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RÉSUMÉ

Il n'existe aucune épreuve permettant de vérifier la durée de désintégration d'un médicament dans le système gastro-intestinal et, de là, son absorption dans l'organisme. Les auteurs s'accordent pour affirmer que les épreuves *in vitro* sont loin de correspondre dans bien des cas aux processus physiologiques, et que le meilleur moyen d'établir le taux d'absorption chez un sujet est de mesurer l'excrétion urinaire. Certaines épreuves pratiquées sur des comprimés de riboflavine enrobés de sucre, grâce à un appareil reproduisant les mouvements péristaltiques par l'entremise de disques de caoutchouc, montrèrent que les pilules dont la désintégration prenait plus d'une heure étaient incomplètement absorbées. (Elles étaient exposées à une solution de suc gastrique pendant 30 minutes et à une autre solution de sécrétions intestinales pendant 30 autres minutes.) Les mêmes tests répétés sur du para-amino-salicylate de sodium donnèrent des résultats semblables. Il existe une grande quantité de médicaments dont la présentation est censée assurer une désintégration à retardement. Après vérification, il appert que les temps de désintégration des fabricants ne correspondent pas à ceux que les auteurs de ce présent article ont trouvés; de plus, il se peut que la majorité de ces produits ne soit qu'imparfaitement absorbée. En dépit des objections que formulent les fabricants à l'égard de la méthode d'évaluation précitée, les auteurs ne voient aucune raison de ne pas appliquer intégralement leurs conclusions aux comprimés enrobés comme à ceux qui ne le sont pas. A mesure que les données s'accumulent, il semblerait qu'un nombre de médicaments sont absorbés et excrétés d'une façon semblable à celle de la riboflavine et du para-amino-salicylate. M.R.D.

AGING AND OSTEOARTHRITIS

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DESPITE THE EXTENSIVE LITERATURE on osteoarthritis our present knowledge of this disease is still unsatisfactory. All writers on osteoarthritis agree that pain is the most characteristic symptom in this disease. It is common knowledge, however, that pain may be an unreliable symptom in some cases. Clinical signs of osteoarthritis are very scanty. Such signs as stiffness and rigidity are typical of osteoarthritis if they are present, but there are many cases of this disease in which all objective clinical evidence is completely lacking. The situation regarding pathological signs is only a little better. In osteoarthritis, the bones, synovial membranes, and cartilages present a typical macrostructure and microstructure, but these can of course be seen only after death. In living man, only radiography may enable us to detect initial or advanced signs of osteoarthritis and to follow the progress of the disease over a period of time. The following radiographic signs are generally recognized as typical of osteoarthritis: exostoses, lipping in various stages of development, calcification of joint cartilages, ligaments, joint capsules or soft tissues in the vicinity of the joint, narrowing or disappearance of the radiological joint and the intervertebral spaces due to degeneration of cartilage, and osteoporosis of various grades. At first sight, it would seem that the diagnostic problem of osteoarthritis is very easy to solve in the presence of so many radiographic signs, but this simplicity is only apparent. Only recently, Lowman[18] has written the following:

> "Roentgenographs (of osteoarthritis) are of value as confirmatory evidence of clinical symptoms. Since 95% of persons with evidence of degenerative joint disease are asymptomatic, the demonstration of changes roentgenologically is of no significance *per se*. Furthermore, the extent of damage demonstrable by x-ray examination is no measure of joint incapacity since major changes may be dissociated with minimal clinical symptoms and vice versa. Total clinical evaluation is the only valid yardstick for management of the individual patient. In other words: roentgenographic signs (i.e. morphological evidence) are of value only when they agree with the clinical diagnosis."

This astonishing quotation from a modern paper shows the present scientific deadlock in the clinico-pathological concept of osteoarthritis.

The relation of osteoarthritis to aging is also very confusing. According to the curve (Table I, adapted from Junghanns[16]), the frequency of osteoarthritis of the spine increases with age, so that everyone is likely to be affected with this disease in the sixth decade of life. Junghanns's opinion is supported by the majority of writers on this subject. There are, however, authors who disagree with the tendency to make every aging person osteoarthritic. As far back as 1877, Weichselbaum[24] pointed out that it is wrong to consider all bone changes in aging man to be pathological. He asserted that there are bone and tissue changes typical only of aging. Also, in the modern literature we find authors who support Weichselbaum's view, e.g. Albright,[1] Bick,[6] Cobb,[12] Cowdry,[14] Veraguth[23] and others. Although all the above authors

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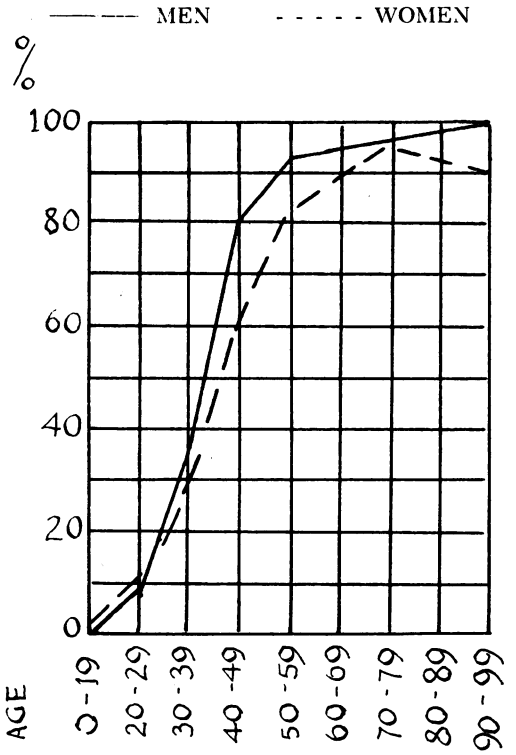
Based on a paper read at the meeting of Quebec Society for Orthopædics and Traumatology, November 19. 1955.

TABLE I.—FREQUENCY OF SPONDYLOSIS DEFORMANS IN MEN AND WOMEN IN VARIOUS AGE DECADES (H. JUNGHANNS)



described changes in bone and soft tissues due to aging very thoroughly, they do not attempt to draw a borderline between the normal and pathological in roentgenographical and other signs of the aging process.

As already mentioned, in osteoarthritis the bone changes are accompanied by several, mostly degenerative, changes of soft tissues. Because of this degeneration, osteoarthritis is called degenerative osteoarthritis, degenerative joint disease, and other similar terms by some authors (see Comroe's *Arthritis*[13]). The adjective degenerative does not explain, however, either the etiology or the pathological anatomy of osteoarthritis. In his *Textbook of Pathology*, MacCallum[19] writes the following about degeneration:

"The term degeneration is usually employed to indicate the effect of an injury sufficient not to cause a death of the cell but to disturb its metabolism to such a degree that the raw material or the products of its activities accumulate in it. . . . It would seem desirable, if possible, to abandon the term degeneration entirely and to use others which refer more accurately to the disturbance in metabolism or to the actual injury of the cell. But even if attempted, it would probably be unsuccessful, for the words are so deeply rooted and express so concisely a complex and obscure idea."

The term degeneration is still more misleading when applied to the process of aging. There is no doubt that the aging changes in bone are accompanied by degeneration of cartilages, synovial membranes, etc. It would be wrong, however, to consider such a degeneration as a sign of disease typical of bone aging. In 1942, Bennet, Waine and Bauer[5] published results of the examination of knee joints in persons of various ages who had died incidentally. These authors found that the first signs of degeneration appear as early as in the third decade of human life. According to their data, there is only a quantitative difference between the degeneration found in a man of 30 and that of an octogenerian. Conclusions of Bennet *et al.* were later confirmed by other authors. Thus the degeneration of soft tissues including cartilage is no prerogative of old age alone. Therefore, such a degeneration is neither the cause nor the consequence of bone changes in old age.

In view of this controversy, we decided to undertake a morphological study of bone aging, and especially a study of the relationship between bone aging and osteoarthritis. This study began in 1951 and was at that time supported by a grant from the Atkinson Charitable Foundation. It is now supported by a grant from the Canadian Rheumatism and Arthritis Society.

MATERIAL AND METHODS

Five hundred inhabitants of Homes for the Aged in Ottawa and ambulatory patients have been repeatedly examined since 1952. Around 560 skeletons from collections of the Western Reserve University Medical School in Cleveland, the University of Toronto and the University of Ottawa have been used for this study. Skeletons (mostly spines) of 15 dogs in the second decade of life have also been examined, and finally, several bones of cats and rabbits.

Individuals of both sexes, mostly over 60, were chosen for this study.

Hands (i.e. phalanges, metacarpal and carpal bones, carpo-radial joint) and elements of the vertebral column have been the principal subject of examination up to the present but we have recently also started the examination of other joints.

In living persons, the following clinical signs were considered along with the collection of usual anamnestic data: posture, constitution, amplitude of joint movements, tenderness of spine and joints during movements, walking, etc.

Two principal methods were used for this study: macroradiography (synonyms: radiography, roentgenography) and historadiography (synonyms: historoentgenography, microradiography, microroentgenography). Macroradiographs in various projections of x-rays and in different positions of patients and dead material were repeatedly made of all bones and joints mentioned above.

Dead bones were also examined by historadiography. In preparation for this method, genuine (undecalcified) bone is cut into pieces of various thicknesses after embedding in plastic. Bones are now sectioned with a special bone microtome made for this purpose by the R. Jung Co. in Heidelberg, West Germany. With this microtome it is easy to get slides of 5 micra and up. The material is embedded by a method recommended by Bélanger and Bélanger.[4] Slides of bone are put on a special fine grain emulsion with which Eastman Kodak plates 649-0 or Gevaert Lippman T.V. films are coated. Radiography of bone slides is performed by soft x-rays (10-12 kV.). After the usual processing, historadiographs are studied under the ordinary microscope at various magnifications.

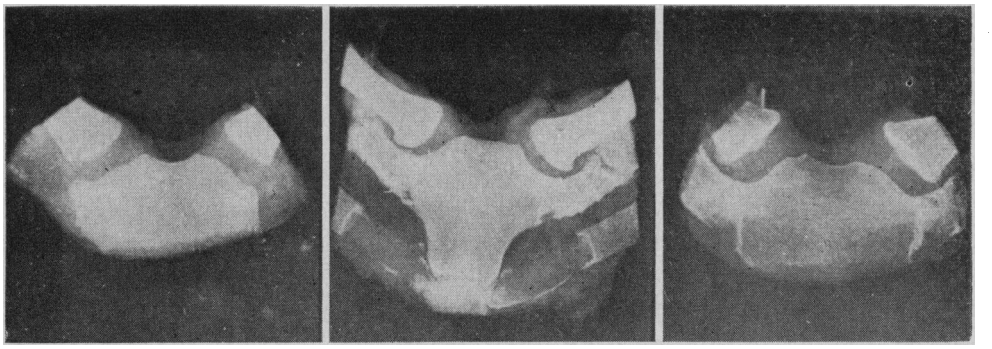


Fig. 1.—Macroradiographs of manubrium sterni with clavicle heads at different ages. (Left to right: male 28, female 48, male 70). Progressive decrease in calcium content with age is conspicuous. (All reproductions of this article are original negatives, therefore decrease in calcium content is manifested by darker colour and increase in content by lighter one.)

The advantage of historadiography in the study of bone is obvious: it permits the study of genuine, undecalcified bone. There are, indeed, many bone conditions which are only characterized by increase or decrease in the amount of calcium. These deviations in calcium content cannot be investigated by the usual histological method, since this requires previous decalcification of bone with all the drawbacks of the latter process. The disadvantage of historadiography is that it is not at present possible to achieve a magnification of more than × 300. The technique of historadiography is, however, improving as each month passes, and there is no doubt that greater magnifications will soon be possible. The technique of historadiography has been thoroughly described in the papers of Barclay,[2, 3] Bohatirchuk,[8-10] Clark,[11] Egström,[15] Lamarque,[17] Mitchell,[21] Sievert[22] and others.

Gross pathology of autopsy material (preferably of spines and hands) has been studied in several cases.

Macroradiographic and historadiographic studies of skeletons of the above-mentioned animals have been made only with dead material.

RESULTS

It was found that between 60 and 70% of old people examined did not complain of any bone and joint ailments. These people considered their muscular stiffness, relatively quick fatigue, limited amplitude of joint movements, even occasional pain or discomfort during these movements, to be quite normal and a necessary attribute of their age. At any rate, these people never complained to a physician about these symptoms, and their bones and joints did not present any obvious abnormalities when inspected or palpated. It is quite justifiable, in our opinion, to regard these aging persons as "asymptomatic".

Macroradiographs of all these asymptomatic persons revealed, however, some radiographic signs, which, as mentioned before, are generally considered typical of degenerative osteoarthritis.

All radiographic signs observed by us in aging asymptomatic persons might be divided into two categories: atrophic (osteoporotic) and hypertrophic (called by some authors osteosclerotic).

Calcium decrease in bone was observed in aging people in the sixth decade. In the seventh decade osteoporosis became quite conspicuous, i.e. not only was x-ray absorption in bones diminished but also morphological signs of bone atrophy came to view. The number of trabeculæ diminished, compact bone was thinned and small cavities in spongy bone appeared. Evidently the atrophic process in aging bones progresses very slowly, because even in the tenth decade of human life we have observed bones which apparently did not lose more than 15-20% of their calcium content, i.e. that content typical of an adult bone. This aging bone atrophy is apparently an irreversible process because we have not seen a single case in which the previous content of bone calcium could be restored by any known means. Women in the study presented a more conspicuous picture of osteoporosis than men (Fig. 1).

A similar atrophic process was found in bones of aging dogs, the only difference being that in dogs bone atrophy was observed earlier (in the second decade of life).

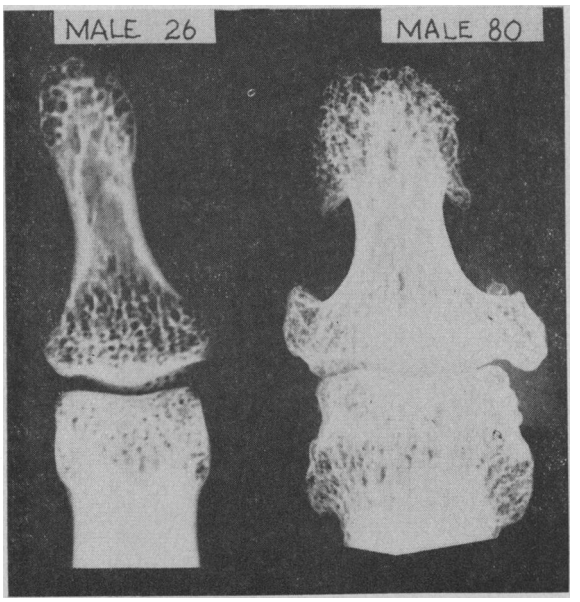


Fig. 2.—Macroradiographs of end phalanges of young (26) and old (80) men. Explanation in text.

Bone hypertrophy was observed in radiographs of bones of all persons late in the fifth decade, sometimes even earlier. The roughness and unevenness of outlines were the first radiographic signs; exostoses and small lippings came to view in later life. The "mushroom sign" described by us[9] was found, as well as calcifications in tendon attachments, rib cartilages, etc. (Fig. 2).

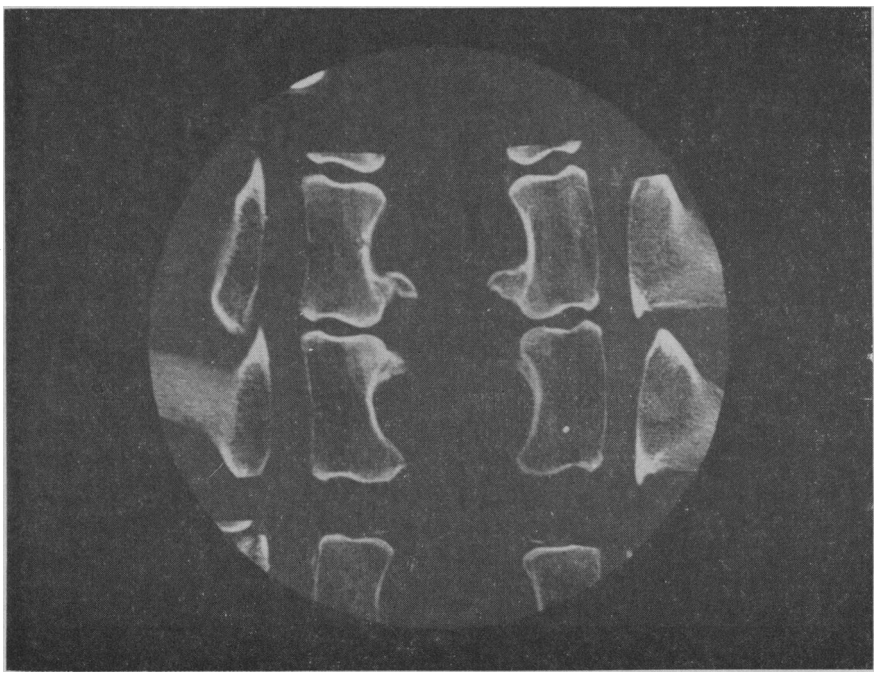


Fig. 3.—Macroradiograph of hypertrophic and atrophic changes in vertebræ of an aging dog.

Similar hypertrophic bone changes were also encountered in dogs in the second decade of life (one or two years earlier than atrophic changes) (Fig. 3).

Atrophic and hypertrophic processes developed in normally aging bone about equally, or else with one of the two processes slightly predominating, but we have never observed such an obvious disproportion between atrophy and hypertrophy in normal bone aging as we have seen in pathological cases (see below).

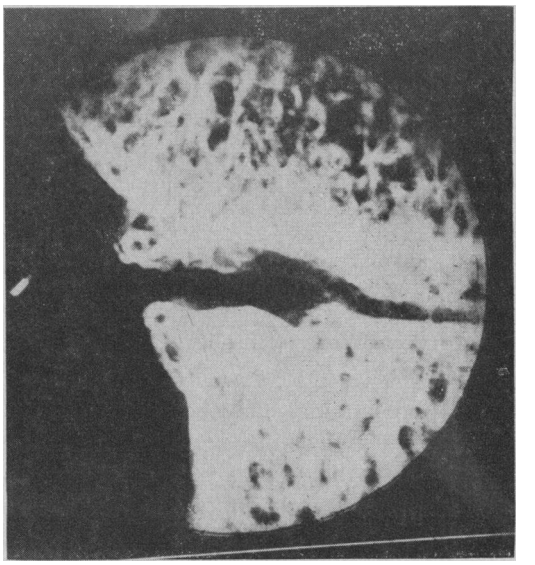


Fig. 4. — Macroradiograph of pathological osteophytes in phalangeal joint.

In contrast with normal aging signs, described above, some of the old persons had radiographic changes in their bones and joints which we consider to be pathological. The majority of these also had such symptoms as permanent pain, very considerable rigidity of spine and joints, swelling in the area of joints, or Heberden and Bouchard nodes. We say "the majority" because a minority of these aging persons had no conspicuous clinical symptoms

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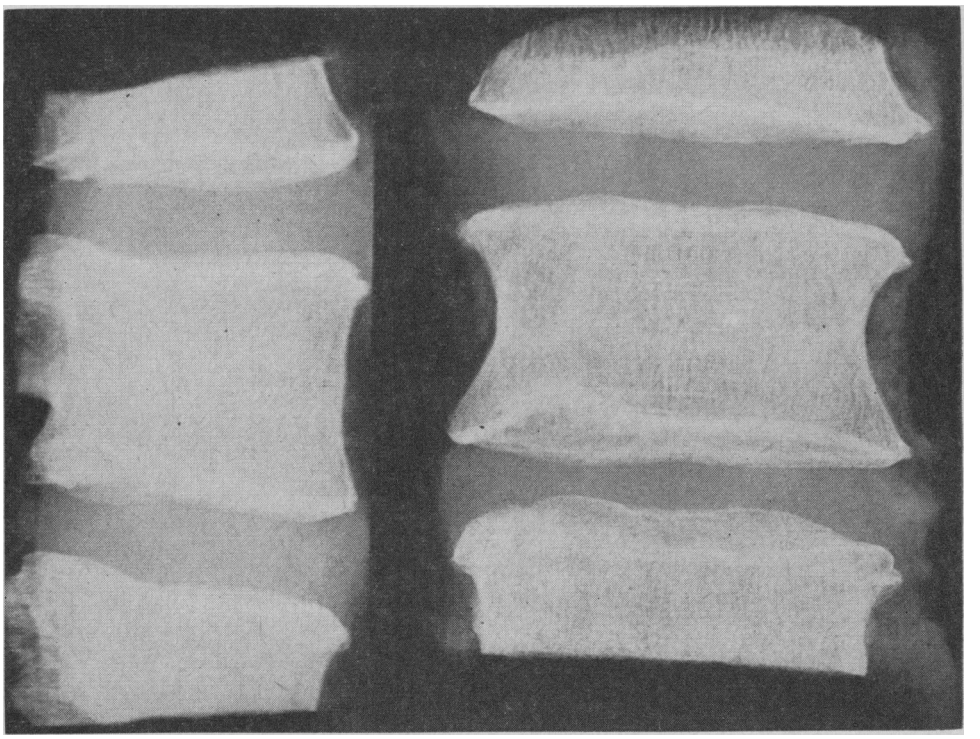

Fig. 5.—Macroradiographs of vertebral bodies in man of 70. Disharmony between the development of prevailing atrophy and hypertrophy is conspicuous. The initial stage of compression fracture with calcium impregnation in the middle part of the vertebral body is seen.

despite quite obvious morphological changes in bones. The previously cited opinion of Lowman[18] is evidently applicable to these people with a demonstrable disproportion between clinical and radiological signs. Aging persons with pathological signs we propose to call "symptomatic". These signs may be clinical plus morphological, only clinical, or only morphological.

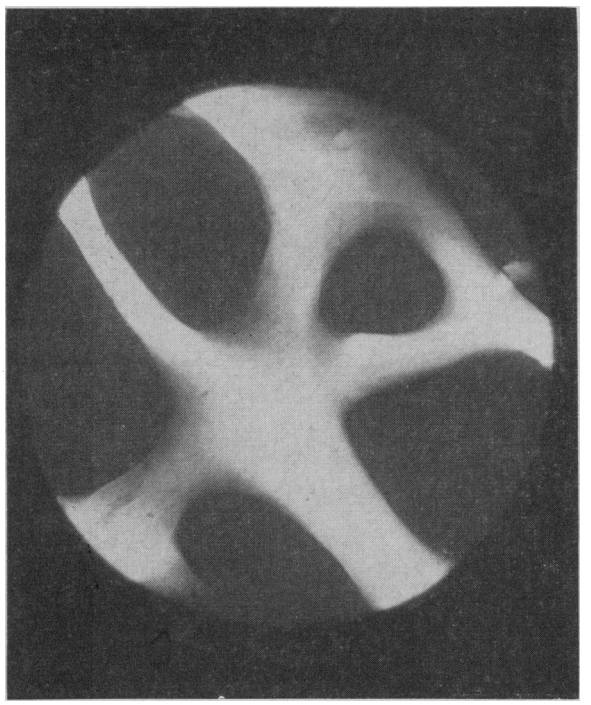

Fig. 6.—Historadiograph (× 35) of adult bone.

In these "symptomatic" persons the following roentgenographic signs were found.

(a) Much more pronounced lipping than in normal aging people. In advanced cases, even complete fusion of neighbouring lippings was encountered (the latter fusion has been found more frequently in the vertebral column).

(b) Exostoses were observed not only at the periphery of the epiphysis but also in the area of the joint surface. We call these abnormally placed exostoses "pathological". Deposits of calcium salts were often seen on the periphery of such exostoses. Outlines of pathological exostoses (called "osteophytes" by some authors) are mostly irregular (Fig. 7).

(c) Numerous calcifications were seen in intravertebral discs, joint cartilages and joint capsules. In contrast to normal aging, we have never observed extensive calcification of rib cartilages in pathological cases.

(d) Disproportion between bone atrophy and bone hypertrophy was quite conspicuous. In cases with prevailing hypertrophy, bone atrophy either did not develop at all or developed very

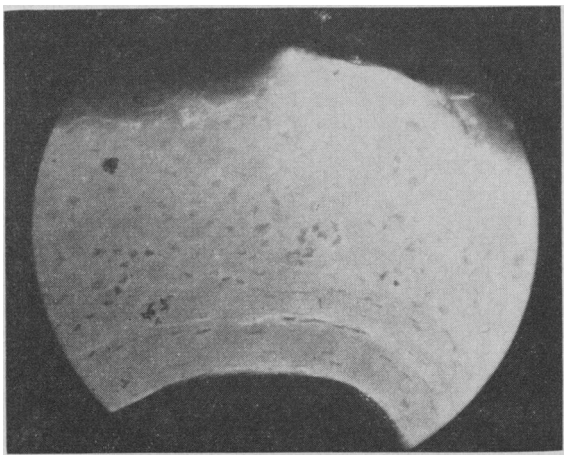

Fig. 7.—Historadiograph of aging bone (× 256); confluent intraosseous lacunæ in the centre of the picture.

moderately. The reverse picture was observed in cases with prevailing atrophy (Fig. 5). In a few cases of extreme osteoporosis, x-ray absorption by bones was equal to that in surrounding soft tissues (so-called "papyraceous" bones). Patients with such osteoporosis (mostly women) were bed-ridden and had very pronounced symptoms. Some authors prefer to separate this group of extreme osteoporosis into a special nosological entity, calling it "senile osteoporosis" (Black *et al.*,[7] Marum[20]). In such cases we have seen excessive decrease in the number of bone trabeculæ, and almost complete disappearance of compact bone simultaneously with development of big cavities in spongy bone. In some cases, compression fractures (mostly of vertebral bodies) were found (Fig. 5).

Historadiographs show no considerable difference as regards x-ray absorption between adult and normally aging bone (Figs. 6, 7). The decrease in calcium content especially in the initial stage of aging atrophy is usually detectable only photometrically. As has been pointed out in our previous publications,[9, 10] historadiographs present, however, quite a typical morphological picture in the case of aging bone atrophy: an increase in size of intraosseous lacunæ, resulting sometimes in fusion of neighbouring lacunæ, a much more pronounced bone destruction around Howship's lacunæ than in adult bone; sometimes even almost complete decalcification of some trabeculæ. The enlargement of intraosseous lacunæ in cases of bone atrophy is especially important for understanding the mechanism of bone atrophy. This observation brings forward again the old theory of halisteresis which emphasized the role of the intraosseous lacunæ in this mechanism.

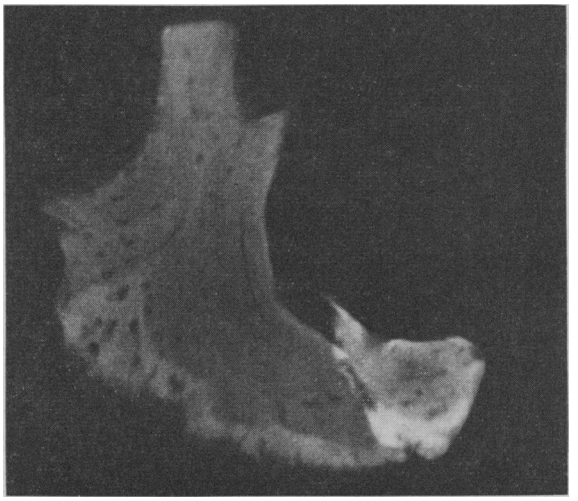

Fig. 8.—Historadiograph of normal lipping (× 120). Explanation in text.

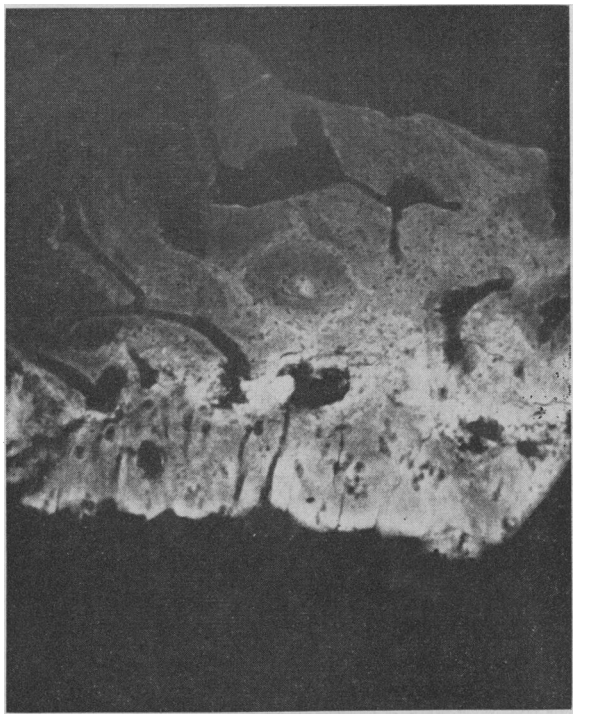

Fig. 9.—Historadiograph of bone (× 120). Two cavities impregnated with calcium are conspicuous (seen as structureless, white).

In normal aging, a picture is seen in historadiographs of an area of exostosis or small lipping. Here the bone tissue seems to constitute an entity with the main bone. Identical structures of bone laminæ, intraosseous lacunæ, and the same type of bone canalization are seen, indeed, in exostosis, initial lipping and principal bone (Fig. 8).

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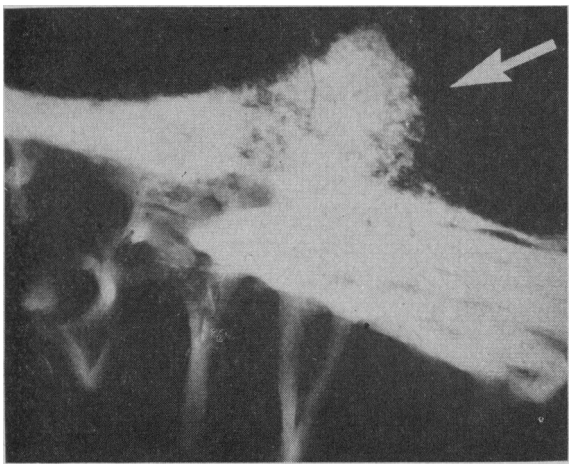

Fig. 10.—Historadiograph (× 50) of pathological exostosis (arrow).

Another historadiographic picture was observed when the process was pathological. The following details were seen in such cases:

(a) Much more conspicuous bone decalcification.

(b) Formation of large cavities.

(c) Impregnation of cavities with calcium salts (Fig. 9).

Where extensive calcification had taken place, bone structure was not present (Fig. 10). In pathological cases, the accumulation of calcium was also seen in the periphery of structurally normal exostosis.

Historadiographs of bones of aging dogs did not differ from those in aging humans (Fig. 11).

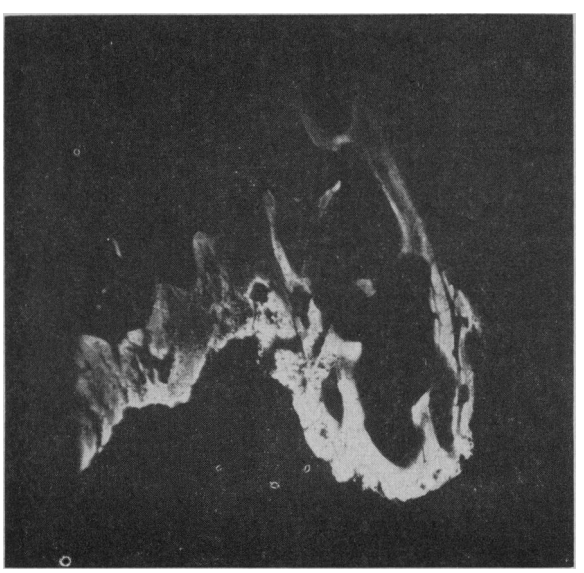

Fig. 11.—Historadiograph (× 35) of exostosis in spine of an aging dog. The identical structure in main bone and in exostosis is shown.

DISCUSSION OF RESULTS

Though we do not consider our research completed, the results so far obtained permit us to emphasize the need for differentiation between changes in bones during normal aging and those resulting from pathological conditions. The term "osteoarthritis" may be retained, in our opinion, only for cases where clinical and radiographic signs of pathology are present. We suggest a scheme for differential diagnosis between the normal and the pathological (Table II), based on our findings. In this scheme we use the term "osteoarthritis" for a large group of pathological bone processes resulting in bone destruction or bone deformation. There is no doubt, however, that many of these processes have different causes—trauma, infection, etc. Therefore it is quite possible that in the near future, instead of one term "osteoarthritis", many entities will be distinguished, having various names. One example of such a differentiation is the abovementioned senile osteoporosis. It is not the aim of the present article, however, to analyze all the possibilities of this differentiation.

The similarity of aging changes in bones of man and dog supports the views of those authors who consider hormonal disturbances in old age to be the principal cause of aging changes in tissues and organs, in particular those in the skeleton. Our results give no support to the views of those who consider the weight of the body, due to erect posture, the main cause of development of hypertrophic changes in old age.

Nowadays, we often speak of "physiological or normal old age". We have, however, no exact definition of the condition of human organs and tissues which may be held typical of this normal old age. Our research is an attempt to draw a line between the normal and the pathological in bone aging. This borderline has not only a theoretical but also a practical importance. It is necessary to relieve a normal old man from the psychological burden of a diagnosis of osteoarthritis whenever possible. Here is but one example of this necessity. In the case of normal bone aging, physical exercise alone may delay the progress of bone changes; nevertheless the physician, afraid of the complications of a nonexisting osteoarthritis, advises complete rest and special therapy for a normal old man.

TABLE II.—RADIOGRAPHIC SIGNS OF BONE CHANGES IN NORMAL AGING AND OSTEOARTHRITIS

	Normal Aging	*Osteoarthritis*
Bone Atrophy or Osteoporosis	*Change in x-ray absorption:* Moderate increase in bone transparency, quite conspicuous in the late sixth decade; maximum atrophy in late eighth decade; later on, the progress of atrophy is slowed. Harmonious development of atrophy and hypertrophy in whole skeleton. *Change in x-ray morphology:* Gradual thinning of compact bone, especially in areas of metaphysis and epiphysis. Slight diminishing of amount of trabeculae in spongy bone. Sometimes small cavities in spongy bone (more frequently in vertebral bodies).	*Change in x-ray absorption:* Advanced osteoporosis in earlier decades (sometimes atrophy is conspicuous in fifth decade); faster progress of osteoporosis than in normal aging. Disproportion between the development of atrophy and hypertrophy. *Change in x-ray morphology:* Excessive thinning of compact bone in whole bone, large cavities in spongy bone.
Bone Hypertrophy, Calcifications	*Change in x-ray absorption:* In areas of hypertrophy and calcifications (ossifications) increased absorption of x-rays. *Change in x-ray morphology:* Harmonious development of hypertrophy in whole skeleton. Unevenness, roughness of bone outlines; general enlargement of epiphysis and joint surface. Appearance of small lippings and exostoses. Progressive development of rib-cartilage calcifications (ossifications).	*Change in x-ray absorption:* Idem *Change in x-ray morphology:* Disharmonious development of hypertrophy in whole skeleton. Unusual localization of exostoses in separate joints; irregular calcium deposits on the periphery of exostoses; excessive development of lipping, complete or partial fusing of neighbouring lippings (most frequently between lippings of vertebral bodies). Compression fractures. Appearance of calcifications inside bone; development of inordinate calcifications inside joint and in close vicinity to it; signs of bone destruction

To this category of normally aging persons, the wise words of Hippocrates may be applied: "Our natures are the physicians of our diseases—refrain from meddlesome interference."

SUMMARY

1. Macroradiographic and historadiographic data of bone in 500 elderly persons as well as in 560 human skeletons of various ages and bones of aging animals are analyzed.

2. Some bone changes are typical of normal (physiological) bone aging; they cannot be considered as pathological, i.e. osteoarthritic signs. Along with other signs, a harmonious development of bone atrophy and bone hypertrophy is typical of physiological bone aging; disharmonious development of these bone processes is typical of osteoarthritis.

3. A chart for differentiation between the normal and the pathological in bone radiographs is suggested.

4. Historadiography of undecalcified (genuine) bones is recommended for bone studies, especially for those in which the bone content of calcium may be used as a diagnostic sign. Historadiographic findings of bone microstructure in normal bone aging and in osteoarthritis are discussed.

The author wishes to thank Dr. J. Auer, Professor of Anatomy, University of Ottawa, for his constant support and valuable advice used in this research. He also thanks Dr. P. N. Karnauchow, Department of Pathology, University of Ottawa, for supplying him with necessary material.

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RÉSUMÉ

Notre connaissance de l'arthrose est fort imparfaite. La douleur, que tous s'accordent à considérer comme un des symptômes les plus importants, n'a peu ou pas de corrélation avec l'état de dégénérescence osseuse. La radiographie montre souvent des lésions avancées ne causant aucune douleur. Certains auteurs soutiennent qu'il existe des manifestations osseuses typiques de la vieillesse qu'il faut bien se garder de considérer comme pathologiques et d'inclure dans le syndrome de l'arthrose.

L'étude présente porte sur des examens radiologiques multiples de vieilles personnes, et inclut aussi certains aspects d'anatomie comparée découlant de dissections de vieux chiens, de chats et de lapins. La radiographie microscopique a apporté un concours précieux en fournissant des données qui n'auraient pu être obtenues autrement. Les changements atrophiques du squelette ne s'effectuent que lentement au cours des années, mais semblent irréversibles; les modifications de nature hypertrophique les précèdent. Les lésions pathologiques comprennent les exostoses multiples, la soudure des articulations et la calcification des tissus; l'ostéoporose entre également dans cette catégorie. L'auteur offre certains critères de différenciation entre les processus pathologiques et soi-disant physiologiques. M.R.D.

A FOLLOW-UP ON PEPTIC ULCERS*

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THE PRESENT SURVEY was begun primarily to obtain a follow-up on peptic ulcer cases treated both medically and surgically. Records were reviewed over a specific period of time ending four years before the survey began, so that all cases included in the series had had a diagnosis established for a minimum of four years. Included in the original series were:

1. All cases operated on during this period for cancer of the stomach or ulcer of the stomach or duodenum.

2. All cases showing radiological evidence of ulcer of the stomach or duodenum. (This group included cases showing deformity of the duodenal cap sufficient to make the diagnosis of ulcer presumptive, but in which no definite crater was visualized.)

3. All cases showing abnormalities of the stomach. (These were merely collected for completeness, and no attempt at follow-up was made.)

Such a series unfortunately shows a rather high percentage of cases treated surgically, since a number were referred to the surgeons of the group specifically for operation because of intractability, hæmorrhage or other complications, but no attempt has been made to break down the figures and differentiate cases referred for operation from outside and those originally and continuously treated by the medical department beforehand.

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There was a total of 414 patients in the series —324 male and 90 female. The breakdown of cases is as follows:

1. *Duodenal ulcer*—337, with an average age of onset of 36.4 years. (Of these, 28 were 20 years or under in age and the youngest was 12 years; 13 were over 65 and the oldest was 82 years.) Female—71, with an average age of onset of 38 years; male—266, with an average age of onset of 36 years.

2. *Gastric ulcer*—43, with an average age of onset of 48.7 years. (Three cases had both duodenal and gastric ulcers.)

3. *Cancer of the stomach*—18, with an average age of onset of 58 years (two women and 16 men).

4. *Additional miscellaneous lesions*—In all, 16 such lesions were noted by the radiologist: hiatus hernia, 7; duodenal diverticulum, 6; hypertrophic gastritis, 2; congenital abnormality of the duodenum, 1.

TYPE OF OPERATION

There was a total of 74 operations on 70 patients (female 9, male 61) with duodenal ulcer. Nineteen were for perforations (one patient had perforated twice). Gastric resection was performed 54 times; three of these patients had had previous perforations. Gastroenterostomy was done once. There was one postoperative death, due to acute pancreatitis.

There was a total of 28 operations on 28 patients (20 males) with gastric ulcer—three for perforation and 25 for gastric resection. There were no postoperative deaths.

In cancer of the stomach, all cases had at least a laparotomy.

REASON FOR OPERATION

Duodenal ulcer (70 cases): repeated recurrences or intractability, 32 cases; hæmorrhage, 9 cases; perforations, 18 cases; pyloric stenosis, 10 cases; old gastroenterostomy with stomal ulcer, 1 case. (In many cases there was more than one reason for surgery, such as repeated attacks with periods of intractability, previous