CHEMICAL CONSEQUENCES OF THE REMOVAL OF THE PARATHYROID GLANDS*

By Dr. William F. Koch

The complete removal of the parathyroid glands is attended with fatal consequences. This experimental fact speaks decisively with regard to their importance for the maintenance of the bodily functions; it does not, by itself, give any indication of the mode in which the parathyroidal tissue determines the healthy continuance of the normal process in the organism. As has been done in the case of other so-called glands with internal secretion, so here we may assume that they act in one of several ways, either they furnish some regulatory or stimulating product (a hormone) which is distributed to appropriate parts of the body, or they may act as antitoxic agencies, neutralizing, modifying or destroying products which would otherwise be harmful to the individual.

The most prominent symptoms of abnormality, which attend the removal of the parathyroids, are perhaps those of tetany. This is of itself suggestive, though by no means demonstrative, of the participation of a toxic agent in the physiologic events caused thereby. The discovery of toxic bases in large quantities in the urine of parathyroidectomized dogs by Dr. Koch [2] at the University of Michigan is therefore of more than a passing interest. In every case studied methyl guanidine was present in the secretion of the kidneys. When this substance was found in smaller quantities, other guanidine bases were present, so that the excreted guanidin nitrogen approached a constant. In addition to these bases were observed, namely, beta-imidazolylethylamin, cholin, neucin as well as unidentified bases, although these were not distributed uniformly in the cases studied.

The histologic picture, which appears in the tissues of parathyroidectomized animals, is one of cellular disintegration, particularly in such organs as the liver, kidney and brain. Various degrees of chromatolysis are observed in the nuclei, and in some places the latter disappear entirely in large areas. Koch suggests that the passive protein destruction, which must accompany such tissue changes, may give rise to basic products and thus account for the unusual compounds excreted. Inasmuch as in animals which have been operated on the specific toxic symptoms can be provoked by the feeding of digested protein, it may be that the toxic effects are initiated by products of intestinal or even of parenteral digestion. Normally these derivatives are incorporated in some cell molecule or stored up in some form. In the case of parathyroidectomized animals after feeding digested proteins, it is suggested that the products remain free and act as toxins. In animals operated on when no feeding occurred, the symptoms in creased in degrees of violence with only short intermissions until death. The intensity of the symptoms doubtless followed the rate of disintegration of body protein. This part of the metabolism of the cell, Koch reminds us, is regarded as the function of the nucleus. Such indications, together with the formation of free ‘neuclein’ components, point to a nuclear atrophy. The histologic findings, moreover, show an active ‘neuclein’ degeneration. The reputed relation of the parathyroid to calcium metabolism and the theories of glandular function built up on it have not made effective progress of late. One is not justified at present in saying that these are quite unfounded. Doubtless in the complex disturbances set up by so serious an

operation as the complete exclusion of vitally important glands the interrelated consequences are varied and numerous. The outcome of the discovery of the toxic bases in the urine is the suggestion of Koch that the parathyroid secretion appears to be concerned also with anabolic processes related to the synthesis of nuclear contents. Whether or not such a hypothesis can be further substantiated remains to be seen; in any event the final successful isolation of recognized toxic chemical products of traceable origin has paved the way to definite conceptions and specific lines of inquiry where hitherto the explanations have been vague and the outlook unpromising.

2 Koch, W. F.: Toxic Bases in the Urine of Parathyroidectomized Dogs, Jour. Biol. Chem., 1913, xv, 43.

* Journal of the American Medical Association, Sept. 27, 1913, Vol. 61, No. 13, p. 1049.