Potent Rulers of Bone and Muscle—
Parathyroid Glands

Endocrinology

By Jane Stafford

The endocrine glands have intrigued the interest of scientist and layman alike. In spite of considerable research, there is still much uncertainty in the scientific mind, and consequently much mystery in the popular mind, regarding the exact nature and functions of these important organs. Science Service has prepared a series of stories, of which this is the third, giving some of the facts and theories about these glands. The first two have appeared in previous issues of the News-Letter and the concluding story will appear next week.

SHE ached all over. And then she began to waddle like a duck when she walked. To the alarm and astonishment of her friends she actually got a bit shorter in height. This young married woman in her mid-thirties was a puzzle to the doctors and a source of alarm to her family.

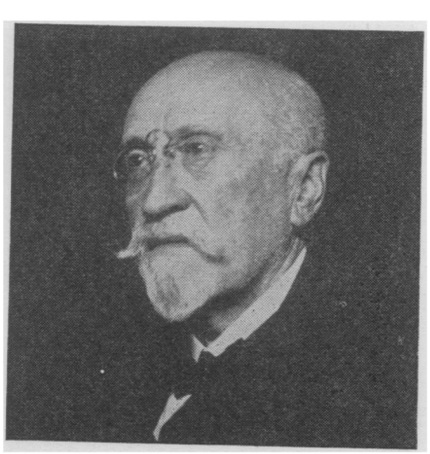
And because she had these pains, grew pale, became unduly nervous and lost weight, the X-ray, searching instrument, was turned on her. Strangely, her bones were softening and her very skeleton was becoming deformed. That is what the X-ray photographs showed.

As physicians studied her unhappy case the unfortunate patient became weaker. Various treatments brought only temporary relief. She became bed-ridden and could not walk a step even with the aid of crutches.

Finally her physicians pronounced: "Hyperparathyroidism." Her parathyroid glands, four little grain-of-wheat organs located near the Adam's apple, were pouring too much secretion into her body.

One of the constantly recurring miracles of modern surgery was performed. A tumor of the glands that was causing their over-activity was removed by an operation and the patient was on the route to renewed health.

"Within two weeks she was able to abandon crutches and take walks of considerable length around the hospital grounds, merely with the help of a cane," Dr. Russell M. Wilder of Mayo clinic was able to write in his report of her case to the Association of American Physicians.



Dr. Eugene Gléy, French physiologist, who showed that tetany resulted when the parathyroid glands were removed.

The patient was able to return home and followed simple dietary and medical instructions. She continued to gain strength, her bones hardened and she had no more pain.

In this case, a tumor had caused an over-functioning of the four small glands of the neck, but the opposite condition, occurring when these glands become injured or destroyed, is just as serious. In the latter case, muscle spasms, convulsions and frequently death occur.

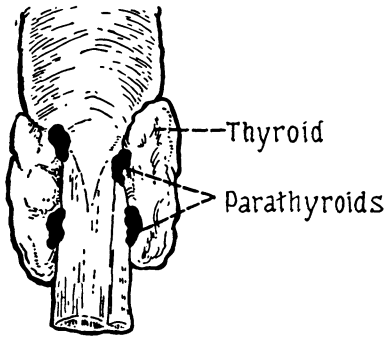
The four parathyroids are each about a quarter of an inch long and half as big in diameter—about the size of wheat grains. They are located two on each side of and back of the thyroid gland. Often they are imbedded in the tissue of the thyroid. Until 1879, they were not recognized as separate organs, although they are not like the thyroid in either structure or function. At that time Ivar Sandstrom, a Swedish anatomist, discovered that they were not part of the thyroid gland and described their anatomical characteristics. Little, however, was known about their function.

Early operations for the removal of the thyroid gland were sometimes accompanied by alarming symptoms, quite often with a fatal ending, even when the operation had seemed successful. The symptoms set in about 36 hours after the operation. The patient was depressed, had tingling and numbness of fingers and toes. Facial twitchings and muscle spasms followed, the latter developing into convulsive seizures, in which very characteristic positions of hands and feet were assumed.

The convulsive seizures or fits sometimes occurred frequently but more often at long intervals. The patient lost weight and his heart, respiratory tract and body temperature were all affected by the disease. Nearly always death followed. The condition is known as tetany, not to be confused with tetanus or lockjaw, an entirely different disease.

However, soon after the parathyroids had been identified by Sandstrom, a French physiologist, Eugene Gléy, showed that tetany resulted when they were removed with the thyroid in surgical operations or in experimentation. The parathyroids are so close to the thyroid and often so imbedded in it that it was difficult for surgeons to distinguish the one from the other while in the midst of the operation. Fortunately the glands are extremely potent, so that a very tiny piece of even just one gland, left behind by the surgeon's knife, suffices to protect the patient and prevent the development of tetany.

These small glands are still the subject of investigation and study. Scientists are not entirely satisfied that they know what the functions of the parathyroids actually are. One group of investigators holds that the parathyroids control the calcium, or lime, of the body. When tetany occurs or is produced in an animal or man, administration of either the glandular substance or of calcium salts relieves the condition. The theory is that when the glands are underactive and do not secrete enough of their hormone, the nerve and muscle tissues do not get enough calcium and the tetanic seizures result. One investigator found that the brain of an animal dying in tetany had a low calcium content. Another scientist placed muscle tissue in a solution which resembles the body fluids in mineral content and which contains among other things salts of sodium, potassium and calcium. Ordinarily muscle tissue would not show any change when placed in this solution, but when a muscle was placed in such a solution from which the calcium had been omitted, the muscle underwent contractions resembling those of tetany. These observations tend to strengthen the theory of the role of the parathyroids in calcium regulation.



The parathyroids lie close to the thyroid gland in the neck. They are about the size of a wheat grain.

When animals have lost their parathyroid glands, their blood has much less calcium in it, there is an increased excretion of calcium, and the animals show symptoms of tetany which are relieved by injections of calcium.

The parathyroids, like most other glands, secrete a hormone which affects the body processes. This hormone has not yet been synthesized in the laboratory but an extract from the glands, which is very potent, has been isolated by Dr. J. B. Collip of the University of Alberta in Canada. This extract has been used successfully on both animals and humans who have had tetany. The symptoms are relieved and the amount of calcium in the blood is restored to normal when this extract is injected under the skin. Another method of relieving tetany, which has sometimes been successful, is that of transplantation or gland grafting.

These glands can do their work when they are in other parts of the body besides the neck, scientists have found. Theoretically, this would seem to mean that if all the parathyroids are removed accidentally and tetany develops, the surgeon can quickly graft a bit of gland into another part of the body and relieve the condition. Actually it was found to be not such a simple matter and the procedure met with indifferent success until comparatively recent times. Soon after Gléy showed that it was the removal of these glands that caused tetany, scientists tried to relieve the condition with gland grafts, but the early efforts were not very successful.

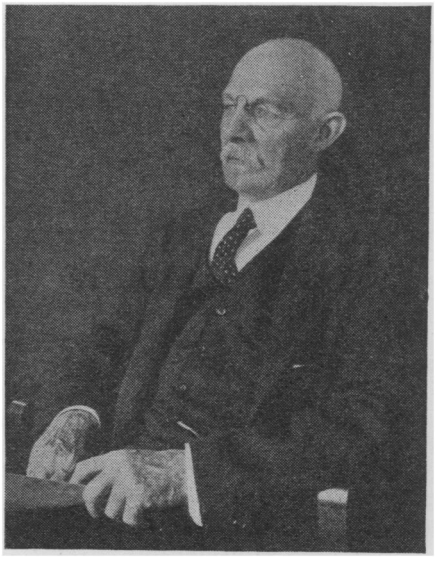
It was Dr. William Stewart Halsted, distinguished American surgeon, who did the most important work in this field. He was successful in nearly two-thirds of his autotransplantations in a large series of dogs. In this operation, the animal's own gland is grafted onto another part of the body. In a successful transplantation, the gland continues to function in its new position. Halsted found that when his transplantations failed it was because the animal did not require the transplanted tissue. The glandular tissue that had been left in the neck was sufficient to carry on normal functioning and the transplanted tissue lost its potency from lack of use. In order to obtain a successful transplantation it was necessary to remove all the remaining parathyroids at the time of transfer or to injure them in some way, so that a glandular deficiency would be created. Failure to recognize this fact and to act accordingly explained why previous investigators had not had better results with their grafts.

Halsted showed what a small amount of the gland was really necessary to protect the animal from tetany. He was able to keep one dog alive and in good condition for several months with a graft measuring one-quarter by one-half millimeter. It takes about 2 millimeters to make an eighth of an inch, so this graft was barely visible to the naked eye. However, when this tiny bit of glandular tissue was removed the animal died. Transplants of glands from one animal to another were unsuccessful in 38 dogs, Halsted reported.

These gland grafts cannot be made just anywhere in the body. One essential condition for success is that there be a readily available blood supply so that the transplanted tissue will get nourishment quickly. Various experimenters have tried various positions for the graft. The marrow of the inner bone of the leg, the intestine, the thyroid gland and muscle have all been tried. Halsted placed them under a muscle of the abdomen.

A few cases of successful grafts of the parathyroid on human beings have been reported. Grafts from one person to another have generally not been successful, but where a bit of the patient's own gland is used the results seem to be favorable. Quite recently at a meeting of the American Association for the Study of Goiter, a Boston surgeon, Dr. Richard B. Cattell, reported successful transplants of parathyroid tissue in one patient. At the Lahey Clinic where he works, in every operation for the removal of a thyroid gland, the gland is examined during the operation for the parathyroids that may have been removed with it. If any of the latter are found, they are immediately grafted onto another part of the patient's body, so as to prevent the possible development of tetany. If not all of the parathyroid tissue had come away with the thyroid, the gland graft would not take, but in that case the remaining parathyroid tissue would have been enough to protect from tetany. However, in the event that all the parathyroids had been removed or injured to such an extent that tetany would have developed, the graft would probably have been successful and would have protected the patient against tetany.

While the evidence is strong for the theory that the parathyroid regulates the body's supply of calcium and that tetany is the result of disturbed calcium metabolism, due to disorder of these glands, other authorities believe that tetany is the result of a poison, called guanidin. According to this theory, the parathyroids regulate the supply of guanidin in the body and prevent its development in undue amounts. Still another theory is that the symptoms of tetany result when the balance between acidity and alkalinity in the blood and body (*Turn to page* 158)



Dr. William Stewart Halsted, distinguished American surgeon, who did important experiments in transplanting the parathyroid glands in animals. This method is now being applied to human beings who have lost their parathyroids through operation.

Tomb of Alexander May Now be Sought

Archaeology

Royal Society of Alexandria Discusses Plans

A SEARCH for the tomb of Alexander the Great is likely to be conducted at last in his namesake city. Howard Carter, explaining his plans for the coming season's final work at the tomb of Tutankhamen, expressed interest in seeking the tomb of Alexander after his excavations at the Valley of the Kings are ended. Residents of Egypt have countered with the suggestion that Egypt might well undertake this important search, and at present the need for locating Alexander's tomb is a much discussed topic.

The Macedonian conqueror who fought the greater part of his world and won it, died in Babylon. Plutarch stated that Alexander was taken to Alexandria and buried in a gold coffin. Another historian, mentions seeing a glass sarcophagus of Alexander as it was carried in a procession leading westward from the Euphrates River.

If the tomb is in Alexandria at all, it is most likely to be at the site of the Mosque of Nebi Daniel. Plans for excavating in this neighborhood were discussed at the annual meeting of the Royal Society of Alexandria, held this month. Prof. Breccia, curator of the Greco-Roman Museum at Alexandria, urged that the city undertake the excavations to unearth the tomb of its founder.

The neighborhood of the mosque is considered worthy of careful exploration, for it was the part of the ancient city where other rulers probably were buried. A granite pillar, still erect, was partly unearthed not long ago by workmen engaged in street repairs in this neighborhood, and this bit of evidence of ancient construction has further stimulated interest in scientific study of the place.

Doubt that Alexander was ever buried in Egypt has been expressed by a correspondent in the Egyptian Gazette, who cites reasons why the Greek hero would more likely have been taken back to his native town of Pella for burial. He points out that Perdicas was the most influential of Alexander's generals, and that this Perdicas would not have taken the conqueror's body to Egypt, because Perdicas' arch-rival was Ptolemy of Egypt. The cortege moving westward, might well have been heading towards a port to embark for the Macedonian town of Pella, he contends.

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The Pueblo Grande de Nevada, known as the Lost City of the Moapa Valley, is to be investigated by government officials and archæologists.

A life insurance statistician says that we eat 30 per cent. more food than our grandfathers and 374 per cent. more sugar.

Parathyroid Glands—*Continued*

tissues is upset so that there is increased alkalinity of blood and tissues.

Sometimes children develop tetany spontaneously without removal of the parathyroids or any known injury. This condition is known as idiopathic tetany. The symptoms are similar to tetany in adults following removal of the glands. This form of tetany is often associated with rickets, which also makes it seem likely that the parathyroids in some way control the calcium supply of the body. In rickets it is generally held that there is a deficiency of calcium in the bones. Children with rickets get bow-legs and other bony deformities because not enough calcium goes into the bones and consequently they are soft and become bent out of shape when pressure, such as the weight of the body, is put on them. It may be that the children who get rickets are not getting enough calcium, or lime, into their bodies. It is also thought that even if they get enough calcium in food and water, they may not assimilate it properly if they do not get enough vitamin D, either in food or from the sun's rays. But some investigators now think that the assilimation of calcium, that is, its transference from food or water taken into the stomach to lime salts in blood and bones and muscles, is regulated entirely by the tiny, parathyroid glands. In that case the role played by vitamin D may be quite different.

"The study of cases of hyperparathyroidism may provide a clue to the nature of rickets," suggested Dr. Wilder in discussing the case of the young women who suffered from tumor of the parathyroids. The symptoms of osteitis fibrosa, the name for the condition of the bones which the young woman had, probably as a result of over-functioning of her parathyroid glands, are not unlike those of rickets. In the common form of rickets there is too much calcium in the blood serum and too little phosphorus, as is the case in osteitis fibrosa. Tumors and enlargement of the parathyroid glands have been found in cases of rickets.

Other investigators showed that the parathyroid glands of chicks became enlarged when the chicks were kept away from the sun's rays and were fed a ration poor in the antirachitic vitamin D. These observations have been confirmed.

The early history of the patient of Dr. Wilder's who suffered from a tumor of her parathyroids shows that she had had a capricious appetite ever since childhood. Consequently she had over-indulged in sweets and neglected vegetables, milk and cream. Probably she did not get an adequate amount of vitamin D, and while she escaped rickets in childhood she developed a condition similar to rickets later in life. When she was treated with ultraviolet light and a diet rich in vitamin D, marked gain in weight and strength and general improvement resulted. This, together with the results of the experiments with the chicks, suggested to Dr. Wilder that some antagonism exists between vitamin D and the parathyroids.

"It seems not unlikely that rickets, and osteitis fibrosa, may be due to over-function of the parathyroid glands and that the healing effect of vitamin D in these conditions may be due to inhibition of the parathyroid glands by this vitamin," Dr. Wilder concluded. Such a theory puts a new construction on previous ideas about the function of vitamin D. Further scientific investigations will doubtless provide the solution to the riddle of how rickets, tetany, calcium metabolism, vitamin D, and the parathyroid glands are related.

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