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BONES
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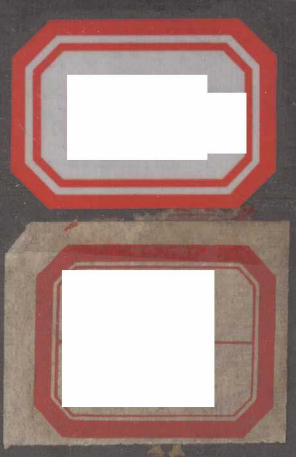

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PRACTICE OF SURGERY

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VOLUME II

HAGERSTOWN, MARYLAND

W. F. PRIOR COMPANY, INC.

1958

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PRINTED IN THE UNITED STATES OF AMERICA

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VOLUME II

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CHAPTER ONE

BONES

By S. L. Haas, M.D.

Bone, in addition to being a supportive and protective tissue, is to be considered as an organ when it contains red marrow. As such it offers the possibility for the source of the greatest variety of new growths of any organ of the body. All of its primary tumors are of necessity mesoblastic in nature and it is conceivable that they may arise as a benign or malignant growth at any stage in the development from the undifferentiated fibroblastic cell to the mature bone cell. In view of the fact that osseous tissue is especially active in its reparative response to injury and inflammation, it is not surprising that osteogenic tumors may show at times exceptionally active signs of growth.

The outer layers of the periosteum are composed of fixed fibroblastic cells and the tumors that take their origin from these cells remain fibroblastic throughout their development; while from the inner osteoblastic layers the true osteogenic tumors have their starting place. The other sources for osteogenic tumors are from the outer surface of the cortex, the haversian canals, the endosteum, the trabeculae, and possibly from osteoblasts that have escaped into the marrow.

Primary cartilage tumors may arise from the chondroblast during bone growth and repair, from the articular cartilage, and misplaced remnants of cartilage.

In the marrow cavity the marrow cells may be transformed into the various types of myeloma, while the associated fatty tissue may be the source of lipoma, and the blood vessels the starting point for angioma and endothelioma.

The benign bone tumors are easily classified as a rule according to their gross appearance or microscopical structure, but considerable confusion may arise in the case of the malignant osteogenic tumors.

The malignant tumors in which there is a rapid invasion in all directions give no clue as to the source of origin. Their cellular structure may be altered by the change in type of the original tumor. Thus a growth that arises from the undifferentiated osteoblastic cell may be entirely cartilaginous at first, but in time some of these cells may be transformed into osteoblasts and form osteoid and osseous tissue. Furthermore there may be degenerative and reparative changes on the part of the invaded bone and one may find intermingled with the tumor all kinds of tissue that are found in developing callus, from the organized fibrous tissue to bone. Because of the fact that callus may simulate tumor tissue it is easy to realize how difficult it would be in such a mixed picture to separate the various types of normal tissue from the true tumor. It is on this account that various descriptive names are often given to the same tumor by different pathologists and because of this confusion the entire group of malignant bone tumors is classified in the Registry of Bone Sarcoma under the one heading of Osteogenic Tumors. The classification of bone tumors and allied conditions, according to the Registry, is as follows:

Metastatic tumors of bone
Periosteal fibrosarcoma
Benign osteogenic tumors
Malignant osteogenic tumors
Inflammatory conditions
Benign giant-cell tumor
Angioma
Angiosarcoma
Endothelioma
Myeloma

The main difficulty and controversy is in regard to the osteogenic tumors and it is possible that the study of a larger number of tumors will afford a basis for a more definite division. With more frequent roentgenographic study of bone lesions it may be possible to diagnose sarcoma at earlier periods and specimens may be obtained showing the source and primary type of cell. The early exploration of pathological fractures and other bone lesions may reveal an osteogenic tumor in the early stages. The submission of all cases of bone sarcoma, with the necessary data and material, should be made to the Registry in order that more valuable information on bone tumors may be obtained.

The following classification is used here with the understanding that there are no set rules regarding the type of cell in the malignant osteosarcomata or definite corresponding clinical entities. It is believed that many tumors may be fitted into one or another of these groups, occasionally as a pure type, but generally because of the predominating cell-type:

Periosteal			
BENIGN	MALIGNANT	METASTATIC	UNCLASSIFIED
fibroma osteoma chondroma osteochondroma	fibrosarcoma (a.) fibroblastic (b.) osteoblastic osteosarcoma chondrosarcoma	chloroma	ossifying haematoma myositis ossificans
Medullary			
BENIGN	MALIGNANT	METASTATIC	UNCLASSIFIED
fibroma osteoma chondroma lipoma myxoma angioma giant-cell tumor	fibrosarcoma osteosarcoma chondrosarcoma liposarcoma myxosarcoma angiosarcoma endothelioma myeloma	carcinoma hypernephroma sarcoma	osteitis fibrosa cyst

OSTEOMA

True osteoma, in the sense of an independent progressive growth of osseous tissue not associated with an inflammatory condition, is rather infrequent. It is formed by direct proliferation of the osteoblasts or through the intermediate cartilage stage. Tumors arising from the periosteum are called exostoses, while those forming from the endosteum and projecting into the medullary canal are called enostoses.

Pathology.—It is difficult to distinguish the true osteoma from the irregular forms. Grossly, both show nothing to distinguish them from normal bone; and histologically, they are composed of the same type of cells. Osteoma may be composed of cancellous tissue (spongiosum), extremely dense bone (eburnated), (Fig. 1), (Fig. 2), or contain marrow spaces (medullary). There are several groups of false osteoma that are associated with inflammatory processes. In one of these they occur as flat flake or spur-like growths about the edges of sinuses, about chronically infected teeth or associated with some

metabolic disturbance, and are known as osteophytes. The sharp pointed projections from bones are called spurs, while the diffuse enlargements of the shafts usually due to periostitis or chronic osteomyelitis are known as hyperostoses. Microscopic examination shows the variation in structure conforming to the type of growth, although there is nothing abnormal in the character of the osseous tissue. In

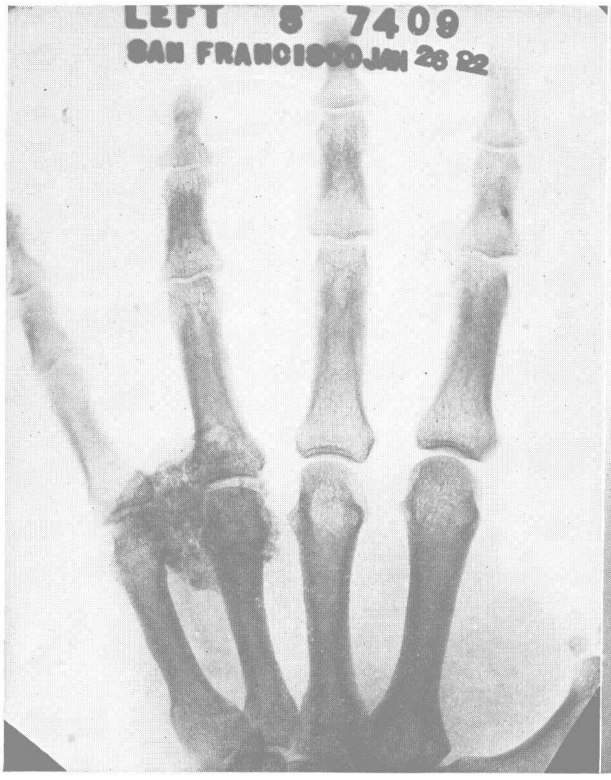

FIG. 1.—Osteoma spongiosum.

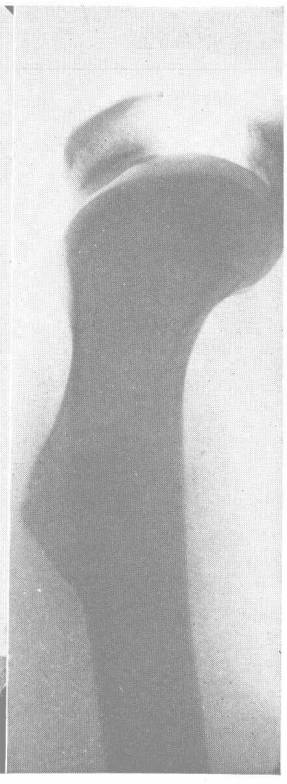

FIG. 2.—Osteoma eburnatum.

the true growing osteomata there may be a very active osteoblastic proliferation.

Symptomatology.—The majority of osteomata appear without symptoms and are recognized only when the tumors assume a large size or are discovered accidentally. The true osteoma found in the frontal sinuses or the maxillary sinuses often causes severe local and reflex symptoms (Fig. 3). It may cause pain when there is pressure on nerves, and paralysis when there is pressure on the spinal cord.

Osteoma may be detached spontaneously. Roentgen examination will reveal the size, origin and structure of the growth.

Diagnosis.—The diagnosis of true osteoma can be made from the history of a spontaneous growth, which is hard, circumscribed, with

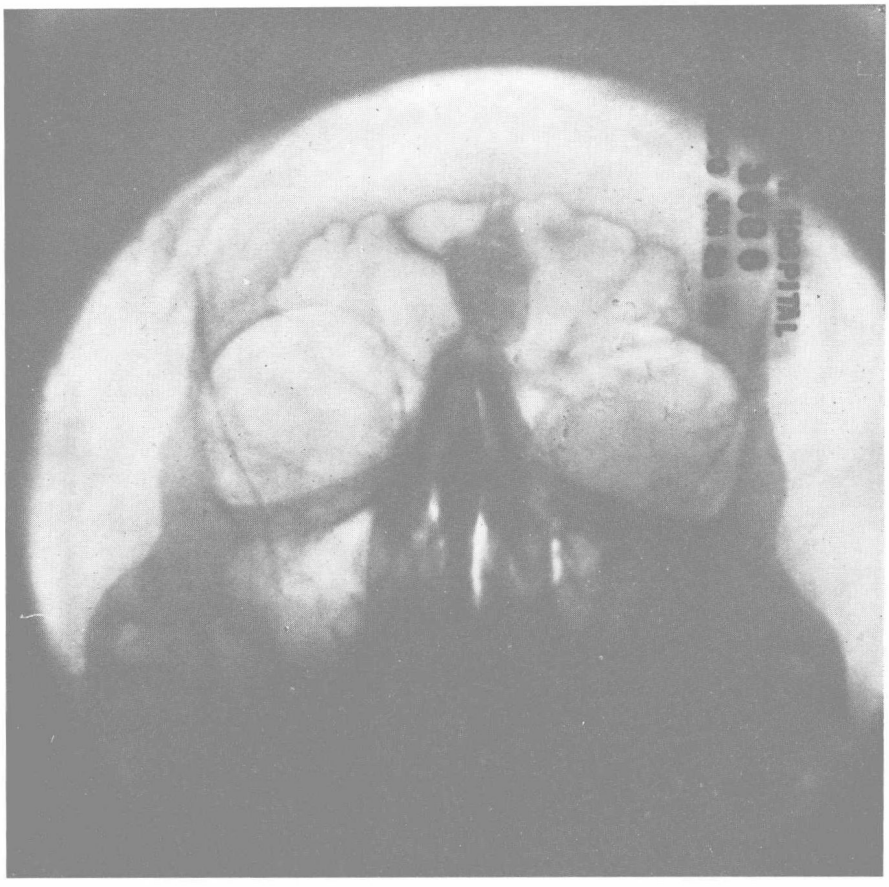

FIG. 3.—Osteoma of the frontal sinus. (Case of C. M. Cooper, M.D., San Francisco.)

slow increase in size and microscopically shows active proliferation of osteoblasts. The false osteoma is associated with inflammatory lesions, is limited in size and shows less active osteoblastic proliferation.

Treatment.—Operative interference is indicated when the tumors interfere with function, cause pain by pressure on nerves or sensitive regions, or when they are disfiguring. Osteoma seldom shows malig-

nant changes, but if there is a sudden rapid growth or a change in consistency the growth should be removed without delay.

CHONDROMA

Simple tumors may arise from cartilage wherever it is found in the body. If the outgrowth is limited it is called an *ecchondroma,* but if it is progressive or arises from tissue not normally containing cartilage it is called an enchondroma or true chondroma.

Ecchondroma

This is a small outgrowth from pre-existing cartilage.

Etiology.—The most frequent site for ecchondroma is on the chondrocostal junctions and it is thought that rickets may be the exciting agent. The common tumors which are found about the joint surfaces are due to the same causative agent, as is the chronic arthritis with which they are associated.

Pathology.—They appear as small, diffuse, smooth and nodular growths on the cartilage and have the same microscopical structure as the cartilage from which they take their origin. They may undergo ossification or calcification.

Symptomatology.—These tumors are discovered accidentally or when they produce functional disturbances, as in the joints. The growths that are found about the epiphysis of bones, about the symphysis pubis, intervertebral disc and the cartilage rings of the trachea and larynx may at times produce local disturbances.

Treatment.—Excision is indicated for the relief of painful symptoms or where there is interference in function.

Enchondroma

This is the progressive type arising from cartilage or tissue that is not normally cartilaginous.

Etiology.—Because of the fact that many of these tumors occur early in life and are situated where length growth is active, it is

thought that they are related to disturbances in development. Trauma, misplaced islands of cartilage, and rickets are all important factors in some cases.

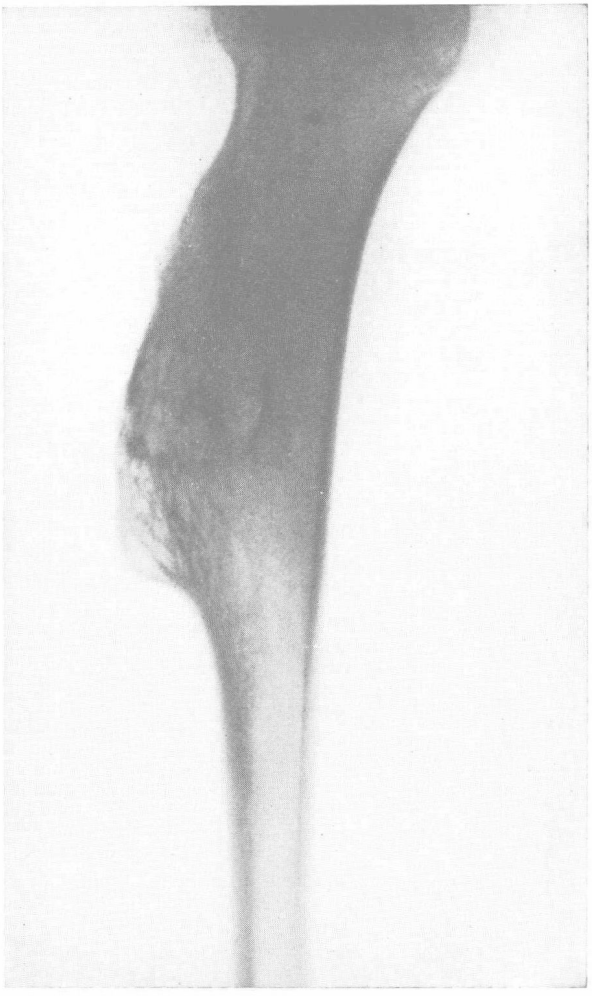

FIG. 4.—Osteochondroma of the upper end of humerus. (Shriners' Hospital, San Francisco.)

Pathology.—The tumors are lobulated, undergo slow steady growth even to a very large size, and are encapsulated. The capsule at times may become osseous. Chondromas may undergo cystic degeneration, become calcified or ossified, or change into sarcoma. The gross appearance is similar to the normal cartilage, but miscroscopic examina-

tion shows the cells to have a more irregular arrangement than the cartilage cells. There is a variable amount of intercellular connective tissue in which are found blood vessels, and associated lymphatics, differing in this respect from normal cartilage.

Symptomatology.—There is nothing significant in the clinical history except that the growth is generally discovered accidentally or after it begins to produce pressure symptoms. Large growths in the pelvis may cause disturbance in the intestines or in delivery in pregnant women. The tumors may be found on any of the bones, but the most frequent place is on the hands and feet. The multiple tumors associated with growth disturbance will be described separately as a definite clinical entity. The chondromas of the parotid, breast, uterus and other organs will not be discussed under bone tumors, as they are considered as belonging to another class of growths. The enchondroma arising within bone is not recognized until it causes an expansive enlargement of the shaft or until a pathological fracture takes place at the site of the growth.

Diagnosis.—The diagnosis of chondroma on the surfaces of a bone is at times quite difficult without the aid of the x-ray. The lobulated contour and the elastic consistency are helpful points. The roentgenogram shows the light shadow and the septa between the lobules.

The tumors within bone are often difficult to differentiate from cysts, myxoma, osteitis fibrosa, and at times from the giant-cell tumor. In the roentgen examination the septa are not so distinct and the divisions are smaller than in those of the giant-cell tumor. Cysts have a more distinct outline and are not lobulated.

Treatment.—The indications for operation are unsightly growths, pressure symptoms, disturbance in function, pathological fracture, or sudden rapid growth. The tumor should be widely excised with a thin layer of surrounding tissue and care should be taken that no particles are left in the surrounding tissue. Because of the fact that these tumors tend to recur, it is advisable to use the cautery or pure carbolic acid followed by alcohol after removal of the tumor. In spite of the fact that some of these tumors have the histological structure of normal cartilage they may recur and cause fatal metastasis.

MYXOMA

Myxoma is derived from mucous tissue. As there is no primary mucous tissue in bone, except perhaps in the bone marrow, it must come from embryonal mucous tissue or by a metaplasia or degeneration of cartilage. Many observers deny that myxoma ever occurs in bone.

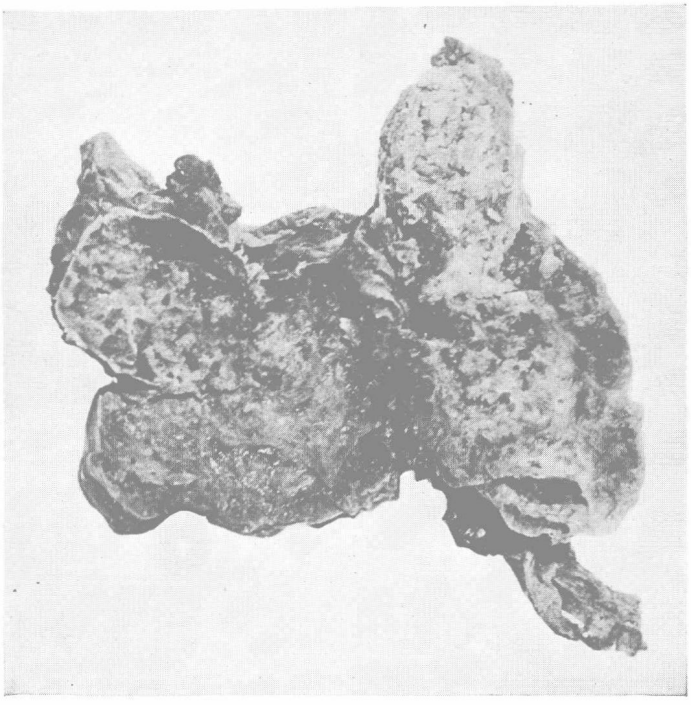

FIG. 5.—Chondro-myxo-sarcoma of rib. This tumor has the appearance of a myxosarcoma in the gross specimen.

Pathology.—A myxoma may form in the periosteum or within the medulla. It may be pure myxoma or associated with chondroma. The opponents to the conception of primary myxoma believe that it is a degenerative form of chondroma. The gross appearance is not unlike soft cartilage tissue and it is often impossible to recognize it except by microscopic examination. It is gelatinous and in appearance resembles white tapioca. The microscopic appearance is like myxomatous tissue found in other places: star-shaped cells with dendritic processes in a very light basophilic stroma. Myxosarcoma differs but little in structure, although it is more cellular and vascular.

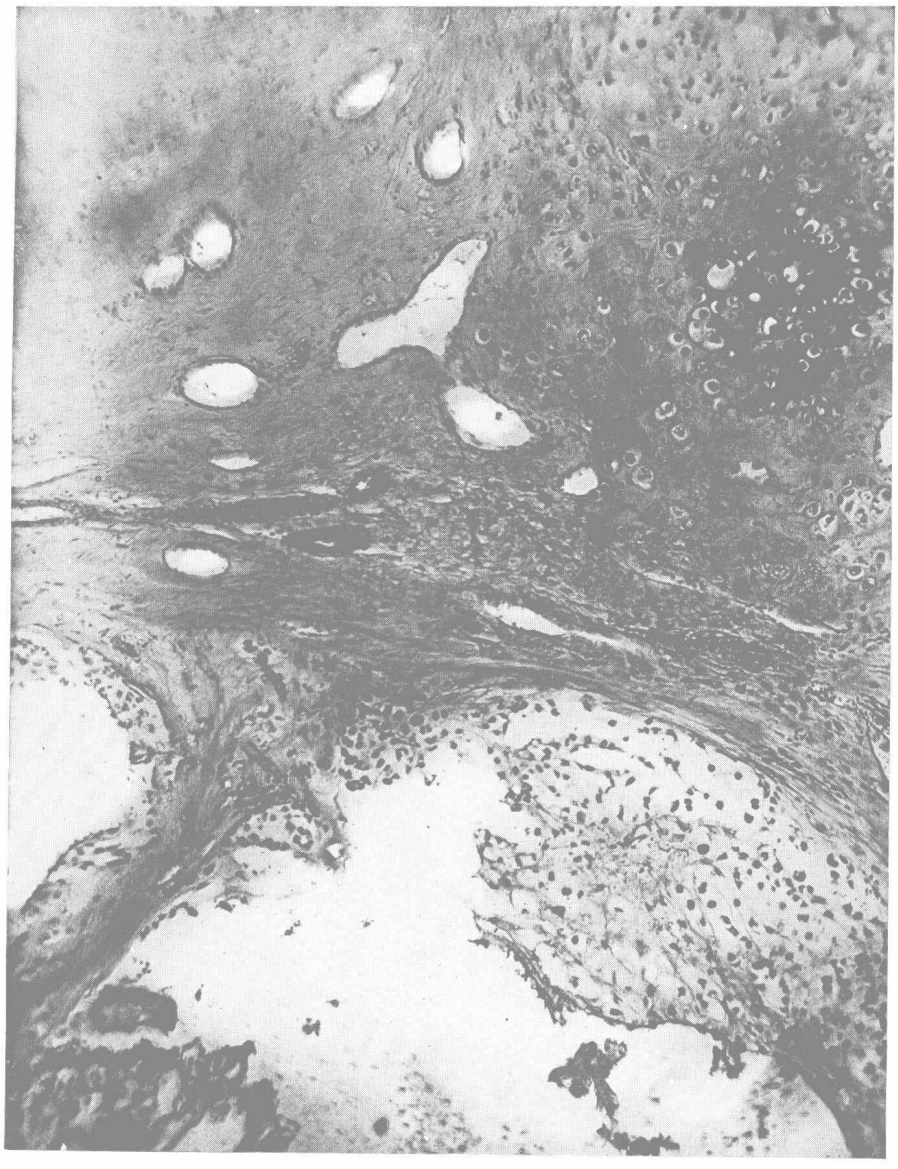

FIG. 6.—Chondro-myxo-sarcoma. This may be interpreted as a chondrosarcoma undergoing myxomatous change. The light myxomatous areas may represent very young, rapidly dividing cartilage cells rather than myxomatous tissue.

Symptomatology.—Pain is a rather prominent symptom and is often quite severe. This may be an aid to diagnosis if the x-ray picture is that of a benign lesion.

Differential Diagnosis.—Myxoma cannot be distinguished from chondroma without microscopic examination. Some of the lesions described as occurring in the phalanges resemble fibroma. Osteitis fibrosa may present a similar appearance and can only be recognized after gross and microscopic examination. The giant-cell tumor and early sarcoma may need exploration before a diagnosis can definitely be made.

Treatment.—Local excision, giving the tumor a wide margin, followed by the use of the actual cautery, offers the best hope of a cure. An exploratory incision should not be made, but if it is necessary, the wound should be cauterized. When the tumor is large and the integrity of the bone is endangered, resection and bone graft substitution is the operation of choice. Roentgen-ray or radium therapy may be tried and if regression and ossification does not take place operation is indicated. Radium implants or post-operative x-ray therapy may be used as a safeguard against recurrences.

Prognosis.—A guarded prognosis must be given in any tumor with a myxomatous structure because of the tendency to recur or to produce early metastasis.

BONE CYSTS

True bone cysts are found in the medullary cavity usually as single lesions. Bone cysts may be secondary to enchondroma, myxoma, giant-cell tumor and some of the bone diseases.

Etiology.—A history of trauma is often obtained and it is possible that it is secondary to a haemorrhagic area.

Pathology.—The cyst appears as a distinct cavity within the bone. It may or may not have a distinct lining. When a lining is present it is firm and strips easily from the bone. There may be white granular deposits of calcium salts on the surface. The content of the cyst is a fluid containing some degenerated blood cells, but not blood as is the case in malignant bone cysts. Microscopic examina-

tion reveals a fibrous capsule to the cyst, outside of which there is an area of osteitis fibrosa. In some cases there are giant cells.

Symptomatology.—Bone cysts generally occur before the age of twenty and are of slow growth. The cyst is generally unrecognized

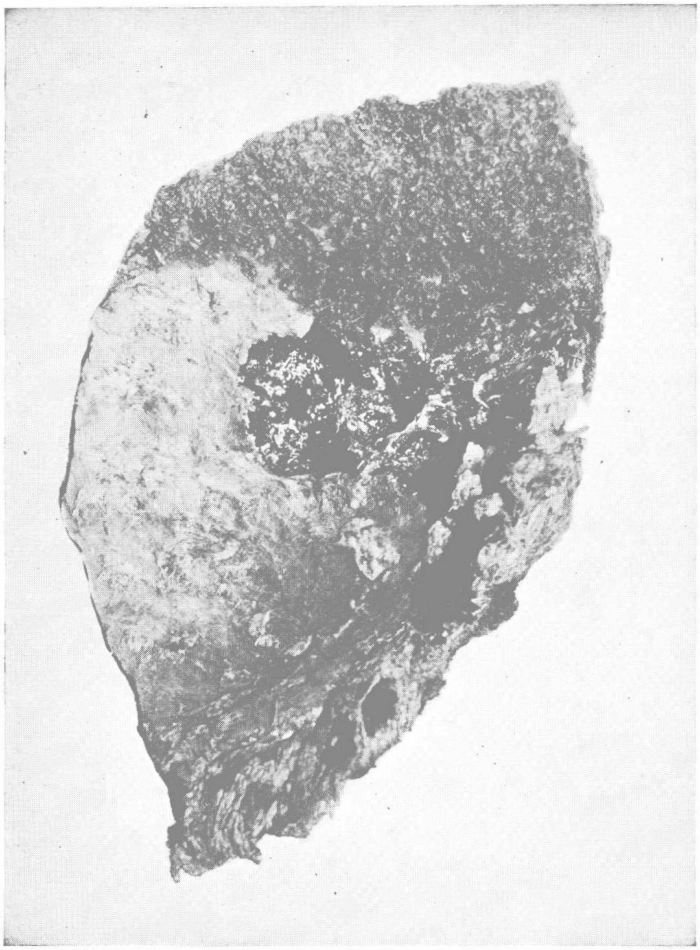

FIG. 7.—Cysts of the ilium. Chondroma and giant-cell tumor must be considered in the differential diagnosis. (E. C. Bull, M.D., San Francisco Hospital.)

until a pathological fracture takes place, although in some instances pain may be a prominent symptom. The roentgenogram is usually quite characteristic, although other lesions may resemble it.

Diagnosis.—Bone cysts must be differentiated from condromas, myxomas, giant-cell tumors, and Brodie's abscess. Chondromas are