

21.7.11.

THE UNIVERSITY OF MINNESOTA
GRADUATE SCHOOL

Report
of
Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given Henry William Meyerding final oral examination for the degree of Master of Science in Surgery. We recommend that the degree of Master of Science in Surgery be conferred upon the candidate.

Minneapolis, Minnesota

June 1 1918

Arthur Gillette
Chairman

W. F. Brasch

Wm Carpenter MacCarty

E. J. Bell

A. H. Sanford

E. J. Juel

231A02

Ms. 29. 1918 54. 56

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report
of
Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by Henry W. Meyerding for the degree of Master of Science in Surgery. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of

W. S. Henderson (Jr.)
Chairman

Arthur J. Gillette

C. H. Wray (Asst. W.F.B.)

June 1 1918

Wm. Carpenter MacCall

E. T. Bell

A. H. Sanford

E. S. Judd



THESIS

CYSTIC AND FIBROCYSTIC DISEASE OF THE LONG BONES

Henry William Meyerding

Submitted to the Graduate Faculty of the University of
Minnesota in partial fulfillment of the requirements
for the Degree of Master of Science in Orthopedic Surgery.

1918

724
8/15/37

CYSTIC AND FIBROCYSTIC DISEASE OF THE LONG BONES

The literature of fibrocystic disease of the long bones is comparatively recent and is of very great interest to the orthopedic surgeon, giving rise as it does to the differentiation of a hitherto unrecognized benign lesion. With the recognition of the lesion, the surgery became more conservative and a technic was adopted which gave permanent and gratifying results. The etiology, diagnosis, differential diagnosis, and the gross and microscopic character of the condition were studied and, later, the roentgenographic appearance and extent of surgical interference were determined.

Virchow, in 1876, described a cyst of the humerus and ascribed its formation to liquefaction of a chondroma, a view which was then generally accepted and is still given a place in classifications known by his name. Rindfleisch, in 1886, and Hirschberg, in 1889, described cysts occurring in osteomalacia. Von Recklinghausen, in 1891, described general osteitis fibrosa cystica of the long bones and the pathologic changes associated therewith (Von Recklinghausen's cystic degeneration of the long bones). Beck, in 1901, described two cases of cystic disease of the tibia which he believed due to trauma. Muller, in 1906, and Pfeiffer, in 1907, reported 43 and 49 cases respectively. Bloodgood, Beck, Silver, Freiberg, Murphy, and Percy are among the American writers on the subject. Bloodgood reviewed 69 cases in 1910. Silver reviewed 97 cases in 1911, and reported a case of cyst in the femur of a boy aged 4 years, who was cured after a second operation. Elmslie has published two most interesting papers, the later one in 1914, being a thorough review and study with case reports. Lotsch's monograph of 127 pages, in 1916, is a thorough study of the general fibrocystic types. It is to be remembered that the roentgenograph has been a most useful aid in the diagnosis of, and the differentiation between, single and multiple cystic disease. Heineke, in 1903, reported its use in his cases; previous to that time most material was

reported from necropsy findings. Cysts frequently are discovered only after fracture, and the roentgenograph, as commonly used today, aids materially in the early diagnosis.

The etiology of fibrocystic formation is obscure, the general fibrocystic types especially remaining unsolved. The theory of trauma is most generally accepted, but there are reasons for believing infection to be the etiologic factor. The theory of inflammation has many adherents, and culture material gathered in the future should be given thorough study.

TYPES

1. Cystic degeneration of enchondroma, etc., single or multiple (Virchow).
2. Callous, subperiosteal, etc. Hematoma, traumatic.
3. Cysts occurring in osteomalacia.
4. Cysts occurring in Paget's disease (Osteitis deformans).
5. Localized osteitis fibrosa cystica.
6. General osteitis fibrosa cystica (von Recklinghausen).
7. Echinococcus, and cysticercus.
8. Dentigerous.
9. Cysts occurring from mercurial poisoning.
10. Cysts resulting from infection.

Virchow's theory, while possible, has now been generally discarded, cartilage being found in varying quantity in the different types and looked on as a part of the metaplastic process. Von Recklinghausen believed trauma and mechanical factors were the probable causes of the production of osteitis fibrosa cystica and that it was pathologically impossible to differentiate between osteomalacia, Paget's disease, cysts, etc., and osteitis fibrosa. Boit believes that the changes result from toxic, metabolic, traumatic or infectious processes, and derangement of internal secretions. Rehn believes that the process is not an entity but a phase of dystrophy in rapidly growing bones, and likens it to the disease known as snuffles in the hog, using the term osteodystrophy deformans infantilis and senilis.

Ropke and Lubarsch report the finding of organisms and ascribe the formation of cysts to infection, a view held by Murphy and others. (Material from 2 cases cited in this series showed organisms on culture). "It would appear that bone cyst is a term which should be restricted to the cavities in bones which contain fluid and have no definite connection with disease of the surrounding tissue (Silver)."

Silver and Landon recognize three groups in the morphologic classification of intra-osseous bone lesions: (1) Infection, (2) metaplasia, and (3) neoplasm. To the first group belong the cysts arising from tuberculosis, syphilis, and osteomyelitis, which may be primary or secondary, single or diffuse; the type is usually recognized definitely from the history, clinical findings and roentgenograph. The second group affords considerable difficulty in the establishment of the etiology, being either local or general and at times showing a tendency toward malignant change. They probably occur as a result of trauma, hemorrhage, metabolic disturbance or systemic disease. The third group shades off from the almost benign giant-cell sarcoma to the very malignant sarcoma types, and will not be considered in this paper.

It would appear reasonable in the classification of the intra-osseous lesions to consider the clinical history and findings, and the roentgenographic together with the pathologic findings in determining the diagnosis. Elmslie in his second paper notes the lack of the clinical picture in previous literature and the preponderance of pathologic description and reviews of literature. It is with the hope of adding somewhat to the already rapidly accumulating data by presenting the clinical, laboratory, pathologic, roentgenographic, and surgical findings, and by abstracting the histories of the patients studied in the Mayo Clinic, that this paper is presented.

Local fibrocystic disease.- Fibrocystic changes may be local or general and occur usually in the growing period of life. The proximal ends of the bones are principally involved and the tumor is unilocular or multilocular. The condition is most frequent in the femur, humerus, tibia and fibula. In Silver's

97 cases the legs were involved in 57 and the arms in 40, 73 per cent being in the three largest bones, the femur, humerus, and tibia, in the ratio of 6-5-3. The symptoms vary, and in many instances a fracture is the first indication of a disease condition in the long bone. However, usually there is pain, rheumatic or neuralgic in character, and a local swelling. In some cases there is tenderness, atrophy, deformity, shortening, or a limp complained of.

The diagnosis can be made only after a thorough clinical history, and physical and roentgenographic examinations have been made, and then cannot always be determined with certainty until an exploratory operation has been performed to rule out chondroma and giant-cell sarcoma, etc., by pathologic examination. The principal point to be determined is the question of malignancy, next the extent of bone involved, and whether the disease is truly a local process. Having this in mind, the surgery necessary in a given case may be arranged. The age incidence, slow growth, lack or character of pain, or the roentgenograph alone cannot always be depended on in making accurate diagnoses.

In the differential diagnosis it is necessary to consider sarcoma, chondroma, osteomyelitis, and syphilis, and rarely, secondary carcinoma. Malignancy is the most important factor to be considered as on this often depends the fate of the extremity. Giant cell sarcomas are more often found extending from the diaphysis and involving the epiphyseal ends of the long bones. They seldom break through the cortex to invade the surrounding structure as the more malignant types are prone to do, rather remaining local and appearing more fibrocystic in character. It is impossible always to differentiate the sarcomatous group from osteitis fibrocystica by the roentgenogram alone.

Carcinoma of the bones secondary to malignant growth elsewhere is usually evident from the physical findings, the history, the characteristic roentgenographic appearance of the tumor formation, and the intense pain that usually accompanies it. The roentgenogram shows a moth eaten destructive appearing area. Fractures may occur and there may be a loss of normal bone striation, etc.

Syphilis is usually evident from the history and the physical or laboratory findings, and the roentgenograph often shows the periostitis and cortical thickening which are more or less characteristic, but it is not to be forgotten that syphilis may simulate almost any other lesion. The Wassermann test is not to be considered as final unless substantiated by other findings.

Osteomyelitis may simulate a cyst, and after considerable time, may produce one containing fluid free from bacteria, called osteitis aluminosa. As a rule there is an invasion of the surrounding structures however, with a shading off from normal tissue into the cyst. Frequently there are inflammatory changes in the neighboring areas and a thickened cortex and periosteum, and, not infrequently, the presence of a sequestrum. The characteristic features of osteitis fibrosa cystica are: It usually appears before the patient is 30 years of age. It is always in the diaphysis and never invades the epiphysis. After slow growth it appears to move upward in the diaphysis and is most common in the proximal end of the shaft. If a single cyst, it arises from the center of the bone usually and slowly enlarges at the expense of the cancellous bone, leaving a clear line of demarcation. It causes no thickening of the periosteum and tends to grow away from rather than toward the epiphysis. There is little or no pain but limp, deformity or fracture, etc., frequently occur. It would appear that the formation of a fibrous lining of the cyst was an index to its duration. Silver found it in a case at the second operation; he had noted its absence at the first. It might be likened to the condition found in chronic empyemas in which the wall of the cavity may become an inch thick as a result of the chronic inflammatory process. If the cyst becomes multilocular it presents a series of translucent areas surrounded by striae of irregular outline known as trabeculations. The cortex being gradually encroached on becomes thin or fused with the medullary substance so that there are areas in which only the outline of the cortex can be made out. As the process continues the periosteum bulges out and becomes irregular, but in benign growths does not burst its bounds and invade the soft tissue as is usual in the

malignant growths. Later the bone having lost its normal structure becomes weak and fractures on moderate trauma.

It is possible to diagnose some cases of osteitis fibrosa cystica from the roentgenograph alone, in others the gross and microscopic characteristics and the entire clinical picture or exploratory surgery must be resorted to in order to diagnose the condition. Too much value should not be placed on the roentgenographic appearance. Evidence of the invasion into the surrounding soft tissue by the extension of the tumor through the broken periosteum should make one think of malignancy. It is to be remembered that the benign growths cause pain by pressure on sensitive structures, nerves, etc., while acute infections cause pain, tenderness, local heat and fever. Carcinoma, usually from a primary focus, has a typical roentgenographic picture, showing ill-defined outlines and marked destruction with moth-eaten appearance or the metastatic round areas of increased density and loss of striation.

TREATMENT

It has been demonstrated that osteitis fibrosa cystica may develop and after a period of growth may reach a period of rest, then gradually disappear or fracture and then heal. Fractures seem to unite in the greater number of cases with little or no callous formation and may be often treated as simple fractures. The indications for operation are therefore not urgent unless there is interference with function, deformity, pain from pressure of the soft or surrounding more sensitive areas or for the prevention of fracture. Thoroughly to eradicate the diseased area would seem advisable when the diagnosis has been made early. However, total excision of the shaft and bone transplantation is seldom indicated as results show practically complete cure from thorough curettage and crushing in of the cortex. Percy believes that radical operation is indicated "because of the pernicious character of the pathology, especially the ruinous work of the osteoblasts." In determining the extent of operation, the roentgenograph is of utmost importance and one should be on guard as to the local or general character

of the disease, especially if bone grafting is to be done. The postoperative care consists principally of protection against fracture, the giving of a nutritious diet, and the building up of the general health. McCrudden studied the chemistry of the bone in Painter's case, showing a deficiency in lime salts. He states: "Whenever bone is taken up, organic and inorganic constituents are taken up as a whole and the new bone laid down is osteoid tissue poor in lime salts." The giving of lime salts has shown no definite results in our experience; surgery has been the most satisfactory method of treatment.

GENERAL FIBROCYSTIC DISEASE

With the recognition of a generalized type of osteitis fibrosa cystica by von Recklinghausen, the necessity of a search for more than one lesion in the long bones was evident. The use of the roentgenograph made this comparatively easy, and multiple fibrocystic disease has become more frequently recognized. Bloodgood, in 1910, in reviewing 69 cases of bone cysts, found 27 of the general type. The formation of cysts in osteomalacia, Paget's disease, etc., has led to a confusion as to diagnosis. A review of the literature makes it apparent that various authors disagree as to the classification of the cases reported. Von Recklinghausen did not believe it was possible to differentiate the various types pathologically. Areas of cyst, osteitis fibrosa and giant-cell tumor formations are found in the same bone. In the late stages hyperostosis and a tendency toward what has been diagnosed as malignant change have been noted, the patients dying in a condition of marasmus.

General fibrocystic disease is a metaplasia of the long bones which results from the effect of some general metabolic process, producing a medullary fibrosis with cystic tendency and involving the cortex in the later stages. The symptoms are vague. Rheumatic pains, bending of long bones and sudden fracture with slight trauma and the subsequent roentgenograph are the usual means of diagnosis. The roentgenographic picture reveals a normal periosteum, the cortex may be thin, smooth or bulging, or almost fused with the medulla, the normal bone

tissue being replaced by a fibrosis arranged in whorls or as longitudinal striae usually containing cysts.

CONCLUSIONS

1. Cysts and osteitis fibrosa cystica may arise from either local or general processes.
2. Cysts, osteitis fibrosa cystica and giant cells may occur in the same bone.
3. Giant cells in moderate numbers, especially the atypical forms, are not prognostic of malignancy.
4. Before diagnosis of a local osteitis fibrosa cystica is made it is necessary to rule out the general form, and this is most practical by means of the roentgenograph.
5. Curetting and crushing in of the diseased wall is usually sufficient surgery.
6. The microscopic picture is clear and should not be confounded with malignancy.
7. The roentgenograph is of the greatest value in its recognition and is fairly diagnostic but it cannot accurately determine the contents of the cyst; the localization in the diaphysis and the tendency to remain inside the cortex and periosteum are valuable signs in the differentiation from malignancy, the epiphysis being free from involvement.
8. The history, clinical findings, examination of the patient, and laboratory and roentgenographic reports should be included in making the diagnosis.

REPORT OF CASES

Case 1 (63924).- M. L., a girl, aged 8 years, was examined Feb. 8, 1912. She had had measles, pertussis and la grippe. She complained of pain and soreness, and swelling in the upper third of the left humerus of ten months' duration following a fall and injury to the left shoulder. Six weeks later swelling was noticed at the site of the injury and there was some restriction of motion which was relieved by massage, but the swelling persisted. Seven months later, and again within a month, she fell and injured the same shoulder. The symptoms increased and the family physician operated, incising for pus but finding none. The patient was somewhat better but the symptoms returned and she was referred to the Mayo Clinic. Examination: The child was well nourished. The right breast contained a small nodule and the cervical glands were shot-like. The left upper third of the humerus was enlarged and somewhat tender and there was a slight restriction of the shoulder motion. The urine findings were negative. The roentgenogram showed a tumor of the upper half of the left humerus, probably an osteosarcoma.

Operation, Feb. 13, 1912.- Subperiosteal excision of the upper shaft and neck of the left humerus, and a transplantation of a triangular piece of the tibia was done, the tibia being driven into the medulla of the humerus a distance of 1 inch. The pathologist reported a bone cyst of the left humerus (Fig. 1).

Case 2 (176139).- F. P., a girl, aged 7 years, was examined Oct. 24, 1916. She had had pneumonia, tonsillitis and la grippe. The present complaint was pain and soreness with a limp and a tumor the size of a lemon in the upper third of the left fibula. Without knowledge of trauma, the child had complained of pain, principally in the morning and evening, in the upper third of the fibula some four months previously. The mother, on examination, had found some swelling and thought there was a little redness. During the last month there had been a decided aggravation of the limp. Examination.- A tumor about 2 inches in

diameter was noted in the upper third of the fibula. There was a slight enlargement of the superficial veins with a little tenderness and a shiny skin. The tonsils were enlarged and there were adenoids. The left leg measured $10\frac{1}{2}$ inches and the right 9 inches in diameter. The examination otherwise was negative. The urine findings were negative. The blood hemoglobin was 75 per cent. The leukocytes were 14,000; the polynuclear neutrophils 52 per cent, small lymphocytes 24 per cent; large lymphocytes 18.3 per cent; eosinophils 4.3 per cent; basophils 7 per cent. The roentgenogram showed a tumor of the upper third of the diaphysis of the fibula not involving the epiphysis and fusing the cortex and medulla into a cystic cavity containing fine trabeculations. The epiphyseal line was distinct. The periosteum at the lower border was raised and the border of the tumor rough.

Operation, Oct. 27, 1916.- Subperiosteal excision of the upper third of the left fibula, and closure without drainage was done. The epiphysis was not removed. Pathologic report: Hemorrhagic bone cyst.

The cyst had probably been present a long time before the symptoms developed. Trauma may or may not have been a factor. The pain was only present when the child was not asleep or at play. The limp may have resulted from perineal nerve pressure. The case had been diagnosed as a sarcoma clinically because of the findings in the roentgenogram, and the apparent rapidity of growth with enlarged veins, etc. The marked destruction of the fibula was a misleading feature. There were no complications following operation and the child was discharged the ninth day, walking (Figs.

Case 3(144401).- N. D., a female, aged 15 years, was examined Oct. 27, 1915. Four years previously the girl's teacher had noticed a deformity of the right wrist. There was no knowledge of previous trauma and no impairment of function. One year previously she had fallen off a wheelbarrow and thought her right thumb had been broken. For the past six months the wrist had been weak and painful. Examination.- There was marked deformity at the wrist and limitation of motion in all directions with crepitation on movement. The teeth were foul and th

tonsils inflamed and very large; adenoids were present. There was tenderness over the appendix and the temperature was 99. The urine showed albumin on two successive days. The Wassermann test was negative. The hemoglobin was 80 per cent, the red blood count was normal, and the white blood count 14,200 on two examinations. The roentgenogram showed destruction of the lower diaphysis, probably due to cystic disease.

Operation, Nov. 4, 1915.- The lower 2 inches of the diaphysis of the right radius were excised and a bone graft transplanted from the tibia. The bone removed appeared to be fibrous and the cyst cavity was filled with fibrous tissue. Pathologic report: Fibrous tissue from an old ruptured cyst, osteitis fibrosa cystica.

The family physician wrote that the child, when 3 or 4 years of age, had fractured the right radius and he believed the deformity resulted therefrom. The case is of unusual interest because of the roentgenographic appearance and limitation of growth to the epiphyseal line, the latter giving evidence as to its true type before operation (Figs.

Case 4 (106074).- H. B., a female, aged 11 years, was examined May 15, 1914. When 1 year old the girl fell and fractured the left tibia; union took place without difficulty, no deformity was noticed, and there was no further complaint until five years later when she again fractured the tibia at the same point. The second fracture was treated by a cast which was left on for three months and on removal a tumor was evident but gave no discomfort other than itching and an occasional twinge of pain. During the past three months the tumor had been enlarging and her family feared malignancy. Examination.- A hard bony tumor formation was palpable in the middle third of the left tibia, together with some local heat and tenderness. The circumference at the left calf was $10\frac{1}{2}$ inches and at the right $10\frac{1}{4}$ inches. The temperature on three occasions was 99 plus. Urinalysis showed albumin on two tests, the Wassermann test was negative, hemoglobin 82 per cent, and white blood count 8,100. The roentgenogram showed osteitis

fibrosa cystica and the chest was suspicious of apical tuberculosis.

Operation, May 21, 1914.- Incision was made and a curettage done of multiple fibrocystic disease of the middle third of the left tibia.

Three months after operation she was free from pain and had gained 7 pounds. If the history is correct and cysts were present at the time of the first fracture, this would be the earliest case on record.

Case 5 (181807).- I. F., a female, aged 17 years, was examined Jan. 3, 1917. The patient had been subject to colds and hay fever. Seven and a half years previously she began to have pain in the upper right humerus of a sharp, stabbing character at irregular intervals. At the same time a dull pain was noticed in the palm of the right hand and in the fingers which became worse when she was working. There was no acute infectious process and the temperature and general condition was good. The pain gradually became more severe until at the end of six months when it became unbearable and consultation was sought. A roentgenogram showed diseased bone. An operation was done and a diagnosis of tuberculosis made. There was no pus until the second or third day. The drainage continued for a year and the symptoms were relieved for two years; then gradually returned but were not so severe as before the operation. During the previous five years there had been but little change; changes of weather and temperature aggravated the pain. Little local tenderness, heat, or definite fever were noted. Examination showed enlargement of the upper right humerus with some tenderness on firm pressure and a bony mass on the inner aspect, probably resulting from the previous operation, the scar of which was on the anterior surface of the arm. There were enlarged tonsils and adenoids, hypertrophic rhinitis and a partly occluded left nostril. The urine showed a specific gravity of 1026, acid, and a small amount of albumin. Hemoglobin 70 per cent. The roentgenogram showed osteitis fibrosa cystica.

The patient was not operated on and four months later wrote stating that her condition was unchanged and that there was still some soreness in the palm

and shoulder, and slight tenderness on pressure.

Case 6 (150574).- V. J., a male, aged 19 years, came for examination Jan. 22, 1916. The patient, a delivery clerk, had noticed pain off and on for the past four years in the left tibia. The pain was present mainly at night and was accompanied by swelling of varying degree. On one occasion the pain was of such severity that he was unable to work for a month and sleep was interfered with. Three days before examination at the Mayo Clinic, pain and swelling appeared and subsided within forty-eight hours. There had been no discharge from the ankle. Examination showed an enlargement of the tibia just above the ankle, with slight edema. There was no limitation of motion in the ankle. No note was made as to tenderness or local heat. The temperature was 99. Rhinitis and pharyngitis were present and the tonsils contained pus and caseous material. The urine was negative. Hemoglobin was 80 per cent, and white blood count 10,600. The roentgenogram showed areas of decreased density in the lower end of the tibia, one large and the other small, - The two evidently communicating. There was no evidence of inflammatory change about the bone nor was the periosteum altered.

Operation, Jan. 27, 1916.- The cysts were found to communicate and to contain fluid. The wound was packed and healed quickly. Subsequent roentgenograms showed the cavity filling in with bone at the end of nine months, the patient having been entirely relieved. Diagnosis: Bone cyst of the lower end of left tibia at the epiphyseal line, resulting from an inflammatory process, probably tuberculous (Fig. 6).

Case 7 (171941).- L. J. L., a male, aged 16 years, was examined Sept. 7, 1916. The boy had had tonsillitis and a tonsillectomy was performed nine years previously. For the past nine months he had had recurring attacks of severe pain in the right arm, without knowledge of trauma. The condition had been diagnosed as neuritis and later as bone cyst or sarcoma. Examination showed a well developed boy. The right arm was slightly deformed and a small, hard bony mass could be palpated at the right bicipital groove. The urine was normal.

Hemoglobin 88 per cent; white blood count 9,200. The Wassermann test was negative. The roentgenogram showed a cystic formation in the upper third of the right humerus, probably a subperiosteal hematoma which had ossified and formed a cavity.

Operation, Sept. 12, 1916.- Through an incision passing longitudinally with the deltoid muscle a bony mass was exposed and chiseled into, liberating a red serosanguineous material. The cavity, which was wholly in the cortex, was curetted and cauterized. Pathologic examination revealed a fibrous bone tumor containing a few giant cells.

The bone cyst was probably of traumatic origin. The patient was discharged on the seventh day and has since been free from pain or recurrence.

A roentgenogram taken six months later failed to show recurrence (Figs.

Case 8 (86957). M. P., a female, aged 25 years, a school teacher, who gave a history of having had erysipelas six years previously, was examined July 1, 1913. Until five years previously she had walked normally; there had been pain or weakness in the legs. About this time she had had a severe jar, but no discomfort until six months later when pain became noticeable running down the outer side of the right thigh and the hip seemed to catch when she attempted to run. Disability and discomfort gradually increased. She had been treated by osteopathy without benefit. While walking in the snow one day there was a sudden crack in the hip and she was unable to bear weight on the leg. She was taken to a hospital; it was believed that the hip was fractured, and ether was given and the hip set. Weights were applied for six weeks, when roentgen and clinical examinations were made and tuberculosis and coxa vara diagnosed. Weights were again applied for three months, and massage given. Since then she had been about on crutches, and had been generally healthy. The pain was most marked when the leg was used a great deal. On examination the right leg was one inch shorter than the left, and there was swelling of the calf. Abduction was limited but adduction was normal. There was pain on flexion. The patient held the right leg crossed over the left and used two crutches. Urinalysis showed 1020, acid, and albumin a trace. The hemoglobin was 80 per cent; white blood count 8,400; red blood count

5,440,000. The Wassermann test was negative, the blood pressure was normal. The roentgenogram showed an old fracture with cyst-like formation in the greater trochanter.

Operation July 4, 1913.- A cyst at the head of the right femur was found. An ivory plug was driven through the greater trochanter into the neck of the right femur. One year later the right hip was injected with 2 per cent formalin and glycerin. Three and one-half years afterward the leg was much stronger, and the patient was able to get about on it. X-ray examination Aug. 3, 1915, showed the head of the femur in good position. There was apparently some cystic formation remaining. X-ray examination July, 1916, showed no apparent change. The patient walked with more comfort and there was less pain.

Case 9 (95333).- Mrs. A. A., aged 30 years, was examined Nov. 12, 1913. Six years previous to examination the patient had had pain of a general character, in the right leg and at times in the hip, thigh, knee, ankle, etc.; the pain coming on only when a sudden jar was sustained. Little attention was paid to the pain until two years previously when it became worse and was more localized about the hip and knee. There was difficulty and stiffness in walking, but crutches or a cane had not been used. Massage had been given for four years. Examination: The right hip held stiff; motion limited in all directions; adductor spasm; one and one-half inch shortening, and the trochanter extended above Nelaton's line. The x-ray showed arthritis with coxa vara of the right hip and cystic degeneration of the head and neck of the femur.

Case 10 (219836).- N. B., a boy, aged 8 years, a farmer's son, was examined Jan. 23, 1918. Six months previously the boy was kicked in the hip by a cow. No pain followed but he limped at times. While skiing about five months later he fell, and a physician declared the leg to be broken. He was taken to a hospital where the x-ray showed a diseased condition of the bone. A definite diagnosis was not made, sarcoma, tuberculosis, and cyst being considered. The examination at the Mayo Clinic showed enlargement of the left thigh, its circum-

ference being 4 cm. greater than that of the right; there was no shortening.

There was pain on deep pressure. The teeth were decayed, the tonsils enlarged, and enlarged cervical glands were present. The urinalysis was 1019, acid, with a few granular casts. The roentgenogram showed a large cyst of the left femur, probably hemorrhagic.

Operation, Jan. 31, 1918.- The cortex of the left femur was so thin it could be cut with scissors. A large cavity from 4 to 5 inches in length and 1 to $1\frac{1}{2}$ inches in diameter, filled with a serous mahogany-colored fluid and some old blood clots, was broken into. There was no distinct lining membrane. A diagnosis of osteitis fibrosa cystica was made.

This patient is still under observation (March, 1918) and sections of tissue are being decalcified (Figs.

Case 11 (115150).- S. B., a female, aged 16 years, came for examination Sept. 14, 1914, because of a swollen, painful right knee. She had had a peritonsillar abscess, otitis media, recurring attacks of tonsillitis, and diphtheria. Two years previously she had noted at irregular intervals sudden sharp pain in walking or climbing stairs. There was some limitation of motion in the joint, but no definite locking. Four months previously the knee became swollen and was treated with iodine applications, etc., and a roentgenogram taken. She was advised to have the bone opened and curetted. About this time the knee was injured and she was confined to bed. The pain, particularly at night, was very severe. A diagnosis of sarcoma was made from the roentgenogram, and amputation at the hip joint advised by a surgeon of international reputation after the knee joint had been aspirated. Examination: The right knee was swollen and enlarged, the flexion limited to 30 degrees, but complete extension was allowed. There was a small scar at the upper end of the patella; little or no local heat. The circumference was $1\frac{1}{2}$ inches greater than that of the left knee. The knee was held in a somewhat flexed position and attempts to straighten it caused intense pain. The patient's general appearance was excellent. The temperature was $99\frac{1}{2}$. The urinalysis was

negative; the hemoglobin 77 per cent and leukocytes 13,000. The Wassermann test was negative. After a roentgenographic examination an exploration of cystic tumor of the lower end of the femur was advised.

Operation Sept. 17, 1914.- The tumor of the right femur was found to be filled with blood-tinged fluid. The cavities were curetted and cauterized, and the wound was closed without drainage. The pathologic examination showed bone and organized blood clot. There was no evidence of malignancy.

Sept. 15, 1915, one year after operation, the patient states that she is in perfect health, and there is no evidence of recurrence of the trouble (Figs.

Case 12 (76480).- M. G., a male, aged 13 years, was examined Nov. 22, 1912. Four years previously, in throwing a stick, the patient thought he felt something snap in the right humerus. A physician examined the arm and assured him there was no serious trouble. Two years later the same accident occurred, and three weeks before examination he fell and injured the shoulder and since then there had been limitation of abduction. Examination: A hard smooth fusiform swelling in the upper third of the right humerus was found. The roentgenogram showed a cystic mass in the upper third of the right humerus with evidence of fracture.

Operation Nov. 25, 1912.- The cyst was curetted and swabbed out with iodine. Diagnosis: Osteitis fibrosa cystica right humerus with old fracture.

Five weeks after the operation the patient reported that the tumor was becoming smaller and he was beginning to use the arm.

Case 13 (115338).- R. W., a male, aged 17 years, was examined Sept. 16, 1914. A paternal aunt was epileptic and tuberculous. Five years previously the patient had noticed a slight stiffness in the left hip and had begun to limp and have occasional pain. Five months later he fell and fractured the left femur 6 inches above the knee; union resulted and he had no further trouble until seven months later when the same bone fractured 2 inches higher up. A roentgenogram taken at this time showed the fracture but nothing else was noted. Union was slow in taking

place and it was nine months before he was able to bear full weight, and malunion occurred. Three more fractures occurred in the next four years, the patient presenting himself to the Mayo Clinic with a fracture in the upper third of the femur of nine weeks' duration. Examination showed a marked outward bowing of the left femur with $3\frac{1}{4}$ inches of shortening, atrophy of the thigh and calf and limitation of motion of the hip in abduction flexion. Flexion of the knee was limited to 90 degrees. The tonsils were enlarged and adenoids were present. The urine showed albumin on two examinations. The Wassermann test was negative. Hemoglobin, 87 per cent; red blood count 5,480,000, leukocytes 8,100, polymorphonuclears 56.7, small lymphocytes 26.3, large lymphocytes 13.0, eosinophils 3.0, basophils 1.0. On roentgenographic examination the right femur showed general fibrocystic disease, coxa vara and old and recent fractures; the cortex and medulla were fused in certain areas and showed fine trabeculations. Similar changes appeared in the right tibia and fibula. Other bones were negative.

Operation Sept. 24, 1914.- Excision of 4 inches of the upper half of the left femur and transplantation of bone graft. Pathologic examination revealed osteitis fibrosa cystica.

Eight months later the family physician wrote that union was firm, with 4 inches of shortening and there was no further pain. A type of general osteitis fibrosa cystica, probably of the von Recklinghausen type (Figs.

Case 14 (56898).- L. L., a female, aged 21 years, was examined Feb. 6, 1918. An appendectomy had been done three years previously. Fifteen years previously the right radius was fractured and no further trouble was noted until eight years later when a tumor formation was recognized in the same region and a physician was consulted, who advised operation; a specimen was removed for examination. A diagnosis of sarcoma was made and amputation advised and refused. Pain disappeared and improvement was shown until seven years previously when the patient was brought to the Mayo Clinic and the tumor excised by removal of the upper 3 inches of the right radius. A diagnosis of giant-cell sarcoma was made.

Meyerding--19.

The arm recovered perfect function. Five years later a tumor developed in the right frontal region, and about four years later a small mass appeared in the right tibia. There was no pain and the general health was good. Examination showed a mass in the right frontal region 1 inch in diameter which felt cystic on firm pressure. There was slight enlargement in the right tibia and femur and there was some heat over the enlarged portion of the tibia. The right ovary was enlarged. The tonsils were large and chronically inflamed. Urinalysis was negative seven years previously and at this examination. The Wassermann test was negative. Hemoglobin 74 per cent; white blood cells 7,800. Roentgenograms made seven years previously showed a tumor the size of a hen's egg in the upper third of the right radius. The latest roentgenogram showed osteitis fibrosa cystica of the right tibia, right humerus and femur. The chest showed healed tuberculosis of the upper right lobe.

Operation Feb. 14, 1918. The flat internal surface of the tibia was exposed by a long curved incision and then removed, disclosing a fibrocystic degeneration which could be removed by a gouge and curet. The wall was then crushed in, the wound closed without drainage, and a large cotton pressure pad bandaged firmly over the leg. Pathologic examination revealed osteitis fibrosa cystica.

The patient is in the hospital at the present time (March, 1918).

(Figs.

Cases 15 (119482) and 16 (119483).-- Family history: J. S. W. (father, aged 54 years, blacksmith and engineer. In 1896 the right fibula was fractured by a horse kick; in 1898 the right femur was fractured in a runaway but healed in six weeks; in 1900 the left femur was fractured by tripping. His left leg was amputated on account of trouble (poor union) with the last fracture, rebroken. He still has a small sinus on the stump. He was anemic in appearance and afflicted with neuralgia.

G. W. (brother), aged 32 years. At the age of 11 years he slipped and fell, fracturing the right femur. Seventeen months later the left femur was fractured in falling from a horse; healed with good result. In 1905 he fell from

a bicycle and fractured the left femur. There was bending at the site of fracture later, In 1907 the right forearm was broken, poor union.

Two brothers, aged 22 years and 24 years, were without fractures.

T. W. (brother) had five fractures: In 1912, the right humerus; 1914, left femur; 1914, right femur; 1915, left femur; 1915, humerus.

D. W. (brother), aged 12 years. In 1911 the right femur was fractured; 1912, the right humerus; 1915, the left humerus; 1915, the right humerus; 1915, left femur.

J. R. W., had three fractures, and J.G. W. had two fractures. Note Case 15 (119482) and Case 16 (119483). The total number of fractures in the family was twenty-three. The mother and three sisters were healthy. One sister has asthma and was anemic in appearance.

Case 15 (119482).- J. R. W., a male, aged 29 years, single, was examined Nov. 20, 1914. No venereal disease was admitted. At the age of 10 years he sustained a fracture of the right humerus which healed and gave no further trouble. When 14 the left femur was fractured. Under splints, and later, a cast, it healed in excellent position with good functional result. When 17 years of age the right femur was fractured in a fall. A cast extending only a few inches above the site of fracture was applied and an attempt to walk the fifth week afterward disclosed non-union; malposition developed which has persisted and has required the use of crutches ever since. Examination disclosed five-sixths of an inch shortening in the right leg, together with a pseudo-arthrosis and considerable angulation of the fragments. General examination showed a man appearing somewhat older than his years; gray hair; fairly well developed and nourished, height 5 ft. 2.5 inches; weight 105 pounds. The urine was negative but for a trace of albumin. The systolic blood pressure was 146; the diastolic 80. Examination of the nose and throat showed enlarged tonsils, shaded antra and atrophic rhinitis. Blood count showed hemoglobin 87 per cent; erythrocytes 5,100,000, leukocytes 10,000, 300 cells counted; polynuclear neutrophils 56.7, small lymphocytes 27.7, large lymphocytes 9.3.

eosinophils 6.3. The Wassermann test was negative. Roentgenographic examination disclosed a fibrocystic degeneration of the long bones characterized by striae and involving the medulla mostly, but sometimes encroaching on the cortex with slight or no change in the periosteum (Figs.

Operation Jan. 28, 1915.- The pseudo-arthritis was cut through, releasing fluid, the fibrous tissue was excised and a piece of bone from the upper fragment was removed. A Steinman peg was driven through the os calcis and an extension applied. Five weeks later bone was transplanted from the flat internal surface of the right tibia by the intramedullary method, and a Thomas extension splint applied. The wound healed by first intention. A month later a plaster of Paris cast was applied from the costal margin to the ankle. During the next six months temperature and pulse were normal and union slowly took place. Pathologic examination revealed osteitis fibrosa cystica.

Sept. 28, 1915, the general condition was good, there was a gain in weight, but the leg was weak and unable to bear weight. Aug. 20, 1917, the patient's brother wrote that the leg had healed "all right" (Fig.

Case 16 (119483).- J. G. W., a male, aged 26 years, was examined Nov. 20, 1914. He denied venereal infection. At the age of 12 years the right humerus was fractured while throwing a stone. When 19 years old he fell, ^{which} resulted in a fracture of the middle third of the left femur. The treatment consisted of a 12 pound Buck's extension for fifteen days, then of a plaster of Paris cast for seven weeks. He was allowed to walk at the end of six months but non-union was found and Buck's extension was again resorted to for two months, followed by splints, but no improvement was noted. Examination disclosed pseudo-arthritis and malposition of the middle third of the left femur with a 3 inch shortening. Roentgenograms of bones are shown in Figures . The patient appeared older than his years. The heart, lungs, and other organs were negative. Blood count: Hemoglobin 88 per cent, erythrocytes 4,520,000, leukocytes 36.0, large lymphocytes

6.0, eosinophils 8.7, basophils 2.0. The Wassermann test was negative. The urine showed a trace of albumin, but was otherwise negative.

Operation, Nov. 27, 1914.- The ends of the bones were freed and traction obtained by Steinman's pegs from the os calcis and extension applied (Fig.). On Feb. 4, 1915, a second operation was done. The fractured ends were exposed, $\frac{1}{2}$ inch sawed off either end and an intramedullary bone-plug, obtained from another patient, inserted and a Thomas splint applied. Two weeks later the Steinman plug was removed and the Thomas splint replaced. The wound had healed by first intention. There were no postoperative findings of any importance; the temperature as well as the pulse remained normal. Subsequent to operation there was a $\frac{3}{4}$ inch shortening. There was evidence of union of the bone graft on the upper end, but apparent failure in the lower end. In a letter from the patient Sept. 28, 1914, he stated that his general health was good and his weight had increased from 112 to 166 pounds, but that as yet the leg had not firmly united.

The patient returned to the Clinic in February, 1917, for further treatment. The general condition was good.

Operation Feb. 21, 1917.- A bone graft was taken from the left tibia and transplanted to the left femur for malunion. The patient was discharged May 5, 1917.

In a letter written Aug. 20, 1917, the patient states that the cast had been removed on the advice of the attending physician. The leg was very weak, the muscles swollen and hard, but there was no pain. The right leg was a little sore. Nov. 1, 1917, the leg was still weak and unable to bear weight in walking. The right leg was entirely healed. The patient's general condition was not so good as in the previous report. (Fig.

Case 17 (41571).- Mrs. W. H. N., aged 30 years, was examined June 18, 1915. The patient first came to the Clinic in 1910 on account of goiter symptoms; the second occasion was in 1915, when she was again under observation because of exophthalmic goiter. She gave a history of having fractured the left humerus as

a result of slipping; in attempting to save her from the fall her husband caught her by the hand, the slight trauma breaking the arm. A diagnosis of giant-cell tumor was made. Union was obtained by conservative measures. Recent trauma had resulted in a thickening of the right humerus. No evident bone disease was discovered until a roentgenogram was taken following the fracture. A letter from the patient's family physician, May 24, 1915, gave the following report: "On April 29 she suffered a pathologic fracture of the humerus through a bone cyst. Osteitis fibrosa cystica was diagnosed. X-ray showed a similar but smaller area of diseased bone in the upper end of the radius. The fracture seems to be doing well."

Examination showed, in addition to the goiter findings, enlargement of both humeri in the middle third. There was albumin in the urine; specific gravity 1019.

Roentgenographic examination showed cystic degeneration of both humeri, - osteitis fibrosa cystica.

June 24, 1915, the patient was operated on for exophthalmic goiter (thyroidectomy). No operation was performed for the bone condition (Fig.).

Case 18 (156552).- F. T., a male, aged 19 years, a bank clerk, was examined April 4, 1916. He had noticed since 6 years of age a swelling over the fifth metacarpal bone of the right hand. There was no definite history of trauma. He had been told by his family physician that the finger was dislocated. No treatment was used, but the finger was pulled in an attempt to straighten out the dislocation which he thought present. Two months previous to coming to the Mayo Clinic an x-ray was taken, a diagnosis of tumor was made, and operation advised. On admission the patient complained of weakness in the left hand but had free use of all fingers. The tumor was enlarging slowly but caused no pain unless traumatized. Examination showed a bony mass over the fifth metacarpal bone of the right hand. X-ray examination showed a cystic degeneration of the fifth metacarpal bone and second proximal phalanges of the fourth and fifth fingers. There was no pain and only slight tenderness on pressure. There was moderate hypertrophic rhinitis, the tonsils were considerably enlarged and contained caseous material. The Wassermann

test was negative. Urinalysis was negative.

Operation April 14, 1916.- The cyst walls were crushed, liberating a currant-red gelatinous material. Bacteriologic examination showed cultures on anaerobic agar of a facultative anaerobic diphtheroid bacillus. The patient was heard from six weeks later and was doing well (Fig.).

Case 19 (172169).- Mrs. M. E. B., aged 41 years, was examined Sept. 12, 1916. One sister and two brothers had died of tuberculosis. Three children were living and well, 19, 18, and 14 years of age respectively. She had had grip and tonsillitis many times and gave a history of "neuralgia" off and on for fifteen years. She had always complained of being constipated. Previous operations were trachelorrhaphy, perineorrhaphy, and curettage ten years before. Fifteen years previously there had been a dull aching pain in the left forearm, diagnosed as "neuritis", which improved in a few weeks with treatment. Thirteen years previously there had been attacks of severe pain in the superior maxillary bones with headaches followed by malaise. Seven years previously pain developed in the outer side of the right thigh; it was treated as "neuritis", and disappeared in a few weeks with treatment, but was followed by a nervous breakdown. A second nervous breakdown occurred five years previously, and one year later abdominal exploration was advised because of dull persistent pain in the right side. The first recognized sign of bone trouble appeared in the upper tibia in 1913. In 1914 aching was noticed in the left ulna and a lump appeared just above the wrist. The pain was of the same neurotic type as before and later the neck, shoulder and left side became involved. Operation was done January, 1916, elsewhere. The left tibia was explored and a section taken, which was pronounced non-malignant. The intense pain subsided. The right tibia had been less painful than the left and seemed to improve of itself. Seven months previous to her coming to the Clinic she was x-rayed and all the long bones were found to be cystic. She spent nine weeks in a hospital afterward and her condition became better generally under treatment.

Examination showed that the lower end of the left ulna was enlarged. There was moderate chronic rhinitis. The tonsils were enlarged but no pus demonstrated. The Wassermann test was negative. Examination of the blood showed hemoglobin 80 per cent, leukocytes 8,600, erythrocytes 4,880,000. Urinalysis showed acid reaction, a trace of albumin and some pus cells. Roentgenographic examination.- There was cystic degeneration of the upper third of the tibia, lower third of the ulna and both radii. A diagnosis of generalized fibrocystic degeneration of the long bones of the von Recklinghausen type was made. Exploration of the tumor of the left forearm with crushing together of the shell of bone was advised.

REFERENCES

1. Barrie, G. : Fibrocystic and cystic lesions in bone. *Ann. Surg.*, 1918, *Lxvii*, 354-363.
2. Beck, C.: Caseous cysts of the tibia. *Am. Jour. Med. Sc.*, 1901, *cxxi*, 666-671.
3. Boitz; Ueber Leontiasis ossea und Ostitis fibrosa. *Arch. f. klin. Chir.*, 1912, *xcvii*, 515-573.
4. Boyd, S.: A case of "fibrocystic disease" of the femur. *Proc. Roy. Soc. Med.*, London, 1914-1915, *viii*, *Clin. Sect.*, 35-40.
5. Bloodgood, J.C.: Benign bone cysts, ostitis fibrosa, giant cell sarcoma and bone aneurism of the long pipe bones. *Ann. Surg.*, 1910, *lxi*, 145-189.
6. Burchard, A.: Zur Diagnose der chondromatösen fibrosen und cystischen Degeneration der Knochen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1912, *xix*, 113.
7. Bythell, W.J.S., Scott, G., et al.: Discussion on the radiographic appearance of bone tumors, benign and malignant. *Proc. Roy. Soc. Med.*, London, 1913-1914, *vii*, *Electro-Therap. Sect.*, 63-78.
8. Christie, A.C.: Diagnosis of bone tumors. *Med. and Surg.*, 1917, *i*, 376-384.
9. Davies, H.M.: Osteitis fibrosa cystica. *Proc. Roy. Soc. Med.*, London, 1914-1915, *viii*, *Clin. Sect.*, 34.
10. Elmslie, R.C.: Fibrous and fibrocystic osteitis. *Brit. Med. Jour.*, 1912, *ii*, 1367-1369.
11. Elmslie, R.C.: Fibrocystic disease of the bones; benign cysts, osteitis fibrosa with formation of tumors and giant-cell sarcomata (von Recklinghausen), and mollities ossium with giant-cell sarcomata. *Brit. Jour. Surg.*, 1914, *ii*, 17-67.
12. Faulds, A.G. and Teacher, J.H.: A most unusual case of pathological fracture - myeloid sarcoma and cystic disease of bone. *Glasgow Med. Jour.*, 1918, *lxxxix*, 17-21.
13. Freiberg, A.H.: Some diagnostic features of certain intraosseous lesions, ostitis fibrosa, bone cyst, and their relation to other intraosseous lesions. *Lancet-Clinic*, 1913, *cix*, 504-511.
14. Fujii: Ein Beitrag zur Kenntnis der Ostitis fibrosa mit ausgedehnter Cystenbildung. *Deutsch. Ztschr. f. Chir.*, 1912, *cxiv*, 25-74.

15. Halstead, A.E.: Benign bone cyst; pathologic fracture of upper end of humerus; intramedullary bone graft. Resection of the upper half of the humerus for sarcoma (medullary) of the upper end; bone transplant. *Surg., Gynec. and Obst.*, 1918, xxvi, 361.
16. Heineke, H.: Ein Fall von multiplen Knochencysten. *Beitr. z. klin. Chir.*, 1903, xl, 481-498.
17. Hirschberg, K.: Zur Kenntnis der Osteomalacie und Ostitis malacissans. *Beitr. z. path. Anat. u. z. allg. Path.*, 1889, vi, 513-524.
18. Jacoby, M. and Schroth: Ueber die Einwirkung von Calcium lacticum auf einen Fall von Ostitis fibrosa mit experimentell-therapeutischen Stoffwechseluntersuchungen. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1912, xxv, 383-390.
19. Landon, L.H.: Ostitis fibrosa cystica. *Ann. Surg.*, 1914, lx, 570-582.
20. Lotsch, F.: Ueber generalisierte Ostitis fibrosa mit Tumoren und Cysten (V. Recklinghausen's Knochenkrankheit) zugleich ein experimentellen Beitrag zur Aetiologie der Knochencysten. *Arch. f. klin. Chir.*, 1915, cvii, 1-137.
21. Lubarsch: Cited by Percy, loc. cit.
22. McCrudden, F.H.: Chemical analysis of bone from a case of human adolescent osteomalacia. *Jour. Biol. Chem.*, 1909-1910, vii, 199-201.
23. Muller, G.P.: Bone cysts. *Univ. Penn. Med. Bull.*, 1906-1907, xix, 173-177.
24. Murphy, J.B.: Osteitis fibrosa cystica of the upper end of the femur, not involving the head and neck - transplant placed in cavity. *Surg. Clin., Chicago*, 1913, ii, 785-805.
25. New, G.B.: Cystic odontomas. *Jour. Am. Med. Assn.*, 1915, lxiv, 34-39.
26. Percy, J.F.: Ostitis fibrosa cystica. Report of case. *Surg., Gynec., and Obst.*, 1913, xvi, 536-540.
27. Pfeiffer, C.: Ueber die Ostitis fibrosa und die Genese und Therapie der Knochencysten. *Beitr. z. klin. Chir.*, 1907, liii, 473-495.
28. Platon, E.: On osseous cysts and so-called giant-cell sarcoma. *Ann. Surg.*, 1918, lxvii, 312-330.
29. Von Recklinghausen, D.: Die fibrose oder deformirende Ostitis, die Osteomalacie und die osteoplastische Carcinose in ihren gegenseitigen Beziehungen. *Festschr. d. Ass. Virchow*, Berlin, 1891, 1-39.
30. Rehn, E.: Die Schnuffelkrankheit des Schweines und ihre Beziehungen zur Ostitis fibrosa infantilis des Menschen. *Beitr. z. path. Anat. u. z. allg. Path.*, 1908, xlv, 274-295.

31. Rindfleisch and Harris, T.: Eine melanotische Geschwulst des Knochenmarks. Arch. f. path. Anat., 1886, ciii, 344-354.
32. Ropke: Cited by Percy, loc. cit.
33. Silver, D.: The so-called benign cyst of the bones; report of a case simulating hip-joint disease; review of the literature; bibliography. Am. Jour. Orthop. Surg., 1911-1912, ix, 563-568.
34. Skinner, M.: On benign bone-cysts. Surg., Gynec. and Obst., 1915, xx, 571-576.
35. Virchow, R.: Ueber die Bildung von Knochencysten. Berlin, 1876, pp. 369-381.

LEGENDS

- Fig. 1. Case 1 (63924). Bone graft in position after excision of the diseased bone.
- Fig. 2a. Case 2 (176139). Osteitis fibrosa cystica. Sections taken from the margin of diseased area. (Low power). (a) Very vascular periosteum, (b) bone containing some cartilaginous cells, (c) fibrosis, (d) cells lining the bone margin, probably osteoclasts and osteoblasts, (e) blood cells, (f) cartilage cells.
- Fig. 2b. Case 2 (176139). Osteitis fibrosa cystica. (High power).
- Fig. 2c. Case 2 (176139). Osteitis fibrosa cystica of the left fibula in a girl aged 7 years. The diaphysis only is involved. Cortex and medulla are fused into a cystic mass showing fine trabeculations. Operation: Subperiosteal excision of upper third of fibula. Pathologic report: Osteitis fibrosa cystica.
- Fig. 3a. Case 3 (144401). Osteitis fibrosa cystica of the right radius with fracture. Cyst limited to the diaphysis. Operation: Bone graft used.
- Fig. 3b. Case 3 (144401). Osteitis fibrosa cystica. Bone graft in place. Roentgenogram taken two months after operation.
- Fig. 4. Case 4 (106074). Osteitis fibrosa cystica of the left tibia in a patient aged 11 years. Fractures occurred at the age of 1 and 5 years. The cystic areas are marked and invade the cortex as well as the medulla and are bulging out, causing deformity.
- Fig. 5. Case 5 (181807). Fibrocystic disease of the right humerus which had been operated on seven years before and infected, draining one year. The cortex is uniformly bulged and thin. Trabeculations are evident.
- Fig. 6. Case 6 (150574). Cyst of the left tibia. Communicating cysts found at operation. Recovery after operation - curettage.
- Fig. 7a. Case 7 (171941). Cyst of the cortex of the right humerus before operation. (Probably subperiosteal).
- Fig. 7b. Case 7 (171941). Right humerus six months after the removal of cyst.
- Fig. 8. Case 10 (219836). Left femur. Cystic degeneration (single). Medulla enlarged and cortex thinned. Trabeculations not typical of osteitis fibrosa, being heavier at the edge of the cyst and not running out into it; more like a rarefaction of bone from pressure, as in hemorrhage, etc.

History of trauma two years and a few days before. At operation the cyst was found to contain a mahogany colored fluid and a small blood clot.

- Fig. 9a. Case 11 (115150). Bone cyst of the right femur. Specimen taken from the thinned cortex. At operation the cavity was found filled with blood-tinged fluid and organized blood clot. The wound was curetted and cauterized. Three years and three months later the patient was reported well without evidence of deformity or recurrence. (a) Bone, (b) giant cell (one was found in four slides examined), (c) area of fibrosis, (d) blood vessel. (High power).
- Fig. 9b. Case 11 (115150). See Fig. 9a. (Low power).
- Fig. 10a. Case 13 (115338). General osteitis fibrosa cystica. Bone trabeculae and the fibrous connective tissue lying between. (Low power). (a) Bone trabeculae, (b) area of fibrosis, (c) cells along border of bone, probably osteoclasts and osteoblasts, (d) whorl of fibrous tissue about a blood vessel.
- Fig. 10b. Case 13 (115338). General osteitis fibrosa cystica. (High power). (a) Bone trabecula, (b) area of fibrosis, (c) cells along border of bone, probably osteoclasts and osteoblasts.
- Fig. 10c. Case 13 (115338). General fibrocystic disease. Coxa vara, fracture of femur and deformity. Thin cortex blending with medulla, the entire bone showing fine trabeculations.
- Fig. 10d. Case 13 (115338). General fibrocystic disease. Femur below site of fracture shows cortex thicker but invaded at several points by cyst.
- Fig. 10e. Case 13 (115338). General fibrocystic disease. Tibia and fibula. No line of demarcation between cortex and medulla in tibia and several well defined cysts in fibula.
- Fig. 11a. Case 14 (56898). General osteitis fibrosa cystica. (a) Bone, (b) fibrosis, (c) cartilage cell. (High power). This patient had been operated on seven years previously and the upper third of the right radius resected for what was diagnosed as giant-cell sarcoma. The second operation consisted of curetting and crushing in the wall of a cystic right tibia.
- Fig. 11b. Case 14 (56898). General osteitis fibrosa cystica. Trabeculations and thinning of the cortex of femur. Right humerus, femur, tibia, and radius involved.
- Fig. 11c. Case 14 (56898). General osteitis fibrosa cystica. Right humerus shows thinning of cortex and trabeculations.
- Fig. 11d. Case 14 (56898). General osteitis fibrosa cystica involving right tibia.

cystica

- Fig. 11e. Case 14 (56898). General osteitis fibrosa/cystica showing the resected right radius after seven years. The cystic changes in the lower end of the humerus are visible.
- Fig. 12a. Case 15 (119482). General osteitis fibrosa cystica. (a) Dense bone, (b) blood vessels, etc., (c) cartilage call in bone, (d) area of fibrosis.
- Fig. 12b. Case 15 (119482). Right femur. Non-union for twelve years. Cystic disease with trabeculation of medullary cavity and thin cortex. Notwithstanding this malposition and non-union, the patient was able to bear considerable weight on the leg.
- Fig. 12c. Case 15 (119482). Left femur. Results of a fracture fifteen years before. Bone cysts numerous about site of fracture. Cortex is not thin; medullary cavity is somewhat filled in. Treatment: Splints and cast.
- Fig. 12d. Case 15 (119482). Fracture of right humerus nineteen years previously. Old, perfectly healed fracture, multiple bone cysts and thinning of cortical bone.
- Fig. 12e. Case 15 (119482). Tibias and fibulae showing cystic disease. Cortex and medullary cavity cystic, seem to have lost their characteristic radiographic features; fused in certain areas.
- Fig. 12f. Case 15 (119482). Roentgenogram after the insertion of a Steinman peg through the os calcis and the application of extension; fragments loosened and a part of the upper bone excised. Position improved and lengthening obtained. Taken five weeks after first operation.
- Fig. 12g. Case 15 (119482). Roentgenogram of skull showing normal sella turcica. No evidence of cystic degeneration observed. Patient has plate in upper jaws.
- Fig. 13a. Case 16 (119483). Left femur showing ununited fracture in malposition after seven years. Multiple cyst formation. Pseudo-arthritis. Patient able to bear considerable weight.
- Fig. 13b. Case 16 (119483). Tibia and fibula showing longitudinal striae containing cysts. Involvement of both medullary cavity and cortex.
- Fig. 13c. Case 16 (119483). Right humerus showing healed fracture of upper third of fourteen years standing. Few cysts.
- Fig. 13d. Case 16 (119483). Cystic bone disease of left femur after operation. Was freshened and traction obtained by Steinman peg through os calcis.
- Fig. 14. Case 17 (41571). General fibrocystic disease. Right humerus showing fibrocystic change.

Fig. 15. Case 18 (156552). Cystic degeneration in the hand. Cystic formation in the fifth metacarpal and the proximal and middle phalanges of the fourth and fifth fingers. The contents of the cysts were found to be jelly-like at operation.

Meyerding.



Fig. 1 (Case 1 - 63924).



Fig. 2a (Case 2 - 176139).

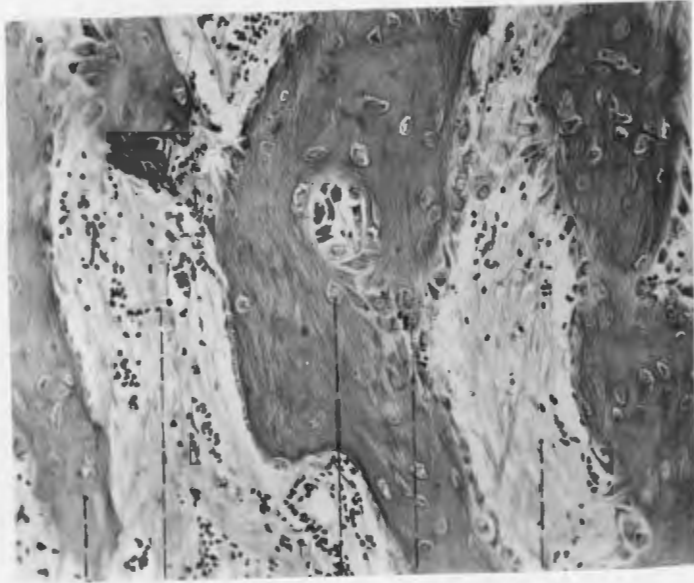


Fig. 2b (Case 2 - 176139).



Fig. 2c (Case 2 - 176139).

Meyerding.



Fig. 3a (Case 3 -144401).



Fig. 3b (Case 3 - 144401).



Fig. 4 (Case 4 - 106074).



Fig. 5 (Case 5 - 181807).



Fig. 6 (Case 6 - 155574).

Meyerding.



Fig. 7a (Case 7 - 171941).

Meyerding.



Fig. 7b (Case 7 - 171941).



Fig. 8 (Case 10 - 219836).

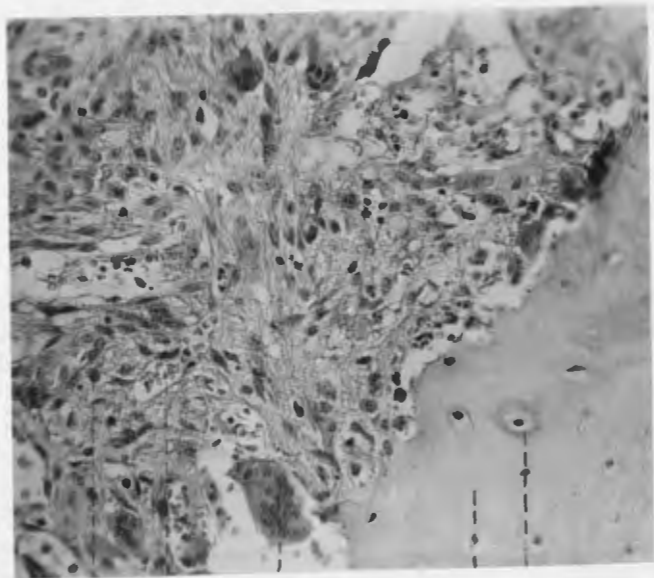


Fig. 9a (Case 11 - 115158).

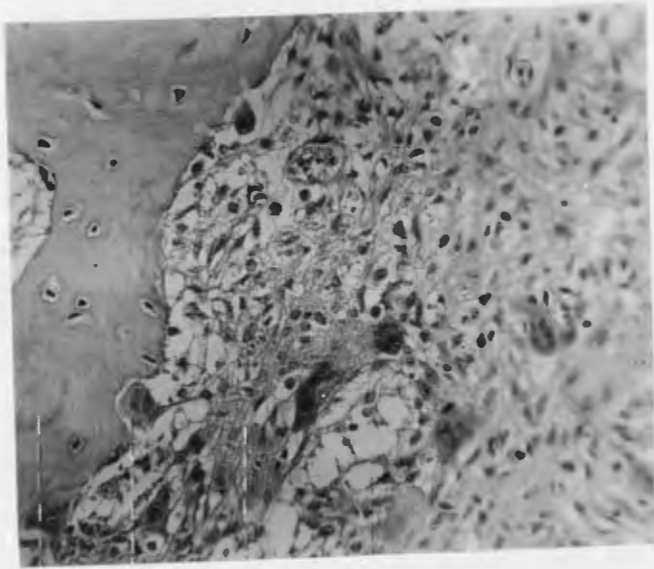


Fig. 9b (Case 11 - 115150).

Meyerding.

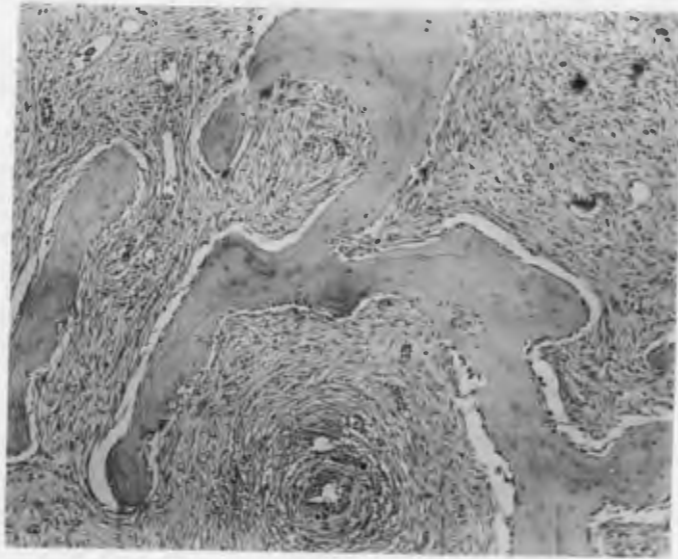


Fig. 10a (Case 13 - 115338).

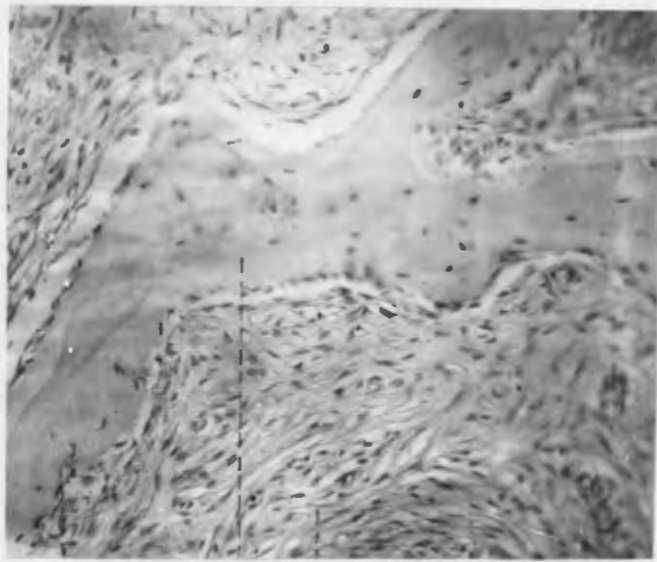


Fig. 10b (Case 13 - 115338).



Fig. 10c (Case 13 - 115338).

Meyering.



Fig. 10d (Case 13 - 115338).

Meyerding.



Fig. 10e (Case 13 - 115338).

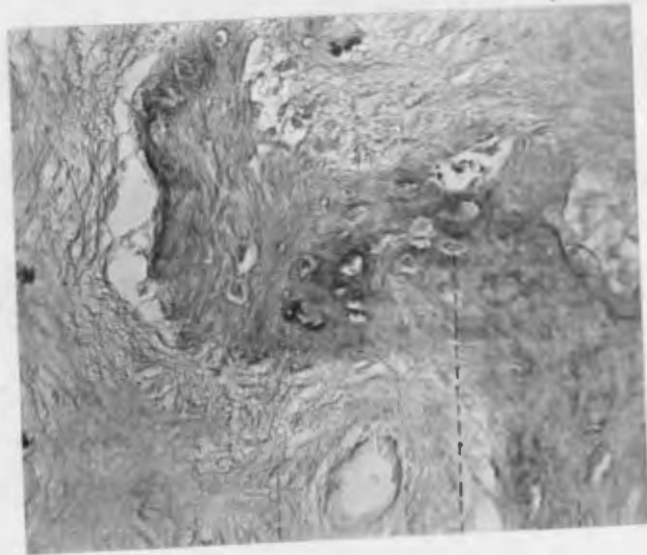


Fig. 11a (Case 14 - 56898).

Meyerding.



Fig. 11b (Case 14 - 56898).



Fig. 11c (Case 14 - 56898).



Fig. 11d (Case 14 - 56898).



Fig. 11e (Case 14 - 36898).

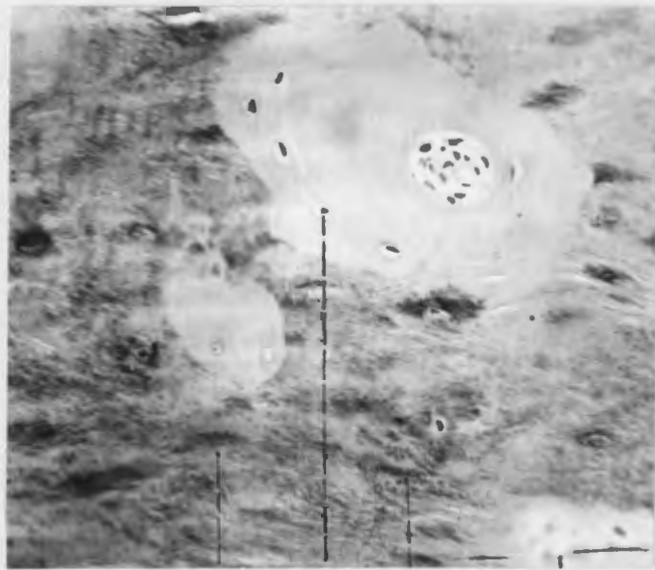


Fig. 12a (Case 15 - 119432).

Meyerding.

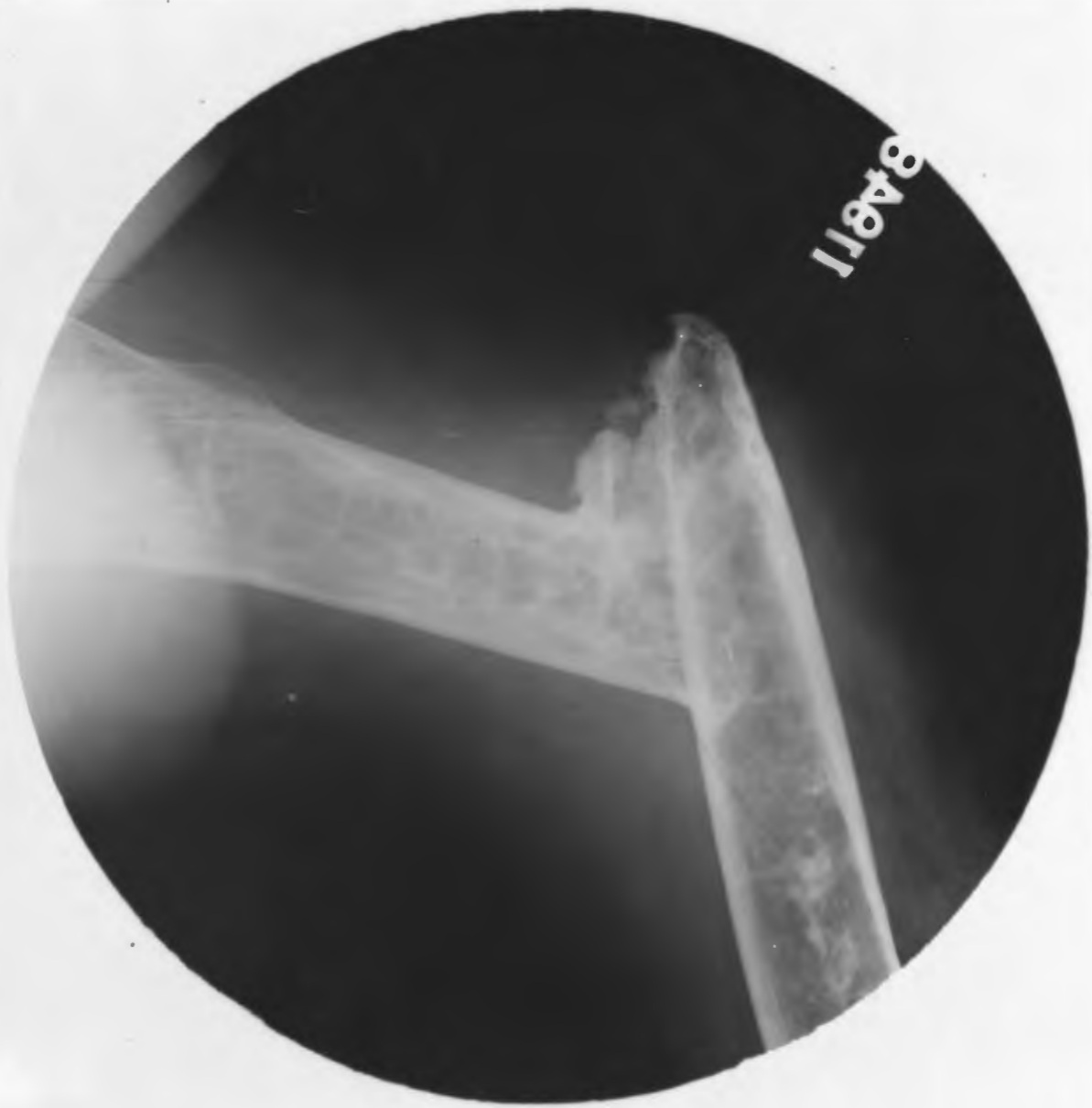


Fig. 12b (Case 15 - 119482).



119482

Fig. 12c (Case 15 - 119482).

Meyering.

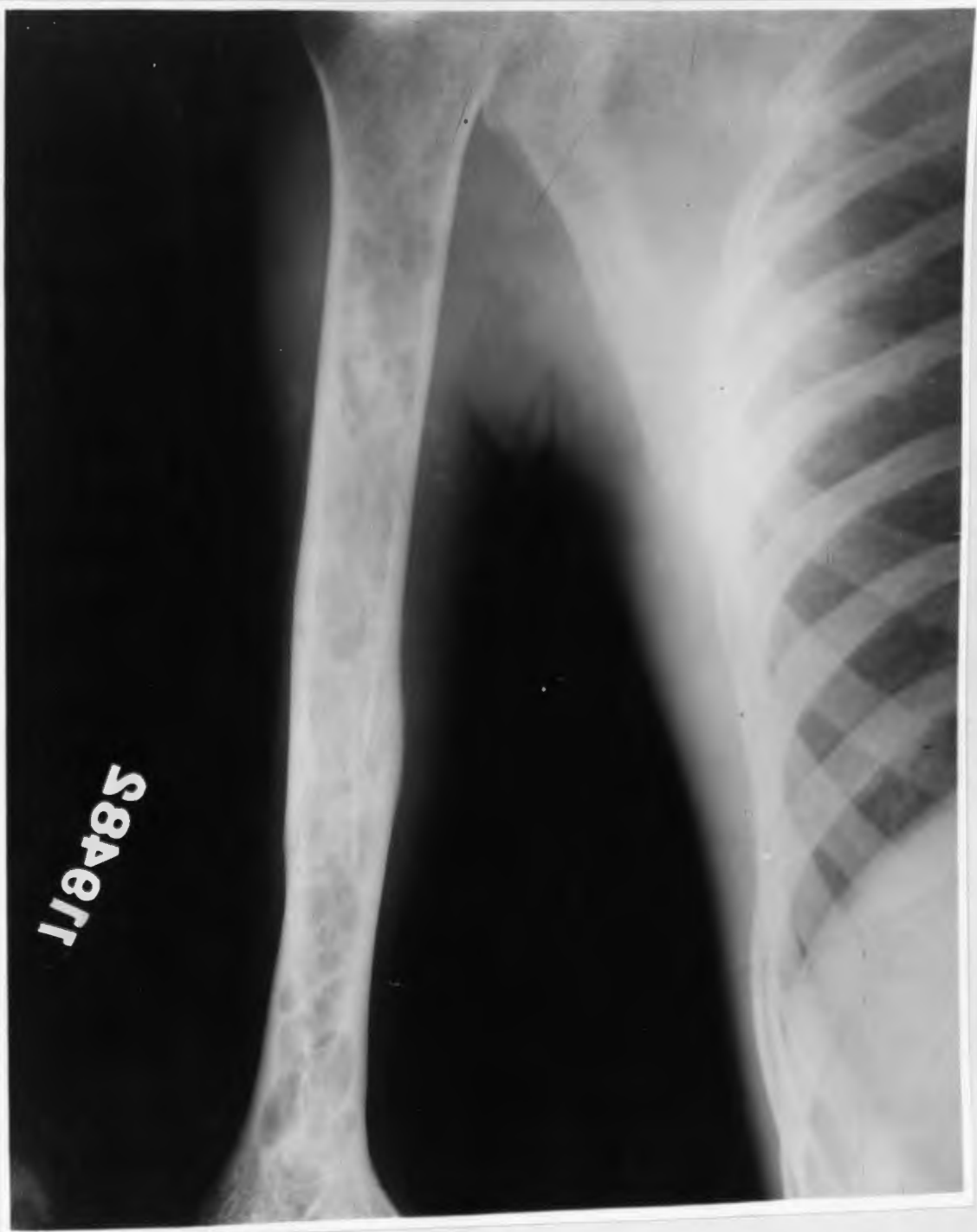


Fig. 12d (Case 15 - 119485).

Meyerding.



Fig. 12e (Case 15 - 119482).

Meyering.



Fig. 12f (Case 15 - 19482).



Fig. 12g (Case 15 - 119482).

Meyerding.



Fig. 13a (Case 16 - 119483).

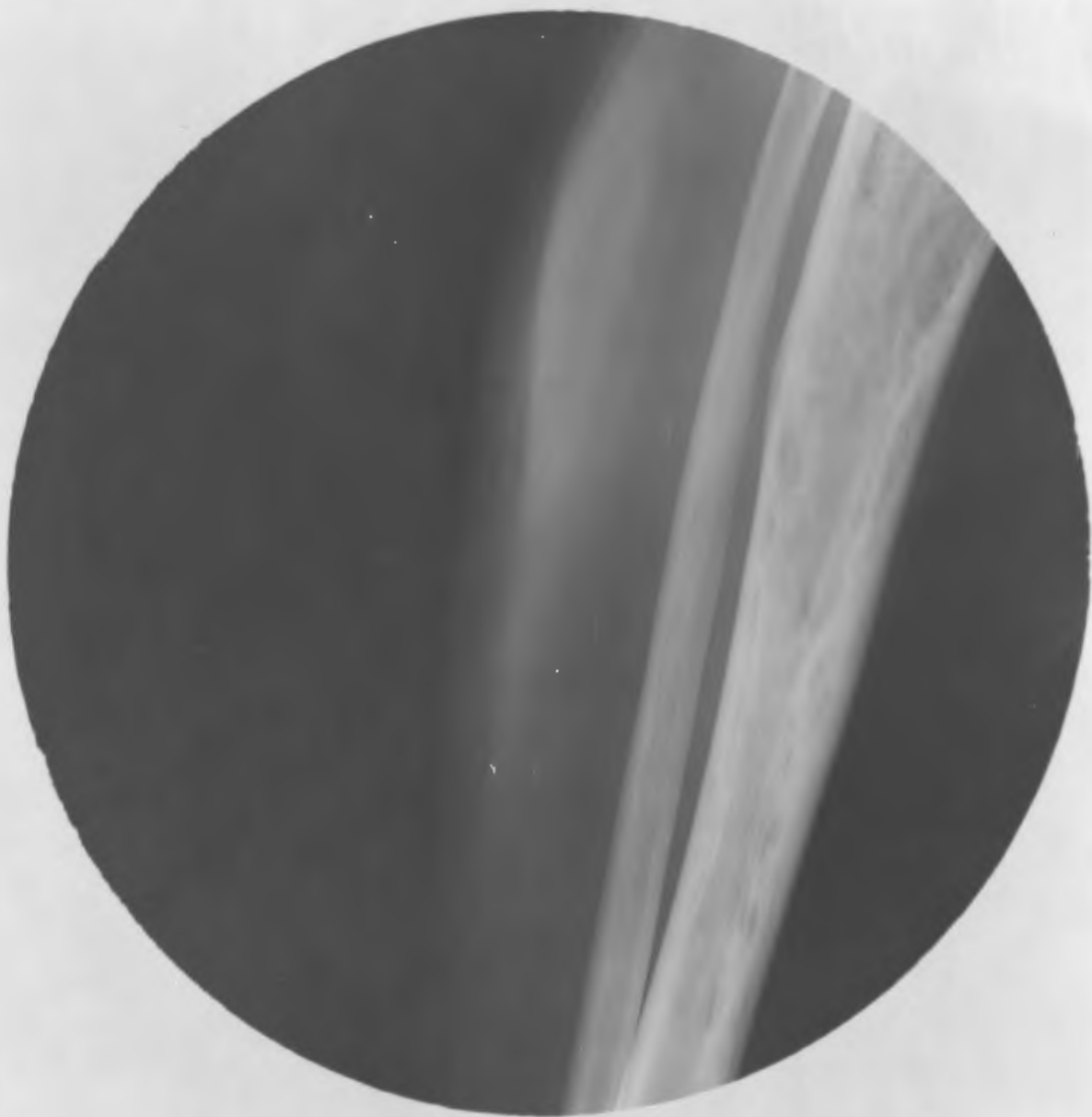


Fig. 13b (Case 16 - 119483).



Fig. 13c (Case 16 - 119483).

Meyerding.



Fig. 13d (Case 16 - 119483).

Meyerding.



Fig. 14 (Case 17 - 41571).



Fig. 15 (Case 18 - 156552).