

above stated, all nerve degenerations of the brain or spinal cord are due to foregoing vascular changes.

The nerves of the body, and especially of the extremities, may be enlarged generally, this change being due to an increase in the interstitial connective tissue. They may show sclerosis in some places and fatty changes in others, and the vessels of the nerves and spinal cord

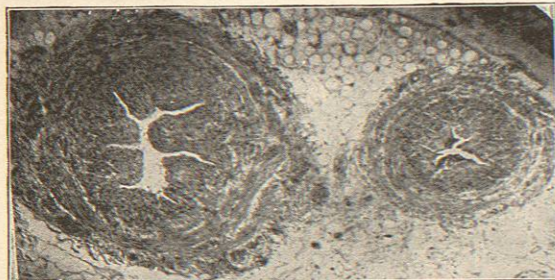


FIG. 23.—Section of Arteries of the Leg Near the Posterior Tibial. Showing Thickened Intima. (Author's case.)

may show hyaline degeneration. The ganglia of the posterior roots are often enlarged from an increase in the connective-tissue elements.

The ganglia and nerves of the sympathetic system show no special changes, though they may be enlarged, and from the same cause as in the case of the spinal nerves, viz., from connective-tissue growth.

**Heart.**—The heart is probably always enlarged in acromegaly, by reason of an actual hypertrophy, especially of the left ventricle; this being due to the increased work which it must perform in overcoming the resistance offered by the thickened blood-vessels. The heart may become enormous, and in my case it weighed forty-one ounces. Also the pericardium and endocardium may be increased in thickness, and there may be an increase of fibrous connective tissue between the muscle fibres. Later the heart, though hypertrophied, becomes weakened by the impaired action of its muscle fibres due to this connective-tissue formation or perhaps to the presence of fat globules, or else to the impaired blood supply of its walls, which in turn is due to thickening of the intima of its own nutrient blood-vessels.

**Blood-Vessels.**—I believe the vascular changes to be a constant feature of acromegaly, the intensity of these changes or the localization of the most marked changes in the blood-vessels causing the many variations of symptoms or conditions seen in different cases of acromegaly.

More or less generally all over the body the coats of the arterioles are thickened, and generally it is the intima which is the most affected. This may also be true of the veins, although in many places the vein walls seem to be thinned, allowing varicose conditions to take place. This may occur in the lower extremities, or as hemorrhoids, or in the large veins of the arms and neck. The epistaxis noticed in some cases is probably due to this weakening of the blood-vessels.

The blood is normal, or late in the disease it may show simple anemia.

**Lungs.**—The lungs are probably not often affected, but many times, both in autopsical reports and in clinical accounts of cases of acromegaly, "phtisis" has been mentioned, or tuberculous consolidation has been found. Chronic bronchitis, oedema, or passive congestion can develop from a weak heart action in the later stages.

**The Digestive System.**—The stomach and intestines present no specific abnormalities. The pancreas often shows changes, especially in those cases in which glycosuria has been present.

The liver is probably generally enlarged, sometimes very greatly, and may show a great increase in connective-tissue growth; in other words, it is an hypertrophic cirrhosis. There may be a passive congestion or fatty degeneration of the liver.

The spleen may be enlarged by passive congestion and an increase in its connective tissue.

**Genito-Urinary System.**—The kidneys are often found diseased (chronic nephritis), or they may be cystic. The kidneys and suprarenal capsules are often found increased in size.

Microscopical examination of the genitals shows an increase in connective-tissue growth and even at times the formation of fibrous tissue; these changes being accompanied by a gradual diminution of all functional activity.

**Skin.**—The skin is hypertrophied over the affected portions of the body, sometimes in a marked degree. This is especially true of the scalp, hands, and feet, all of the layers of the skin taking part in this thickening. The sweat glands may have a double layer of epithelium. Fibromata, neuromata, and elephantiasis of the skin have been observed, and molluscous growths are of frequent occurrence.

The subcutaneous fat may be increased or decreased in thickness, but in the later stages it is probably nearly always decreased.

**Muscles.**—Many of the muscles at the time of death, unless the patient dies early in the disease from some intercurrent affection, are found atrophied, and yet there may be many local hypertrophies. Certain muscles, especially the deltoid or the supraspinatus, may become greatly hypertrophied, forming veritable muscle tumors.

One side of the body, most frequently the right, may be larger than the other, both in the size of the bones and in the bulk of the soft parts, more especially the latter.

**Skeleton.**—A considerable number of acromegalic skeletons have now been carefully studied, and it is found that in well-marked cases nearly all of the bones of the body are enlarged, although a few individual bones may not take part in this increased growth.

Of course the bones of the extremities are the ones most evidently enlarged, still I cannot believe that these are more apt to be enlarged in true acromegaly than are the bones of the body. The long bones undoubtedly show the greatest enlargement and growth at their extremities, which fact seems to me to be due to the tendency of articular cartilages to ossify and to become co-ossified with the articular surfaces of the bones; still in many instances the shafts of the bones are also decidedly enlarged. The spongy bones of the skeleton are all more or less thickened, and all articular surfaces, whether of long or spongy bones, show a tendency to spread out, widen, and grow more prominent. The flat, thin bones, while increasing in extent show a tendency to become thinner in their plates. This is not true of the cranial bones, because the spongy tissue in the diploë increases in thickness. We sometimes find at the ends of the long bones, just back of the articular surfaces, a thinning of the bone, while they are at the same time extending their articular surfaces. This growth of bone is a hypertrophy, the new bone growing from the periosteum and also within the medullary spongy tissue at the ends of the long bones. In the early part of the disease this growth seems to be more especially confined to the periosteum; later the apophyses and epiphyses become affected.

The crests, tuberosities, and eminences are enlarged and grow in the direction of the muscular action. This seems to me to be due to the fact that a portion of the tendons of the muscles become ossified and co-ossified with the bone. This condition is so prominent at the articular surfaces that I think the same thing must be true of the ridges and tuberosities to which the muscles are attached. The tendons of the muscles are often found in deep grooves or bony canals, and the foramina for the nutrient arteries, and especially for the articular arteries, are often enlarged.

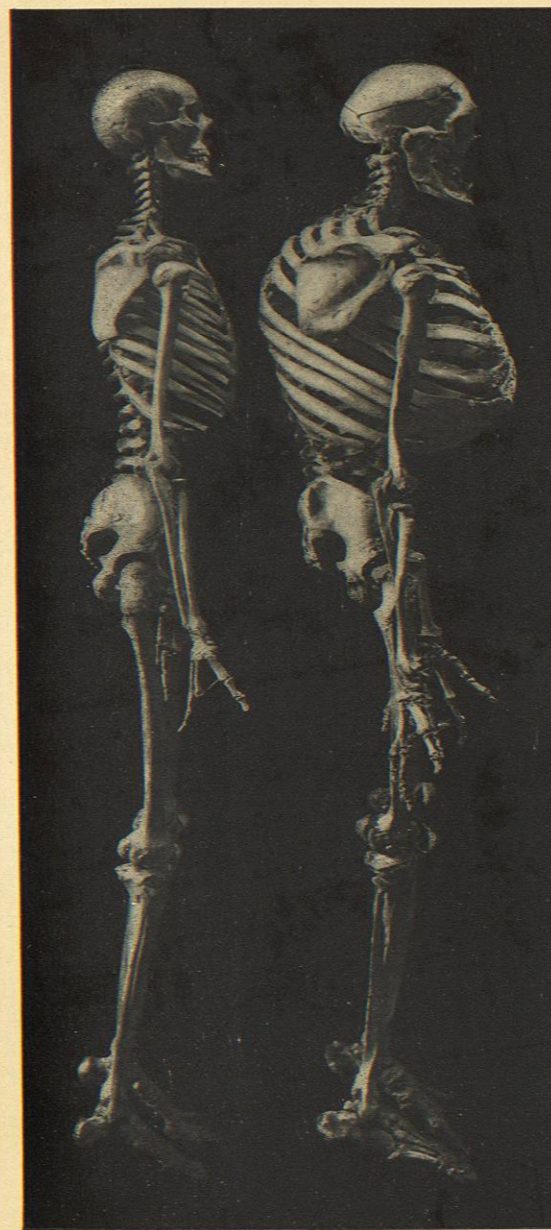


FIG. 1.

FIG. 2.



FIG. 3.

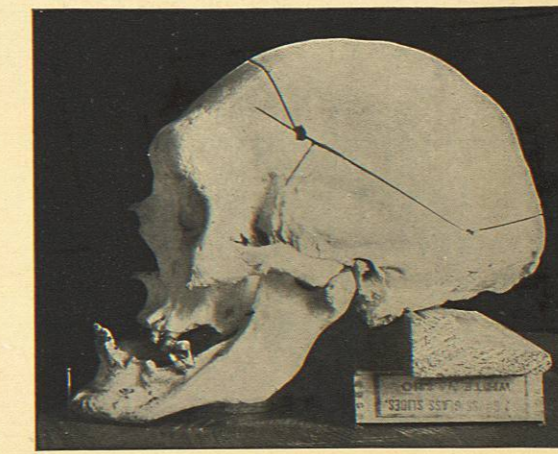


FIG. 4.

ACROMEGALIC SKELETON—(OSBORNE'S CASE)—AT THE YALE MEDICAL SCHOOL

[EXPLANATION OF PLATE]

FIG. 1.—Normal skeleton.

FIG. 2.—Skeleton of Acromegaly showing Kyphosis, enormous antero-posterior diameter of thorax, great obliquity of the ribs, long arms reaching almost to the knees, large feet, great projecting os calcis, etc. (author's case).

FIG. 3.—Spine of Fig. 2; shows co-ossification of bodies of dorsal vertebrae and many bony unions of spinous and transverse processes.

FIG. 4.—Skull of Fig. 2, showing enormous inferior maxilla, prognathism, projecting supraorbital ridges, large and prominent molar bones, etc.

Osteophytes may be found in the joints, especially over the wrist and ankle joints, or pieces of calcareous material may be found loose in a joint. The spongy ends of the long bones may become more compact, through eburnation and a change in the architecture of the part. The ends of the bones in some cases have shown condensing osteitis. This laying on of bone at the extremities, the articular surfaces, may lengthen a long bone without the shaft being at all affected.

Before critically surveying the individual bones in any particular patient dying with this disease, the duration of the case must be considered, as the longer the patient has lived with this disease the more decided will be the growth of a bone and the irregularities which it manifests.

*Head.*—The bones of the cranium are always more or less thickened, this change being due largely to an increase of the diploë, while the external and internal plates may be thicker than normal, or even thinner and softer than usual. The ridges and crests for the attachment of the muscles and fasciæ are more prominent, while the occipital protuberance has been found as a spicula-like outgrowth, an exostosis. The parietal eminences are sometimes abnormally prominent, as are always the superciliary ridges, the latter condition being due not only to dilatation of the frontal sinuses, but also to the thickening of the plates of the frontal bone in this region. The sphenoidal sinuses may be enlarged and pushed forward by the growth of other parts of the sphenoid, and the antrum of Highmore is probably always enlarged. Thompson found the margin of the foramen magnum surrounded by irregular protuberances of spongy bone. The sella turcica is always enlarged and deepened, probably because the enlargement of the pituitary body causes the surrounding bone to undergo absorption.

The lengthening of the face is largely due to the increase in the vertical diameters of the superior and inferior maxilla. The maxillary bones and the sphenoid bones contribute the principal part of the total enlargement of the bones of the skull.

Many of the sutures of the cranium and of the face are obliterated by complete co-ossification. The enlarging malar processes, orbital processes, and nasal processes of the superior maxillary bones cause the pushing outward of the malar bones, the lateral widening of the orbital cavities, and the pushing upward of the nasal bones respectively; thus causing the prominence of the malar bones, the quadrilateral appearance of the orbital cavities, and the wide nasal openings seen in skulls of acromegaly.

The external auditory canals may be increased in length, and are often encroached upon by bony growths which spring from their walls. The styloid processes may be greatly elongated by ossification of their tendons. The glenoid cavities are increased in size, probably due to the large size of the condyles of the lower jaw.

The lower jaw is massive, the chief growth being in the body, which is found lengthened and widened, especially at the symphysis, while the mental process stands out with undue prominence. The alveolar process is widened and thickened, and the rami also may take part in the growth, while the angle formed by the junction of the body and the rami becomes more obtuse, often to a marked degree. The coronoid processes are often greatly enlarged. The growth of the alveolar process is rarely participated in by the teeth, they remaining normal in size, so that while the alveolar cavities undergo enlargement we frequently have spontaneous falling out of the teeth.

The hyoid bone may be enlarged with all of its ridges very prominent, and the laryngeal cartilages may also be enlarged.

Though the projecting lower jaw (prognathism) may not have been observed in a few undoubted cases of acromegaly, still the presence of this characteristic feature, in combination with actual bone enlargement of the hands and feet, is clinically, I believe, pathognomonic of this disease.

*Spine.*—Marked changes are always found in the spine, the degree being due to the age of the disease. The bodies of the vertebrae are enlarged, especially from the laying on of bone on the anterior part in the cervical and dorsal regions. The increase of bone is often restricted to the upper part of the interarticular cartilages, while in the lumbar region the increase of the bone is more general.

The irregular thickening of the intervertebral cartilages, with the irregular growth of the bodies of the vertebrae, sooner or later causes deformities of the spine, namely, kyphosis, lordosis, or scoliosis, or more than one deformity. An absorption of the intervertebral discs, especially on the anterior borders, with co-ossification of the anterior parts of the bodies, and ossification of the



FIG. 27.—Skiagraph of Part of Acromegalic Hand, Showing Hypertrophy of the Soft Parts and the Increase of Spongy Tissue at the Ungual Ends of the Distal Phalanges. (Author's case.)

anterior ligaments, which often occurs, may cause an enormous kyphosis, the anterior part of the spine appearing, under these circumstances, as if formed of a single bone.

The transverse processes probably always are enlarged, and may be joined together by the ossification of their connecting ligaments. This ossification may take place along the interspinous ligaments, or we may find ossification of the posterior intervertebral ligaments. The lumbar vertebrae are sometimes of great size, and the sacrum may have its lateral masses much enlarged.

*Thorax.*—The sternum is enlarged and thickened, and the ensiform cartilage is ossified and generally projects