

bland and irritating chemicals to the visceral pericardium, with pressure factors absent, are described. The chief of these are marked ST elevations of several types, occurring quickly; bundle branch block; and the rarity of extrasystoles. The controls proved very important, and are emphasized.

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Effect of Maximal Feeding on Metamorphosis in *Amblystoma*.

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Twitty and Schwind¹ have shown that in heteroplastic grafting between the 2 species *Amblystoma tigrinum* and *A. punctatum*, comparable results with respect to growth are obtained only when the hosts are all maintained at the same nutritional level, an effect obtained by maximal feeding, thus insuring the rapidly growing voracious *tigrinum* larvae opportunity to realize their full capacity for growth. The effect of maximal feeding upon the more slowly growing species has not been emphasized, although various workers have noted that along with the spectacular acceleration of the growth rate, and a consequently earlier metamorphosis, there is a high mortality during the metamorphic period in maximally fed groups of *A. punctatum*, regardless of the type of diet.

The present experiments were undertaken in order to show the results of quantitative variation in a single diet upon the developmental rate and viability of *A. punctatum* from the earliest feeding stage through metamorphosis. Two hundred animals, taken from several bunches of eggs all at approximately the same stage of development, were reared from stage 39 onward in separate finger bowls. At the feeding stage the animals were divided into 4 groups of 50 each. The first 50 animals were starved, the second group given one feeding weekly, the third fed 3 times a week, and the fourth fed maximally. Enchytraeus, a small white worm, was used as the sole diet. All animals were measured at approximately 2-week intervals, the total length being recorded.

Fig. 1 shows the average growth rate for each group. The minimally fed larvae ate poorly, had low vitality, and remained of ap-

¹ Twitty, V. C., and Schwind, J. L., *J. Exp. Zool.*, 1931, **59**, 61; Twitty, V. C., and Elliott, H. A., *J. Exp. Zool.*, 1934, **68**, 247.

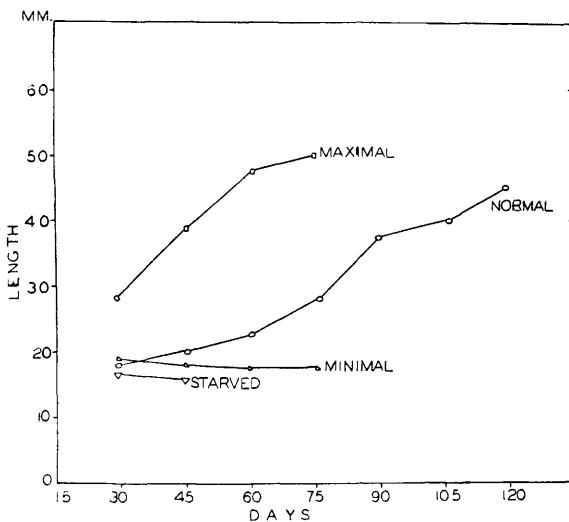


FIG. 1.
Growth rate in *A. punctatum*.

proximately the same size. By the 75th day most of these animals had died, before the 90th day the group was extinct. However, these animals survived a month longer than the starved group, all of which died by the 45th day. Three feedings a week—marked as “normal” because they approximate the usual laboratory feeding schedule—were enough to maintain a growth rate roughly about one-half that of the maximally fed group. The growth of the latter group approaches that of Twitty’s maximally fed animals in both rapidity and ultimate size attained; the largest specimen was 57 millimeters long by the 60th day, as compared with 46 millimeters reached by the largest normally fed animal by the 120th day. The average final size of the maximally fed animals is no greater than that reached by the same species in nature (Dempster²) but the growth rate is much more rapid and metamorphosis is earlier than in the free-living specimens.

Correlated with the marked acceleration of the growth rate by maximal feeding, was a high death rate, particularly in late larval stages. Early larval deaths were apparently no more frequent in one group than in another. In Fig. 2 the percentage of survivors is plotted against time in days, and the average body length in millimeters is indicated in small figures for the maximally and normally fed groups. The high mortality in the maximally fed group began after the animals had reached an average length of 40 millimeters, with only 15% surviving by the time the group average

² Dempster, W. T., *Biol. Bull.*, 1930, **57**, 182.

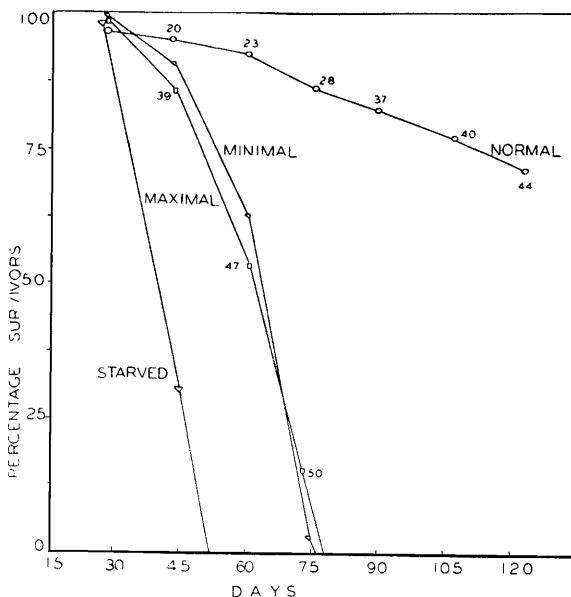


FIG. 2.
Death rate in *A. punctatum*.

had reached 50 millimeters. This is the length at which metamorphosis usually occurs, and 35% of the animals dying at this time were almost completely metamorphosed, with the gills reduced to short stumps and the color pattern changed. No maximally fed animals were brought through metamorphosis, although in the normal group over 50% of the animals metamorphosed normally at about the 120th day.

This high mortality at metamorphosis in maximally fed *A. punctatum* is in complete agreement with the work of Twitty (personal communication) who has used this method of feeding for several seasons and with larvae from different localities. It may also explain the failure of Patch³ to obtain metamorphosis in *A. punctatum* fed on *Enchytraeus*. These results indicate that maximal feeding is not practicable in this species except in the earlier larval stages.

³ Patch, E. M., Proc. Soc. EXP. BIOL. AND MED., 1927, 24, 218.