## THE RECURRENCE OF ACUTE PARATHYROID TETANY IN COMPLETELY PARATHRYOIDECTOMIZED ANIMALS DURING THE OESTRUS CYCLE[1]

IN a previous communication Luckhardt and Rosenbloom[2] have shown that completely parathyroidectomized animals can be cured of all symptoms of tetany by the intravenous injection of Ringer's solution administered daily as indicated for a period of about forty days. After that period of time[3] the animals can be put on a meat diet limited in quantity only by their own choice and enjoy excellent health with no signs or symptoms of tetany except as noted.

Clinically it has been known for some time that some women who had been subjected to goiter operations suffered from tetany at each menstrual period. It was not clear, however, that the tetany was due to hypofunction of the parathyroid glands.

As is perhaps generally known, bitches go into "heat" about twice a year. At this time even normal dogs may show signs and symptoms which are indistinguishable from attacks of mild tetany occurring in parathyroidectomized animals. Anorexia, hyperpnoea, retching, vomiting, and mild fibrillations of the skeletal muscles are seen off and on particularly during the last week of œstrus.

It was therefore interesting to note what would happen during the œstrus period of bitches that had suffered a complete removal of all four parathyroids months previously.

We can present a report on two of such animals.

The one animal was completely thyroparathyroidectomized on October 23, 1921. All injections were stopped in January, 1922. From that time on the animal remained in splendid condition on a stock diet of meat, bread and bones. Tetany in very severe form was induced for the last time in February, 1922, by feeding the animal a large amount of meat mixed with barium sulphate. Mild tetany consisting of fibrillations of front and hind legs appeared spontaneously on ordinary diet on March 10, 11 and April 4, 1922. The dog was not depressed. The symptoms would be present one moment and absent the next hour only to recur several hours later together with a mild hyperpnoea. At these times the animals had a marked polydipsia. On April 9 an enlarged vulva and a distinct bloody vaginal discharge was first noticed. The tetany symptoms became more severe from day to day until on April 15 the animal had a severe tetanic seizure with depression, anorexia, hyperpnea, generalized fibrillations, clonic contraction of the temporal muscles (chattering), and a spasticity so marked that walking was difficult. Intravenous injections of Ringer's solution were freely given; and the animal was better on the following day. The tetany continued in more or less severe form until May 4. But even now (May 30, 1922) fibrillations of the neck and leg musculature can be seen now and then (perhaps because of early pregnancy).

The other animal was parathyroidectomized on January 29, 1922. Four days later the animal had depression, salivation, groaning, spasticity, tremors, clonic and tetanic convulsions. Indeed, artificial respiration had to be given because of a tetanic spasm of the diaphragm. As a result of the usual treatment the animal recovered. For a week or two it seemed doubtful whether the animal would survive. After that the general condition improved. Intravenous injections were discontinued on the forty-sixth day. The animal was exceptionally alert and playful. Its food (meat) consumption was not limited. On May 7, almost two months later, the vulva was noticeably enlarged. On the following day anorexia appeared. A fit of sneezing was followed by a spasm of the facial muscles. The ears were kept back; and the animal was greatly depressed. The condition became worse on the succeeding days. On May 12 retching and vomiting began. On the following day the animal was spastic. Fibrillations and clonic contractions were generalized but were especially noticeable in the temporal muscles.

[1] From the Hull Physiological Laboratory, the University of Chicago.

[2] Luckhardt and Rosenbloom: *Proc. Soc. Exp. Biol. and Med.*, XIX, No. 3, 1921, p. 129.

[3] Luckhardt and Rosenbloom: *Proc. Soc. Exp. Biol. and Med.*, this number.

Periodic spasms of the larynx and incessant vomiting continued for the next eight days. The generalized fibrillations gradually diminished in intensity but the clonic jerkings of the temporal muscles persisted together with anorexia and a marked depression. The gastric juice which was vomited up contained appreciable free and total acidity. Throughout this period intravenous injection of Ringer's and enemata were freely given. On May 20 the animal seemed decidedly better. Thereafter the condition gradually improved. At the time of writing (May 30) the animal is again free from all symptoms of tetany. All treatment was discontinued 14 days after the reappearance of the tetany.

In many respects the tetany appearing during the œstrus cycle of this animal was more severe than the tetany seen the first month following the parathyroidectomy.

We are in no position to explain the reoccurrence of the tetany with all its severity during the œstrus cycle months after the absense of any sign suggestive of tetany. The facts however seem to show that the tetany appearing in partially strumectomized women during menstruation is due primarily to hypofunction or absence of the parathyroids. As in previous work we observed during the tetany seizures signs pointing to a paresis of the sympathetic nervous system (enophthalmos), pseudoptosis, paretic nictitating membrane, bradycardia, conjunctival injection, general vasodilation, and a sluggish *atonic gastero-intestinal tract*. The latter condition (paralytic ileus) would favor the production of toxic products by bacterial action; the splanchnic dilatation (paresis of vasoconstrictor control) would permit of so rapid an absorption of these poisonous products that the liver would be functionally inadequate to neutralize them because of the speed of their delivery (alimentary toxemia). As in Eck fistula animals parathyroidectomized animals suffer from an intestinal toxemia. On this hypothesis the reported Ca deficiency in parathyroidectomized animals might well be an *effect* of the tetany condition rather than its *cause*.

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## THE ALGEBRAIC METHOD OF BALANCING A CHEMICAL EQUATION

A CHEMICAL equation is said to be "balanced" when, for each element involved, the number of gram atoms in the left member of the equation is equal to the number of gram atoms in the right member. Given, then, the initial and final substances concerned in a chemical reaction, say

$$\alpha Ag_2AsO_4 + \beta Zn + \lambda H_2SO_4 = \delta AsH_3 + \varepsilon Ag + \zeta ZnSO_4 + \eta H_2O$$

"balancing" the equation consists in finding a set of values for $\alpha$, $\beta$, $\lambda$, etc., such that the above named condition is fulfilled.

There are several methods of balancing a chemical equation. With simple equations the necessary coefficients are at once evident, or become so on brief application of the expedient of trial and error. In more complicated equations, however, the method of trial and error becomes tedious and other methods are convenient. In an oxidation-reduction reaction, consideration of the valence changes will usually give enough data to enable one to arrive at a solution of the problem, but this method is limited, even in application to such equations.

The algebraic method of balancing an equation is of general application and will be found time saving in dealing with complex equations. This method is outlined in a few of the textbooks, but is not in general use.

### THE ALGEBRAIC METHOD

The ordinary method of balancing a chemical equation algebraically is a very simple procedure. In the following equation, let $a$, $b$, $c$, etc., represent the coefficients of the balanced equation:

$$aAg_2AsO_4 + bZn + cH_2SO_4 = dAsH_3 + eAg + fZnSO_4 + gH_2O$$

It is obvious that one may write algebraic equations expressing the number of gram atoms of each element involved in the reaction. Thus:

For silver: $2a = e$
For arsenic: $a = d$
For oxygen: $4a + 4c = 4f + g$
For zinc: $b = f$
For hydrogen: $2c = 3d + 2g$
For sulphur: $c = f$

Since this results in six equations amongst