period of mechanical flocculation of the bacteria. The heat liberated by the combination between agglutinin and the antigen in this bacterial suspension, which consisted of 19 x 10^9 bacteria in saline, was 29 gram calories. The heat liberated by the clumping and flocculation of these bacteria was 10.8 gram calories. The immunological units employed in this instance have no quantitative significance.

Summary

The differential microcalorimeter was found to be suitable for the study of the heat produced by reactions between antigens and antibodies. Approximate values, which cannot be given definite quantitative meaning because of the nature of the crude solutions which must be employed, were obtained for the first time as follows:

The heat produced by the combination between 1 unit of diphtheria antitoxin and its equivalent L_f amount of diphtheria toxin was found to be 0.0645 gram-calories.

The reaction between dead typhoid bacilli and their specific agglutinin was also exothermic. Heat is produced during this reaction in two periods; the first corresponding to the phase of the union of the antigen with the antibody, the second to the clumping and flocculation of the bacteria.

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The weight curves of castrated kids.

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Twin kids, born February 5, 1923, were used for the experiments. One, without horns, was used as the control; the other with horns was castrated at the age of 74 days. Later another kid with horns born April 1, 1923, was castrated at the age of 83 days and was added to the experiment. The age at which the operation was performed, it is believed, caught the young goats at about half way to the age of puberty. Daily records (except Sundays) were kept of the weights since the operations.

Weekly averages were obtained, and another average based upon four of the weekly averages was taken as the average for an approximate month.

For a period of eight months after the operation in the case of the first castrate, and of nine months after the operation in the case of the second castrate, there was apparently just as favorable growth in the castrates as in the control. From this point onward for nearly a year, there has been no material gain in the weight of the castrates although there have been minor fluctuations. The growth of the control, as evidenced by his increased weight, continued for seven months longer, when he weighed about 100 percent more than the castrates. Reckoning from the time of the operation, the growing period for the control lasted fifteen months while that for the castrates lasted only eight and nine months respectively. The removal of the testicles had abbreviated the growing period of the castrates by about seven months as compared with the control. Fig. 1.

During the eighth month it was discovered that the first castrate and the control had been deprived of salt for probably two or three weeks. (The salt brick had broken and the pieces were covered by the bedding.) During this period the weight of both goats diminished but gradually returned to the original level after the salt was renewed. The second castrate received salt continuously, and there was no depression of his weight at this time. During the ninth month, the second castrate was afflicted

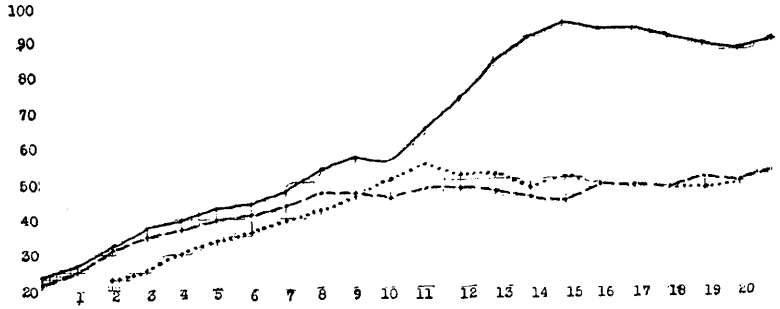

FIG. 1.

The figures in the vertical column represent the weight in pounds. The figures on the horizontal line represent the time in approximate months (four-week units). The curves begin just after the operation was performed. The continuous line is the curve of the control; the interrupted line that of the first castrate, and the dotted line that of the second castrate. In the case of the first castrate the curve shows that an approximate level has been maintained since the eighth month and in the case of the second castrate since the ninth month.

with a dermatosis (probably mange) and from this point his weight diminished over quite an extended period. Both of these events—salt deprivation and the dermatosis—occurred at the end of the growing period of the castrates. Whether these events had an influence in checking their growth is not known. The effect of salt deprivation upon the control was only temporary, for his weight increased rapidly for some months afterward. The first castrate was also afflicted with the dermatosis shortly before the second castrate, but the control was exempt from this trouble although all three were equally exposed. Since the dermatosis appeared only in the castrates it would appear that their power of resistance had been materially weakened by castration.

Reckoning from the date of the operation the control reached his maximum gain of 300 percent increase in about fourteen months. The first castrate at the eighth month had gained 120 percent; after various fluctuations he has reached 122 percent and 125 percent, and recently, probably as a result of endocrine treatment, he has attained a maximum of 143.4 percent. The second castrate reached his maximum gain of 140 percent at the ninth month and has not since returned to that level.*

The influence of the endocrine secretions upon growth is quite generally recognized and has been pretty well established in the case of the pituitary and thyroid glands. The results of this experiment would indicate that the internal secretion of the testes is also concerned as a factor in growth, although the effects may vary according to the age at which castration is performed. The fact that growth continued satisfactorily and at an equal rate with that of the control for several months after the operation may indicate that the loss of the interstitial secretion is compensated for by an increased activity of other endocrine organs, that finally this compensation fails and when this occurs subsequent growth is retarded.

One experiment although long extended, is not conclusive, but the fact that both castrates reacted to the operation in a similar way is significant.

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* In his paper on "The Effect of Thyroidectomy on Growth in the Sheep and Goat as Indicated by Body Weight" (*Quarterly Journal of Experimental Physiology*, Vol. xiv, pp. 161-183, April, 1924) Sutherland Simpson shows growth curves, some of which are very similar to those obtained from the castrated kids.