The symptoms usually begin during or immediately after a menstrual period. The patient gives the history of a leucorrheal discharge which originated after marriage or after suspi-

cious intercourse. There are severe sharp pains in the lower abdomen, usually worse on one side. The menstrual flow may be arrested. Urination is frequent and painful, the bowels are constipated; the abdomen is distended, and the abdominal muscles are tense or rigid. Nausea and vomiting may occur. The temperature varies between 101° and 103°; the pulse is increased proportionately; 110 to 120 beats per minute is not uncommon.

Examination.—If no history confirmatory of gonorrheal infection can be elicited, Skene's glands, the vulvovaginal glands, and the cervix should be inspected for evidence of the disease, and if it is expedient smears should be made and examined for the gonococcus. *Bimanual pelvic examination* is unsatisfactory at first because of tenderness and rigidity. Usually it is possible to determine that the uterus is more or less fixed, and that any attempt to move it causes intense pain. After several days, under appropriate treatment, the pyrexia, the rapid pulse, and the abdominal tenderness and rigidity subside. Then, upon *bimanual palpation* the uterus is found to be fixed, and back of it, on one or on both sides, induration is felt through the vault of the vagina. The pelvis contains inflammatory masses (pyosalpinx, tuboövarian abscess, encapsulated intraperitoneal abscess, pelvic exudate) which are immovable and very tender, and have a more or less globular or retort shape. From experience it is known that in the majority of cases of gonorrheal pelvic peritonitis a pyosalpinx is formed. The mass felt upon palpation, however, often consists of the tube, the ovary, and a peritoneal exudate bound together, and it is often impossible to determine to what extent each of these is involved.

Differential Diagnosis between Gonorrheal Pelvic Peritonitis and Appendicitis.—In appendicitis there is often the history of a previous attack associated with an indiscretion in diet, or habitual overeating and chronic intestinal indigestion. Pain at first is not well localized, affecting more or less the entire upper abdomen. Later it is localized to the region of the appendix. The gastro-intestinal symptoms, nausea, vomiting, and constipation are more pronounced and less apt to respond quickly to treatment. Pain and tenderness are at a higher point and are more or less confined to the right side. There is no fixation of the uterus, and simple digital pelvic examination is not painful.

Puerperal pelvic peritonitis dates from labor, abortion, or some intrauterine operation or manipulation during pregnancy. It begins suddenly with a chill and hyperpyrexia (103° to 105°), or gradually, during the first few days of the puerperium. The pulse is usually increased out of proportion to the temperature. There may be no actual chills, but merely chilly sensations. There is pain in the lower abdomen, worse perhaps on one side; there is abdominal distention and more or less tenderness in the hypogastrium. Constipation is the rule early; later, in some of the most septic cases there is diarrhea. Nausea and vomiting are common. The lochia is usually diminished in amount. If necrotic material (placenta) exists inside the uterus the lochia will be putrid. In some of the worst cases the lochia does not have a foul odor.

Examination.—Palpation shows the uterus enlarged and the os patulous. Beyond this at first there is little information to be gained. Later the uterus is fixed and pelvic masses are found on one or both sides. They are more apt to be unilateral than in gonorrheal pelvic peritonitis. The vaginal vault and the pelvic masses have an almost stony hardness; later, if suppuration occurs, the masses soften. It is difficult often to differentiate an ovarian from a tubal enlargement, as there is a pelvic exudate which surrounds and envelops both the tube and the ovary. Ovarian abscess is more common than pyosalpinx in puerperal pelvic peritonitis.

Instrumental or postoperative pelvic peritonitis follows operation upon the uterovaginal canal or instrumentation of the uterus. It may be a result of the extension of a gonococcus infection from the uterus to the tubes and the pelvic peritoneum. It may be produced by the direct introduction of infectious material (attempts to produce abortion) into the uterus. When due to the spread of gonorrhea, the *symptoms* are those, already discussed, of gonococcus pelvic peritonitis; when it follows the introduction of an unclean instrument into the uterus during pregnancy, the symptoms are those described under puerperal pelvic peritonitis (p. 728). If pregnancy actually did not exist and yet the uterus is infected, the symptoms will be less severe than in the puerperal form.

Chronic Salpingitis.—See Chronic Pelvic Peritonitis.

Adherent Tube and Ovary.—See Chronic Pelvic Peritonitis.

Hydrosalpinx.—See Chronic Pelvic Peritonitis.

Chronic pelvic peritonitis is the residuum of a previous acute peritonitis. Gonorrhea is more apt to produce it than puerperal infection. The latter, as a rule, either results in death or is entirely relieved by symptomatic or operative treatment. The former is not directly dangerous to life, but shows no tendency to spontaneous cure, and, unless the diseased organs are removed after the acuteness of the attack has subsided, they may continue to give trouble and be responsible for recurrent attacks of acute pelvic peritonitis. The lesions associated with chronic pelvic peritonitis comprise chronic pyosalpinx, hydrosalpinx, ovarian abscess, cystic enlargement of the ovary, tuboövarian abscess or cyst, intraperitoneal collections of pus or serum, and adhesions which bind the pelvic organs together in malposition. When the pus originally present has been absorbed and serum has replaced it (hydrosalpinx, tuboövarian cyst, intraperitoneal cyst), the recurrence of peritonitis is less likely.

Symptoms.—Backache, pain in the thighs and lower abdomen, pain during defecation, frequent and painful urination, irregularity of the menses, menorrhagia, dysmenorrhea, and persistent leucorrhea. In the case of chronic gonorrheal pyosalpinx there are repeated attacks of acute pelvic peritonitis.

Examination shows fixation of the uterus with or without displacement. Adnexal masses are found to either side or behind the uterus. It is difficult to positively distinguish the tube from the ovary in cases where there is much distortion or many adhesions. Tubal enlargements

are apt to be sausage-shaped, ovarian enlargements are spherical or elliptical, tuboövarian masses are retort-shaped.

Tuberculosis of the Tubes.—Tuberculosis of the tubes is usually secondary to tuberculosis elsewhere, although it is more frequent than tuberculosis of any other part of the genital tract. Both tubes are affected as a rule, but the lesion may be farther advanced on one side. The diseased tube may have the form of an ordinary pyosalpinx, its true nature being recognized only by microscopic examination. More commonly the enlargement is nodular, chalky yellow in color, and confined to distinct areas, the intervening parts appearing to be little affected. Miliary tubercles may be present on the serous coat.

Symptoms.—The symptoms are not often distinctive, and, unless there is ascites or indications of tuberculosis in some other organ, its true nature may be unsuspected. In young virginal women tuberculosis is the most frequent cause of pelvic inflammatory disease. The symptoms in general resemble those of chronic pelvic peritonitis from which it is often indistinguishable before operation.

Tubal Pregnancy.—Tubal pregnancy may affect primipara, but, as a rule, multipara in whom a considerable interval has elapsed since the birth of the last child.

Symptoms.—Often in the early weeks the general and the local manifestations are quite like those of normal pregnancy. There may be on the contrary very little or no evidence of pregnancy whatever. The menstrual symptoms are extremely variable. In the majority of cases the menstrual flow ceases for a period of from eight to twelve weeks. At that time, in connection with the death of the fetus or a rupture of the embryonic sac, there is a discharge of decidual tissue and blood from the uterus, and hemorrhage continues thereafter either at irregular intervals or continuously. After the second month, sometimes earlier, there are periodic pains in the lower abdomen on the affected side, or a numbness or an aching pain in the groin. The pain is caused by contractions of the uterus and the tube, or by the peritoneal irritation or pressure of the enlarging tube. There is commonly some slight degree of pyrexia—99° to 100°. The bladder is frequently irritable, and constipation may be marked.

Rupture of the tube or tubal abortion is usually preceded by paroxysmal cramp-like pains of great severity in one iliac region. At the time of rupture there is an agonizing stabbing pain on the diseased side, followed by indications of internal hemorrhage, rapid, running pulse, air hunger, dilatation of the pupils, and a cold, clammy skin. There may be no further complaint of severe pain, but the patient is pallid and bears an anxious expression. The severity and degree of the symptoms vary in relation to the amount of blood which has been lost and the strength of the patient. Tubal abortion may produce the same symptoms as rupture. Usually the stabbing pain does not occur and the symptoms of internal hemorrhage are less marked.

Examination before rupture shows an enlargement of the uterus rather less than would correspond to the duration of pregnancy. There are

softening of the cervix, discoloration of the vagina, and the mammary changes of pregnancy; all may be less marked than usual or they may be absent entirely. Bimanual examination reveals a tubal enlargement to one side of the uterus. It may be small and freely movable in the early weeks and if no adhesions have formed; as a rule, there is a slightly adherent mass of some size, and the uterus is correspondingly displaced.

Immediately after rupture has occurred the remains of the enlarged tube may be found by bimanual palpation to one side of or behind the uterus. Rupture causes a diminution in the size of the tubal enlargement, and in some cases almost nothing but tenderness and an ill-defined sense of fulness will be distinguished by bimanual palpation. When the hemorrhage is intraperitoneal and large, the signs of free fluid in the peritoneal cavity may be elicited. After tubal abortion, in which the bleeding is slower and the blood coagulates, and in cases examined some time after rupture, bimanual examination will discover a pelvic mass which usually is back of the uterus, displacing it forward and upward and perhaps to one side. The mass is doughy and semisolid, and by rectal palpation a sensation will be imparted to the finger like that experienced in breaking up a thick jelly. It should be emphasized that bimanual palpation must be very gently performed in all cases of suspected tubal pregnancy; otherwise it may cause a rupture or abortion, or, if either has already occurred, it may retard the formation of a clot and cause renewed hemorrhage.

THE OVARY.

Prolapse of the Ovary.—*Causes.*—Prolapse of the ovary occurs either alone or in combination with retroposition of the uterus. In the former case chronic wasting diseases with loss of the pelvic fat and relaxation of the ligaments, increased weight of the organ because of cystic degeneration, and small ovarian tumors are causes. Subinvolution of the infundibulo-pelvic ligaments may produce it. The left ovary is more often affected than the right.

Symptoms.—Pain varying from a dull, heavy ache to a sharp, agonizing sensation, with faintness and nausea. The pain is relieved by a recumbent posture. It is made worse by walking, coitus, and defecation. After defecation it may last for several hours. Dysmenorrhea and menorrhagia may ensue. Reflex symptoms, such as headache, indigestion, nervousness, and mental depression, may be present.

Examination.—Simple digital palpation of the vaginal vault to one side of the cervix discovers the ovary lying at the bottom of Douglas' cul-de-sac, or upon bimanual palpation it is found along the pelvic wall at a slightly higher point. Care must be taken to distinguish a prolapsed ovary from a fecal mass in the rectum or sigmoid.

Cystic degeneration of the ovary or follicular cysts of the ovary result from an inflammation of the ovarian surface or from adhesions between

the ovary and the pelvic peritoneum in chronic pelvic peritonitis. The fluid of maturing Graafian follicles which are prevented from undergoing the normal rupture is retained within the ovary. Cystic degeneration may also occur in a prolapsed ovary as the result of slow thickening of the ovarian capsule, due to the more or less constant mechanical irritation to which it is exposed; rarely there may be thickening of the ovarian capsule and cystic degeneration without any demonstrable cause.

The *symptoms* and the objective signs are dependent upon the associated lesion, being usually like those of a chronic pelvic peritonitis or a prolapsed ovary. In the rare form which occurs without apparent reason the patient suffers from backache, pain in the ovarian region, severe dysmenorrhea, menorrhagia, and leucorrhea. Nervous symptoms are often pronounced. On palpation the ovaries feel larger than normal and are freely movable or slightly adherent.

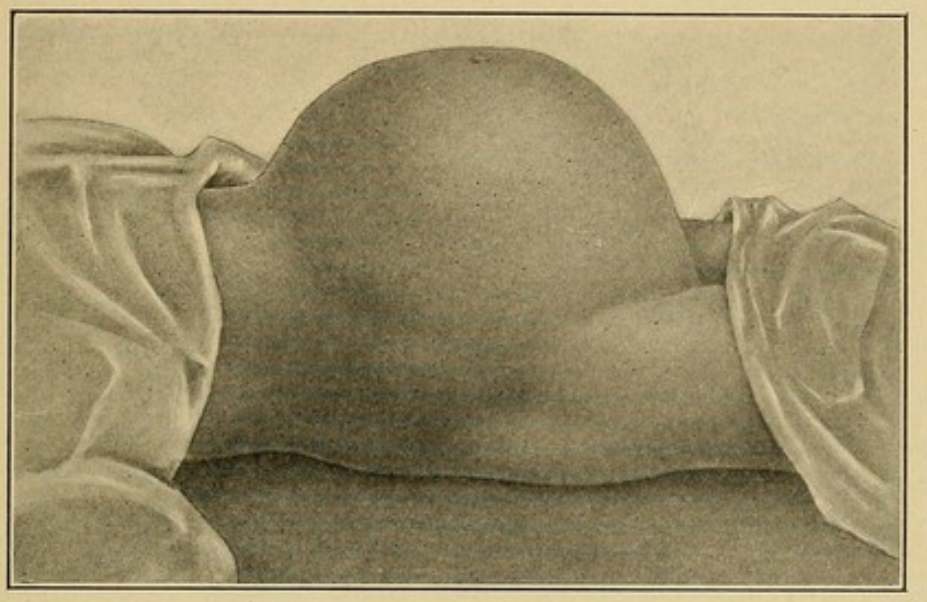
Ovarian Tumors.—**Glandular cyst** is the most common ovarian tumor, cystic or solid. It usually develops about the age of forty-two, although it may occur in the very young or the very old. Nullipara and multipara are equally susceptible.

Symptoms.—There may be no indications of the tumor until it is large enough to distend the abdomen. Early symptoms are dysmenorrhea and profuse menstrual flow. As the ovarian stroma is destroyed the periods become scanty. Pain is a variable symptom and usually depends upon torsion of the pedicle or adhesions. The bowels may be constipated and the bladder irritable. In large tumors, distending the abdomen, digestive disturbances are common; anorexia, nausea and vomiting, catarrhal jaundice, and intestinal obstruction have been noted. The heart may be embarrassed by the increase of intra-abdominal pressure and often there is considerable dyspnea. The abdominal wall is overstretched and very thin or edematous; dilated veins appear on the surface; edema of the vulva and of the lower extremities may be present. Hemorrhoids and ascites are not infrequent complications. With increasing impairment of nutrition there is progressive emaciation, and the face has a weazened appearance, the *facies ovariana.*

Abdominal Examination.—Ovarian tumors which distend the abdomen, must be differentiated from pregnancy, uterine fibroids, ascites, and an excessive accumulation of fat. *Inspection:* Large tumors distend the abdomen symmetrically, the greatest prominence being in the median line and the surface smooth and regular. The abdominal wall drops gradually from the umbilicus to the ensiform. Smaller tumors may lie more to one side than the other, but a median position is most common unless the cyst is adherent or intraligamentous. *Palpation* confirms inspection in regard to position. The tumor is neither so hard nor so distinctly outlined as a fibroid. A multilocular tumor may be slightly irregular, but it has no knob-like protuberances from the surface. Fluctuation may be elicited in large tumors and in small ones which are unilocular and thin-walled. In large cysts the

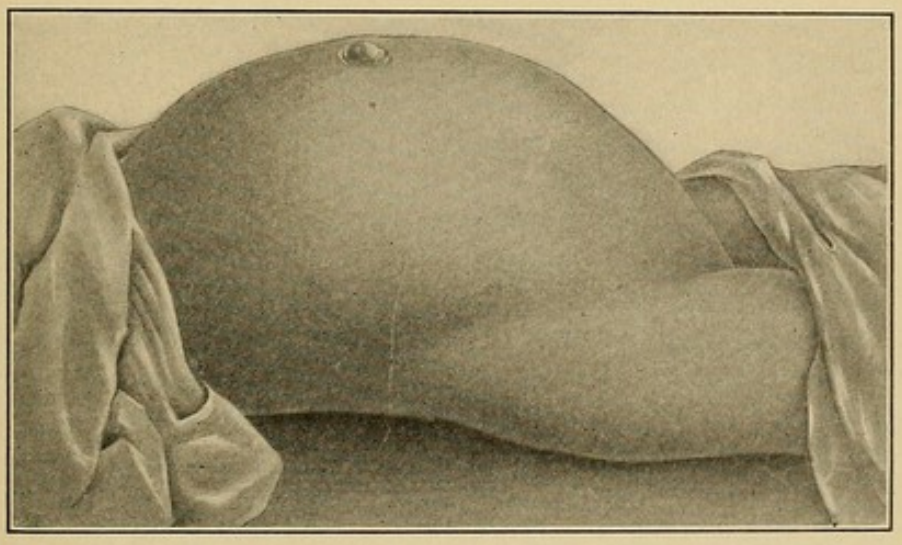
percussion wave may be limited to certain areas (loculi), and in small multilocular growths with thick contents there may be little transmission of impulse. The *percussion* note is dull over the tumor and resonant around it (coronal resonance) except toward the pelvic brim.

FIG. 444



Ovarian cyst distending the abdomen. Note the regularity of outline, the general symmetry and the more gradual fall of the abdominal wall from the umbilicus to the epigastrium.

FIG. 445



Abdominal enlargement due to ascites. The peritoneal cavity is filled with fluid. The surface line of the abdomen shows a less abrupt projection than in the case of a fibroid tumor or an ovarian cyst. The distention also noticeably affects the flanks.

Bimanual Palpation.—In small cysts a spherical mass is felt lateral to and behind the uterus, which is commonly displaced anteriorly and to the opposite side. The smaller the tumor the more it is found to one

side and the less the uterus is displaced. The surface is quite regular, and fluctuation can usually be elicited by having a second person tap the abdominal fingers, when the tumor is palpated bimanually. In small multilocular tumors with thick contents fluctuation may not be very distinct. Unless the tumor is adherent or impacted in the pelvis, it can be displaced above the brim of the pelvis. The uterus may now be distinctly outlined as a separate body; it is usually normal in size. Moving the uterus up or down will not influence the position of the tumor to the same degree as is noted in subperitoneal pedunculated fibroids. A normal ovary cannot be felt upon the affected side.

In the case of large ovarian cysts which fill the pelvis and distend the entire abdomen, it is very often impossible to palpate the body of the uterus, as it is pressed against the pelvic wall and partially enveloped by the lower pole of the tumor. In such cases a sound, passed with aseptic precautions may be used to determine the size and position of the uterus.

Papillomatous ovarian cyst is often bilateral and does not usually reach an enormous size. There is little distention of the abdomen except by ascites, with which it is frequently complicated. Papillomatous, warty, or cauliflower-like masses may be felt through the vaginal vault, or perhaps through the abdominal wall, if the patient is emaciated.

Parovarian Cyst.—A parovarian cyst is usually smaller than a glandular cyst. It is felt low in the pelvis in direct relation with the lateral border of the uterus, which is pushed to the opposite side. There may be some bulging of the vaginal vault on the affected side. There is no induration. Fluctuation is usually distinct. In the case of a very large parovarian cyst distending the abdomen the surface is smooth and fluctuation is very distinct over the entire tumor.

Dermoid Cyst.—Dermoid cysts do not attain the size of glandular cysts. They may develop about the age of puberty. The physical signs are those of the smaller glandular cysts, but they are prone to become adherent, so that fixation and induration of the surrounding tissues are not uncommon. Fluctuation is not distinct, but the tumors have a semisolid, putty-like consistency.

Accidents to Ovarian Cysts.—*Acute torsion* of the pedicle of an ovarian cyst is marked by sudden extreme pain in the lower abdomen, symptoms of collapse, and slight enlargement of the tumor. *Rupture of an ovarian cyst* is evidenced by severe pain, the general symptoms of shock, and a complete or partial disappearance of the tumor. The severity of the symptoms depends upon the extent of the rupture and the amount of hemorrhage. Serous contents are absorbed; thick mucilaginous contents may cause low grade peritonitis and ascites; if the cyst is papillomatous, the warty masses will become transplanted to the general peritoneum.

Solid Tumors of the Ovary.—Fibroma, sarcoma, carcinoma, and papilloma may occur. All are rare. A majority of the solid ovarian tumors are sarcomata. The symptoms are those produced by pressure and by peritoneal irritation. They are most apt to be confused with single,

subperitoneal, pedunculated, fibroid tumors of the uterus. A body corresponding to the position and size of the normal ovary cannot be felt upon the affected side.

THE BLADDER AND URETHRA.

Genital Fistula.—A number of varieties are encountered; the vesico-vaginal and the rectovaginal are the commonest. Other varieties are: urethrovaginal, vesico-uterine, vesicoutero-vaginal, ureterovaginal, and uretero-uterovaginal.

A vesical fistula may be caused by the delayed or improper use of forceps in a difficult labor. It may follow vaginal hysterectomy, cancer, syphilis, tuberculosis, or ulceration produced by a foreign body, such as a pessary, in the vagina.

Symptoms.—Onset. Difficulty in urination followed by hematuria, febrile disturbance, and vaginal discharge; after the sloughing tissue has been cast off there is an escape of urine which is more or less constant but which may vary according to the posture of the patient and the site of the fistula. The vagina is excoriated and encrusted with deposits of urinary salts; there are excoriations of the external genitalia and the inner surface of the thighs; the urine undergoes ammoniacal decomposition and has a foul odor. Emaciation, depression of spirits, and general ill-health occur.

Examination: Fistulous openings may be hard to find. Smaller fistulæ must be searched for among the vaginal folds with a Sims speculum and a probe. A sound or a probe in the bladder may be passed through the fistula or the bladder may be distended with milk or with methylene-blue solution while the anterior vaginal wall is exposed to view. Large fistulæ are easily found; they are surrounded by scar tissue, and the vesical mucosa sometimes prolapses through the opening.

Rectovaginal fistula may be caused by laceration during childbirth, faulty plastic operation, tuberculosis, syphilis, or carcinoma. The fistula permits the passage of gas and liquid feces from the rectum to the vagina.

Urethritis is usually due to gonorrhea; highly concentrated urine, irritating vaginal discharges, chemical irritants, and trauma are predisposing causes and sometimes actually produce mild forms.

The first *symptom* is frequent urination, accompanied by burning and scalding pain, with the occasional passage of a few drops of blood after urination. There is a purulent discharge from the urethra.

Examination.—The external meatus is swollen and red, the mucosa bulging from the meatus like a prolapse of the urethra; the orifices of Skene's glands are conspicuous. Pus is present at the meatus unless urination has recently occurred. Pressure along the urethra will cause pus to appear. The urethroscope shows the mucosa swollen and red. In chronic urethritis all subjective symptoms are absent except perhaps frequency of urination. The urethroscope shows small ulcers or granular patches with little or no swelling of the mucous membrane between them.

Urethral caruncle is the most frequent neoplasm of the urethra. It varies from a pale to a bright red color, resembling somewhat a raspberry; its size ranges from a pinhead to a hickory nut. It is usually found on the posterior wall of the urethra, just on the margin of or inside the meatus. The growth may be sessile or pedunculated, is exquisitely sensitive to touch, and bleeds readily.

Symptoms.—There is pain during urination which lessens gradually, but sometimes lasts for ten or fifteen minutes. There is pain also on walking; coitus may be impossible. The suffering may be so great and so constant that the general health is seriously impaired.

Suburethral Abscess.—There are the symptoms of an acute urethritis together with the presence of a tumor projecting into the vagina along the course of the urethra. The enlargement is extremely tender and upon pressure discharges its contents into the urethra.

Cystitis.—Cystitis is produced by the extension of a urethritis, the trauma and the infection which may be incident to catheterization, retention of urine within a cystocele, a stricture or a neoplasm of the urethra, vesical calculus, exanthemata, or injuries. The *acute* form is produced by gonorrhea or infection from instrumentation.

The *symptoms* are frequent and painful urination, pain, and a feeling of fulness in the bladder, vesical tenesmus, and slight bleeding at the end of urination. Tenderness is elicited by pressing on the base of the bladder through the vagina. On cystoscopic examination the mucosa is found to be covered with a thick, tenacious pus; it is swollen and has a deep red color. There may be partial exfoliation of the mucosa. Catheterized specimens of urine show pus and blood. *The subacute* or *chronic form* is the residuum of an acute attack or is produced by milder grades of infection with retention and decomposition of the urine. Tuberculous cystitis may occur secondary to tuberculosis of the kidney.

Symptoms.—There is more or less dull pain in the bladder region, frequent and painful urination, and tenderness on pressure over the base of the bladder. Cystoscopic examination shows the mucosa of a dirty or grayish red color, covered with mucopurulent discharge, and areas of erosion or actual ulcers scattered over it. The lesions often are confined largely to the vesical trigone. A catheterized specimen of urine is alkaline and contains mucus, pus, bladder epithelium, and perhaps blood.

Vesical calculus is less frequent in women than in men because of the greater diameter and shortness of the urethra. The symptoms of the disorder differ in no wise from those in the male. A large stone may be felt by bimanual palpation.

Gonorrhea.—Gonorrhea in the female does not have the violent initiative course which it has in the male. In sluggish or in uncleanly women the disease may exist for some time before being observed; it usually starts in one of three localities, or in two or all of them combined, viz., the urethra, the vulvovaginal glands, and the cervix. A coincident suppurative inflammation of the three is highly suggestive of gonorrhea. Gonorrhea usually is first evidenced by the symptoms of urethritis which continue for a few days and then subside. Chronic suppuration persists

in Skene's tubules, the ducts of the vulvovaginal glands, and the cervix. Acute vulvitis rarely develops from the initial infection except in the young.

Gonorrhea is most apt to extend to the endometrium, and from there to the tubes and the pelvic peritoneum, during or after a menstrual period or after labor. The symptoms and the diagnosis of the various lesions of gonorrhea (vulvitis, cervical catarrh, endometritis, salpingitis, peritonitis) have already been described.

The gonococcus may be detected in smears taken *directly* from Skene's tubules, the vulvovaginal ducts, and the cervix. Although the coincident infection of the urethra, vulvovaginal glands, and the cervix, and the presence of gonorrheal macules at the orifices of Skene's tubules and the vulvovaginal glands constitute almost undoubted evidence of gonorrhea; still, in a forensic sense, at least, the diagnosis is not positive until the specific organism has been found.

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