1929

The rate of growth of worker, drone, and queen larvae of the honeybee, Apis mellifera Linn

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THE RATE OF GROWTH OF WORKER, DRONE AND QUEEN LARVAE OF THE HONEYBEE, APIS MELLIFERA LINN.

by

Henry A. Stabe

A Thesis Submitted to the Graduate Faculty

for the Degree of

DOCTOR OF PHILOSOPHY

Major Subject Apiculture

Approved

Signature was redacted for privacy.

In charge of Major Work

Signature was redacted for privacy.

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Graduate Dean

Iowa State College

1929

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INTRODUCTION

In this work an attempt has been made to obtain accurate information on the rate of growth of worker, drone, and queen larvae of the honeybee, Apis mellifera Linn. Aside from the interest from the scientific point of view, it was thought that a comparison of the rate of growth of worker and queen larvae would be of interest to the queen breeder.

HISTORICAL

Until comparatively recent times, little or nothing was known concerning the rate of growth of honeybee larvae. Cheshire (1886) states in one place that the mature larvae weigh nearly twice as much as the adult bee into which it transforms. In another place he makes the statement that the honeybee increases about 1400 times in weight during its larval life.

The first important work on the rate of growth of honeybee larvae was by Straus (1911). His results with worker larvae may be briefly tabulated as follows:

EGGS	LARVAE					
	1 day	2 days	3 days	4 days	5 days	6 days
mg.	mg.	mg.	mg.	mg.	mg.	mg.
0.06	0.3	3.4	33.3	100.1	134.5	153.2

His results with drone larvae may be tabulated as follows:

LARVAE

2 days mg.	3 days mg.	4 days mg.	5 to 6 days mg.	7 days mg.	8 days mg.	9 days mg.
3.32	16.50	142.00	192.00 211.00	300.0	405.00 376.00	348.00 347.00

Nelson and Sturtevant (1924), using a method similar to that of Straus on worker larvae, obtained the following data:

WORKER LARVAE

1 day mg.	2 days mg.	3 days mg.	4 days mg.	5 days mg.	6 days mg.
0.650	4.745	24.262	93.378	144.85	149.966

EXPERIMENTAL

The experimental work was done during the summers of 1928 and 1929 in Zoology Department of Iowa State College, Ames, Iowa. Italian bees from the College Apiary were used. Standard ten-frame hives were used and strong colonies in two or three hive-bodies were selected.

METHODS OF PROCEDURE

The first necessity in this experiment was a method of obtaining larvae of known ages in considerable numbers. The greater the difference in age of the individual larvae of any given age group, the less accurate the results would be. Since the methods of obtaining the larvae in the two years and with the different kinds of larvae were very

different, the discussion of methods can be conveniently divided into four parts: (1) Worker larvae (1928); (2) Worker Larvae (1929); (3) Drone larvae; and (4) Queen larvae.

Worker Larvae 1928

A two-story observation hive was used. Each story had a single frame with a queen excluder placed in between them so that the queen could be confined to either story at will. The colony was built up by the addition of brood and bees until it was strong enough so that the bees would occupy both frames. The queen was in the lower frame for the greater part of the time and laid normally there. A frame which had been above an excluder in a normal hive for more than three days was removed and the bees shaken off. The frame was so selected that it had empty cells and unsealed brood but no eggs. The frame in the upper story of the observation hive was removed and the bees shaken in front of the hive. The frame, containing unsealed brood but no eggs, was placed in the upper story of the observation hive. One or two hours after, when the bees had settled down, the queen was hunted out on the comb in the lower story and removed by opening the glass wall of the hive and picking her up with the fingers. She was placed in the upper story with as little confusion as possible. She was kept under observation until she laid the first eggs. The time of laying the first egg was recorded. Three hours after laying the first egg the queen was placed below. About thirty-six hours after the queen was first placed above she was again placed above, kept under observation until she laid again and removed and placed below three hours after

laying the first egg.

The frame was now removed from the observation colony; the bees were shaken off; the frame was marked with a number and was placed over an excluder in a Mulleins queen rearing hive with other frames of brood. Another frame containing unsealed brood and empty cells, but no eggs, was placed in the upper story of the observation hive and more eggs of known age were obtained in the same way.

The frames placed in the Mulleins queen rearing hive were removed at definite intervals so that groups of larvae of certain ages were obtained. All of the larvae produced from eggs laid in the three hour periods were weighed at the same sitting in order to eliminate the effects of change of environment due to the removal of the frame and from the hive. The larvae were removed from the frame by means of a transferring needle in the case of the smaller ones, and, by means of a pair of forceps, in the case of the larger ones. Adhering food was removed by washing the larvae in water and the larvae were then dried by placing them on a blotter. They were weighed in watch glasses in groups of five or ten, depending on the size, by means of a chemical balance accurate to one-tenth milligram.

It was planned to obtain groups of larvae at age intervals of six hours from six to 144 hours, but due to unforeseen conditions, the series could not be completed. Larvae from two queens were used. The results obtained are recorded in Tables II and III and will be discussed in conjunction the results obtained in 1929.

Worker Larvae 1929

In the summer of 1929, a different method of obtaining larvae of known

ages was devised. A two story observation hive with a queen excluder between the upper and lower story was again made up and strengthened by the addition of brood and bees until the bees occupied both the upper and lower frames. The upper story in addition to having glass sides was provided with screen wire, twelve meshes to the inch, on the inside of the glass. When the glass was removed the screen formed the wall of the upper story. It was found that, if the operator were careful not to breathe on the bees, they would continue their work without interruption when the glass was removed. Small sticks of wood were cut of such size that they could be inserted tightly into the meshes of the screen with their inner end entering the cells of the comb for about one-half inch. As the queen left a cell after laying, one of these sticks was inserted into the opening of the cell through the screen wire. The screen served to hold the stick which was used only as a temporary mark. When the queen finished laying a series of eggs and rested, each of these cells was marked by means of a quick drying lacquer applied with a stick to the side of cell. It was found that the lacquer would remain on the wall of the cell for several weeks, and after drying, it did not interfere in anyway with the work of the bees.

It was desired to obtain groups of larvae at age intervals of six hours from six hours to 144 hours. A frame containing eggs and unsealed brood and some empty cells was taken from the brood-chamber of a strong hive, designated Colony B. The bees were shaken off and the frame was placed in the upper story of the observation hive. After the bees had occupied the new frame, the queen was placed above and kept under constant

observation for a period of two hours after laying the first egg. As the queen left a given cell, it was temporarily marked by means of a stick inserted into the opening of the cell through the screen.

Later the side of cell was marked by means of the lacquer as stated above. After the two hour observation period, the queen remained in the upper story and continued to lay in the comb. Six and one-half hours after the beginning of the first observation period, the queen was observed for another two period hours and cells marked as above. Again thirteen hours and nineteen and one-half hours after the beginning of the first observation period, the cells in which the queen laid were marked as above. The following illustrations will serve to show the method of marking used.

1st. series 2nd. series 3rd. series 4th series

It was found that when green or red lacquer was used, the marked cell could be more easily found than when white was used and the former colors were adopted.

It was found that, on the average, the queen would lay about fifty eggs in a two-hour period. The actual numbers ranged from thirty-five up to sixty-five. It was necessary to use great care in making the cells in order not to excite the queen.

At the end of the fourth two-hour observation period the frame was carefully removed from the upper story of the observation hive and another frame, containing eggs, and unsealed brood and empty cells, taken from the brood-chamber of Colony B was placed in the observation hive immediately. The queen was removed from the frame and placed in the upper story of the

observation hive on the new frame. The bees were shaken off in front of the observation hive and the frame, marked I, was placed in the brood-chamber of Colony B. The bees in the observation hive occupied the new frame in a short time, and, within an hour, the queen was already laying.

About twenty-six hours after the beginning of the first observation period on frame I, the queen was again observed for two hours and the cells marked as before. Again six and one-half, thirteen, and nineteen and one-half hours after the first observation period on this frame, the queen was observed for two hours and the cells marked as before. The frame was then removed and marked II. The bees were shaken off and the frame was placed in the brood-chamber of Colony B. Another frame from the brood-chamber of Colony B was placed in the upper story of the observation hive. This process was repeated until twenty-four series of eggs on six frames at age intervals of six hours were obtained. Care was taken to arrange the observation periods so that the larvae on frames I, II, and III could be weighed on one day and the larvae on frames IV, V and VI on the next day. According to Nelson (1915) the incubation period of honeybee eggs is approximately seventy-six hours. Accordingly frame I was removed from the hive nine days and four hours after the beginning of the first observation period. The larvae in the cells marked during the first observation period were weighed first. The weighings were made on chemical balances accurate to one-tenth milligram, the larvae being placed on watch glasses. Adhering food was removed by washing the larvae in water. The larvae were then dried by placing them on a blotter. After weighing each of the larvae

in the first series of marked cells, those in the second series were weighed and so on until all of the larvae in marked cells on this frame had been weighed. Frame II was then removed and the larvae were weighed as above. In the older age groups as many of the larvae as time permitted were weighed individually, the remainder being weighed in groups of five. In the age groups twenty-four to forty-two hours inclusive all of the larvae were weighed in groups of five while in the age groups of six to eighteen hours, they were weighed in groups of ten. Results are recorded in Tables IV and IVa.

Some of the advantages of this method of securing larvae of known age over the former method may be listed as follows:

1. Maximum age difference in the eggs is two hours instead of three.
2. Larvae are reared in the brood-chamber instead of over an excluder.
3. Larvae are normally distributed over the frame because the queen is laying in the comb for a longer period.
4. A greater number of larvae can be secured in a shorter period of time.

Some of the disaivantages of this method may be listed as follows:

1. The queen may not lay in a cell or she may lay in a cell which already contained an egg or a stick of wood used in marking the cell may destroy the egg. In order to reduce the error from this source as much as possible the marked cells were quickly observed before each frame was placed in the brood-chamber of Colony B. When no egg or more than one was found in a marked cell, the mark was destroyed by removing the marked part of the cell wall. In all cases very few marked cells were found which contained no eggs or more than one.

Drone Larvae 1929

In securing drone larvae of known ages the following method was used. A frame containing drone foundation was inserted into the brood-chamber of a strong hive. In a day or two the bees had drawn out the foundation and the queen had laid eggs in some of the cells. The frame was removed and all of the eggs were destroyed. The frame was then replaced and removed twelve hours later. All cells, usually up to 100, that contained eggs were marked with lacquer a system of marking similar to that used with worker larvae being used.

Any eggs remaining in unmarked cells were destroyed and the frame was replaced in the hive. Twelve hours later the frame was removed again and the unmarked cells, usually up to one hundred, were marked with lacquer. This was continued until five lots of eggs on one frame were obtained. The first four lots were marked as with the worker larvae and the fifth lot was marked with a differently colored lacquer. This process was continued with other frames until a total of twenty lots were obtained. The frames were removed at such intervals and the larvae weighed, that eighteen lots of larvae from twelve to 216 hours of age were obtained. In two age groups, those of 156 and 180 hours two different lots of larvae were secured. The weighings were made as near the middle of the egg-laying period as possible; that is, for the twenty-four hour age lot, the weighings were made four days and nine hours after the comb was placed in the brood-chamber. In the older lots of larvae from twenty to twenty-five larvae were weighed singly, the remainder being weighed in lots of five. For the younger lots either five

or ten were weighed at a time. All of the larvae in the marked cells were weighed.

The results were recorded in Tables V and Va.

Queen Larvae 1928

During the summer of 1928 worker larvae of known ages were obtained as stated above. These were reared over a queen excluder. As a result the bees started queen cells around some of these larvae of known age. These larvae were weighed and the results are recorded in Taole VI.

Queen Larvae 1929

Because of the small numbers of queen larvae obtained during the summer of 1928, it was decided that it would be necessary to use the Doolittle method of queen rearing. It was also thought adviaable to use more than one hive to rear the larvae in. Three hives, A, B and C were prepared. A and C were strong colonies in three ten-frame hivebodies. The queen was placed in the bottom hivebody. A queen excluder was placed over this. The second hivebody, containing empty combs and combs of honey, was placed on this. The third hivebody contained combs of honey and brood. The frames containing the grafted larvae were placed between combs of brood in this upper hivebody.

Colony B was a Mulleins queen rearing hive which consists essentially of a 30-frame hivebody divided into three ten-frame compartments by means of two queen excluders. One queen with brood and bees was placed in each of the two end compartments. The middle compartment was filled with empty combs. A ten-frame hivebody containing frames of brood and honey was placed over the middle compartment. The frames containing

grafted larvae were placed in this hivebody between frames of brood. Covers were placed over the end compartments.

In obtaining larvae for transferring the same observation hive and the same queen were used as were for the worker larvae. Between 3:30 and 4 P.M. each day the frame in the upper story of the observation hive was removed and replaced by another which had at least 800 empty cells. The queen was put back in the hive and the bees were shaken in front of the hive and the frame, properly marked, was placed in the queen rearing part of the Mulleins hive. Three days later between 1:30 and 2 P.M. most of the eggs had hatched. The unhatched eggs were grafted into queen cells cups. If there were an insufficient number of eggs, the smallest larvae were used. Sixteen cell cups on one bar were placed in each of the three queen-rearing hives. This was repeated for five more days at the end of which time each colony had six bars of sixteen cell cups each. The weighing was begun about one A.M. on the sixth day from the time grafting was begun. After one-half of the larvae from each grafting were weighed at this time, the remainder being weighed beginning at one P.M. on the same day. This resulted in securing lots of queen larvae at age intervals of twelve hours to 144 hours. This process was repeated for six times. After the third time, a fourth colony, D, similar to A and C was added so that sixty-four cells were grafted every day. Beginning with the fourth time only larvae were used in transferring because, on two successive days, the bees had failed to accept a single cell when eggs only were used.

All of the larvae, except those twelve hours old were weighed singly.

The larvae twelve hours old were weighed in groups of five. The results are recorded in Table VIII. They are recorded separately both as regards the date of weighing and the colony that reared them.

RESULTS

Data in this experiment can be conveniently presented under the following headings: (1) Weight of eggs; (2) Rate of growth of worker larvae; (3) Rate of growth of drone larvae; and (4) Rate of growth of queen larvae.

Weight of Eggs

One hundred newly laid eggs were weighed in lots of twenty-five on August 31, 1929. The total weight of the hundred was 14.7 mg. or an average weight of 0.147 mg. as recorded in Table I. One hundred eggs, approximate age twenty-four hours, weighed 13.8 mg. or an average of 0.138 mg. Two day old eggs weighed 0.120 mg. on the average while three day old eggs averaged 0.119 mg. in weight.

These data indicate a reduction in weight of honeybee eggs during incubation amounting to about 19% of the original weight.

Rate of Growth of Worker Larvae

Data secured during the summer of 1928 do not represent a complete series of lots at age intervals of six hours. Furthermore two queens were used in obtaining the eggs. It seems likely that there is an hereditary difference in growth rate of honeybee larvae. Also the larvae from queen A were weighed during the early part of August when there was a nectar flow

while those from Queen B were weighed during the latter part of August during a dearth. Alpatov (1929) has shown that a considerable part of the differences in honeybees is due to seasonal variation and Nelson and Sturtevant (1924) have shown that dearth of nectar results in decrease in weight of the older larvae. For these reasons the data secured in 1928 on worker larvae have been treated separately. Data from Queen A are recorded in Table II and those from Queen B, in Table III.

Considerable differences in average weights of groups of five larvae in any given age group are in evidence. For instance, in Table II, age group thirty hours, the mean weight of eighty larvae is 1.57 mg. The minimum average weight for five larvae is 0.88 mg. while the maximum is 2.04. Again in the age group sixty hours, the mean weight for seventy is 8.83 mg. while the minimum for five is 7.12 mg. and the maximum is 10.30 mg. The The same is true of the data in Table III. In the age group sixty-six hours, the mean weight for thirty-five larvae is 16.68 mg. while the minimum for five is 12.76 mg. and the maximum is 18.94 mg. While these data have not been statistically treated, it is obvious that these differences are due to something besides chance.

In this connection it might be well to observe that, according to the method of securing the eggs for the different age groups, there is a probable age difference of approximately three hours in the age of the eggs. Furthermore the incubation period of individual eggs probably varies as this has been found to be true in other species of insects. This would make the possible age difference of the larvae somewhat more than three hours. While

this difference in age is insufficient to account for the difference noted, it is merely brought forward here to show that factors other than individual variability are concerned in the variations in weight recorded.

During 1929 the experiment was arranged so as to eliminate, as far as practical, causes of variation other than inherent individual variation. All of the larvae in the series were obtained from eggs laid by one queen. Observation periods on egg-laying were arranged so that all the larvae were weighed on two consecutive days in order to eliminate seasonal variation. It should be recalled, however, that there is a difference of two hours in the age of eggs in a given age lot. Furthermore, the difference in incubation of individual eggs would probably add another hour. Also all individuals of a given lot were not weighed at the same instant usually from thirty to sixty minutes elapsing from the time the first was weighed until the last. This allows for a maximum age difference of from three to four hours, which is more than one-half the age interval between groups and would serve to account for considerable of the variations noted.

Results are recorded in Table IV. As far as time permitted, the older larvae beginning with those forty-eight hours of age were weighed singly. These individual weights, together with some statistical constants are recorded in Table IV a. The formula used in calculating the probable error of the mean is $.6745 \frac{\sqrt{\Sigma x^2 - \Sigma x(M)}}{n-1}$ where x is the observed value; M is the mean and n is the number of observations. The formula used to calculate the percentage increase in weight is mean weight of given group minus mean weight of previous age group divided by mean weight of previous age group multiplied by one hundred.

These results show that, for the first two days, the increase in weight is comparatively slow. At six hours the mean weight is only 0.17 mg. At twelve hours it is 0.29 mg., eighteen hours 0.36 mg., while at forty-eight hours, it is 2.67 mg. After this the increase is relatively rapid so that at 114 hours the maximum average, 159.06 mg. is attained, In graph I these weights are plotted against the age. The resulting curve is more or less S-shaped with several irregularities the probable significance of which will be discussed later.

Referring to Table IV a, in which the inilividual weights are recorded it is seen that the mean weights of the different age groups agree closely with the averages based on all of the observations except in three instances. At fifty-four hours the mean based on the single observations is 0.75 mg. larger than that based on all of them. At sixty-six hours the difference is 2.20 mg., and at 102 hours it is 4.23 mg. Since the larvae for the individual weights were removed and weighed first and then the remaining larvae, in groups of five, it follows that, in these three instances at least, there was a selection for larger size during the first weighings. These differences do not materially affect the results.

Referring to Table IVa it is seen that the coefficient of variability varies within wide limits. At forty-eight hours, it is 17.80 ± 2.17%, rising to 20.70 ± 2.30% at fifty-four hours and to 29.94 ± 3.25%. It then falls to 11.58 ± 1.24% at sixty hours. At sixty-six hours it is 13.18 ± 1.37% while at eighty-four hours it is up to 29.82 ± 2.99%. At ninty hours it is down to 12.12 ± 1.30%. In graph II the coefficient of vari-

ability is plotted against the age and its variability is well brought out.

Graph II also brings out the great differences in percentage increase in weight over previous weight. Peaks occur at twelve hours, thirty hours, forty-eight hours to sixty hours, eighty-four hours to 102 hours. It should be noted that the larger coefficients of variability occur at nearly the same times as the larger percentage increases. The smaller coefficients of variability at sixty-six hours and ninety hours correspond closely to the lower percentage increases except that there appears to be a lag of six hours in the latter..

Rate of Growth of Drone Larvae

In Table V are recorded the data on drone larvae. Beginning with larvae sixty hours of age a number of larvae in each age group was weighed individually. These weights are also recorded separately in Table Va. It should be recalled, at this point that there is a possible age difference of twelve hours in the eggs of a given group. The mean weight of the larvae weighed individually in most instances agrees closely with the mean based on all observations. However, at 108 hours, 132 hours, and 192 hours, the differences between the two means are comparatively large but can be explained on the basis of selection as was explained before in the case of worker larvae.

With the drone larvae as with the worker larvae, increase in weight is slow at first. At twelve hours the mean weight is 0.25 mg.; 24 hours, 0.39 mg.; 36 hours, 1.08 mg.; forty-eight hours, 2.01 mg.; sixty hours, 3.30 mg. Beginning at about sixty hours the increase in weight becomes

more rapid until a maximum average weight of 384.83 mg. is attained at 180 hours. In graph III these weights are plotted against the age. An S-shaped curve results.

In graph IV the percentage increase and coefficients of variability are plotted against the age. The percentage increase varies considerably from one age group to the next especially during the first four days. Thereafter it drops off gradually except for a slight rise at 144 hours. The coefficient of variability is large at 72 hours, being 28.27 ± 3.25%, and decreases gradually in the older age groups. There seems to be no correlation between high coefficients of variability and high percentage increases as was the case with worker larvae.

Rate of Growth of Queen Larvae

In arriving at an estimate of the probable age difference of individual queen larvae, it should be recalled that during the last half of the time only larvae were selected for grafting. These were taken from a frame which contained larvae from zero hours to about eighteen hours. In Table VII are recorded the weights of seventy such larvae in lots of five. These larvae were selected under conditions identical to those under which the larvae were selected for grafting. The average weight of the seventy larvae was 0.112 ± 0.007 mg. The estimated probable error of a single larvae is $0.007 \times \sqrt{5}$ or 0.016 mg. Assuming a probable range of ± four P. E. it is seen that the probable maximum weight of a larvae selected was 0.175 mg. Since the average weight of worker larvae at six hours of age is 0.17 mg., it seems likely that the maximum age difference of larvae selected for grafting was approximately six hours. During the first half of

the time both eggs and larvae were used so it is likely that the maximum age difference was probably somewhat more.

In Table VI are recorded the weights of twenty-six queen larvae reared in cells started naturally by the bees. The average weight of ten larvae at 120 hours of age was 263.3 mg. which is somewhat less than the average weight at this age obtained in 1929. At 156 hours the average of sixteen larvae was 245.6 mg.

The results obtained in 1929 are recorded in Table VIII. With queen larvae as with worker and drone larvae the increase in weight is slow at first and becomes very rapid after the beginning of the fourth day. In graph V, the weight has been plotted against the age. The resulting curve is S-shaped. The coefficient of variability at twenty-four is 44.07 ± 3.61%. At thirty-six hours it is down to 21.09 ± 1.62% and at forty-eight hours it is 33.55 ± 2.38%. It tends to remain high until about the end of the fifth day after which it falls rapidly and at 144 hours it is only 5.26 ± 0.39%.

The percentage increases over the previous weight varies widely. Beginning at 159% at twelve hours it falls to 106% at twenty-four hours and then rises to 132% at forty-eight hours. At sixty hours it falls to 51% and then abruptly to 265% at eighty-four hours. After this it falls rapidly until the larvae reach their maximum size except for a small rise at 108 hours. Both the coefficients of variability and the percentage increases are plotted on graph VI.

Here again as with the drones there seems to be no relation between

the high coefficients of variability and the high percentage increases. They seem to fluctuate independently of each other.

DISCUSSION

Bertholf (1925) has shown that the honeybee larvae moult at twelve to eighteen hours, thirty-six hours, sixty hours, and eighty-four hours. The fifth moult does not occur until the end of the eight day of larval life. Yagi (1926) and others have shown that just before and during the moult in insects there is a reduction in the rate of growth. Referring to graph II it is noted that at eighteen and thirty-six hours the percentage increases are relatively low being 24% and 27% respectively whereas at twelve and thirty hours they are relatively high being 71% and 94% respectively. Since these percentages really measure the rate of increase during the six hours preceding the age at which they are listed it follows that they fit in very well with the assumption that the growth is reduced before and during moulting.

At forty-eight hours the percentage increase is 83%; at fifty-four hours, 94%. At sixty hours it is 89% and thereafter it drops rapidly until at seventy-two hours it is only 13%. Since the third moult occurs at about sixty hours it would seem that the reduction in growth rate occurs after moulting. However, since the percentage increase in reality measures the growth rate during the preceding six hour period and there is a probable age difference of four hours in the larvae, it follows that there would be

a lag in the percentage increase as compared with the reduction in growth rate. This is brought out more clearly perhaps in the comparison of the coefficients of variability. Since these are measures of variability they would be greatest during the periods of most rapid growth because a given age difference in individuals would result in a greater actual variation in weight. As the older larvae attain the age at which the reduction in growth rate occurs, the younger larvae with their more rapid growth rate would reduce the individual differences and thus reduce the coefficient of variability. This is well shown in graph II. The coefficient of variability is at its maximum at sixty hours and drops to its minimum at sixty-six hours. This illustrates very well the lag of the percentage increase as compared with the actual reduction in growth rate. From these data one would expect that the third moult would occur at about sixty-six hours but since the ages of the larvae vary somewhat it is not possible to state the exact time of the third moult.

It seems likely that, if the periods between weighings had been shorter, that is two or three hours instead of six, the relationship between the growth rate, as indicated by the percentage and coefficient of variability, and the actual growth rate would been closer and the reduction in apparent growth rate would have coincided more nearly with the moulting period. This is brought out by the fact that, in the case of drone and queen larvae where the interval between weighings is twelve hours, there is no relation between the changes in growth rate as indicated by percentage increase and the moults.

The same relationships hold with the fourth moult which, according to Bertholf, occurs at about eighty-four hours. After the third moult both the coefficient of variability and the percentage increase rise, attaining their maximums at eighty-four hours. The coefficient of variability falls to its minimum at ninety hours while the percentage increase does not reach its minimum until ninety-six hours. Here again from these data one would expect that the moult would occur probably at about ninety hours rather than at eighty-four hours.

Yagi (1926) has also brought out the fact that, at least in the silk worm, Bombyx mori, the growth rate is not constant throughout an instar. It seems that near the middle of each instar a reduction in rate occurs which is followed by an increase. When the weights are plotted this results in two S-shaped curves for each instar.

The instars in the honeybee are so short in comparison to the age intervals between the different groups that it is impossible to say from these data whether or not the above holds true for the honeybee.

COMPARISON OF GROWTH RATE OF WORKER AND QUEEN LARVAE

In graph VII are plotted the weights of worker and queen larvae from zero to eighty-four hours. It is seen from this that the average weights of queen and worker larvae at corresponding ages are practically identical for the first forty-eight hours. At twelve hours the average weight of queen larvae is 0.287 mg. while that of worker larvae is 0.29 mg. At twenty-four hours the corresponding figures are 0.59 mg. and 0.52 mg. respectively and at thirty-six hours, 1.28 mg. and 1.29 mg. At forty-eight

hours the weights are 3.10 mg. and 3.03 mg.

Following this the worker larvae appear to grow more rapidly than the queen larvae so that at sixty hours the queen larvae are less than half as large as the worker larvae, the figures being 4.69 ± 0.16 mg. and 11.12 ± 0.48 mg. respectively. At seventy-two hours the weights are 11.60 ± 0.55 mg. and 20.56 ± 0.40 mg. At eighty-four the queen larvae have nearly caught up with the worker larvae the weights being 42.31 ± 1.79 mg. and 47.79 ± 1.88 mg. respectively. After this the queen larvae increase much more rapidly than the worker larvae and at the end of the growth period are more than twice as heavy as the worker larvae.

From the standpoint of weight alone then it would be possible to use worker larvae for grafting into queen cells until at least forty-eight hours of age. It is possible, of course, that for other reasons these older larvae would not make as good queens as younger ones.

AGE AT WHICH MAXIMUM SIZE IS REACHED

The highest average weight for any age group of worker larvae is attained in the 114 hour age group as is shown in Table IV. There is a marked decrease in the average weight at 120 hours as compared with that at 114 hours. However, some of the larger larvae in the age group 120 hours are larger than the smaller ones in the age group 114 hours. Since there is a probable age difference of four hours and also a difference due to individuality it is difficult to state just when an individual larva attains its maximum size.

Assuming that the age of an individual larva in the age group 114 may vary from 112 to 116 hours and that that in the age group 120 hours, from 118 to 122 hours, it follows that, according to these data, the majority of the larvae attain their maximum growth before 120 hours. It is probable that some larvae attain their full growth by 114 hours while others do not reach this stage until about 122 hours.

The highest average weight for any age group of queen larvae is attained in the 132 hour age group. Since there is a marked increase in weight from 120 to 132 hours and a marked decrease from 132 to 144 hours it seems likely that the age at which the maximum weight is attained is close to 132 hours. Since there is a probable age difference of about six hours in the queen larvae and it is probable that some of the larger larvae in the 120 hour age group have nearly reached their maximum size while some of those in the 132 hour age have passed it, it seems probable that the age at which full growth is attained lies between 122 and 132 hours.

In the case of drone larvae the average weights at 168 and 180 hours are nearly identical while previous to this there had been a marked increase and following this there is a slight decrease. Since the possible age difference is twelve hours, it seems likely that the age at which the maximum weight is attained lies between 164 hours and 184 hours.

CONCLUSIONS

1. The growth rate of the worker larvae varies greatly during a given instar being greatly reduced just previous, during, and after a moult.

2. The growth rate of worker and queen larvae for the first forty-eight hours is nearly identical.

3. The maximum weight of worker larvae is attained between 114 hours and 122 hours of age.

4. The maximum weight of queen larvae is attained between 122 hours and 132 hours of age.

5. The maximum weight of drone larvae is attained between 164 hours and 184 hours of age.

6. The growth period of the queen larvae appears to be slightly longer than that of the worker larvae.

7. Sealing of the cell is begun before the larva has attained its maximum weight.

8. Part of the difference in weight of individual larvae noted is due to difference in age.

SUMMARY

1. A total of 2064 worker larvae in twenty-five age groups at intervals six hours was weighed.

2. A total of 1570 drone larvae in nineteen age groups at intervals of twelve hours was weighed.

3. A total of 495 queen larvae in thirteen age groups at intervals of twelve hours was weighed.

4. Worker larvae of known age were obtained by allowing a queen to lay in frames in an observation hive and marking the cells with lacquer. The frames were removed at definite intervals so that larvae of the desired age were obtained.

5. Drone larvae were obtained by placing a frame of drone comb in the center of the brood chamber of a strong colony. This was removed at twelve-hour intervals and the cells containing eggs were marked with lacquer. The frame was removed after a definite interval so that larvae of certain ages were obtained.

6. Queen larvae of known age for grafting were obtained by allowing a queen to lay in a frame for about twenty-one hours. The frame was then placed above an excluder and removed after most of the eggs had hatched. The smallest larvae were selected for grafting.

7. The average weights for worker larvae were as follows: Just hatched, 0.112 mg.; six hours, 0.17 mg.; twelve hours, 0.29 mg.; eighteen hours, 0.36 mg.; twenty-four hours, 0.52 mg.; thirty hours, 1.01 mg.;

thirty-six hours, 1.29 mg.; forty-two hours, 1.63 mg.; forty-eight hours, 3.03 ± 0.36 mg.; fifty-four hours, 5.87 ± 0.19 mg.; sixty hours, 11.12 ± 0.48 mg.; sixty-six hours, 18.30 ± 0.33 mg.; seventy-two hours, 20.56 ± 0.40 mg.; seventy-eight hours, 25.92 ± 0.55 mg.; eighty-four hours, 47.79 ± 1.88 mg.; ninety hours, 66.76 ± 1.25 mg.; ninety-six hours, 80.19 ± 1.98 mg. 102 hours, 115.62 ± 1.79 mg.; 108 hours, 138.90 ± 0.79 mg.; 114 hours, 159.06 ± 0.36 mg.; 120 hours, 152.38 ± 0.42 mg.; 126 hours, 145.57 ± 0.62 mg.; 132 hours, 143.03 ± 0.65 mg.; 138 hours, 141.83 ± 0.50 mg.; 144 hours, 143.94 ± 0.51 mg.

8. The average weights for drone larvae were as follows: Just hatched, 0.112 mg.; twelve hours, 0.25 mg.; 24 hours, 0.39 mg.; thirty-six hours, 1.08 mg.; forty-eight hours, 2.01 mg.; sixty hours, 3.24 ±0.12 mg.; seventy-two hours, 9.34 ± 0.41 mg.; eighty-four hours, 18.03 ± 0.73 mg.; ninety hours, 42.85 ± 1.59 mg.; 108 hours, 77.04 ± 2.68 mg.; 120 hours, 115.30 ± 4.90 mg.; 132 hours 159.88 ± 4.66 mg.; 144 hours, 240.67 ± 5.67 mg.; 156 hours, 347.26 ± 5.38 mg.; 168 hours, 381.83 ± 2.60 mg.; 180 hours, 387.22 ± 1.96 mg.; 192 hours, 380.10 ± 1.88 mg.; 204 hours, 361.39 ± 1.92 mg.; 216 hours, 363.00 ± 1.84 mg.

9. The average weights for queen larvae were as follows: Just hatched, 0.112 mg.; twelve hours, 0.287 mg.; twenty-four hours, 0.59 ± 0.026 mg.; thirty-six hours, 1.28 ± 0.028 mg.; forty-eight hours, 3.10 ± 0.094 mg.; sixty hours, 4.69 ± 0.16 mg.; seventy-two hours, 11.60 ± 0.55 mg.; eighty-four hours, 42.31 ± 1.79 mg.; ninety-six hours, 87.05 ± 2.01 mg.; 108 hours, 198.59 ± 5.02 mg.; 120 hours, 285.50 ± 5.81 mg.; 132 hours,

322.60 ± 2.52 mg.; 144 hours, 302.89 ± 1.68 mg.

10. The growth rate of worker larvae measured by the percentage increment method varies greatly during each instar, being greatly retarded just before, during and after a moult.

11. The growth rate of worker and queen larvae for the first forty-eight hours is approximately the same.

12. The growth periods of the three kinds of larvae are approximately as follows: Worker larvae, 114 to 122 hours; drone larvae, 164 to 184 hours; queen larvae, 122 to 132 hours.

13. Individual differences in mature worker larvae as measured by their coefficients of variability are relatively small.

14. Individual differences in younger larvae in certain age groups are very large. At the time of moulting the differences are considerably reduced showing that part of the former differences are due to differences in age.

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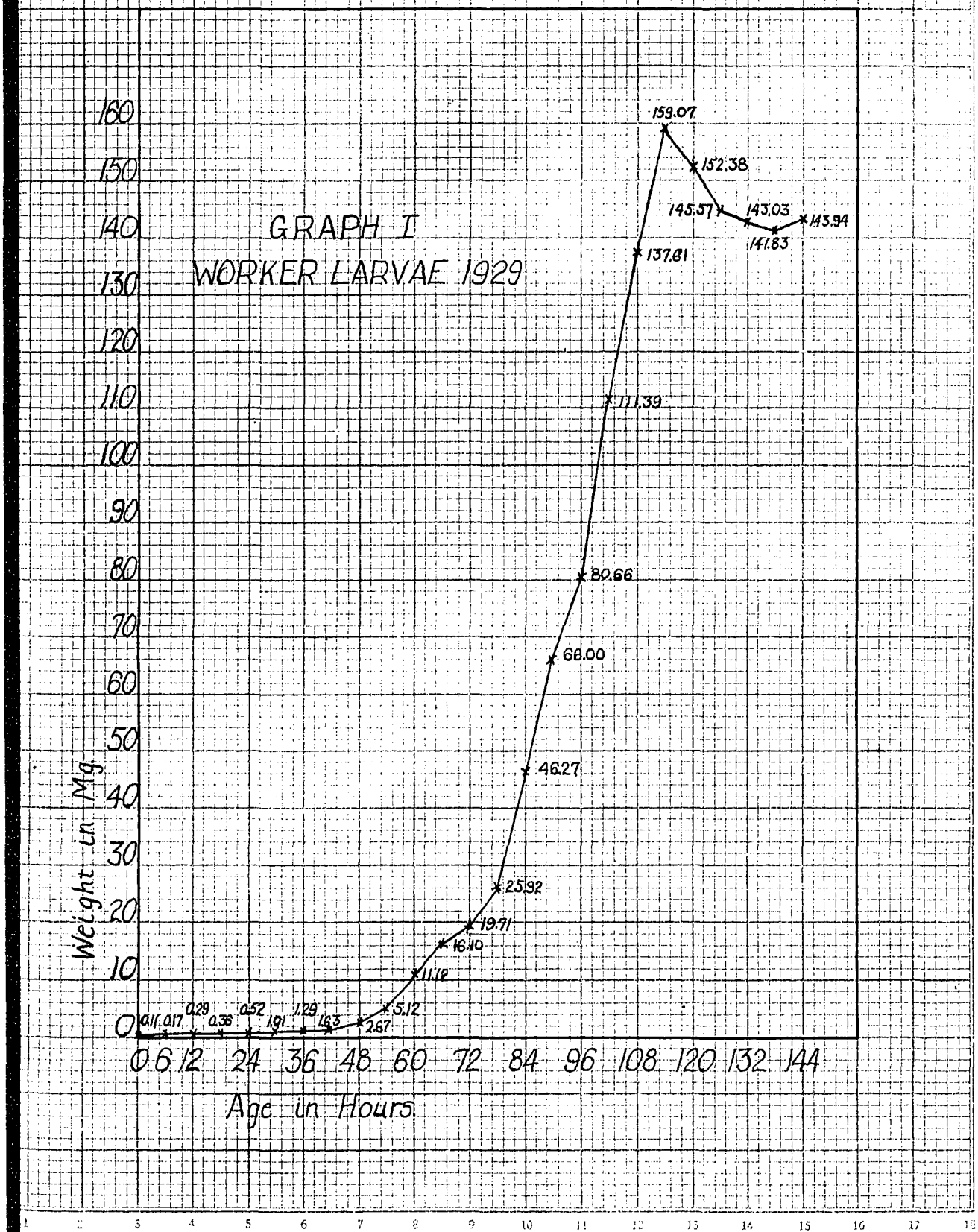
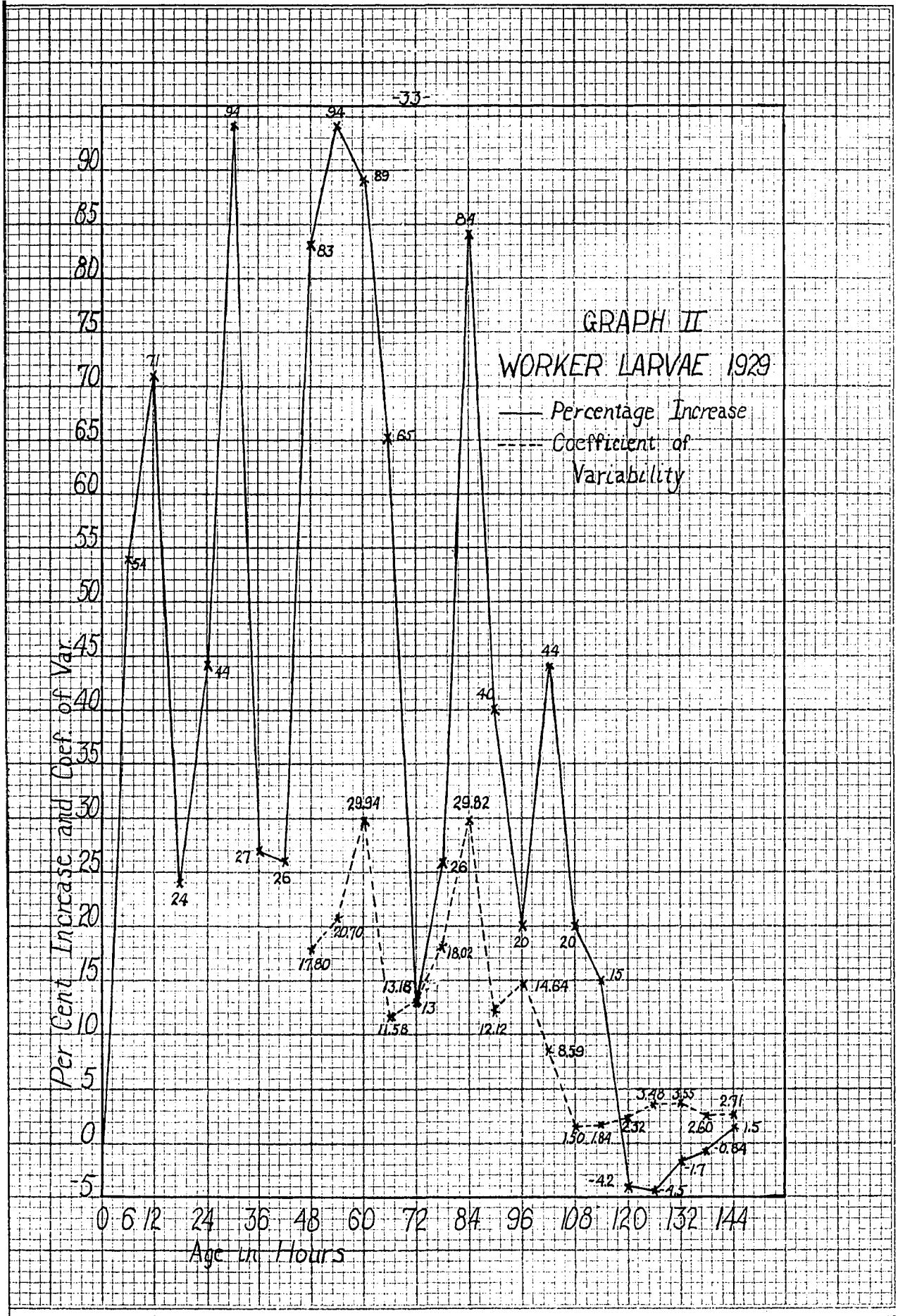
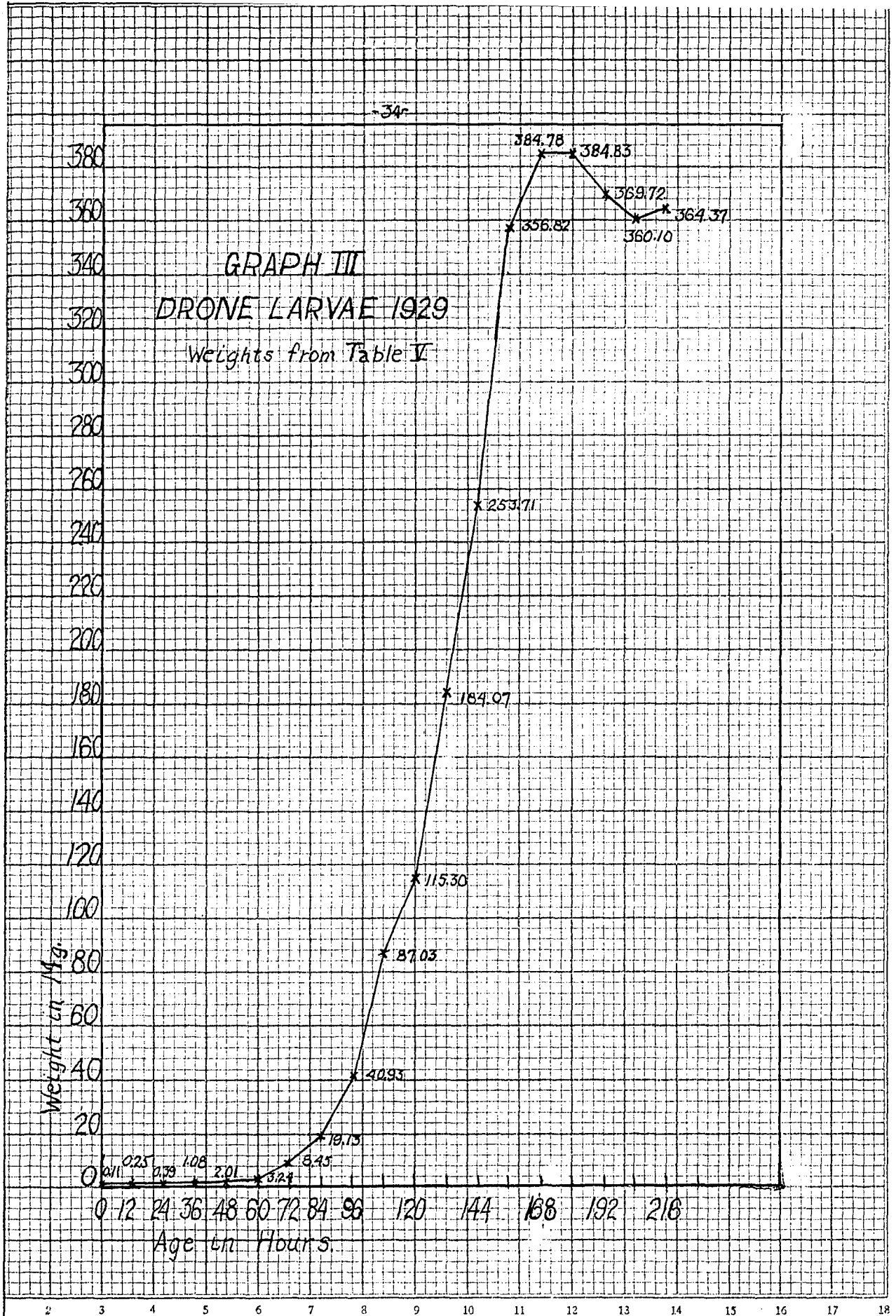
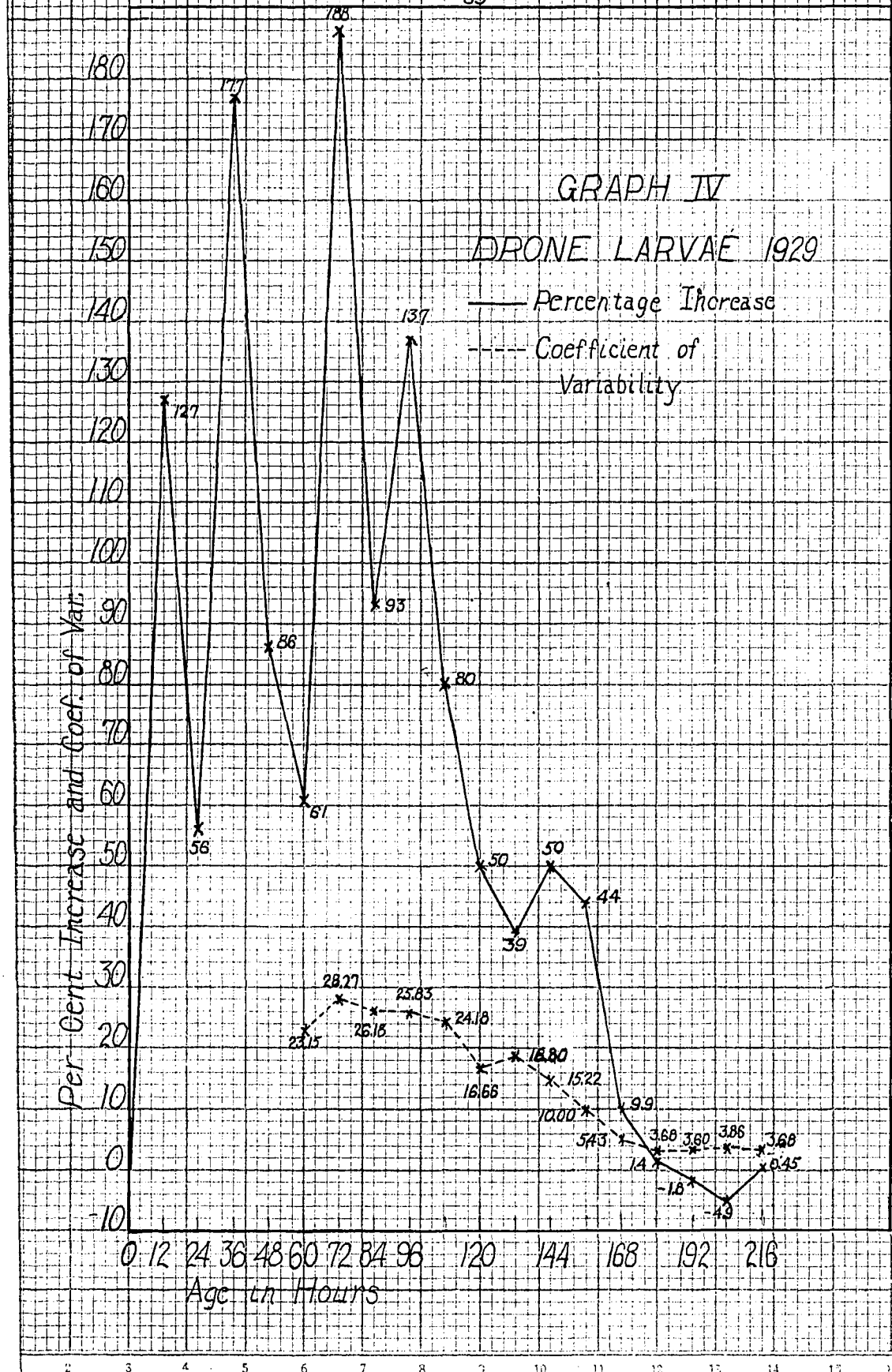
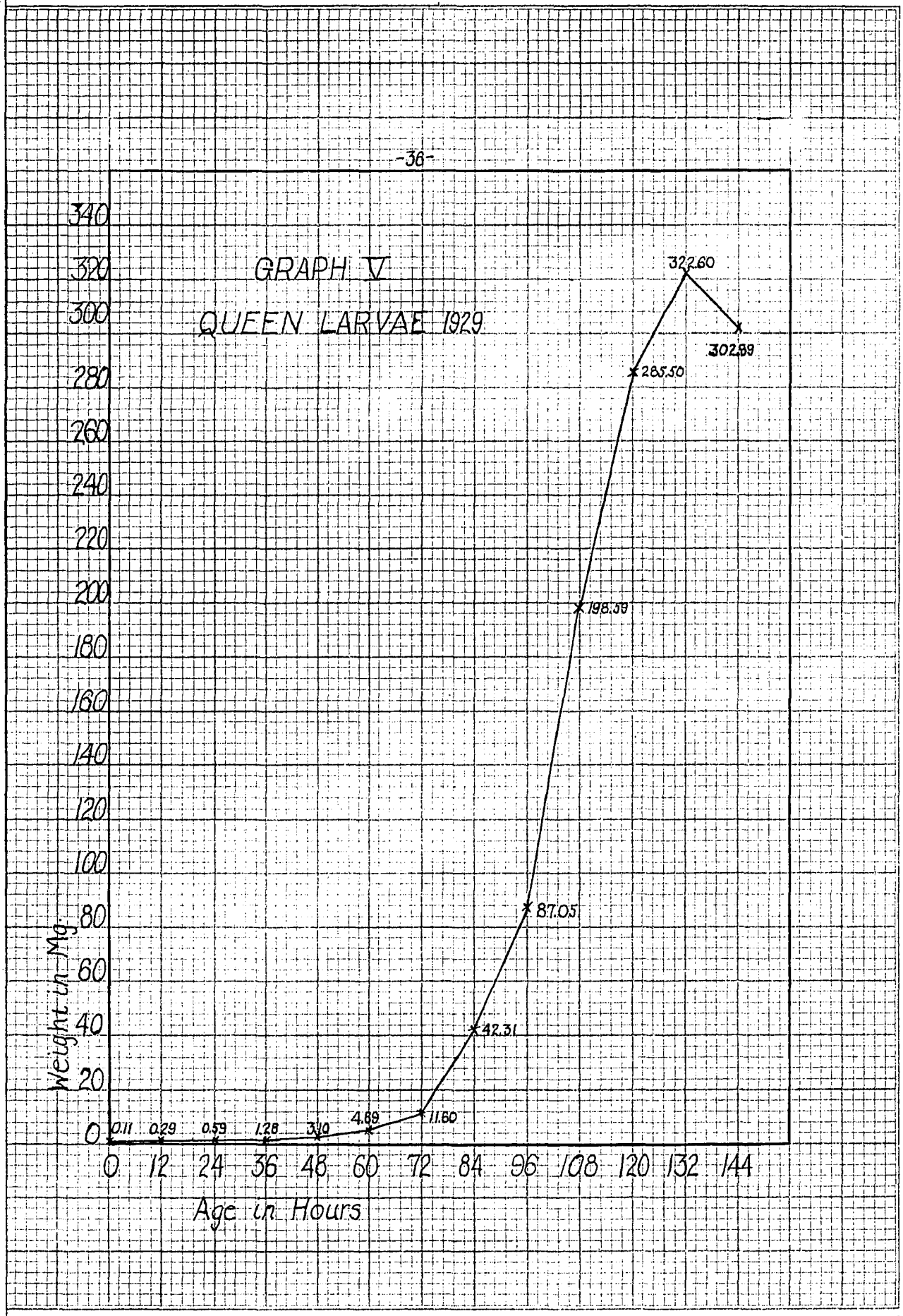
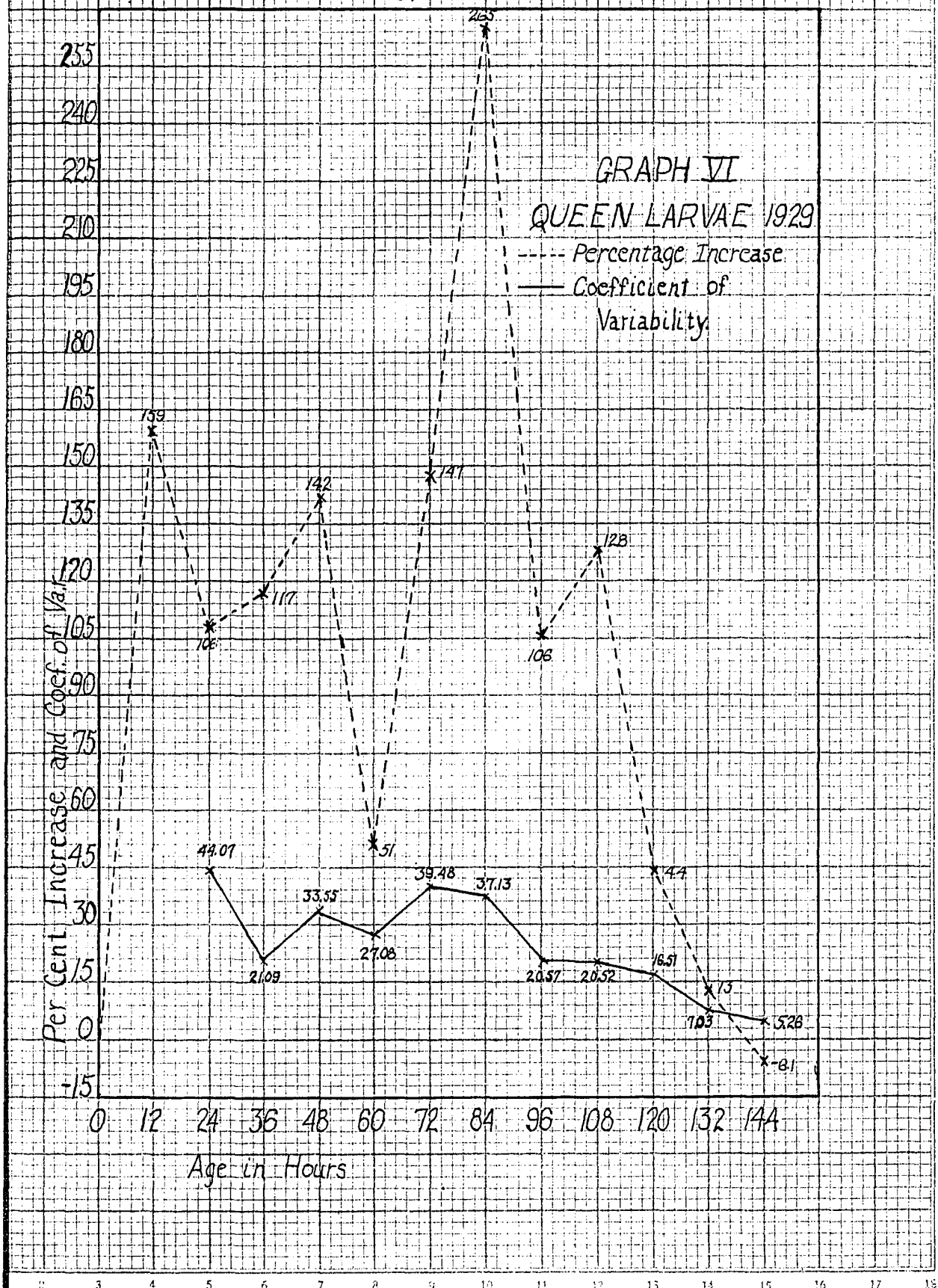

GRAPH I
WORKER LARVAE 1929
Weight in Mg.
Age in Hours
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0 6 12 24 36 48 60 72 84 96 108 120 132 144
0.11
0.17
0.29
0.36
0.52
1.01
1.29
1.63
2.67
5.12
11.12
16.10
19.71
25.92
46.27
68.00
80.66
111.39
137.81
159.07
152.38
145.57
143.03
141.83
143.94


GRAPH II
WORKER LARVAE 1929
Percentage Increase
Coefficient of Variability
Per Cent Increase and Coef. of Var.
Age in Hours
0 6 12 24 36 48 60 72 84 96 108 120 132 144
90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 -5
54 71 24 44 94 27 26 83 94 89 65 17.80 20.70 29.94 13.18 11.58 13 18.02 26 29.82 12.12 84 40 20 44 20 14.64 8.59 1.50 1.84 15 2.32 -4.2 -4.5 3.48 3.55 2.60 2.71 1.5 -0.84 -1.7


GRAPH III
DRONE LARVAE 1929
Weights from Table V
Weight in Mg.
Age in Hours.
0 12 24 36 48 60 72 84 96 120 144 168 192 216
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380
0.11
0.25
0.79
1.08
2.01
3.24
8.45
18.13
40.93
87.03
115.30
184.07
253.71
356.82
384.78
384.83
369.72
364.37
360.10


GRAPH IV
DRONE LARVAE 1929
—— Percentage Increase
----- Coefficient of Variability
Per Cent Increase and Coef. of Var.
Age in Hours
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
0 12 24 36 48 60 72 84 96 120 144 168 192 216
188
177
137
127
93
86
80
61
56
50
50
44
39
28.27
25.83
24.18
23.15
26.15
18.80
16.66
15.22
10.00
9.9
5.43
3.68
3.60
3.86
3.68
1.4
0.45
-1.8
-4.9


GRAPH V
QUEEN LARVAE 1929
Weight in Mg.
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0.11
0.29
0.59
1.28
3.10
4.69
11.60
42.31
87.05
198.39
285.50
322.60
302.89
0 12 24 36 48 60 72 84 96 108 120 132 144
Age in Hours


GRAPH VI
QUEEN LARVAE 1929
----- Percentage Increase
—— Coefficient of Variability
Per Cent Increase and Coef. of Var.
Age in Hours
255
240
225
210
195
180
165
150
135
120
105
90
75
60
45
30
15
0
+15
0
12
24
36
48
60
72
84
96
108
120
132
144
139
106
117
142
51
141
263
106
128
44.07
21.09
33.33
27.08
39.48
37.13
20.57
20.52
16.51
14.4
13
10.3
5.28
-8.1

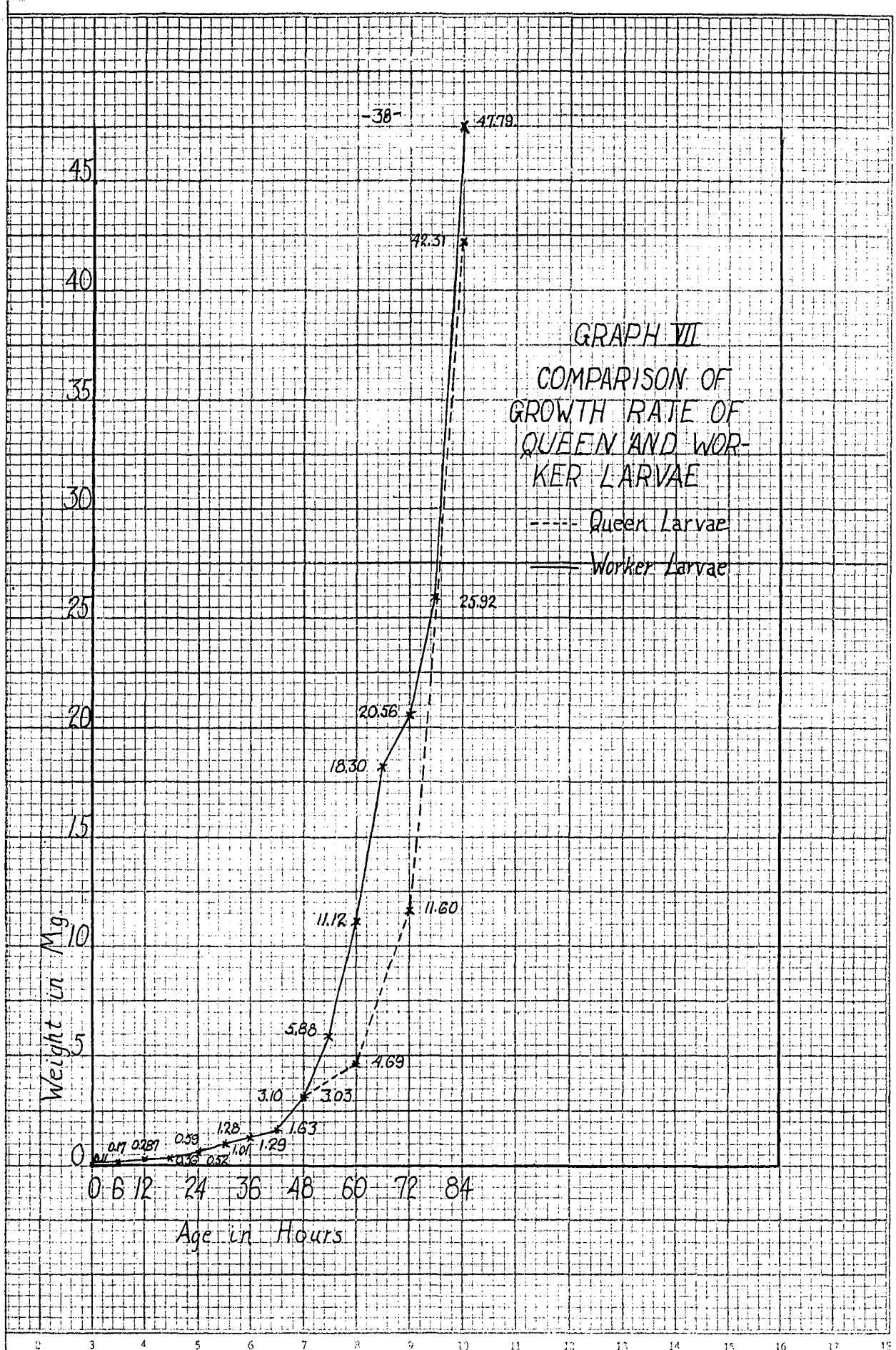

GRAPH VII
COMPARISON OF GROWTH RATE OF QUEEN AND WORKER LARVAE
----- Queen Larvae
——— Worker Larvae
Weight in Mg.
Age in Hours
0 6 12 24 36 48 60 72 84
0 5 10 15 20 25 30 35 40 45
47.79
42.31
25.92
20.56
18.30
11.12
11.60
5.88
4.69
3.10
3.03
1.63
1.29
1.28
1.01
0.59
0.52
0.36
0.287
0.17
0.11

TABLE I

WEIGHT OF EGGS.

DATE	AGE IN HRS.	NO. OF EGGS	WEIGHT IN MG.	AVERAGE WEIGHT
Aug. 31	Just laid	25	3.7	0.148
"	" "	25	3.7	0.148
"	" "	25	3.6	0.144
"	" "	25	3.7	0.148
	Totals	100	14.7	0.147
Aug. 31	24	25	3.4	0.136
"	24	25	3.4	0.136
"	24	25	3.5	0.140
"	24	25	3.5	0.140
	Totals	100	13.8	0.138
Aug. 30	48	25	3.0	0.120
"	48	25	3.0	0.120
"	48	25	2.9	0.116
"	48	25	3.1	0.124
	Totals	100	12.0	0.120
Aug. 10	72	10	1.2	0.120
"	72	10	1.2	0.120
"	72	10	1.2	0.120

TABLE I (Continued)

DATE	AGE IN HRS.	NO. OF EGGS	WEIGHT IN Mg.	AVERAGE WEIGHT
Aug. 10	72	10	1.2	0.12
"	72	10	1.2	0.12
"	72	25	3.0	0.12
"	72	25	3.0	0.12
"	72	25	3.0	0.12
Aug. 11	72	25	3.0	0.12
"	72	25	3.0	0.12
"	72	25	3.0	0.12
"	72	25	2.9	0.116
"	72	25	3.0	0.12
"	72	25	3.0	0.12
"	72	25	3.0	0.12
Aug. 30	72	5	0.5	0.10
"	72	5	0.6	0.12
"	72	5	0.6	0.12
"	72	5	0.6	0.12
"	72	5	0.6	0.12
"	72	5	0.5	0.10
	Totals	330	39.3	0.119

TABLE II

WORKER LARVAE 1928

QUEEN A

DATE	AGE IN HRS.	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 13	24	10	5.6	0.56	
"	"	10	5.7	0.57	
"		10	5.1	0.51	
"		10	4.9	0.49	
"		10	4.5	0.45	
Totals		50	25.8	M = 0.52	
Aug. 8	30	5	5.2	1.04	
"		5	4.4	0.88	
"		5	6.4	1.28	
"		5	8.0	1.60	
"		5	8.4	1.68	
"		5	8.2	1.64	
"		5	9.6	1.92	
"		5	7.2	1.44	
"		5	10.2	2.04	
"		5	7.2	1.44	
"		5	8.8	1.76	
"		5	8.0	1.60	

TABLE II (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 8	30	5	9.0	1.80	
"		5	7.8	1.56	
"		5	8.0	1.60	
"		5	8.8	1.76	
"	Totals	80	125.2	M = 1.57	
Aug. 6	48	5	12.8	2.56	
"		5	13.7	2.72	
"		5	12.0	2.40	
"		5	16.4	3.28	
"		5	13.4	2.68	
"		5	14.0	2.80	
"		5	15.0	3.00	
"		5	12.4	2.48	
"		5	16.8	3.36	
"		5	20.2	4.04	
	Totals	50	146.7	M = 2.93	
Aug. 10	48	5	14.2	2.84	
"		5	14.8	2.96	
"		5	13.8	2.76	
"		5	13.2	2.64	

TABLE II (Continued)

DATE	AGE IN HOURS	NOL OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 10	48	5	14.2	2.84	
"		5	15.6	3.12	
"		5	13.8	2.76	
"		5	14.2	2.84	
"		5	14.8	2.96	
"		5	15.4	3.08	
"		5	14.8	2.96	
	Totals	55	158.8	M = 2.89	
Aug. 10	60	5	36.7	7.34	
"		5	51.5	10.30	
"		5	43.0	8.60	
"		5	41.5	8.30	
"		5	35.6	7.12	
"		5	46.9	9.38	
"		5	49.6	9.92	
"		5	49.5	9.90	
"		5	44.0	8.80	
"		5	44.3	8.86	
"		5	43.7	8.74	
"		5	44.0	8.80	

TABLE II (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 10	60	5	50.3	10.06	
"		5	37.5	7.50	
	Totals	70	618.1	M = 8.83	
Aug. 4	72	5	96.6	19.32	
"		5	96.6	19.32	
"		5	96.0	19.20	
"		5	92.0	18.40	
"		5	87.0	17.40	
"		5	84.4	16.88	
"		5	89.0	17.80	
"		5	88.4	17.68	
"		5	100.4	20.08	
"	Totals	45	830.4	M = 18.45	
Aug. 8	78	5	127.8	25.56	
"		5	115.6	25.12	
"		5	132.8	26.56	
"		5	127.0	25.40	
"		5	134.8	26.96	
"		5	118.8	23.76	
"		5	128.4	25.68	

TABLE II (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 8	78	5	123.2	24.64	
"		5	121.0	24.20	
"		5	113.8	22.76	
"		5	101.0	20.20	
	Totals	55	1344.2	24.44	
Aug. 14	84	5	152.2	30.44	
"		5	165.6	33.14	
"		5	192.2	38.44	
"		5	177.6	35.52	
"		5	180.2	36.04	
"		5	200.6	40.12	
"		5	214.4	42.88	
"		5	139.0	27.80	
"		5	209.0	41.80	
"		5	226.2	45.24	
"		5	176.6	35.52	
"		5	178.2	35.64	
a	Totals	60	2211.8	36.86	
Aug. 6	90	5	328.8	65.76	
"		5	316.2	63.24	

TABLE II (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 6	90	5	310.4	62.08	
"		5	340.2	68.04	
"		5	288.6	57.72	
"		5	310.8	62.16	
"		5	291.6	58.32	
"		5	337.2	67.24	
"		5	338.6	67.72	
"		5	299.4	59.88	
"		5	307.4	61.48	
"		5	391.8	78.36	
"		5	408.2	81.64	
"		5	359.8	71.96	
"		5	370.2	74.04	
"		5	367.4	73.48	
"		5	308.8	61.76	
"		5	287.8	57.56	
"		5	356.2	71.24	
"		5	330.2	66.04	
	Totals	100	6649.6	66.50	
Aug. 4	96	5	388.6	77.72	
"		5	373.0	74.60	

TABLE II (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 4	96	5	389.4	77.88	
"		5	403.0	80.60	
"		5	389.4	77.88	
"		5	391.8	78.36	
"		5	414.6	82.92	
"		5	359.6	71.92	
"		5	351.8	70.36	
"		5	389.6	77.92	
"		5	402.6	80.52	
	Totals	55	4253.4	77.33	
Aug. 14	120	5	773.4	154.7	All sealed
"		5	795.0	159.0	" "
"		5	760.5	152.1	" "
"		5	770.2	154.0	" "
"		5	731.8	146.4	" "
"		5	739.2	147.8	" "
"		5	732.4	146.5	" "
"		5	717.6	143.5	" "
"		5	730.4	146.1	" "
"		5	719.4	143.9	" "

TABLE II (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 14	120	5	722.4	144.5	All sealed
"		5	738.4	147.7	" "
	Totals	60	8930.7	148.85	

TABLEI III

WORKER LARVAE 1928

QUEEN B

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 21	6	10	1.4	0.14	
"		10	1.2	0.12	
"		10	1.6	0.16	
"		10	1.6	0.16	
"		10	1.8	0.18	
	Totals	50	7.6	0.15	
Aug. 18	12	10	3.2	0.32	
"		10	3.2	0.32	
"		10	4.3	0.43	
"		10	3.5	0.35	

TABLE III (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 18	12	10	3.2	0.32	
"		10	2.9	0.29	
	Totals	60	20.3	0.34	
Aug. 22	18	10	4.4	0.44	
"		10	5.3	0.53	
"		10	4.2	0.42	
"		10	5.2	0.52	
"		10	4.9	0.49	
	Totals	50	24.0	M = 0.48	
Aug. 22	66	5	94.5	18.90	
"		5	79.3	15.86	
"		5	85.8	17.16	
"		5	85.5	17.10	
"		5	94.7	18.94	
"		5	80.2	16.04	
"		5	63.8	12.76	
	Totals	35	583.8	M = 16.68	

TABLE III (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 21	90	5	355.8	71.16	
"		5	403.2	80.64	
"		5	389.4	77.88	
"		5	355.6	71.14	
"		5	392.6	78.52	
"		5	359.4	71.88	
"		5	386.1	77.22	
"		5	352.2	70.44	
"		5	399.2	79.84	
Totals		45	3393.5	M = 75.41	
Aug. 22	114	5	743.6	148.7	Allsealed
"		5	728.8	145.8	All sealed
"		5	754.5	150.9	" "
"		5	762.8	152.6	" "
"		5	784.7	156.9	" "
"		5	756.5	151.3	" "
"		5	773.6	154.7	" "
"		1	147.5	147.5	"
"		1	138.3	138.3	"
Totals		37	5590.3	M = 151.09	

TABLE III (Continued)

DATE	AGE IN HOURS	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT	REMARKS
Aug. 23	132	5	733.8	146.8	
"		5	683.6	136.7	
"		5	733.2	146.6	
"		5	723.8	144.8	
"		5	720.0	144.0	
"		5	721.8	144.4	
"		5	698.2	139.6	
Totals		35	5014.4	M = 143.27	
Aug. 24	156	5	648.2	129.6	
"		5	662.8	132.6	
"		5	693.6	138.7	
"		5	655.4	131.1	
"		5	682.2	136.4	
Totals		25	3342.2	M = 133.69	
Aug. 25	180	5	622.8	124.6	
"		5	675.2	135.0	
"		5	653.2	130.6	
"		5	674.2	134.8	
"		5	614.3	122.9	
Totals		25	3239.7	129.59	

TABLE I V

DEVELOPMENT OF WORKER LARVAE

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
6 hours	10	1.8	0.18	
	10	1.7	0.17	
	10	2.0	0.20	
	10	1.5	0.15	
	10	1.7	0.17	
Total	50	8.7	M = 0.17	
12 hours	10	3.3	0.33	
	10	2.6	0.26	
	10	2.5	0.25	
	10	3.0	0.30	
	10	2.9	0.29	
Total	50	14.3	M = 0.29	
18 hours	10	3.7	0.37	
	10	3.9	0.39	
	10	3.6	0.36	
	10	3.3	0.33	
	10	3.5	0.35	
	10	3.6	0.36	
Total	60	21.6	M = 0.36	

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
24 hours	5	2.5	0.50	
	5	3.0	0.60	
	5	2.7	0.54	
	5	2.6	0.52	
	5	2.9	0.58	
	5	2.5	0.50	
	5	2.3	0.46	
	5	2.7	0.54	
	5	2.3	0.46	
	5	2.5	0.50	
	Total 50	26.0	M = 0.52	
30 hours	5	5.1	1.02	
	5	5.9	1.18	
	5	4.9	0.98	
	5	6.6	1.32	
	5	5.5	1.10	
	5	4.0	0.80	
	5	4.8	0.96	
	5	5.0	1.00	
	5	3.7	0.74	
	Total 45	45.5	M = 1.01 mg.	

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
36 hours	5	7.2	1.44	
	5	6.1	1.22	
	5	5.2	1.04	
	5	7.3	1.46	
	5	6.5	1.30	
	5	6.6	1.32	
	5	5.9	1.18	
	5	6.2	1.24	
	5	6.8	1.36	
	5	6.6	1.32	
Total	50	64.4	M = 1.29	
42 hours	5	8.9	1.8	
	5	7.6	1.5	
	5	9.2	1.8	
	5	8.5	1.7	
	5	8.6	11.7	
	5	8.7	1.7	
	5	7.8	1.6	
	5	8.1	1.6	
	5	7.5	1.5	
	5	7.1	1.4	
	5	7.9	1.6	
Total	55	89.9	M = 1.63 mg.	

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
48 hours	1	3.1		
	1	3.0		
	1	3.8		
	1	3.5		
	1	4.1		
	1	3.1		
	1	2.8		
	1	2.5		
	1	2.4		
	1	2.1		
	1	2.9		
	1	3.6		
	1	2.4		
	1	2.9		
	1	3.1		
	1	3.2		
	5	13.5		
	5	10.9		
	5	11.2		
	5	12.0		
Total	36	96.1	M = 2.67	
54 hours	1	6.4		
	1	7.8		

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	6.3		
	1	5.5		
	1	6.9		
	1	6.6		
	1	5.8		
	1	7.0		
	1	6.4		
	1	6.7		
	1	8.3		
	1	5.2		
	1	3.7		
	1	4.6		
	1	5.6		
	1	6.1		
	1	4.9		
	1	5.1		
	1	4.8		
	1	3.8		
	5	15.4		
	5	22.9		
	2	7.0		
	Total 32	163.8	M = 5.12 mg.	

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
60 hours	1	15.9		
	1	13.9		
	1	15.9		
	1	12.0		
	1	15.8		
	1	12.1		
	1	16.0		
	1	16.1		
	1	10.3		
	1	9.9		
	1	11.2		
	1	11.9		
	1	10.9		
	1	8.7		
	1	8.5		
	1	12.3		
	1	11.9		
	1	7.1		
	1	7.9		
	1	7.3		
	1	7.6		
	1	6.5		
Total	23	255.8	M = 11.12 mg.	

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
66 hours	1	19.2		
	1	15.8		
	1	19.5		
	1	18.7		
	1	15.5		
	1	16.1		
	1	17.4		
	1	18.2		
	1	16.6		
	1	15.8		
	1	16.6		
	1	21.4		
	1	16.5		
	1	23.6		
	1	17.4		
	1	20.5		
	1	19.9		
	1	18.9		
	1	19.7		
	1	18.7		
	5	66.9		
	5	73.3		

TABLE IV (Con.)

Age	Number of Larvae	Weight Mg.	Average Weight mg.	Remarks
	5	74.1		
	5	78.1		
	5	67.8		
	5	78.6		
Total	50	804.8	M = 16.10 mg.	
72 hours	1	19.5		
	1	21.2		
	1	24.8		
	1	19.6		
	1	17.8		
	1	22.9		
	1	19.1		
	1	17.9		
	1	23.6		
	1	21.9		
	1	20.5		
	1	21.2		
	2	43.3		
	4	68.4		
	/	24.1		
	/	20.5		
	/	25.8		

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	21.3		
	1	20.4		
	1	18.6		
	1	15.8		
	1	17.5		
	1	22.4		
	1	15.9		
	5	86.3		
	5	98.7		
	Total 38	749.0	M = 19.71 mg.	
78 hours	1	28.8		
	1	27.8		
	1	29.6		
	1	27.5		
	1	27.1		
	1	29.5		
	1	34.5		
	1	23.8		
	1	39.3		
	1	19.3		
	1	27.8		
	1	23.7		
	1	19.3		

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	19.3		
	1	20.8		
	1	23.8		
	1	24.5		
	1	30.5		
	1	26.2		
	1	29.1		
	1	88.8		
	1	30.1		
	1	34.2		
	1	27.8		
	1	22.3		
	1	21.1		
	1	24.9		
	1	21.2		
	1	20.8		
	1	21.9		
	1	24.3		
	1	24.8		
	1	23.3		
	1	23.6		
Total	34	881.3	M = 25.92 mg.	

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
84 hours	1	69.7		
	1	64.6		
	1	51.2		
	1	52.1		
	1	43.8		
	1	51.9		
	1	47.5		
	1	48.3		
	1	53.1		
	1	43.1		
	1	35.3		
	1	35.9		
	1	42.3		
	1	41.2		
	1	45.6		
	1	39.0		
	1	44.3		
	1	47.1		
	1	74.7		
	1	47.9		
	1	71.1		
	1	51.9		

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	52.6		
	1	52.1		
	1	48.7		
	1	42.4		
	1	46.9		
	5	208.8		
	5	193.9		
	5	196.3		
Total	42	1943.3	M = 46.27 mg.	
90 hours	1	66.8		
	1	61.5		
	1	68.2		
	1	67.1		
	1	85.8		
	1	74.4		
	1	58.3		
	1	62.3		
	1	58.2		
	1	67.3		
	1	67.2		
	1	62.5		
	1	86.1		

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	67.6		
	1	62.9		
	1	65.0		
	1	64.4		
	1	74.1		
	1	57.1		
	1	58.3		
	2	301.1		
	5	291.6		
	5	118.3		
Total	49	3234.3	M = 66.00	
96 hours	1	63.7		
	1	64.5		
	1	63.5		
	1	99.3		
	1	91.4		
	1	75.8		
	1	67.6		
	1	87.3		
	1	92.1		
	1	85.6		
	1	70.1		
	1	75.3		

TABLE IV (Con.)

Age	Number of larvae	Weight mg.	Average Weight mg.	Remarks
	1	97.6		
	1	85.0		
	1	85.2		
	1	84.3		
	1	74.9		
	5	399.9		
	5	365.9		
	5	428.5		
	5	443.7		
	5	410.4		
	5	379.3		
	Total 47	3790.9	M = 80.66 mg.	
102 hours	1	94.5		Unsealed
	1	112.1		"
	1	128.0		Sealing begun
	1	123.9		" "
	1	108.7		" "
	1	110.7		" "
	1	110.2		" "
	1	113.8		" "
	1	107.1		" "
	1	109.4		" "
	1	118.8		" "

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	132.4		Sealing begun
	1	128.8		" "
	1	116.3		" "
	1	119.6		" "
	5	549.6		
	5	518.9		
	5	538.9		
Total	30	3341.7	M = 111.39 mg.	
108 hours	1	141.1	141.1	Nearly sealed
	1		140.1	" "
	1		137.5	" "
	1		141.4	" "
	1		135.2	" "
	1		139.5	" "
	1		137.6	" "
	1		138.8	" "
	5	669.3	134.9	" "
	5	695.6	139.1	" "
	5	687.3	137.5	" "
	5	691.2	138.2	" "
	5	686.6	137.3	" "
Total	33	4541.2	M = 137.61 mg.	

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
114 hours	1	155.4		Sealed
	1	164.9		"
	1	165.6		"
	1	163.9		"
	1	158.7		"
	1	154.6		"
	1	159.0		"
	1	153.7		"
	1	162.6		"
	1	158.3		"
	1	159.4		"
	1	163.8		"
	1	156.6		"
	1	159.8		"
	1	157.7		"
	1	156.2		"
	1	158.7		"
	1	164.3		"
	1	157.5		"
	1	156.0		"
	1	162.6		"
	1	164.5		"
	1	155.2		"

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	156.6		Sealed
	1	157.6		"
	1	159.3		"
	1	159.9		"
	1	158.4		"
	1	161.8		"
	1	157.3		"
	1	159.8		"
	Total 31	4930.7	M = 159.06 mg.	
120 hours	1	150.9		Cocoons started
	1	153.0		" "
	1	158.1		" "
	1	155.5		" "
	1	156.6		" "
	1	152.5		" "
	1	152.3		" "
	1	150.5		" "
	1	154.2		" "
	1	150.8		" "
	1	156.0		" "
	1	150.0		" "
	1	149.6		" "
	1	150.5		" "

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	149.9		Cocoons started
	1	145.8		" "
	1	150.5		" "
	1	142.8		" "
	1	150.9		" "
	1	157.6		" "
	1	149.7		" "
	1	154.3		" "
	1	153.9		" "
	1	153.0		" "
	1	153.9		" "
	1	152.6		" "
	1	156.3		" "
	1	145.8		" "
	1	152.2		" "
	1	153.2		" "
	1	155.3		" "
	1	154.8		" "
	1	155.7		" "
Total	33	5028.7	M = 152.38 mg.	
126 hours	1	147.8		Spinning
	1	146.5		"

TABLE IV (CON.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	141.8		Spinning
	1	138.2		"
	1	159.3		"
	1	141.6		"
	1	147.2		"
	1	153.6		"
	1	154.2		"
	1	145.5		"
	1	150.8		"
	1	142.4		"
	1	147.2		"
	1	135.3		"
	1	137.3		"
	1	148.8		"
	1	144.1		"
	1	145.5		"
	1	147.5		"
	1	144.3		"
	1	147.1		"
	1	145.8		"
	1	148.3		"
	1	144.6		"

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	147.5		Spinning
	1	139.9		"
	1	141.5		"
	1	143.8		"
	1	140.6		"
	1	148.2		"
	1	144.6		"
	Total 31	4512.7	M = 145.57 mg.	
144 hours	1	148.8		
	1	136.3		
	1	151.3		
	1	142.6		
	1	151.6		
	1	141.6		
	1	145.5		
	1	141.3		
	1	149.3		
	1	142.8		
	1	146.3		
	1	137.2		
	1	147.9		
	1	148.9		

TABLE IV (Con.) -73-

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	147.3		
	1	143.2		
	1	144.5		
	1	140.6		
	1	142.4		
	1	144.5		
	1	139.6		
	1	141.8		
	1	141.3		
	1	145.5		
	1	140.2		
	1	143.8		
	1	141.5		
	1	142.9		
Total	28	- 4030.3	M - 143.94	
138 hours	1	136.8		
	1	142.4		
	1	137.8		
	1	142.3		
	1	138.5		
	1	142.9		
	1	141.1		
	1	137.8		

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	146.2		
	1	150.1		
	1	145.9		
	1	147.0		
	1	137.8		
	1	139.9		
	1	138.8		
	1	145.6		
	1	143.3		
	1	145.9		
	1	137.5		
	1	138.8		
	1	138.3		
	1	139.5		
	1	145.3		
	1	143.5		
	1	144.3		
	1	141.3		
	Total 26	3687.6	M = 141.83 mg.	
132 hours	1	141.0		Cocoons spun
	1	136.3		" "
	1	141.2		" "
	1	153.9		" "

TABLE IV (Con.)

Age	Number of Larvae	Weight mg.	Average Weight	Remarks
	1	137.8		Cocoons spun
	1	151.4		" "
	1	145.5		" "
	1	142.8		" "
	1	138.6		" "
	1	144.0		" "
	1	151.2		" "
	1	139.7		" "
	1	143.7		" "
	1	137.3		" "
	1	140.0		" "
	1	149.6		" "
	1	145.1		" "
	1	143.7		" "
	1	136.8		" "
	1	135.6		" "
	1	142.7		" "
	1	152.3		" "
	1	139.3		" "
	1	142.8		" "
	1	140.2		" "
	1	148.5		" "

TABLE IV (Con.)

Age	Number of Larvae	Weight Mg.	Average Weight Mg.	Remarks
144 hours	1	145.3		Cocoon spun
	1	142.8		" "
	1	138.8		" "
	Total 29	4147.9	M = 143.03	

TABLE IVa

WORKER LARVAE 1929

AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	MEAN	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
6	50	8.7	0.17	0.06	54	
12	50	14.3	0.29	0.12	71	
18	60	21.6	0.36	0.07	24	
24	50	26.0	0.52	0.16	44	
30	45	45.5	1.01	0.49	94	
36	50	64.4	1.29	0.28	27	
42	55	89.9	1.63	0.34	26	

TABLE IVa (Con.)

AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	MEAN	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
48	16	48.5	3.03 ± 0.09	1.40	83	17.80 ± 2.17%
54	20	117.5	5.87 ± 0.19	2.84	94	20.70 ± 2.30%
60	23	255.8	11.12 ± 0.48	5.25	89	29.94 ± 3.25%
66	20	366.0	18.30 ± 0.33	7.18	65	11.58 ± 1.24%
72	22	452.3	20.56 ± 0.40	2.26	13	13.18 ± 1.37%
78	34	881.3	25.92 ± 0.55	5.36	26	18.02 ± 1.51%
84	27	1344.3	47.79 ± 1.88	21.87	84	29.82 ± 2.99%
90	20	1335.1	66.76 ± 1.26	18.97	40	12.12 ± 1.30%
96	17	1363.2	80.19 ± 1.98	13.43	20	14.64 ± 1.76%
102	15	1734.2	115.62 ± 1.79	35.43	44	8.58 ± 0.92%
108	8	1111.2	138.90 ± 0.79	23.29	20	1.60 ± 0.25%
114	31	4930.7	159.06 ± 0.36	20.16	15	1.84 ± 0.16%
120	33	5028.7	152.38 ± 0.42	6.68[1]	4.2[1]	2.32 ± 0.19%
126	31	4512.7	145.57 ± 0.62	6.81[1]	4.5[1]	3.48 ± 0.30%
132	29	4147.9	143.03 ± 0.65	2.54[1]	1.7[1]	3.55 ± 0.31%
138	26	3687.6	141.83 ± 0.50	1.20[1]	0.84[1]	2.60 ± 0.24%
144	28	4030.3	143.94 ± 0.51	2.11	1.5	2.71 ± 0.24%

[1] denotes loss.

TABLE V

DRONE LARVAE

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
12 hours	10	3.0	0.30	8/5/29
	10	2.0	0.20	
	10	1.7	0.17	
	10	2.5	0.25	
	10	2.1	0.21	
	10	2.2	0.22	
	10	2.8	0.28	
	10	3.3	0.33	
	10	2.5	0.25	
	10	2.9	0.29	
Total	100	25.0	M = 0.25 mg.	
24 hours	10	3.4	0.34	8/5/29
	10	3.7	0.37	
	10	4.6	0.46	
	10	4.2	0.42	
	10	3.6	0.36	
	10	3.8	0.38	
Total	60	23.3	M = 0.39 mg.	
36 hours	5	5.6	1.12	8/5/29
	5	7.1	1.42	
	5	6.0	1.20	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	8.5	1.70	8/5/29
	5	4.2	0.84	
	5	4.3	0.86	
	5	5.0	1.00	
	5	5.3	1.06	
	5	5.2	1.04	
	5	4.0	0.80	
	5	5.5	1.10	
	5	5.0	1.00	
	5	5.4	1.08	
	5	4.5	0.90	
	5	5.0	1.02	
	5	5.5	1.10	
Total	80	86.2	M = 1.08 mg.	
48 hours	5	9.9	1.98	8/5/29
	5	9.5	1.90	
	5	9.0	1.80	
	5	9.4	1.86	
	5	9.7	1.94	
	5	11.3	2.26	
	5	10.5	2.10	
	5	10.3	2.06	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	9.9	1.98	
	5	9.8	1.96	
	5	10.7	2.14	
	5	10.5	2.10	
	5	10.7	2.14	
	5	9.4	1.88	
	5	11.2	2.24	
	5	9.2	1.84	
	5	10.1	2.02	
Total	85	171.0	M = 2.01 mg.	
60 hours	1		3.1	8/5/29
	1		2.1	
	1		2.4	
	1		2.5	
	1		3.8	
	1		1.7	
	1		3.6	
	1		3.4	
	1		3.7	
	1		3.4	
	1		3.3	
	1		2.6	
	1		4.7	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1		2.5	
	1		3.7	
	1		4.0	
	1		3.5	
	1		3.1	
	1		4.8	
	1		2.9	
	5	16.9	3.4	
	5	17.0	3.4	
	5	19.9	4.0	
	5	17.2	3.4	
	5	16.4	3.3	
	5	16.9	3.4	
	5	17.5	3.5	
	5	17.3	3.5	
	5	15.9	3.2	
	5	12.0	2.4	
	5	16.0	3.2	
	Total 75	247.8	M = 3.30 mg.	
T				
72 hours	1		19.4	8/1/29
	1		14.6	
	1		10.1	
	1		7.8	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1		5.4	
	1		8.3	
	1		9.0	
	1		10.0	
	1		17.5	
	1		7.2	
	1		7.5	
	1		7.0	
	1		6.8	
	1		8.1	
	1		7.7	
	1		8.2	
	1		7.8	
	1		5.5	
	1		8.7	
	1		10.3	
	5	39.2	7.8	
	5	47.0	9.4	
	5	37.1	7.4	
	5	45.1	9.0	
	5	39.0	7.8	
	5	40.6	8.1	
	5	35.8	7.2	

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	37.3	7.5	
	5	43.9	8.6	
	Total 65	551.0	M = 8.45 mg.	
84 hours	1		14.6	8/1/29
	1		18.6	
	1		12.4	
	1		21.9	
	1		16.7	
	1		11.5	
	1		10.4	
	1		18.8	
	1		24.3	
	1		20.0	
	1		23.9	
	1		15.4	
	1		17.5	
	1		27.4	
	1		20.7	
	1		9.5	
	1		17.4	
	1		18.3	
	1		19.0	
	1		25.1	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	95.9	19.2	
	5	101.0	20.2	
	5	99.7	19.9	
	5	94.9	19.0	
	5	101.9	20.4	
	5	97.7	19.5	
	5	99.5	19.9	
	Total 60	1148.2	M = 19.13 mg.	
96 hours	1		40.0	8/1/29
	1		37.2	
	1		39.0	
	1		55.9	
	1		34.5	
	1		29.7	
	1		40.4	
	1		24.5	
	1		45.4	
	1		37.5	
	1		48.1	
	1		56.0	
	11		38.8	
	1		26.5	
	1		31.4	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1		41.6	
	1		39.8	
	1		49.2	
	1		39.4	
	1		65.0	
	1		62.5	
	1		59.9	
	1		43.3	
	5	219.5	43.9	
	5	183.2	36.6	
	5	205.4	41.1	
	5	184.7	36.9	
	5	213.0	42.6	
	5	187.9	37.6	
	5	221.3	44.3	
	5	178.0	33.6	
Total	63	2578.6	M = 40.96	
108 hours	1		73.1	8/16/29
	1		77.7	
	1		104.0	
	1		48.7	
	1		40.1	
	1		50.3	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1		75.3	
	1		103.5	
	1		95.4	
	1		82.8	
	1		83.6	
	1		81.4	
	1		105.7	
	1		91.9	
	1		79.5	
	1		91.1	
	1		75.1	
	1		76.9	
	1		76.0	
	1		84.8	
	1		75.3	
	1		77.4	
	1		55.4	
	1		43.9	
	5	452.1	90.4	
	5	480.9	96.2	
	5	452.0	90.4	
	5	433.5	86.7	
	5	543.2	108.6	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	517.8	103.6	
	5	464.9	93.0	
	5	425.5	85.1	
	5	464.7	92.9	
	5	443.6	88.6	
	5	460.1	92.0	
	5	361.1	72.2	
	5	363.4	72.7	
	5	440.8	88.2	
	5	417.5	83.5	
	5	437.1	87.4	
	5	445.5	89.1	
	5	393.7	78.7	
	5	508.4	101.7	
	5	412.5	82.5	
	5	434.9	87.0	
	5	453.4	90.7	
	5	526.4	105.3	
	5	391.8	78.4	
	5	380.8	76.2	
	5	447.9	98.6	
Total	154	13402.3	M = 87.03 mg.	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
120 hours	1	122.1		8/1/29
	1	145.3		
	1	98.6		
	1	134.4		
	1	99.0		
	1	123.3		
	1	109.7		
	1	90.0		
Total	8	922.4	M = 115.30 mg.	
132 hours	1	128.6		8/1/29
	1	175.2		
	1	126.1		
	1	130.0		
	1	109.8		
	1	182.9		
	1	120.9		
	1	142.8		
	1	170.6		
	1	181.9		
	1	187.4		
	1	177.6		
	1	220.0		

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	119.0		
	1	165.6		
	1	183.6		
	1	186.5		
	1	198.2		
	1	148.7		
	5	189.6		
	5	203.6		
	5	206.3		
	5	195.6		
	5	202.3		
	5	193.3		
	5	197.7		
	5	208.5		
	3	138.2		
Total	63	11,596.7	M = 184.07 mg.	
144 hours	1	167.2		8/1/29
	1	192.5		
	1	186.6		
	1	239.5		
	1	212.1		
	1	257.9		

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1	276.7		
	1	224.3		
	1	186.2		
	1	263.9		
	1	260.6		
	1	253.6		
	1	277.5		
	1	288.7		
	1	231.6		
	1	232.8		
	1	256.9		
	1	301.3		
	1	260.0		
	1	243.5		
	5	252.3		
	5	274.4		
	5	288.0		
	5	262.6		
	5	243.6		
	5	285.5		
	3	214.3		
	3	236.5		
Total	56	14.207.7	M = 253.71 mg.	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight	Remarks
156 hours	1		358.8	Partly sealed
	1		355.4	" "
	1		329.9	" "
	1		380.0	" "
	1		365.1	Sealed
	1		415.2	"
	1		363.8	Partly Sealed
	1		317.5	" "
	1		378.0	" "
	1		366.7	" "
	1		308.0	" "
	1		319.7	" "
	1		369.0	" "
	1		319.9	" "
	1		326.8	" "
	1		282.7	" "
	1		290.5	" "
	1		336.0	" "
	1		371.0	" "
	1		391.2	" "
	5	1752.7	350.5	" "
	5	1846.6	369.3	" "

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
6				
	4	1407.5	351.9	
	5	1782.1	356.4	
	5	1916.5	383.3	
	2	763.0	381.5	
Total	46	16413.6	M - 356.82 mg.	
156 hours	1		345.7	
	1		340.5	
	1		333.9	
	1		340.1	
	1		353.1	
	1		341.4	
	1		359.8	
	1		357.7	
	1		334.4	
	1		352.3	
	1		324.4	
	1		303.4	
	1		342.8	
	1		357.7	
	1		330.5	
	1		349.1	
	1		324.5	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1		341.2	
	1		370.3	
	1		339.4	
	1		340.7	
	1		308.2	
	1		325.0	
	1		358.4	
	1		354.2	
	5	1429.6	285.9	
	5	1643.0	328.6	Partly sealed
	5	1674.9	335.0	" "
	5	1699.7	339.9	" "
	5	1676.4	335.3	" "
	5	1498.0	299.6	
	5	1454.9	291.0	
	5	1725.6	345.1	
	5	1681.8	336.4	
	5	1687.1	337.4	
	5	1444.4	288.9	
	5	1589.4	317.9	
	5	1652.0	330.4	
	5	1699.5	339.9	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	1617.9	323.6	
Total	100	32,702.9	M = 327.03 mg.	
168 hours	1		369.0	Nearly sealed
	1		357.7	
	1		376.7	
	1		329.5	
	1		352.0	
	1		362.6	
	1		391.0	
	1		331.7	
	1		392.1	
	1		384.0	
	1		384.5	
	1		354.0	
	1		411.0	
	1		395.6	
	1		373.2	
	1		391.8	
	1		392.7	
	1		398.8	Sealed
	1		381.8	"

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	1957.5	391.5	Sealed, some cocoons
	5	1952.1	390.4	" " "
	5	2012.7	402.5	
	5	1934.0	386.8	
	5	1959.0	391.8	
	5	1964.9	393.0	Sealed some cocoons
	5	1775.6	355.1	Unsealed
	1		405.3	Sealed
	1		384.0	"
	1		385.2	"
	1		395.2	"
	1		399.3	"
	1		388.6	"
	1		376.9	"
	1		400.9	"
	1		409.0	"
	1		380.9	"
Total	65	25010.80	M = 384.78 mg.	
180 hours	1		371.1	Sealed, spinning
	1		383.1	
	1		390.3	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1		409.5	
	1		370.6	
	1		394.1	
	1		396.5	
	1		400.4	
	1		394.7	
	1		386.2	
	1		396.8	
	1		393.6	
	1		393.4	
	1		392.5	
	1		384.7	
	1		373.2	
	1		369.8	
	1		365.2	
	1		405.5	
	1		385.7	
	1		395.3	
	1		397.1	
	1		403.9	
	1		392.2	
	1		365.1	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	1931.5	386.3	
	5	1839.4	367.9	
	5	1917.3	383.7	
	5	1897.4	379.9	
	5	1915.9	383.2	
	5	1913.5	382.7	
	5	1950.0	390.0	
	5	1947.5	389.5	
	5	1956.5	391.3	
	5	1865.0	373.0	
	5	1877.8	375.6	
	5	1910.9	382.2	
	5	1925.0	385.0	
	5	1903.9	380.8	
	5	1927.8	385.6	
	5	1927.9	385.6	
	5	1968.4	393.7	
	5	1990.8	398.2	
	5	1931.4	386.3	
Total	120	46179.4	M - 384.83 mg.	
180 hours	1		375.9	
	1		367.7	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	1		384.8	
	1		372.7	
	1		386.9	
	1		389.2	
	1		379.5	
	1		364.0	
	1		379.7	
	1		368.6	
	1		388.6	
	1		365.5	
	1		412.7	
	1		407.1	
	1		411.9	
	1		365.0	
	1		355.4	
	1		381.7	
	1		375.8	
	1		369.5	
	5	1875.1	375.0	
	5	1889.3	377.9	
	5	1936.5	387.3	
	5	1934.7	386.9	

TABLE V (Con.)

Age	Number of Larvae	Weight mg.	Average Weight mg.	Remarks
	5	2011.1	402.2	
	5	1928.9	385.8	
	Total 50	19,177.8 M =	383.56 mg.	
192 hours	1		370.3	Cocoons spun
	1		378.8	
	1		376.9	
	1		392.2	
	1		404.8	
	1		388.4	
	1		385.2	
	1		387.8	
	1		374.2	
	1		374.9	
	1		390.8	
	1		405.0	
	1		404.1	
	1		373.5	
	1		364.4	
	1		383.0	
	1		356.4	
	1		379.0	
	1		387.2	

TABLE V (Continued)

AGE	NUMBER OF LARVAE	WEIGHT MG.	AVERAGE WEIGHT MG.	REMARKS
192 hours	1	360.4	360.4	Cocoon spun
	1		366.6	
	1		391.5	
	1		365.7	
	1		362.4	
	1		377.9	
	5	1830.7	366.1	
	5	1835.9	367.9	
	5	1786.8	357.4	
	5	1828.7	365.7	
	5	1892.9	378.6	
	5	1815.8	363.2	
	5	1897.9	379.6	
	5	1800.5	360.1	
	5	1847.4	369.5	
	5	1832.1	366.4	
	5	1799.8	360.0	
	5	1816.2	363.3	
	5	1836.1	367.2	
	5	1813.1	362.6	

TABLE V (Continued)

AGE	NUMBER OF LARVAE	WEIGHT MG.	AVERAGE WEIGHT MG.	REMARKS
192 hours	5	1839.5	367.9	Cocoon spun
	5	1840.4	368.1	
	5	1839.6	367.9	
	5	1861.9	362.4	
Total	115	42,517.7	M = 369.72	
204 hours	1		367.2	Aug. 16
	1		355.9	
	1		358.9	
	1		371.6	
	1		342.7	
	1		355.2	
	1		358.9	
	1		368.4	
	1		338.8	
	1		380.2	
	1		361.8	
	1		351.5	
	1		359.4	
	1		367.2	
	1		379.2	

TABLE V (Continued)

AGE	NUMBER OF LARVAE	WEIGHT MG.	AVERAGE WEIGHT MG.	REMARKS
366				
204 hours	1		372.5	About one-third
	1		390.2	are prepupae
	1		347.0	
	1		365.1	
	1		331.0	
	1		354.2	
	1		376.4	
	1		375.3	
	1		348.4	
	1		357.7	
	5	1860.9	372.2	
	5	1850.0	370.0	
	5	1815.4	363.1	
	5	1850.2	370.0	
	5	1762.9	352.6	
	5	1788.6	357.3	
	5	1838.0	367.6	
	5	1726.4	345.3	
	5	1809.1	361.8	
	5	1742.1	348.4	

TABLE V (Continued)

AGE	NUMBER OF LARVAE	WEIGHT MG.	AVERAGE WEIGHT MG.	REMARKS
204 hours	5	1792.4	358.5	All prepupae
	5	1811.7	362.3	
	5	1788.1	357.6	
	5	1752.9	350.6	
	5	1792.7	358.5	
Total	100	36,016.1	M = 360.16 mg.	
216 hours	1		357.2	All prepupae
	1		343.1	
	1		355.4	
	1		361.8	
	1		381.1	
	1		360.0	
	1		361.2	
	1		339.4	
	1		382.0	
	1		355.4	

TABLE V (Continued)

AGE	NUMBER OF LARVAE	WEIGHT MG.	AVERAGE WEIGHT MG.	REMARKS
216 hours	1		347.2	All prepupae
	1		367.8	
	1		370.3	
	1		349.7	
	1		354.4	
	1		356.6	
	1		335.1	
	1		359.7	
	1		378.2	
	1		358.4	
	1		359.8	
	1		357.4	
	1		371.6	
	1		394.0	
	1		368.2	
	5	1811.2	362.2	

TABLE V (Continued)

AGE	NUMBER OF LARVAE	WEIGHT Mg.	AVERAGE WEIGHT Mg.	REMARKS
216 hours	5	1824.5	364.9	All prepupae
	5	1813.7	362.7	
	5	1788.6	357.7	
	5	1804.8	361.0	
	5	1928.9	385.8	
	5	1929.8	386.0	
	5	1743.5	348.7	
	5	1721.5	344.3	
	5	1733.1	346.6	
	5	1805.6	361.1	
	5	1808.3	361.7	
	5	1773.3	354.7	
	5	1781.7	356.3	
	5	1932.0	386.4	
	5	1983.5	396.7	
Totals	105	38,259.0	M = 364.37	

TABLE Va

DRONE LARVAE 1929

AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	MEAN	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
12	100	25.0	0.25	0.14	127	
24	60	23.3	0.39	0.14	56	
36	80	86.2	1.08	0.69	177	
48	85	171.0	2.01	0.93	86	
60	20	64.8	3.24 ± 0.12	1.23	61	23.15 ± 2.59%
72	20	186.9	9.34 ± 0.41	6.10	188	28.27 ± 3.25%
84	20	360.7	18.03 ± 0.73	8.69	93	26.18 ± 2.98%
96	23	985.6	42.85 ± 1.59	24.72	137	25.83 ± 2.72%
108	23	1848.9	77.04 ± 2.68	34.19	80	24.18 ± 2.60%
120	8	922.4	115.30 ± 4.90	38.26	50	16.66 ± 2.89%
132	20	3197.50	159.88 ± 4.66	44.58	39	18.80 ± 2.07%
144	20	4813.4	240.67 ± 5.67	80.79	50	15.22 ± 1.66%
156	20	6945.2	347.26 ± 5.38	106.59	44	10.00 ± 1.08%
168	30	11,455.0	381.83 ± 2.60	34.57	9.9	5.43 ± 0.47%
180	25	9680.5	387.22 ± 1.96	5.39	1.4	3.68 ± 0.35%
192	25	9502.4	380.10 ± 1.88	7.12[1]	1.8[1]	3.60 ± 0.34%
204	25	9034.7	361.39 ± 1.92	18.71[1]	4.9[1]	3.86 ± 0.37%
216	25	9075.0	363.00 ± 1.84	1.61	0.45	3.68 ± 0.35%

[1] Indicates loss

TABLE VI

QUEEN LARVAE 1928

date	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	AGE IN HRS.
Aug. 10	1	260.6	Cocoon started	120
"	1	320.6	" "	
"	1	287.4	" "	
"	1	255.2	" "	
Aug. 14	1	240.4	" "	
"	1	257.0	" "	
"	1	256.6	" "	
"	1	277.6	" "	
"	1	261.2	" "	
"	1	219.4	" "	
Totals	10	2636.0	M = 263.60	
Aug. 10	1	242.7	Prepupa	156
"	1	205.8	"	
"	1	239.2	"	
"	1	239.4	Pupa	
"	1	221.8	Prepupa	
"	1	248.1	"	
"	1	228.1	Pupa	
Aug. 14	1	309.8	Prepupa	

TABLE VI (Continued)

DATE	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	AGE IN HRS.
Aug. 14	1	212.4	Prepupa	156
"	1	211.6	"	
"	1	231.2	"	
"	1	269.4	"	
"	1	238.6	"	
"	1	282.4	"	
"	1	236.8	"	
"	1	280.6	"	
Totals	16	3897.9	M = 243.62.	

TABLE VII

WEIGHT OF LARVAE SELECTED AS THO FOR TRANSFERRING INTO QUEEN CELLS.

DATE	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT
Aug. 31	5	0.5	0.10
"	5	0.5	0.10
"	5	0.5	0.10
"	5	0.6	0.12
"	5	0.5	0.10

TABLE VII (Continued)

DATE	NO. OF LARVAE	WEIGHT IN MG.	AVERAGE WEIGHT
Aug. 31	5	0.6	0.12
"	5	0.6	0.12
"	5	0.6	0.12
"	5	0.5	0.10
"	5	0.6	0.12
"	5	0.5	0.10
"	5	0.6	0.12
"	5	0.6	0.12
"	5	0.6	0.12
Totals	70	7.9	M 0.1114

$\Sigma x^2 = 0.1752$

$\Sigma x(M) = 0.1738$

$\Sigma x^2 - \Sigma x(M) = 0.0014$

$\sqrt{\Sigma x^2 - \Sigma x(M)} = 0.0374$

$\sigma = 0.01$ mg.

$P.E._x = 0.007$ mg.

$P.E._M = 0.003$ mg.

Estimated σ of single larvae 0.01 mg. x $\sqrt{5}$ = 0.022 mg.

Estimated P.E. of single larvae 0.007 mg. x $\sqrt{5}$ = 0.016 mg.

TABLE VIII

QUEEN LARVAE 1929

COL. NO.	AGE HRS.	NO. of LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGH.	% INC. OVER PREV. WEIGH.	COEF. OF VAR.
B	12	5	1.20	Aug. 9			
B		5	1.00				
B		5	1.90	Aug. 15			
D		5	2.40				
A		5	1.60	Aug. 21			
D		5	1.80				
D		5	1.00	Aug. 27			
D		5	1.10				
A		5	0.90				
	Totals	45	12.90	M = 0.287	0.176	159	
C	24	1	0.4	Aug. 3			
C		1	0.4				
C		1	0.2				
C		1	0.3				
C		1	0.3				
C		1	0.3	Aug. 9			
C		1	0.3				
C		1	0.4				
C		1	0.6				
C		1	0.3				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. of LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGH.	% INC. OVER PREV. WEIGH.	COEF. OF VAR.
C	24	1	0.3	Aug. 9			
C		1	0.4				
A		1	0.3				
A		1	0.4				
B		1	0.9	Aug. 15			
B		1	0.7				
B		1	0.6				
B		1	0.9				
B		1	1.0				
C		1	0.8				
C		1	0.8				
C		1	1.0				
C		1	0.8				
C		1	0.7				
C		1	0.7				
C		1	0.7				
B		1	0.4	Aug. 21			
B		1	0.7				
B		1	1.2				
B		1	0.7				
B		1	0.4				
C		1	0.6				
C		1	1.3				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. of LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGH.	%INC. OVER PREV. WEIGH.	COEF. OF Var.
C	24	1	0.7	Aug. 21			
C		1	0.8				
C		1	0.7				
D		1	0.5	Aug. 27			
D		1	1.0				
D		1	0.5				
D		1	0.5				
D		1	0.5				
C		1	0.5				
C		1	0.5				
C		1	0.4				
C		1	0.4				
C		1	0.4				
C		1	0.6				
Totals		47	27.8	M=0.59±0.026	0303	106	44.07±3.61%
B	36	1	0.8	Aug. 3			
B		1	1.5				
B		1	1.3				
B		1	1.0				
B		1	1.2				
B		1	1.9	Aug. 9			
B		1	1.3				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. of LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGH.	%INC. OVER PREV. WEIGH	COEF. OF VAR.
B	36	1	1.2	Aug. 9			
B		1	1.3				
B		1	1.8				
B		1	1.4				
B		1	1.2				
B		1	1.5				
B		1	1.3				
B		1	0.8				
B		1	2.1				
A		1	1.3	Aug. 15			
A		1	1.3				
A		1	1.2				
A		1	1.4				
A		1	1.4				
A		1	1.0				
A		1	1.0				
A		1	0.9				
A		1	1.0				
A		1	1.3				
A		1	1.6				
D		1	1.4				
D		1	1.4				
D		1	1.2				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. of LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGH.	% INC. OVER PREV. WEIGH.	COEFFICIENT OF VARIABILITY
A	36	1	1.5	AUG. 21			
A		1	1.5				
A		1	1.4				
A		1	1.3				
A		1	0.9				
A		1	1.2				
D		1	1.2				
D		1	1.2				
D		1	1.4				
D		1	1.5				
D		1	0.9				
D		1	1.2				
D		1	1.2				
D		1	1.2				
D		1	1.1				
	Totals	45	57.7	M=1.28±0.028	0.69	117	21.09 ± 1.62%
C	48	1	5.6	AUG. 3			
C		1	3.1				
C		1	5.2				
C		1	2.2				
C		1	2.4				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEFFICIENT OF VAR.
C	48	1	2.3	Aug. 3			
C		1	2.3				
C		1	2.1				
C		1	2.7				
C		1	2.5				
C		1	1.5	Aug. 9			
C		1	2.8				
C		1	1.2				
C		1	1.6				
C		1	1.6				
C		1	2.1				
C		1	2.0				
C		1	2.1				
C		1	2.1				
A		1	4.6				
A		1	3.2				
A		1	3.5				
A		1	4.9				
A		1	3.0				
A		1	2.5				
C		1	2.7	Aug. 15			
C		1	3.9				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEFFICIENT OF VAR.
C	48	1	2.7	Aug. 15			
C		1	2.8				
C		1	4.1				
C		1	4.0				
C		1	3.0				
C		1	4.1				
C		1	2.9				
C		1	2.4				
B		1	4.2				%
B		1	3.7				
B		1	3.8				
B		1	4.0				
B		1	3.6				
B		1	5.6	Aug. 21			
B		1	3.8				
B		1	3.9				
B		1	4.4				
B		1	4.2				
B		1	4.0				
B		1	3.4				
C		1	3.6				
D		1	2.6	Aug. 27			

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEFFICIENT OF VAR.
D	48	1	2.8	Aug. 27			
D		1	2.9				
D		1	3.3				
D		1	2.3				
C		1	1.8				
C		1	2.1				
C		1	2.0				
Totals		56	173.7	M = 3.10 ± 0.094	1.82	142	33.55 ± 2.38%
B	60	1	4.2	Aug. 3			
B		1	4.6				
B		1	4.3				
B		1	3.4				
B		1	3.1				
B		1	3.4				
B		1	3.1				
B		1	3.2	Aug. 9			
B		1	4.8				
B		1	5.1				
B		1	2.9				
B		1	3.4				
A		1	3.7	Aug. 15			

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEFFICIENT OF VAR.
A	60	1	5.2	Aug. 15			
A		1	5.8				
A		1	3.8				
A		1	4.7				
A		1	6.5				
A		1	5.3				
A		1	4.6				
A		1	4.9				
A		1	5.5				
A		1	7.7	Aug. 21			
A		1	6.3				
A		1	6.6				
D		1	5.4				
D		1	6.3				
D		1	3.5				
Totals		28	131.3	M = 4.69 ± 0.16	1.59	51	27.08 ± 2.65%
A	72	1	9.2	July 28			
A		1	13.9				
A		1	13.2				
A		1	20.1				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN Mg.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEFFICIENT OF VAR.
C	72	1	15.9	Aug. 3			
C		1	8.4				
C		1	7.4				
C		1	6.9				
C		1	6.7				
C		1	8.5				
C		1	9.7	Aug. 9			
C		1	11.4				
C		1	16.8				
C		1	19.8				
C		1	14.8				
B		1	14.7	Aug. 21			
B		1	17.4				
B		1	16.7				
C		1	15.8				
C		1	10.7				
C		1	11.2				
C		1	10.3				
C		1	11.9				
C		1	6.7	Aug. 27			
C		1	6.1				
C		1	5.9				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEFFICIENT OF VAR.
C	72	1	4.8	Aug. 27			
C		1	4.2				
B		1	9.3				
B		1	10.8				
B		1	17.1				
B		1	19.2				
B		1	8.1				
Totals		33	382.7	M = 11.60 ± 0.55	6.91	147	39.48 ± 3.77%
C	84	1	30.6	Aug. 3			
C		1	42.9				
C		1	35.6				
C		1	31.9				
C		1	38.7				
A		1	62.1	Aug. 21			
A		1	65.3				
A		1	42.1				
A		1	50.4				
A		1	78.2				
A		1	45.2				
A		1	40.0				
A		1	47.7	Just Moulted			

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
A	84	1	75.6	Aug. 21			
A		1	80.7				
A		1	37.1				
D		1	48.7	Aug. 27			
D		1	39.9	Just Moulted			
A		1	54.8				
A		1	35.7				
A		1	34.1				
A		1	21.1				
A		1	23.1	Aug. 31			
A		1	18.9				
A		1	19.1				
A		1	24.5				
A		1	61.4				
D		1	40.5				
D		1	46.6				
D		1	38.5				
D		1	40.3				
D		1	34.8				
D		1	30.4				
D		1	35.9				
D		1	44.7				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
D	84	1	27.1	Aug. 31			
Totals	36	1523.2	M = 42.31 ± 1.79		30.71	265	37.13 ± 3.33%
B	96	1	75.5	Aug. 3			
B		1	73.4				
B		1	67.7				
B		1	72.7				
B		1	71.4				
B		1	74.9				
B		1	70.6	Aug. 9			
B		1	62.3				
B		1	61.7				
B		1	76.7				
B		1	84.6				
B		1	76.0				
B		1	77.5				
B		1	61.1				
B		1	149.6	Aug. 21			
C		1	126.5				
C		1	101.6				
C		1	65.7				
C		1	79.8				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
C	96	1	64.7	Aug. 27			
B		1	129.5				
B		1	118.2				
C		1	55.4	Aug. 31			
C		1	94.5				
C		1	76.9				
C		1	112.8				
C		1	74.6				
C		1	87.3				
C		1	96.0				
C		1	85.2				
C		1	115.0				
B		1	73.5				
B		1	112.6				
B		1	66.3				
B		1	103.8				
B		1	95.3				
B		1	129.8				
Totals		37	3220.7	M = 87.05 ± 2.01	44.74	106	20.57 ± 1.68%
C	108	1	137.2	Aug. 3			
C		1	220.8	Sealed			
C		1	206.4	"			

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
C	108	1	157.3	Aug. 9			
C		1	196.2	Unsealed			
C		1	238.1	Sealed			
C		1	252.8	"			
				Aug. 21			
A		1	209.5	Sealed			
A		1	189.0	"			
A		1	159.0	"			
D		1	212.7	"			
D		1	223.0	"			
D		1	238.5	"			
D		1	240.8	"			
D		1	260.7	"			
D		1	259.8	"			
D		1	261.5	"			
A		1	173.9	Aug. 27			
A		1	142.9	Unsealed			
D		1	173.7	"			
D		1	138.2	"			
D		1	160.4	"			
D		1	176.9	"			
D		1	144.9	"			
D		1	170.1	"			

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
				Aug. 27			
D	108	1	137.1	Unsealed			
D		1	212.1	Partly sealed			
D		1	214.5	Sealed			
D		1	188.4	"			
D		1	240.6	"			
D		1	237.9	"			
Totals		31	6156.4	M = 198.59 ± 5.02	111.54	128	20.52 ± 1.83%
A	120	1	317.1	July 28			
A		1	356.6	Spinning			
A		1	337.7	"			
A		1	290.9	Aug. 3			
A		1	521.4	Sealed			
B		1	330.5	"			
B		1	286.4	"			
B		1	294.6	"			
B		1	329.9	"			
B		1	343.8	"			
B		1	297.2	"			
B		1	254.4	"			
B		1	276.6	Aug. 9 "			
B		1	300.8	"			

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
B	120	1	307.5	Aug. 9			
B		1	326.4	Sealed			
B		1	309.1	"			
B		1	317.6	"			
B		1	282.4	Aug. 21			
B		1	328.7	Sealed			
B		1	326.1	"			
C		1	267.4	"			
C		1	175.6	"			
C		1	210.6	"			
C		1	199.0	"			
C		1	303.1	Aug. 27			
C		1	226.3	Sealed			
C		1	264.1	"			
C		1	250.4	"			
C		1	246.9	"			
C		1	206.4	"			
Totals		31	8850.3	M = 285.50 ± 5.81	86.91	44	16.51 ± 1.40%
C	132	1	302.3	Aug. 3			
C		1	281.7	Cocoon			
C		1	310.1	"			
C		1	305.9	"			

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NOL OF LARVAE	WEIGHT IN Mg.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
C	132	1	300.2	Aug. 3			
A		1	278.7	Aug. 15			
A		1	290.9	Cocoon			
A		1	295.5	"			
C		1	324.2	"			
C		1	321.6	"			
C		1	298.8	"			
C		1	287.2	"			
C		1	313.5	"			
C		1	320.4	"			
A		1	315.3	Aug. 21			
A		1	332.6	Cocoon			
A		1	307.7	"			
D		1	331.3	"			
D		1	334.9	"			
D		1	305.5	"			
D		1	322.6	"			
D		1	318.3	"			
D		1	341.6	"			
D		1	327.5	"			
D		1	330.0	"			

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN Mi.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
D	132	1	332.1	Aug. 27			
D		1	354.9	Cocoon			
D		1	334.7	"			
D		1	343.4	"			
D		1	321.7	"			
D		1	359.5	"			
D		1	322.7	"			
D		1	336.4	"			
D		1	386.1	"			
D		1	334.6	"			
A		1	344.6	"			
A		1	331.8	"			
A		1	357.1	"			
Totals		38	12,258.9	M ± 322.60 ± 2.52	37.10	13	7.03 ± 0.81%
A	144	1	310.9	Aug. 3			
A		1	287.0	cocoons spun			
A		1	296.1	some prepupae			
A		1	302.6				
A		1	294.9				
A		1	306.5				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
B	144	1	336.5	Aug. 3			
B		1	312.4	some preputae			
B		1	318.2				
B		1	320.5				
B		1	315.0				
B		1	321.6				
B		1	327.4				
B		1	319.8	Aug. 9			
B		1	313.4				
B		1	284.0				
B		1	316.1				
B		1	311.8				
B		1	298.8				
B		1	317.5				
B		1	312.1				
B		1	287.9				
C		1	296.7	Aug. 15			
C		1	308.2				
C		1	294.7				
C		1	303.8				

TABLE VIII (Continued)

COL. NO.	AGE HRS.	NO. OF LARVAE	WEIGHT IN MG.	REMARKS	INC. OVER PREV. WEIGHT	% INC. OVER PREV. WEIGHT	COEF. OF VAR.
Q	144	1	285.8	Aug. 21			
Q		1	318.2	some dropsy			
Q		1	296.1				
Q		1	284.2				
Q		1	322.9				
Q		1	307.7				
Q		1	304.8				
Q		1	288.3				
Q		1	301.2				
Q		1	295.7		Loss	Loss	
Totals		42	12,721.4	M = 302.89 ± 1.68	19.71	6.1	5.26 ± 0.39%