FACTORS AFFECTING THE RATE OF REPRODUCTION IN NEMERITIS CANESCENS (GRAV.) (HYMENOPTERA: ICHNEUMONIDAE.)

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I. INTRODUCTION.

Of the four principal methods of insect control, namely, the mechanical, the physical, the chemical and the biological, the last named method popularly known as the biological control of insect pests or sometimes described as the biological basis of insect control has attracted much attention within recent years. As Munro (1931) observes, " in the main the reasons for this are the astonishing successes of the late Dr. Muir in his Hawaiian work and the strong championship of parasites as controlling agents by Dr. Tillyard in Australia. The establishment at Farnham Royal of the Parasite Station of the Imperial Institute of Entomology has made control of noxious insects by parasites of special interest to the Empire, and the remarkable results recently obtained by Messrs. Tothill, Paine and Taylor in the control of the Levuana moth in Fiji by the Tachinid parasite Pivchomyia selecta have further added to the popularity of this method". A much earlier and a more spectacular triumph than the Hawaiian introductions, a critical summary of which has been published by Imms (1926), was the introduction in 1889 of the Coccinellid beetle Rodolia cardinalis (Muls.) from Australia into California to subjugate the fluted or cottony cushion scale Icerya purchasi Mask. Accidentally introduced into California

from Australia or New Zealand through imported plants and bereft of the restraining influence of its natural enemies that kept the pest under check in its native habitat, the scale multiplied with such alarming rapidity that it threatened the orange and lemon groves of that State with extinction. A. Koebele of the United States Department of Agriculture was sent to Australia to find out if possible any natural enemy of the pest in its native home. As Howard (1930) puts it " the results of Koebele's work are now known everywhere. The story has become a classic in Applied Entomology and Horticulture". The small lady-bird beetle Rodalia cardinalis was introduced and the Coccinellid silently but effectively brought about such an appreciable reduction of the pest that it was no longer a menace.

Though these early successes created a vogue in parasite control, yet there are other reasons as well why the biological basis of insect control has been recognised by entomologists all over the world as an important weapon at the disposal of the economic entomologist. Mechanical and chemical control such as spraying, fumigation etc., are either unsuitable in certain localities or are not always an economic proposition. Moreover they have to be repeated year after year. Further as Thompson (1930) observes " they do not bring the population level of the pest low enough to prevent a recurrence or even an increase of damage in the

following year. In certain parts of the world the amount of arsenic now used during the ordinary treatment against the Codling Moth in apples, is so great that the arsenical residue on the fruit at the time that it is gathered is dangerously large and has to be removed by special processes. There is some reason to suppose that the arsenical compounds washed down into the soil may, after a certain length of time, prove injurious to vegetation. Furthermore, in some cases at least, there is definite evidence that certain species of injurious insects are becoming immune to some of the poisonous substances ordinarily used, such as hydrocyanic acid gas and lime sulphur wash." There are also technical difficulties such as the availability at the required time and place a team of personnel trained in the science and practice of using lethal insecticides. In cases like these the biological method of control offers a very promising and economical method of attack.

But the introduction and establishment of parasites from one country into another is no easy matter. As Munro (1929) remarks " it must in fact be admitted that some of the early successes in parasite introduction were largely fortuitous, and we realise today that the chances of successful introduction are not always good, but that on the contrary failures must be frequent". Indeed in many countries failures have been more frequent than successes and these failures and

successes have been dispassionately discussed country by country by Howard (1930). The limitations of biological control in forest entomology have been discussed by Munro (1931), who gives a telling illustration of the inapplicability of the use of parasites to control the wood wasp of the family Siricidae. These failures and limitations have only served to emphasise the complexity of parasite introductions and workers from different countries in the world have made important contributions to the diverse aspects of parasitic study such as adaptability to new environmental conditions, host selection, specificity, dispersal, super-parasitism, multi-parasitism, hyper-parasitism and ~~power of prolificacy~~ fecundity etc. There is, however, a gap in our knowledge of an aspect of super-parasitism that may be mentioned here. In some cases when the host is super-parasitised, i.e., when the female parasite lays more than one egg in the host only one successfully completes its development and eventually emerges as an adult. The death of the remaining progeny vitally affects the rate of reproduction of the parasite and may considerably reduce the parasite population in the area of its activity. The cause of death of the remaining progeny assumes therefore proportionate importance. Two principal reasons have been advanced to explain the cause of death of the remaining progeny that the mother parasite condemns to

death through an error of her instinct. These are (i) mechanical, (ii) chemical (biochemical). In the first case viz., mechanical, the individuals die as a result of injury inflicted by the larva that hatches out first. Thus Smith (1912) records finding upto five planidia larvae of the Chalcid Perilampus hyalinus in an individual host but not in a single instance out of the many hundreds of hosts that he examined and kept under observation did more than one Perilampus ever emerge. He observes that the individual most advanced in its development gains ascendancy over its confreres, either by devouring the host or by rendering it unsuitable as a source of food. In polyembryony super-parasitism is obligatory and in many instances several individuals emerge successfully from a single host. But even here sometimes only one individual survives in the mortal combat that ensues within the host body. Parker (1931) who has studied polyembryony in Macrocentrus gifuensis Ashm., states that in the normal process of feeding the first larva that emerges kills many parasite bodies with its mandibles. Pemberton and Willard (1918) have observed the same phenomena while studying the interactions of the fruit-fly parasites in Hawaii, though here it is a case of multi-parasitism, i.e., two different species of parasites attacking the same host larva.* When

* Super-parasitism and multi-parasitism were once used as synonyms. This aspect is discussed in detail when dealing with super-parasitism, in Hemeritis canescens.

the Braconids Biosteres arvoni Cam., and Opius humilis Silv., attack the same fruit-fly, the former always emerges as the victor. A newly hatched Biosteres larva inflicts mortal wounds on Opius with its long curved sickle-like mandibles. Instances can be multiplied but suffice it to say that there is clear experimental evidence to explain the cause of death of all the progeny except one when it is brought about by molestation or infliction of mortal injury by the surviving larva.

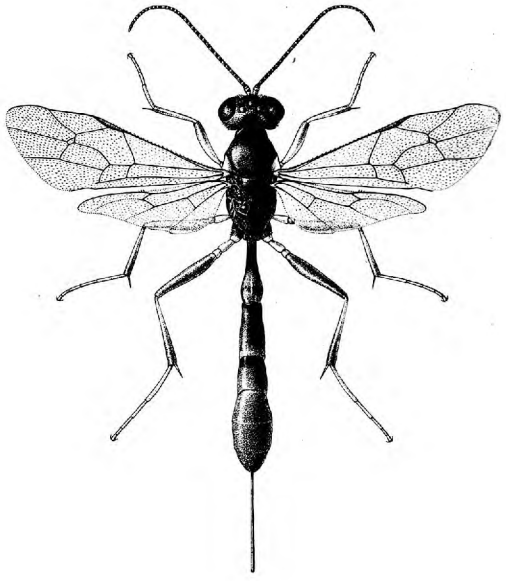
In many cases, however, there is no evidence whatsoever of any injury caused by the larva that hatches out first; the other larvae simply do not develop and grow. It is generally supposed that this suppression of growth and development are brought about by chemical or physiological inhibition. There is, however, very little experimental evidence to confirm this view held by many workers on parasites. Thus Tothill (1922) in studying the Ichneumonid Eulimneria and the Tachinid Ernestia, parasites of the fall-web-worm Hyphantria cunea observes that the late attacking parasite succumbs from chemical and physiological inhibition but adduces no experimental evidence to support this view. Spencer (1926) has proved by histological evidence that in Aphidiinae when only one adult parasite emerges from a single parasitised host, the death of the remaining larvae is due to

a process of biochemical inhibition. Spencer(1926) has advanced no other evidence to support this view. He certainly has not indicated any single stage of the host or any medium in which this inhibitory factor would not act. This aspect of the problem of super-parasitism has been studied critically in the course of these investigations. The gap in our knowledge of the role of nutrition in parasites is wider still. There is little doubt that the use of parasites and predators is becoming a well established method of insect control and when this is so, every aspect of the study of parasite behaviour should take an economic and biological importance proportionately and not the least important of these studies is the role of nutrition in parasites. Many Ichneumonids feed on the extra-floral nectaries of Umbelliferous flowers and they feed on the nectar of other flowers as well. This is also true of many other wasps belonging to the order Hymenoptera. The presence or absence of these blossoms can sometimes determine whether a parasite can be successfully introduced in a locality or not. Thus Wolcott (1939) observes that the successful introduction and establishment into Puerto Rico from Brazil of a large wasp Larra americana Saussure, which is parasitic in its larval stage on the mole-cricket Scapteriscus vicinus Scudder depend on the presence in

Puerto Rico of the two weeds Borreria verticillata and Hyptis alvarubens from whose flowers the wasps obtain their nectar. When the weeds are not in flower the wasps decline in numbers and eventually perish. ~~Does~~ Has this feeding on the nectar which is nothing but sucrose solution and the corresponding increase in longevity anything to do with its power ~~of prolificacy~~ to lay a ~~greater~~ larger number of eggs,?. If this is so then it is an important factor that would govern the successful introduction and establishment of a parasite in a locality. It is also known that many Hymenopterous parasites of the families Chalcidae, Braconidae and Ichneumonidae feed on the blood of the host and it is presumed that protein food of this kind is necessary for the maturation of the eggs. There is, however, very little experimental evidence to prove this in the case of parasites. If this is actually so it has to be found out whether this nitrogenous food could be substituted by ordinary proteins such as milk, meat-juice, yeast etc. A knowledge of this would greatly facilitate the laboratory multiplication of the parasites. The subject of the feeding habit of adult parasites will be discussed at a later stage, but it may be stated in passing that a knowledge of the role of nutrition in parasites should be regarded as a key to a successful introduction, multiplication and establishment of parasites from one country to another or from

one part of the country where they are abundant to other parts of the same country where they are scarce or are not found ~~altogether~~ at all.

Hemeritis canescens (Fig. 1) is a parasite of ~~great~~ some economic importance as it parasitises the larvae of the Mediterranean flour moth Ephestia kuhniella which is a serious pest of flour, especially in steam mills. This parasite was chosen for the present studies of inhibition in super-parasitism and of adult nutrition, longevity and fecundity. The objects of these studies were further to provide an experimental basis for a clear understanding of the factor of inhibition and of the role of nutrition in prolonging the longevity of the adult parasite and the correlation, if any, that exists between this prolongation of life and the ~~power of prolificacy~~ fecundity of the adult female parasite ~~to lay a larger number of eggs~~. Wojnowskaja-Krieger (1927-'28) observes that when super-parasitism occurs in Hemeritis canescens the death of the super-parasitised individuals excepting one is due to mechanical injury inflicted by the surviving larva on the rest. It has been clearly proved in the course of these investigations that this death is caused not by any injury in actual struggles but as a result of an inhibitory factor produced by the surviving larva. Ahmad (1936) studied the number of progeny that was produced by Hemeritis canescens by feeding



Nemeritis canescens (grav.)

Fig. 1.

the parasite with honey solution. His finding was that the total number of progeny that was produced " was not appreciably affected by feeding". Under experimental conditions Nemeritis super-parasitises its host and though he states that this super-parasitism may not be so common in nature where the parasite has unrestricted sphere of movement, he studied only the number of adult parasites that emerged and not the number of eggs actually laid by the parasite. In the present studies this aspect of the problem has been given greater consideration. There is also another side of the problem that is equally important and that Ahmad (1936) has not studied. In the flour mills where Ephestia kuhniella is a serious pest and where Nemeritis canescens is a frequent visitor the larvae of Ephestia do not feed on the surface, and Nemeritis has perforce in the vast majority of cases to parasitise the larvae ~~in the absence of host~~ without contact except through the ovipositor. As Nemeritis feeds on its host it is important to find out whether the absence of contact with the host with the consequent cutting off of protein in any way affects the fecundity of the parasite. It is generally held that the blood that exudes from punctures made by the sharp ovipositor of the parasite offers the parasite the necessary nitrogenous food to complete the maturation of the eggs in its ovaries. This aspect of the problem has been critically studied.

2. MATERIAL and METHODS.

Early in November 1937 two lots of about two dozen Nemeritis canescens adults were obtained from the Zoological Laboratory, Cambridge. Six pairs of copulating moths and about one hundred and fifty full grown larvae of Ephestia kuhniella, both reared at laboratory temperature of about 20°C were obtained from the Biological field station, Slough. Cultures of both host and parasite were started and maintained in the constant temperature room attached to the Huxley laboratory, running at a temperature of 27°C. and an average relative humidity of 68%. The cultures of the host maintained in the constant temperature room were intended for a constant and uninterrupted supply of full grown larvae which were required in hundreds during the course of these investigations. Of the one hundred and fifty full grown larvae received from Slough fifty were liberated in a brevet jar on a fold of muslin and allowed to pupate to get a fresh stock of moths. The jar was covered with muslin gauze and over the gauze a double fold of circular filter paper stretched and secured in position by means of india rubber bands. The filter paper was intended to prevent any stray Nemeritis parasite from ovipositing through the cotton gauze on any larvae that might crawl on it. Moreover the filter paper kept the inside of the jar dry. The remaining one hundred larvae were divided into four lots

of twenty-five and each lot was liberated into a small cylindrical specimen jar 4" in height and 3.25" in diameter, containing a small fold of 2½" square muslin. (Fig.10). Into the jar was also released an adult Nemeritis parasite. The mouth of the jar was covered with muslin gauze and a double fold of filter paper just as in the case of the jar for breeding moths, only in this case the paper fold prevented any stray Microbracon hebetor Say., which is also known to parasitise Ephestia larvae, from ovipositing on any larvae that might crawl inside the muslin. The small square fold of gauze inside the jar served the double purpose of enabling the larvae and the parasite to crawl and walk on it. Observations further showed that the parasite was able to oviposit more easily walking on the muslin than was the case in a jar without the muslin, where it had to walk on the smooth side of the glass jar, up which ~~where~~ the larvae always crawled ~~up~~ when liberated inside the jar. Thus a beginning was made for ensuring a small stock of the host and parasite for general breeding described below.

Breeding of Host.

The technique employed and described by Mansbridge (1933) for the breeding of the moth in large numbers at the Biological field station, Slough, was adopted. Several modifications were found to be necessary and these as later experience showed, proved extremely useful. Instead of tins

with lids used by Mansbridge (1933) to contain the cultures, brevet jars about ten inches in height and six inches in diameter were used. The constricted neck of the jar was about one inch high and four inches in diameter. With the glass jars it was possible to watch the progress of the culture without opening their mouth and more important still to watch the mating of the moths. The latter observation is important because, as Mansbridge (1933) and Norris (1932) have shown, great care has to be taken in the selection of moths when making up the culture, for only those moths that have copulated for three to four hours are properly mated and will lay the normal number of fertilised eggs. The moths that copulate but break away in a short time have malformed genetalia and have therefore to be rejected. Norris (1932) has further shown that unsuccessful pairing occurred with significant frequency in cultures reared at 27°C. and at higher temperatures. In the constant temperature room it took only from six to seven weeks for Ephestia kuhniella to complete its life-cycle, and full fed larvae were available at the end of about five weeks. In the laboratory where the mean temperature fluctuated between 16°C. and 23°C. thirteen to fifteen weeks were necessary for the completion of the life-cycle and fully fed larvae were available only at about the end of the eleventh week. As during the course of these investigations many

hundreds of full grown larvae were required at fairly frequent intervals, and as the maintenance of all the cultures at the laboratory temperature would involve the use of a very large number of jars two distinct cultures were maintained, one in the constant temperature room and the other in the laboratory in the proportion of six to one per week. Only the full grown larvae were used from the cultures in the former and moths that had mated for the normal length of time from the latter for making up the cultures of the former.

When a small stock of Ephestia moths was reared from the full grown larvae received from Slough, the maintenance of the culture of the host was reduced to a weekly routine which in essential details was as follows:-

Seven cultures were made up every week-end. Of these six were transferred to the constant temperature room and the remaining one was kept in the laboratory. The jars used to contain the cultures were thoroughly cleaned in water and dried and then sterilised in a hot oven of 70°C. for about 15 to 20 minutes, in order to eliminate the introduction into cultures of fungi or bacteria. Undressed wholemeal wheat flour was used as food. The flour was always sterilised for about two hours in an oven of about 70°C. in order to avoid the risk of contamination of the culture by beetles, mites or eggs and larvae of unrelated moths. About 1600 grams of flour was used for each culture. Moths in copulation were collected in

specimen tubes and after keeping them under observation for three to four hours by which time they broke apart the female was transferred into the jar containing the flour. The mouth of the jar was covered with muslin gauze and a double fold of filter paper. On the filter paper the date on which the culture was made up was entered in pencil. In the laboratory as well as in the constant temperature room a certain number of minute mites were observed. In order to obviate the danger of these mites getting into the cultures and destroying the eggs a complete ring of grease banding was applied round the middle of the jars. On an average 250-275 full grown larvae were obtained from each culture.

Breeding of Parasite.

In the constant temperature room Nemeritis canescens took 20-21 days to complete its life cycle. Four cultures were made up every week, two during the middle of the week, i.e. on Wednesdays, the remaining two towards the week-end, i.e. on Saturdays. As has been stated once before small cylindrical specimen jars 4" in height and 3.25" in diameter were used as containers for the culture. Into each of the jars twenty-five full grown host larvae were liberated and a freshly emerged parasite was also released amongst them. A small fold of muslin, 2½" square, was introduced into the jar. Observations showed that this piece of muslin to be

very useful for movements of both host and parasites as otherwise the larvae crawled on the smooth sides of the jar and the parasite in trying to follow the quick moving larvae to oviposit, often failed to secure a firm hold on them and fell down exhausted. The fold of muslin enabled the larvae to crawl upon it and the parasite to walk on and manoeuvre to get a firm hold of the larva before ovipositing. The mouth of the jar was covered with muslin gauze and a double fold of filter paper secured in position by means of india rubber bands. On the paper the date on which the culture was made was entered. In the constant temperature room the first parasite emerged on the 20th day after oviposition and others continued to emerge till the 22nd day. Thus the making up of two cultures at the close of every third day ensured a fair supply of live newly emerged parasites, which might be required at any moment to repeat an experiment on oviposition or super-parasitism to clear some particular point. In addition to the four small cultures mentioned above two cultures on a much larger scale were made up every week, one on Wednesday and the other on Saturday. In this case jam jars 11" in height and 4" in diameter were used. Two hundred larvae were used for each culture, and two parasites were released in each jar. A split raisin was pinned to a cork and placed at the bottom of the jar for the parasites to feed on. The large number of parasites that emerged from these cultures were used for finding out

the longevity of the parasites on the various kinds of sugars and sugar and protein solutions used. A unit of 25 parasites was always used for each kind of sugar or sugar and protein.

It may be mentioned here that though the first parasite emerged on the 20th day after oviposition and the emergence continued till the 22nd or 23rd day the vast majority of them emerged on the 21st day. Two separate registers showing respectively the days on which the cultures of the host and the parasite were made up were maintained throughout the course of these investigations. As the period of life cycle of both the host and the parasite were known it was always possible to plan experiments beforehand.

3. General Observations on the Host and the Parasite.

Ephestia kuhniella, commonly known as the Mediterranean flour moth, belongs to the family Phycitidae of the sub-order Heteroneura of the order Lepidoptera. It is a serious pest in flour mills and has an almost worldwide distribution. Richards and Thompson (1932) in a contribution to the study of the genera Ephestia state " that the present day distribution of Ephestia kuhniella is almost worldwide though with certain notable exceptions. It is not found in the Far East nor in Africa south of Atlas mountains, except as a local introduction in Cape Town and East Africa.

" The country of origin of this pest is very uncertain and various suggestions have been put forward. The actual facts are few and partly not well established. There is no absolutely certain record of the moth prior to Zeller's description in 1879. Yet in a few years it had become a pest throughout the greater part of Europe and within 20 years it was giving trouble im many districts of North America". Partly because of its wide distribution and also because of its great economic importance the moth has been the subject of study by various workers throughout the range of its distribution. Burkhardt (1919), Hase (1924), Candura (1928) and Voukassovitch (1929) studied the biology of the moth under natural conditions. Brindley (1930) and Von Gierke (1932), Payne (1933) and Ahmad (1936) studied some aspects of the biology of the moth under controlled conditions of temperature and humidity. Norris (1932), 1933 and 1934) made important contributions on factors affecting fecundity.

Nemeritis canescens belongs to the sub-family Ophioninae of the family Ichneumonidae of the order Hymenoptera. The earliest host record of N. canescens is by Chittenden (1897), who recorded the parasite from E. kuhniella and E. cautella Wlk. Candura (1929) bred it from Plodia interpunctella Hubn. Richmond (1925) also records Galleria mellonella L. as its host. In the Huxley laboratory the parasites were easily bred from Plodia interpunctella and a

few specimens were bred with difficulty from the wax-moth larvae Galleria mellonella. Its chief host, however, is E.kuhniella.

N.canescens has been recorded from England, Holland, Germany, Russia, South Europe, North Africa, Asia Minor, Japan, Sandwich Islands, Australia and North America.

N.canescens is an endo-parasite of E.kuhniella and is therefore an insect of great economic importance. Like its chief host E.kuhniella, the parasite has also been the subject of study in all the countries of its distribution. Ahmad (1936), Beling (1932), Daviault (1930), Diamond (1929) and Wojnowskaja-Krieger (1927) have all studied the biology of the parasite under natural and controlled conditions. Thorpe and Jones (1937) and Thorpe (1938) have made very valuable contributions on the olfactory conditioning and the nature of the conditioning process in N.canescens and their relation to the problem of host selection. Kruger (1921) and Wojnowskaja- Krieger (1927-1928) have studied the anatomy of the adult parasite though not in great detail.

4. PRE-OVIPOSITION PERIOD.

N.canescens breeds parthenogenetically and only females are produced. During the course of these investigations several thousand parasites were reared from Ephestia larvae and not a single male was ever met with. Males, however, have been recorded by Dautert-Willimzick (1931), Beling (1932),

Hase (1937) and Thorpe (1939). Hase (1937) alone bred brought nine sexually vigorous males and they mated freely with the females. The normally mated females, however, produced only females. Thorpe (1939) observes that though the males that he reared showed a slight tendency to follow the females when they were caged together, copulation was never observed. The females thus kept associated with males produced only normal females. Indeed Thorpe (1938) observed a case of intergeneric mating of Angitia chrysosticta Gmel. with Nemeritis canescens but here also the mated females gave rise to only normal female parasites.

N.canescens is ready to oviposit soon after emergence from the pupae. A great deal of confusion exists regarding the exact pre-oviposition period and previous workers are not quite agreed on this point. Wojnowskaja-Kreger (1927) did not observe oviposition taking place until the second or third day after the emergence of the parasite from the pupa. Candura (1928) states merely that first oviposition takes place a few days after the emergence. Beling (1932) and Ahmad (1936) mention that oviposition takes place immediately after the emergence. In every instance mentioned above the conclusion arrived at is based only on observations and not on actual experimental evidence. The actual time of emergence off the parasite has not been noted nor the larvae dissected open at definite intervals to discover whether eggs, if any, have been actually laid. Any conclusions drawn as to the duration of the

pre-oviposition period where these two necessary and important precausions have not been taken, can therefore be only regarded in the nature of a guess. To find out the exact pre-oviposition period the following experiments were carried out. In the constant temperature room with an average temperature of 27°C. and 68 % relative humidity the parasites begin to emerge from the 19th to 20th day after oviposition. When the first batch of parasites that may emerge at any moment on the 19th or 20th day is removed and then a watch is made in the constant temperature room for an hour or two it is possible to get several parasites as they emerge from the pupae. The exact time of emergence of each individual parasite can also be noted. Three such parasites were transfered immediately they emerged to three separate tubes and each supplied with three fresh batches each of five Ephestia larvae at intervals of 15 minutes, the preceding batch of larvae being removed. The larvae were then dissected to see how many eggs, if any, had been laid during each period. The results of the experiment are tabulated in table 1. The experiment was repeated a week later with three newly emerged parasites from a different culture to corroborate the results obtained in the previous experiment. In this experiment each parasite was given only two lots of larvae at an interval of 15 minutes, as the results obtained in the first series of experiments showed that the parasites begin to lay eggs in the second lot of

PRE-OVIPOSITION PERIOD EXPERIMENTS.

Table I.

Date of emergence of parasite	Time of emergence	No. of eggs laid during first quarter of an hour on each of five larvae.	No. of eggs laid during 2nd quarter of an hour on each of five larvae	No. of eggs laid during 3rd quarter of an hour on each of five larvae.
2-3-1938	11.17 A.M.	0 0 0 0 0	2 1 3 1 2	3 4 2 2 4
"	11-20 A.M.	0 0 0 0 0	2 2 0 1 1	3 3 2 4 4
"	11-40 A.M.	0 0 0 0 0	3 1 2 1 1	4 2 4 3 3

Table II.

Date of emergence of parasites	Time of emergence	No. of eggs laid during 1st quarter of an hour on each of five larvae	No. of eggs laid during 2nd quarter of an hour on each of five larvae.
9-3-1938	3.35 P.M.	0 0 0 0 0	3 2 2 0 2
"	4.5 P.M.	0 0 0 0 0	0 1 2 2 2
"	4.10 P.M.	0 0 0 0 0	1 1 4 3 2

larvae and as the object of the experiment is only to find out the pre-oviposition period. The results of this experiment are tabulated in table II.

The two experiments described above conclusively prove :

1. During the first 15 minutes after emergence no eggs are laid.

2. The parasites begin to lay eggs in about half an hour after emergence.

5. TOTAL NUMBER OF EGGS IN THE OVARIES OF PARASITES AT THE TIME OF EMERGENCE.

In order to find out the effect of feeding on oviposition it is necessary to know the number of eggs in the ovaries of a newly emerged parasite. If the total number of eggs in the ovaries is known it is possible to find out what proportion of this total number is laid when the parasite is fed on different kinds of sugars or sugars and proteins. Ahmad (1936) quotes Wojnowskaja-Krieger that there are 280-300 eggs in the ovaries of a newly emerged parasite. This statement by Ahmad is, however, not quite accurate. What Wojnowskaja-Krieger says is that she found 280-336 developing eggs in the ovaries of a newly emerged parasite, but she does not say how many parasites she dissected before she arrived at the above figure. It is also not quite clear what Wojnowskaja-Krieger means when she

says that there were 280-336 developing eggs. If all the eggs are in a state of development at the time of emergence we can only conclude that the parasite is not ready for oviposition soon after its emergence. That this possibly may have been her inference is corroborated by her other statements already mentioned once before in discussing the pre-oviposition period that the parasite begins to lay eggs only on the second or third day after emergence. It has, however, been conclusively proved by experiment that Nemeritis begins to lay eggs half an hour after emergence and therefore some of the eggs in the ovaries atleast are fully developed at the time of emergence of the parasite. In order to find out the exact number of eggs in the ovaries 50 parasites were carefully dissected and the eggs very carefully counted under the low power of the microscope. The total number of eggs in each of the fifty samples is tabulated in table III. From this table it can be seen that the minimum total number of eggs counted in the ovaries was 215.*

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* This was a particularly small specimen and was a little more than half the normal size. (A normal parasite measures approximately 7.15 mm. in length excluding the ovipositor and antenna.) As the number of eggs in its ovaries would be of added interest it was dissected. It may be stated here that during the course of these investigations thousands of specimens were reared and only two of these diminutive adults were recorded amongst them.

TOTAL NUMBER OF EGGS IN THE OVARIES OF PARASITES OF FIFTY SAMPLES.

Table III.

Serial number of parasite	Total number of eggs	Serial number of parasite	Total number of eggs
1	297	26	297
2	280	27	298
3	307	28	316
4	299	29	320
5	297	30	296
6	313	31	301
7	310	32	312
8	297	33 *	215
9	313	34	313
10	314	35	317
11	315	36	297
12	303	37	294
13	299	38	298
14	293	39	294
15	305	40	306
16	300	41	298
17	301	42	292
18	300	43	295
19	318	44	312
20	309	45	309
21	299	46	296
22	301	47	312
23	297	48	295
24	295	49	313
25	315	50	295

* Please see foot note on page 25.

Minimum 215 *

Minimum 280

Maximum 320

Average 303.12

This number was, however, obtained in a parasite which was exceptionally small in size. Excluding this sample the minimum number of eggs counted in the ovaries was 280 and the maximum 320. The average was 303.12.

NUMBER OF DEVELOPED EGGS.

At the time of emergence of a parasite from the pupa a certain number of eggs in the ovaries are fully developed. The parasite begins to lay these eggs soon after emergence. This number of developed eggs is important because the successful laying of most of these developed eggs is only dependent on a slightly increased longevity of the parasite which can be brought about by feeding. In the constant temperature room (27°C. 68 % R.H.) in which all the experiments were carried out the parasite is able to live only for about two days without feeding. By extending this period ~~of longevity~~ for two more days by feeding the parasite on sugar solution it could be induced to lay all the developed eggs. It may be stated here that even if the parasite is prevented from feeding on the host larva it is able to lay most of these developed eggs. The total number of developed eggs in each of the 50 samples and their percentage is given in columns 2 and 3 in table IV. The minimum number of developed eggs was counted in sample No. 33 and was 105. As has already been mentioned once before this minimum was exceptional as

it was counted in the smallest specimen which was an unusually small one. The minimum number otherwise in a normal sample was 144 and the maximum 164. The average number of developed eggs was 150.

NUMBER OF UNDEVELOPED EGGS.

At the time of emergence of the parasite a certain number of eggs in the ovaries are not fully developed and the successful development of these eggs and their oviposition are dependent on two factors; one a prolonged longevity brought about by the feeding of the parasite on some kind of sugar which Nemeritis is able to utilise and two, that the parasite is allowed to contact with Ephestia caterpillars and allowed to feed on the blood that exudes from punctures made by the ovipositor. As will be proved hereafter the nitrogenous food provided by the blood is absolutely necessary for the maturation and successful oviposition of a large number of these undeveloped eggs. The number of undeveloped eggs and their percentage in the fifty samples are given in columns 4 and 5 in table IV. The minimum number was counted in the abnormal sample and was 110. In normal specimens the minimum number was 136 and the maximum 165. The average was 153.

PERCENTAGE OF DEVELOPED AND UNDEVELOPED EGGS.

The proportion of undeveloped eggs is slightly higher

Table IV.

Serial No. of parasite	No. of developed eggs	% of developed eggs	No. of undeveloped eggs	% of undeveloped eggs	Total	Percentage total of developed and undeveloped eggs
1	147	49.50	150	50.50	297	100
2	144	50.14	136	49.86	280	"
3	157	51.10	150	48.90	307	"
4	147	49.20	152	50.80	299	"
5	145	48.80	152	51.20	297	"
6	157	50.20	156	49.80	313	"
7	153	49.40	157	50.60	310	"
8	147	49.50	150	50.50	297	"
9	156	49.80	157	50.20	313	"
10	155	49.40	159	50.60	314	"
11	156	49.50	159	50.50	315	"
12	148	48.90	155	51.10	303	"
13	147	49.20	152	50.80	299	"
14	144	49.20	149	50.80	293	"
15	149	48.80	156	51.20	305	"
16	147	49.00	153	51.00	300	"
17	146	48.50	155	51.50	301	"
18	148	49.30	152	50.70	300	"
19	164	51.57	154	49.43	318	"
20	154	49.80	155	50.20	309	"
21	146	48.80	153	51.20	299	"
22	146	48.50	155	51.50	301	"
23	147	49.50	150	50.50	297	"
24	144	48.81	151	51.19	295	"
25	155	49.20	160	50.80	315	"
26	145	48.80	152	51.20	297	"
27	146	49.00	152	51.00	298	"
28	156	49.30	160	50.70	316	"
29	155	48.44	165	51.56	320	"
30	145	49.00	151	51.00	296	"
31	148	49.20	153	50.80	301	"
32	154	49.30	158	50.70	312	"
33*	105	48.80	110	51.20	215*	"
34	155	49.50	158	50.50	313	"
35	157	49.50	160	50.50	317	"
36	147	49.50	150	50.50	297	"
37	146	49.66	148	50.34	294	"
38	147	49.30	151	50.70	298	"
39	144	49.00	150	51.00	294	"
40	150	49.00	156	51.00	306	"
41	148	49.70	150	50.30	298	"
42	146	50.00	146	50.00	292	"
43	148	50.10	147	49.90	295	"
44	157	50.30	155	49.70	312	"
45	154	49.80	155	50.20	309	"
46	147	49.70	149	50.30	296	"
47	154	49.40	158	50.60	312	"
48	148	50.10	147	49.90	295	"
49	155	49.50	158	50.50	313	"
50	147	49.90	148	50.10	295	"

* This was an abnormal specimen. (Please see text).

than that of the developed eggs. The average percentage of developed eggs was 49.5 while that of undeveloped eggs was 50.5. In seven samples (2,3,6,19,43,44 and 48- see table IV) the proportion of developed eggs was slightly higher than undeveloped eggs. In one sample (42. Table IV) the percentage of developed and undeveloped eggs was equal.

THE MEAN, THE STANDARD ERROR, AND COEFFICIENT OF VARIATION OF THE TOTAL NUMBER OF EGGS, NUMBER OF DEVELOPED EGGS AND THE PERCENTAGE OF DEVELOPED EGGS.

The mean, the standard error and the coefficient of variation for (1) the total number of eggs (developed plus undeveloped), (2) the number of developed eggs and (3) the percentage of developed eggs in the ovaries as based on the dissections made of fifty samples given in tables III and IV are given in table V.

Table V.

	Total number of eggs	Number of developed eggs	% of developed eggs
Mean	303.12 ± 1.26	150 ± 0.68	49.5 ± 0.076
Coefficient of variation	2.90	3.19	1.07

One of the parasites was very small and the total number of eggs in the ovary was significantly lower than in the other cases and hence has been rejected in the calculation

of the mean, the standard error and the coefficient of variation. It was,however, interesting to note that the percentage of developed eggs in this case also was almost the same, i.e., 48.8 as in the other cases. The mean of the total number of eggs, the number of developed and undeveloped eggs and the percentage of developed and undeveloped eggs were 303, 150, 153, and 49.5 % and 50.5 % respectively.

The coefficient of variation for the total number of eggs, the number of developed eggs and the percentage of developed eggs was very low. It was about 3 % for the total number of eggs in the ovary as well as for the number of developed eggs. It was, however, lower for the percentage of developed eggs and was only about 1 %. This shows that the number of dissections that have been made for determining the number of developed and undeveloped eggs in the ovaries of Nemeritis is quite sufficient.

6. SUPERPARASITISM

(a) Historical:

A very important factor affecting the rate of reproduction in Nemeritis canescens is superparasitism. Superparasitism has been defined by Fiske (1910) as a phenomenon "where an individual host is attacked by two or more species of primary parasites or by one species more than once." The definition as given above by Fiske clearly embraces two

distinct phenomena: one phenomenon where the individual host is simultaneously attacked by two or more species of primary parasites and the other where the individual host is attacked by a single species of primary parasite more than once. Pierce (1908) gave the former phase of parasitism the term accidental secondary parasitism. The same author (1910) later designated these two phases as mixed superparasitism, (his earlier accidental secondary parasitism) and cannibal superparasitism. Smith (1916) in an attempt finally to redefine some of the aspects of relationships between the host and the parasite limited the use of the term superparasitism " to that form of symbiosis occuring where there is a superabundance of parasites of a single species attacking an individual host insect more than once". He also restricted the use of the term multiparasitism to that form " of symbiosis where the same individual host insect is infested simultaneously with the young of two or more different species of primary parasites". Haviland (1922) uses the term 'epiparasitism' in preference to superparasitism, because he considers that superparasitism is hybrid and is therefore synonymous with hyperparasitism. Silvestri (1932) uses the term 'hyperparasitism' to describe this phenomenon though the term is used in quite a different sense by entomologists in England and America. The English and the American entomologists consider Smith's definition

as the most satisfactory one and in this paper it is used in the sense as defined by him.

(b) Nature of Super-parasitism in Nemeritis canescens.

In Nemeritis canescens parasitising the Mediterranean flour moth Ephestia kuhniella we meet with a phase of parasitism as defined by Smith. A larva of Ephestia kuhniella may be parasitised by a single parasite more than once or one or more Nemeritis may parasitise the same larva. In either of the above mentioned conditions only one larva successfully completes its development and one adult image eventually emerges though it has been found that all the eggs hatch out all right in the body cavity of the host. It has, however, been found by careful dissection and observation that the survival and the development of the single larva and its eventual emergence as an adult image is not due to competition among the newly hatched larvae for food or to the infliction of injury in ~~pricristic~~ combats but to an inhibitory factor produced by the single surviving larva. Super-parasitism is a very common occurrence in the parasitic families of Chalcidae and Braconidae (Hymenoptera) and all the parasitic individuals successfully complete their development and eventually emerge as adults. Narayanan (1936) reared 15-60 Apanteles flavipes Cameron (Braconidae) parasites from a single larva of the sugarcane stem borers Argyria sticticrasepis Hampson, Diatraea venosata Wlk., and Chilo zonellus, Swinh.

In the Huxley laboratory five to ten adult Microbracon hebetor were bred from a single Ephestia larva. Morris and Cameron (1935) bred a maximum of 120 individuals of the Chalcid Microplectron fuscipennis Zett.,(Family: Eulophidae) from a single cocoon of the pine saw-fly Diprion sertifer Geoff. In the Hymenopterous families of Platygasteridae, Encyrtidae, Braconidae and Bryinidae where the phenomenon of polyembryony occurs super-parasitism is obligatory and a number of individuals sometimes numbering hundreds and even thousands may emerge from a single host. Thus according to Leiby and Hill (1923) Platygaster hiemalis (Platygasteridae) that parasitises the Hessian fly, Phytophaga destructor Say, deposits four to eight eggs in each host; the eggs develop both monembryonically and polyembryonically and when the development is of the latter type twin adults are formed. The same workers observe that in the case of Platygaster vernalis which also parasitises the Hessian fly on an average eight parasites are produced from one egg. Silvestri (1906) records on an average 1500 embryos of Listomastix truncatellus (Encyrtidae) from a single Plusia gamma L., larva. It is interesting that even when polyembryony occurs we sometimes meet with a phenomenon closely resembling that which takes place in Nemeritis canescens. Parker(1931) who has studied polyembryony in Macrocentrus gifuensis Ash., a Braconid parasite of the

European corn borer (Pyrausta nubilalis Hbn.) and Daniel (1932) who has studied the same phenomenon in Macrocentrus ancylivorus (Braconidae) that parasitises the Oriental fruit moth larvae, Grapholitha molesta Busck, have both shown that only one of the polyembryonically produced individuals survives in each case and only one adult emerges from a single host. Lastly in Bryinidae where also polyembryony occurs Kornhauser (1919) (quoted by Imms 1937) has shown that from a single egg laid by the Bryinid Aphelopus theliae into the body of the Membracid Thelia bimaculata 60 parasitic individuals are produced polyembryonically. These are all instances of super-parasitism where all the parasitic larvae normally complete their development and eventually emerge as adults except in the Braconid parasites Macrocentrus kifuensis and Macrocentrus ancylivorus already referred to. But there are several instances like Nemeritis canescens where when super-parasitism occurs only one individual successfully completes its development and eventually emerges into an adult. The example recorded by Smith (1912) of Perilampus hyalinus Say, boring into caterpillars of Hyphantria textor Harv., of which it is a hyper-parasite has already been referred to once before. Though the host is often super-parasitised with as many as five pleuidia of Perilampus not more than a single Perilampus eventually emerges as an adult.

Fiske (1910) in discussing the manifestations of super-parasitism observes that " the prevalence of super-parasitism depends entirely whether or not the female parasite is gifted with a prescience which will enable her to select healthy hosts for her offspring. Pre-supposition that she possesses this instinct is equivalent to a denial of the existence of super-parasitism. This is indubitably not in accordance with conditions as they exist in the field and laboratory." In Nemeritis super-parasitism is a normal occurrence under experimental conditions. Wojnowskaja-Krieger (1927-1928) dissected out 15 eggs from the body of a single caterpillar and Heling (1932) observed 27 parasite larvae and three parasite eggs in one host larva. In the course of these investigations four, five, six and seven parasitic larvae were very commonly met with within the body cavity of a single host caterpillar. In a few cases 8, 9, 10, 11 and even 12 larvae were found within the host body. The occurrence of super-parasitism in Nemeritis canescens can be attributed to, not to a scarcity in host population, but to an error of instinct on the part of the parasite. Experimental evidence points to this conclusion. An examination of the fecundity tables (Nos. 9, 10, 11, 15 and 16) will bear out this fact. In all these cases Nemeritis lays eggs in the presence of the host. In table

(No. 9) where Hemeritis is given only water for drinking the parasite lays on an average 17 eggs during the second day of its life which is also its last day of life. The parasite was given in each of the six replications 25 host larvae on the second day. If the parasite had been able to distinguish a parasitised larva from an unparasitised individual, it would have laid one egg in each of the 17 of the host larvae and still there would have remained 8 host larvae unparasitised. Instead the data show that in each of the six replications there is on an average four cases of super-parasitism. An examination of tables (Nos. 10,11,15 and 16) where the parasites are fed on glucose, sucrose, fructose and maltose the same phenomenon is noticed in more striking detail. An examination of the six replications in each of these experiments shows that when the parasite lays about 18 eggs there are on an average about four cases of super-parasitism. When the parasite lays only as few eggs as 5, 6, 7 or 8 and when in each one of these cases the number of host larvae given is 25 even then the parasite super-parasitises the host caterpillars. It is possible that the parasite might discriminate after a certain stage in oviposition or when the parasite has undergone development upto a certain stage within the host body. This, however, is a problem in itself and comes under host selection, which does not lie within the scope of these investigations.

It has already been stated more than once that when super-parasitism occurs in Nemeritis canescens only one parasite is able to mature within the host body, resulting in the mortality of the remaining individuals. Typical instances where this kind of super-parasitism occurs have been given before. It has also been mentioned earlier that two theories, viz., (1) the infliction of injury by the surviving parasite on others and (2) the inhibition or suppression by the successful parasite of the rest, have been advanced to explain the cause of this death. There is ample experimental evidence in support of the first theory and the studies of Pemberton and Willard (1918) on the interactions of the fruit-fly parasites in Hawaii and of Parker (1931) on the Braconid parasite of the European corn borer have already been referred to before. To this evidence may be added the work of Packard (1916) who in experimenting with the parasites of Hessian fly observes that when Eupelmus allynii (Encyrtidae), Merisus destructor (Pteromalidae), and Micromelus subapterus (Pteromalidae) attack the same host, only one survives and the rest are killed by this one. He further observes that this is true whether the host is super-parasitised by a single species of the parasites mentioned above or multiparasitised by two or all the three species.

There is far less evidence in support of the second

theory, viz., when the surviving larva inhibits the others. The work of Tothill (1922) and Spencer (1926) have been referred to already. To this may be added the studies of Muesebeck (1918) who with great patience dissected 13,000 hibernating brown-tail moth (Euproctis chrysorrhaea L.) caterpillars to study the multiparasitised larvae within the host body. He found that when the host caterpillar was parasitised by the Braconids Apanteles lacteicolor Viereck, and Meteorus versicolor Wesmael the former always won. Even when two larvae of Apanteles lacteicolor occurred in the same host only one normally completed its development. This was also true when Apanteles lacteicolor entered into competition with the Tachinid Exorista nidicola Towns.; only in this case Apanteles was the victor. Muesebeck (1918) observes that Apanteles produced some toxin that killed its competitors. He does not, however, adduce any experimental evidence in support of this toxic theory except that he observed five dead Exorista larvae encysted and the development of three eggs of Meteorus versicolor arrested. The studies of Spencer (1926) that appear to be the best work done so far in support of the toxic theory may once again be described here in greater detail. He made elaborate serial sections of Aphids that had been parasitised by different species of Aphidiinae parasites. When the Aphid host was super-parasitised by these

parasites only one parasite emerged from a parasitised Aphid. The rest were according to Spencer suppressed by a process of biochemical inhibition. We may quote Spencer here; " To account for this the theory was advanced that in some manner all but one of the larvae are inhibited or suppressed by the successful parasite. This much is true, as the serial sections of Aphids that have been super-parasitised in this way substantiate these facts, and in addition suggest a probable manner of accomplishment. Shortly after hatching, the first stage larva is seen to be growing vigorously and rapidly. But younger larvae in the same Aphid soon lag behind with their growth checked; their bodies shrink, the contours and organs lose their definiteness, and the cytoplasm of the cells seems to be abstracted, leaving the nuclei very prominent by contrast, and closely packed together. One glance at such a larva is enough to satisfy one that extensive destructive changes have taken place, and that the process of inhibition is a biochemical rather than a mechanical one, for never are there any evidences of mechanical injury such as would be present if the older larva had eaten parts of the younger or otherwise molested it." Wojnowskaja-Krieger (1927-1928) who studied the biology of Homaritis connexans found when dissecting parasitised host larva a row of the remains of a number of dead'maggots'of the parasite beside

the fully grown parasitic larva. She does not say at what stage she dissected the host larvae. If she had dissected the host larvae at a very late stage when the parasitic larva inside the host was attaining maturity she might have found the parasitic larva devouring the smaller larvae as well. At this stage all the endo-parasitic larvae devour voraciously anything they come across. During the course of the fecundity studies in Hemeritis canescens more than 7,500 host larvae were dissected after all the eggs had hatched inside the Ephestia larvae. In not a single instance was any sign of struggle observed among the newly hatched larvae or injury inflicted by the bigger larva on the smaller ones. It may be stated that one larva was always larger than the rest in every host caterpillar dissected. All the larvae were super-parasitised. Only one larva was growing and growing quickly and the growth of the remaining ones was arrested. They simply did not grow beyond the first instar. The younger ones were looking shrunken and unhealthy beside the single rapidly developing larva that was both healthy and vigorous. These observations made during the course of the fecundity studies only confirmed what had been observed in the following experiments that had been carried out in super-parasitism:

(a) Into a large specimen jar a hundred full grown larvae of Ephestia were released. Four freshly emerged Hemeritis

adults were also released. The mouth of the jar was ~~closed~~ covered with muslin and filter paper with india rubber bands. These parasites oviposited on the day they were released and the next day and then died. (Each parasite lays on an average 102 eggs from emergence till death. Please see table 8.) The four parasites laid about 400 eggs in the 100 host larvae. The super-parasitised stock of Ephestia thus obtained was kept for daily dissections. The incubation period of the egg of Nemeritis at 27°C., and 68 % R.H., was just under 72 hours. The dissections were therefore begun from the fourth day onwards. It was observed that the action of inhibition was quick i.e., the moment the first larva emerged the medium in which it had to grow (here the haemocoele of the Ephestia larva) had been ~~toxinated~~ modified. The growing larva was itself immune in this medium. This toxin, however, was not strong enough to penetrate the egg-shell. All the eggs were observed to hatch without any mishap. The eggs of Nemeritis when firstly laid measured from 464 to 467 µ. The eggs that were about to hatch out within the host body measured from 550 to 556 µ. The remaining larvae that hatched out began to wriggle about and did not grow beyond the first instar. They do not die either immediately or for a long time to come. Daily dissections proved this. They lived on ~~=~~ an average for four to six days after emergence and in two instances

they were found living even on the seventh day after emergence, when the parasitic larva within the host body had just become quite mature. The parasitic larva was about to moult from the fourth to the fifth or final instar. The parasitic larva at this stage ate voraciously anything that it came across and in this all round menu the bodies of the first instar larvae that had by now become so weak and had lost all shape and became lifeless were also included. These observations clearly show that the death of the superparasitic larvae is not due to any infliction of mechanical injury, that they continue to live for a long time and that only the growth is arrested till eventually destructive changes take place resulting in death. These shapeless bodies were eaten by the surviving parasitic larva along with the other vital organs of the host and she did not by any means show any preference to them.

(b). 24 fullgrown Ephestia larvae were selected. Each was parasitised once. This was affected in the following manner. One freshly emerged Nemeritis was taken in a specimen tube 3"X 1" and then corked. A card two inches square was taken and a small circular hole equal in diameter to the middle region of Ephestia caterpillar was made in the middle of the card. The cork was gently removed with the open end of the tube upwards and simultaneously the card was drawn across

the opening. The aperature in the card was brought to the middle and the tube with the opening thus closed with the card was gently held in the left hand with the fore-finger pressing on the card. A dozen Ephestia caterpillars were kept ready in a petri dish. One by one each one of these caterpillars was held gently between the thumb and the fore-finger of the right hand and then the posterior end of the larva was inserted through the aperture in the card. The parasite oviposits readily in the projecting abdomen of the caterpillar held between the fingers. Hemeritis lays only one egg in each sting. In this way all the twelve caterpillars were parasitised. The caterpillars were then transferred to the constant temperature room. After about 80 hours (The incubation period is only 70 hours. This period was prolonged to make sure that the eggs had hatched inside the host larvae.) when the parasitic larvae inside had hatched the same host larvae were parasitised again. Six larvae were parasitised once, six larvae twice, six larvae thrice and the last batch of six four times. Each batch of larvae was put in separate tubes and labelled. After three days the host larvae were dissected. In every case except four (in four cases in the initial stinging the parasite had not laid eggs as the size of the surviving larva was not the same as in others) the eggs had hatched out but the larvae had not grown beyond the first instar. This experiment clearly proves

that the inhibitory factor does not affect the eggs. Muesebeck's (1918) observations are different from this. He observes that the toxin given forth by Apanteles laciscolor arrested the development of the eggs of Meteorus versicolor. (This example is slightly different from Hemeritis as this is obviously a case of multi-parasitism.)

(c) 50 Ephestia larvae were super-parasitised during a known definite interval as follows :- Batches of ten larvae were released in five small specimen jars and in each of the jars a parasite that had emerged about twelve hours before and had not laid any eggs was also released. The object of releasing parasites such as these was that they might lay as many eggs as possible during the shortest possible time. The mouths of the jars were then ~~closed~~ covered with muslin and filter paper with india rubber bands as described before. The jars with the parasite were kept in the constant temperature room for half an hour. After this interval the parasites were removed. It has been stated before that about 70 hours was the incubation period of the egg. The larvae were parasitised at such a time that the four hours between 68 and 72 hours might fall during the hours of the day. After 68 hours two larvae out of the fifty were dissected at intervals of half an hour in Ringer's solution. In this way first instar larvae that might have emerged within half an hour were obtained. Even in this short interval a striking

difference between the single larva that was going to survive and the others that were not ~~growing~~ going to grow beyond the 1st instar could be noticed.

A host larva that was heavily super-parasitised was dissected in Ringer's solution. From the haemocoele of the caterpillar two 1st instar larvae whose growth had been suppressed were removed and put into a watch-glass containing some Ringer's solution. The single rapidly growing parasitic larva and another 3rd instar larva were also removed and put into a 2nd watch-glass, also containing some Ringer's solution. From the 1st watch-glass one suppressed, yet living 1st instar larva was removed and gently placed on a large drop of fresh blood taken from a healthy i.e., non-parasitised caterpillar and resting on a coverslip. The coverslip was then very gently put upside down over a cavity slide so that the drop of blood was hanging inside the cavity with the parasitic larva in the hanging drop of pure blood. (Fig. 2). A very small quantity of vaseline had been smeared on the slide about 3 mm., all round the cavity. The object of this was to see that the coverslip containing the hanging drop firmly rested on the slide when the latter was moved under a binocular for observations. This slide was marked A. Likewise the 2nd first instar larva was removed from the 1st watch glass and gently placed on a drop of ~~toxinated~~ modified blood i.e., blood taken from a parasitised host, resting on

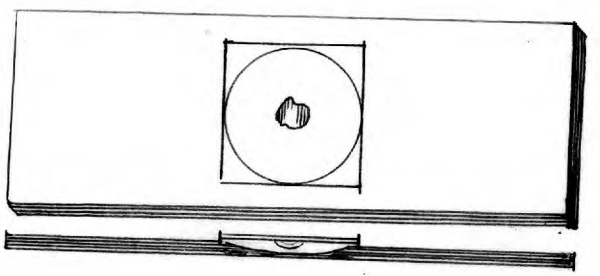


Fig. 2. Hanging drop experiment.

a cover slip. This cover slip was likewise placed upside down over a cavity slide. This slide was marked B.

The rapidly growing larva together with its associate first instar larva were removed from the 2nd watch glass and placed in a drop of healthy blood resting on a cover slip. The latter was removed to a third cavity slide. This slide was marked C.

Both the larvae in the hanging drops in the slides A and B had been initially subjected to inhibition for a maximum period of half an hour by the successful parasite. After this initial inhibition one was supplied with pure blood (slide A) and the other ~~toxinated~~ modified blood from a super-parasitised host (slide B). The blood in both A and B ~~were~~ was renewed every 24 hours. It was noticed that the larva that was supplied with pure blood recovered to some extent and was strikingly healthier and in one instance when it lived for a maximum period of 4 days ~~it~~ and even grew slightly bigger. The larva that was supplied with blood from super-parasitised larva became more and more shrunken every day. This hanging drop experiment was repeated six times in both A and B and the parasitic 1st instar larva that was given pure blood lived for about 60, 65, 72, 81, 68 and 92 hours respectively. The one supplied with ~~impure~~ modified blood lived for about 16, 18, 18, 20, 14 and 20 hours respectively. In the case of slide C

where a 1st instar suppressed larva was kept in pure blood, but <u>in association</u> with the rapidly growing parasitic larva the results obtained were entirely different from those that were obtained in A. The bigger larva lived for a maximum period of 5 days but the suppressed larva did not live for more than 16 to 21 hours. This experiment was also repeated six times and the results obtained were that the single surviving larva lived for 60, 72, 74, 68, 85 and 118 hours. The smaller suppressed 1st instar larva lived for about 16, 17, 16, 17, 19 and 21 hours. This experiment clearly proves that the larvae subjected to the same period of inhibition lives much longer in pure blood (slide A). The surviving larva ~~toxinates~~ modifies the pure blood even when the latter is renewed every time and does not allow the suppressed parasitised 1st instar larva to grow (slide C).

(d) 12 healthy full grown Ephestia caterpillars were selected. By means of silk threads a firm knot was tied in the middle of each one of these 12 larvae. Thus the blood circulation between the anterior and the posterior part of the larva was cut off. The anterior and posterior regions of each one of the 12 larvae was parasitised once. The larvae were then transferred to the constant temperature room. One great difficulty was experienced in this experiment and this was that several of the larvae in which knots

had been put became dark at the end of three days and died. The experiment had to be repeated several times during consecutive days with fresh larvae. In three cases, at each end, the parasitic larva had developed upto the 2nd instar, characterised by the reduction of caudal appendage and the development of respiratory system. This experiment was most modified revealing. The knot prevented the mingling of the ~~toxinated~~ blood from one part of the larva to the other. The two were more or less blood tight compartments.

(e) The toxin engendered by the successful parasite can only act in certain media and not in others. There is little doubt that the physiological conditions obtaining in the haemocoele of the Ephestia caterpillar is a very favourable medium for this inhibitory factor to act. Conversely the physiological condition obtaining in the haemocoele of Hemeritis canescens does not permit this inhibitory factor to act. The following experiments (e) and (f) proved this:

Two freshly emerged parasites were released for six hours in a small jar containing about 40 advanced parasitic pupae from which the imagines were expected to emerge in a day or two. Hemeritis canescens displays a tendency to oviposit in the abdomen of those that will emerge in a day or two. As each adult parasite emerged it was atonce transferred into a tube and fed with sucrose solution till

it died. 25 such parasites were fed in this way and in the abdomen of two of them partly developed larvae were found. In one the parasite larva was in the 2nd instar. In the other two larvae were found, one well advanced in the 3rd instar and the other in the 2nd instar. This experiment ~~conclusively~~ proved that in the physiological condition obtaining in the body cavity of the parasite this inhibitory factor is unable to act.

I named this phenomenon occurring in Nemeritis canescens where one parasite oviposits into the body of another of its own species as 'auto-parasitism' (1938). Thorpe (1937) on two occasions found a dead 1st instar larvae in the abdomen of the Nemeritis but in different circumstances. He observes " when Nemeritis is kept under crowded conditions they jostle against one another and they are frequently seen to stab one another". Flanders (1937) has also observed phenomena of this nature. In Nemeritis, however, this oviposition instinct is brought to play in special circumstances. At the time of emergence the oviducts of the parasite are filled with about 40 to 50 fully developed eggs and other similarly fully developed eggs upto a maximum of about 100 are about to fall from the ovarian tubules into the oviducts as soon as the eggs that are already there are oviposited. As Thorpe (1937) observes " this distension enables the

stabbing reflex to be more easily called forth. This reflex is primarily responsible for the prevalence of auto-parasitism in Nemeritis canescens.

(f) The full fed Ephestia larva is reddish in colour. In the constant temperature room a number of larvae of this description crawled to the top of the jar and all of them ~~are~~ were reddish in colour and retained this colour for 7 to 10 days. Then they become slowly colourless or to give a more accurate description they become greenish in colour. This is the first perceptible change while preparing for pupation. The next changes appear in the eyes of the caterpillar as Umbach (1934) has established. During the prepupal period the stemmata appear from the hypodermal layer and push towards the brain. This retracement of the degenerating larval eyes externally makes itself perceptible by sinking down and the ultimate disappearance of the stemmata pigments. The five stages in the withdrawal of the larval eyes are represented in Fig. 3. The first stage marked (a) corresponds to the full fed larval stage. If the larva is parasitised more than once at the stage marked (b) it was found and confirmed by repeating the experiment several times that both the parasitic larvae develop simultaneously to the second and even third instar stage. There was no suppression by the one on the others. After the 3rd instar

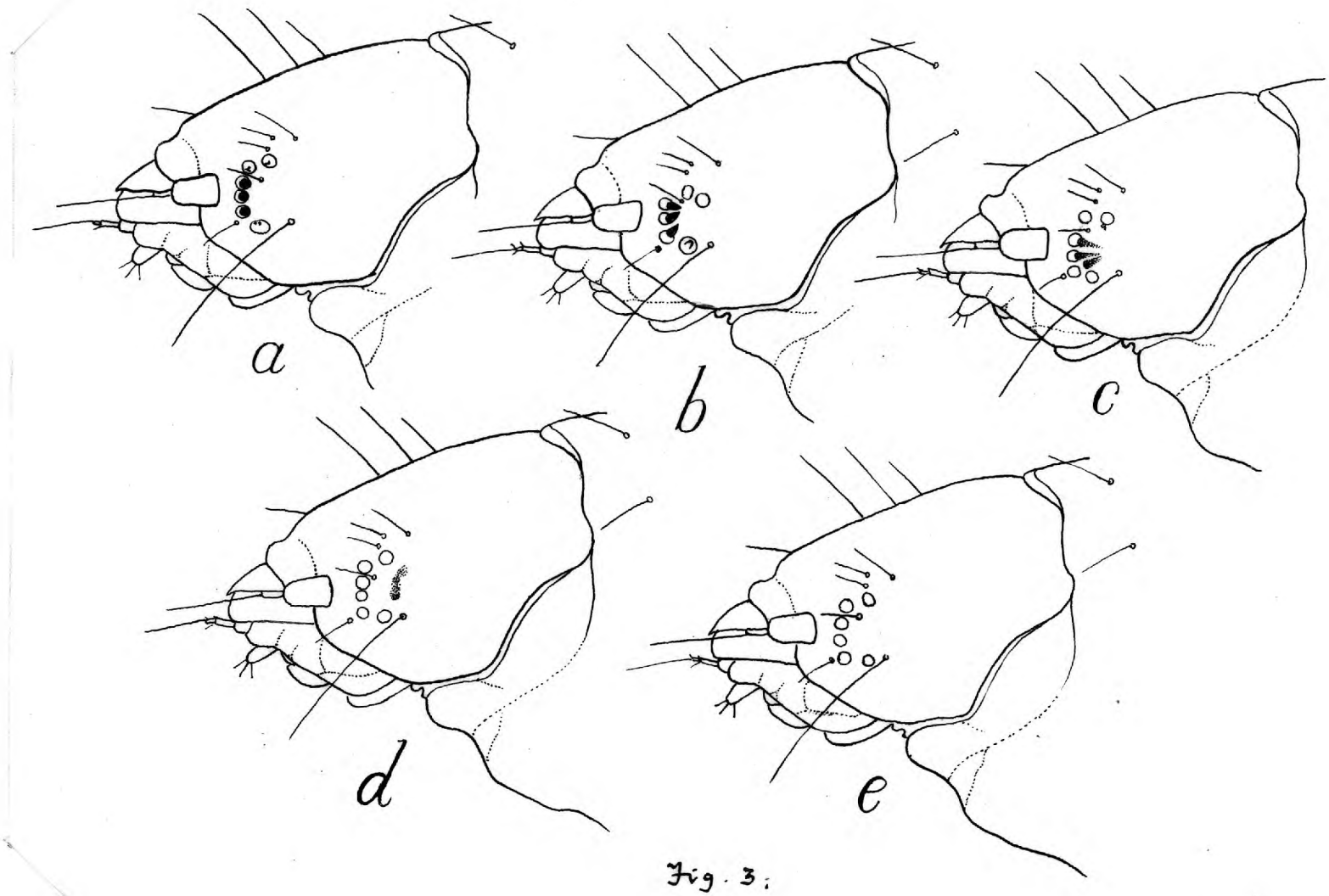


Fig. 3.

The five stages of the changes in the larval pigment that determine the age of the pre-pupa.

stage both the parasitic larvae died for want of food. Even during this tragedy of starvation and ultimate death there was no sign of molestation whatsoever by the one larva on the others. When the pre-pupa is parasitised in (c), (d) and (e) stages (Fig. 3) the Ephestia larvae pupated and when the pupae were dissected the parasitic larvae were found growing together. These very interesting phenomena were observed again and again in several dissections. This experiment clearly proves ~~beyond any possibility of doubt~~ that in the physiological condition existing in pre-pupa and pupa when the tissues break down and when profound physiological changes take place this inhibitory factor is ~~utterly~~ unable to act.

(g) Hanging drops were made separately of the blood of Hemeritis and also the pre-pupae of Ephestia. (Blood of Hemeritis was obtained by sharply pricking a very sharp pointed sterilised needle on the head when a little blood oozed out. Blood from six Hemeritis ~~were~~ was found to be enough for one hanging drop experiment. The blood was renewed every 24 hours). The experiments with the blood of Hemeritis and pre-pupa of Ephestia were conducted in two series (a) and (b). In (a), in the hanging drop blood of Hemeritis and Ephestia pre-pupae, only suppressed first larvae were put as in experiment (c). In the Hemeritis blood the 1st instar larvae lived for 48, 54, 62, 64, 60 and 70 hours

in the six separate hanging drop experiments that were repeated. With the pre-pupal blood the longevity was more and these were 64, 70, 68, 76, 90, and 98 hours respectively for each of the six hanging drop experiments.

In the (b) series the rapidly growing parasite larva and the suppressed first instar larva were both removed from the body cavity of the host caterpillar. When they were placed in the blood of Nemeritis and in the blood of Ephestia pre-pupa both the parasite larvae continued to live. In Nemeritis they lived together for 40, 70, 52, 44, and 64 hours approximately in the six experiments. In the blood of the Ephestia pre-pupae they lived for 90, 84, 78, 96, 98, and 84 hours in the six experiments.

These experiments in super-parasitism from (a) to (g) clearly prove that when super-parasitism occurs the death of all the newly hatched larvae except one is not due to competition among the newly hatched larvae for food or to the infliction of injury in actual struggles as has been erroneously supposed by one or two workers who have studied the biology of this parasite. It has been shown and proved by experiments that the remaining larvae do not grow because they are suppressed by the surviving larva. The experiments (e), (f) and (g) open up vast fields for further research in the phenomena of inhibition in super-parasitism, which we find can act only in certain media.

7. LONGEVITY OF ADULT FEMALE PARASITES FOR DIFFERENT SUGARS, POLYHYDRIC ALCOHOLS AND SOME PROTEINS WITH SUCROSE.

There is very little published record of work done to test the relative food value of various sugars (sweet as well as tasteless) and the more common proteins such as milk, yeast, meat-juice, etc., with sucrose in the case of parasites. According to Phillips (1927) and Vogel (1931) who have studied the longevity of adult worker bees by feeding them with different kinds of sugars and sugar alcohols the bees are able to utilise glucose, fructose, sucrose, maltose, trehalose, cellobiose, arabinose, and xylose. Galactose is utilised by the bees only to a very slight extent. Bertholf (1927) has shown that the larvae of honey bees are able to utilise the various kinds of carbohydrates in the following order : sucrose, fructose, maltose, melezitose, dextrose, trehalose, dextrin, galactose and lactose. The bee larvae are not able to utilise glycogen and starch. Frankel (1936) studied the utilisation of sugars and polyhydric alcohols by the adult blow-fly Calliphora arythrocephala. The following is a summary of the results obtained by him :

"Monosaccharides: utilised: glucose, fructose, galactose, mannose; not utilised: sorbose.

Disaccharides: utilised: saccharose, maltose, trehalose, melibiose, lactose; not utilised; cellobiose.

Trisaccharides: utilised: raffinose, melecitose.

Pentoses: utilised: xylose; not utilised: arabinose, rhamnose

Glucosides: utilised: a-methyl glucoside; not utilised; b-methyl-d-glucoside, helicin, arbutin, and salicin.

Polysaccharides: utilised: starch, glycogen; not utilised: inulin.

Polyhydric alcohols: utilised: mannitol, sorbitol; not utilised: erythritol, dulcitol, inositol.

All the substances are as effective as cane sugar; i.e., the duration of adult life exceeded a month, except in the case of xylose, lactose, starch and glycogen, on which the flies live only one to two weeks. These results differ considerably from those obtained by previous workers on the bee. (Phillips (1927) and Vogel (1931)). Bees utilise cellobiose, arabinose and xylose very well but mannose, lactose and melibiose not at all. Galactose is utilised by them to a very small extent only."

Several workers have studied the longevity of Nemeritis canescens by feeding the parasite with honey and sugar solution. According to Wojnowskaja-Krieger (1927-1928) the parasite lives for 16 days. Candura (1928) and Diamond (1929) state that the parasite is able to live for 54 and 50 days respectively. Beling (1932) observes that with sugar

solution the parasites live for 57 days while with honey solution they live as long as 72 days. Diamond (1929) makes the astonishing statement that he was able to keep Mesaritis alive for 48 days by giving the parasite water alone for drinking. There is little doubt that this water of Diamond must have been a solution containing some life sustaining sugar! Diametrically opposite, yet equally astonishing is the statement that Davisult (1930) makes that Mesaritis when fed with sugar solution lived only for a little longer than three to four days. There is little doubt that the sugar solution used by Davisult was only pure ~~aqua~~ water. Ahmad (1936) has studied the longevity of adult parasites at different temperatures and saturation deficiencies both in the absence of host and not laying eggs and in the presence of host and laying eggs with and without food. Ahmad provided honey solution in the following strength; 1 part of honey with three parts of water. He observes that without feeding and in the absence of host a parasite is able to live only for two days at 33°C. The longevity increases as the temperature falls till the maximum average life of 17 days is reached at 5°C. At 0°C., the average duration of life is 13 days. The maximum life he observes is 27 days at 5°C., and 17 days at 0°C. His findings are that moist conditions are more favourable to the parasite. The longevity of adults by feeding with honey solution ~~was~~ is 46 days at 27°C., and 0 mm.,

saturation deficiency. This ~~was~~ is the maximum period of longevity at this temperature and S.D., the mean being 31.7 days. He further observed that the longevity ~~was~~ is a little reduced in the presence of the host as a result of oviposition. At 27°C., and 0 mm. S.D., the mean longevity in days ~~was~~ is 20.6.

The longevity of Nemeritis canescens was studied with the following sugars, polyhydric alcohols and proteins with sucrose; (a) in the absence of host and not laying eggs (b) in the presence of host and laying eggs and (c) in the absence of host but laying eggs inside the host through muslin:

SUGARS AND POLYHYDRIC ALCOHOLS.

1. No food, no water
2. With water given for drinking
3. Feeding with monosaccharides.
3. Glucose
4. Fructose
5. Galactose
6. Mannose
7. Sorbose

Feeding with disaccharides.

8. Sucrose
9. Maltose
10. Lactose
11. Cellobiose

Feeding with trisaccharides.

12. Raffinose

Feeding with pentoses.

13. Xylose
14. Arabinose

Feeding with glucosides.

15. α methyl-d-glucoside

Feeding with polysaccharides.

16. Starch
17. Dextrin

Feeding with polyhydric alcohols.

18. Mannitol
19. Sorbitol

PROTEINS WITH SUCROSE.

1. Centrifuged milk and sucrose
2. Water extract of yeast and sucrose
3. Autolysed yeast and sucrose
4. Meat juice and sucrose
5. Larval extract and sucrose
6. Peptone and sucrose

The various sugars and polyhydric alcohols were given to the parasite in the form of solution prepared in tap water. The strength of the solutions were 10 %. (10 grams of respective sugars dissolved in 100 c.c. of water.) The solutions were prepared afresh and changed every day. The several proteins were prepared in the following manner:

1. The milk was centrifuged in a centrifuging machine and the fat that came to the top was rejected. The milk thus obtained was made up into the following strengths:- (a) 1 part of milk + 3 parts of water + 5*% sucrose. (b) 1 part of milk + 10 parts of water + 10 % sucrose.

2. The water extract of yeast was prepared by boiling 10 grams of yeast in 100 c.c. of water for about 15 minutes. The boiled solution was kept aside and when cool decanted. The water extract of yeast was made up in the following two strengths of sucrose: (a) water extract of yeast + 5 % sucrose (b) water extract of yeast + 10 % sucrose.

* 5 % and 10 % mean that 5 and 10 grams of sugar were added to 100 c.c. of the solutions prepared.

3. Autolysed yeast was prepared by autolysing at 37°C., a solution of three grams of yeast in 30 c.c. of water to which three drops of toluene had been added. The autolysed yeast thus obtained was prepared in the following two strengths of sucrose: (a) autolysed yeast + 5 % sucrose, (b) autolysed yeast + 10 % sucrose.

4. A small piece of butcher's meat was cut into bits and put in a mortar. 5 c.c. of tap water and a small quantity of clean sterilised sand were added. The whole stuff was well ground for about 10 minutes. The solution thus obtained was strained through muslin. The meat juice thus obtained was prepared in the following two strengths: (a) 1 part of meat juice + 3 parts of water + 5 % sucrose, (b) 1 part of meat juice + 10 parts of water + 10 % sucrose.

5. The larval extract was prepared in the following manner. 25 larvae of Ephestia kuhniella were well ground up with 5c.c. of water in a mortar with a pestle. The solution thus obtained was strained through muslin and prepared in the following two strengths: (a) 1 part of larval extract + 3 parts of water + 5 % sucrose, (b) 1 part of larval extract + 10 parts of water + 10 % sucrose.

6. 1/10 gram of peptone was dissolved in 100 c.c. of water and gently heated. The solution was kept aside and when cool prepared in the following two strengths of sucrose:

(a) peptone + 5 % sucrose, (b) peptone + 10 % sucrose.

A. Technique of experimentation and method of observation.

While discussing the technique employed to breed the parasites it was stated that in addition to four small cultures that were made up every week in small cylindrical jars two large cultures were also made up each of two hundred larvae in larger jars. From these six cultures it was always possible to obtain on most of the days in the week a number of freshly emerged parasites. The parasites obtained from these larger cultures were used for longevity studies. For each kind of sugar and polyhydric alcohol and protein with sucrose a unit of 25 parasites was employed.

(a) In the absence of host and not laying eggs.

For studying longevity in the absence of host and not laying eggs, glass jars 11" in height and 4" in diameter were used. A circular filter paper was spread out at the bottom of the jar closely fitting the base. The object of spreading this paper was to provide the parasites with a rough surface to walk on. A fold of muslin 6 " square was also thrust inside the jar. The muslin provided the parasite with a walking surface. In addition it also prevented them to a great extent from scaling the smooth sides of the glass jar and exhausting themselves. Two corks each half inch high and an inch in diameter through which a small glass tube half inch high and

one fourth inch wide passed, were placed wide apart at the bottom of the jar. (See fig. 10 . This is a smaller jar used for fecundity studies and where only one such feeding tube is placed.) A wick of cotton dipped in the appropriate sugar solution just projected from the tube that was closed at the bottom. The flat upper surface of the cork provided a sort of platform from which the parasites could feed. Two of the feeding apparatus described above were provided so that all the twenty-five parasites might not crowd at one feeding tube.

(b) In the presence of host and laying eggs.

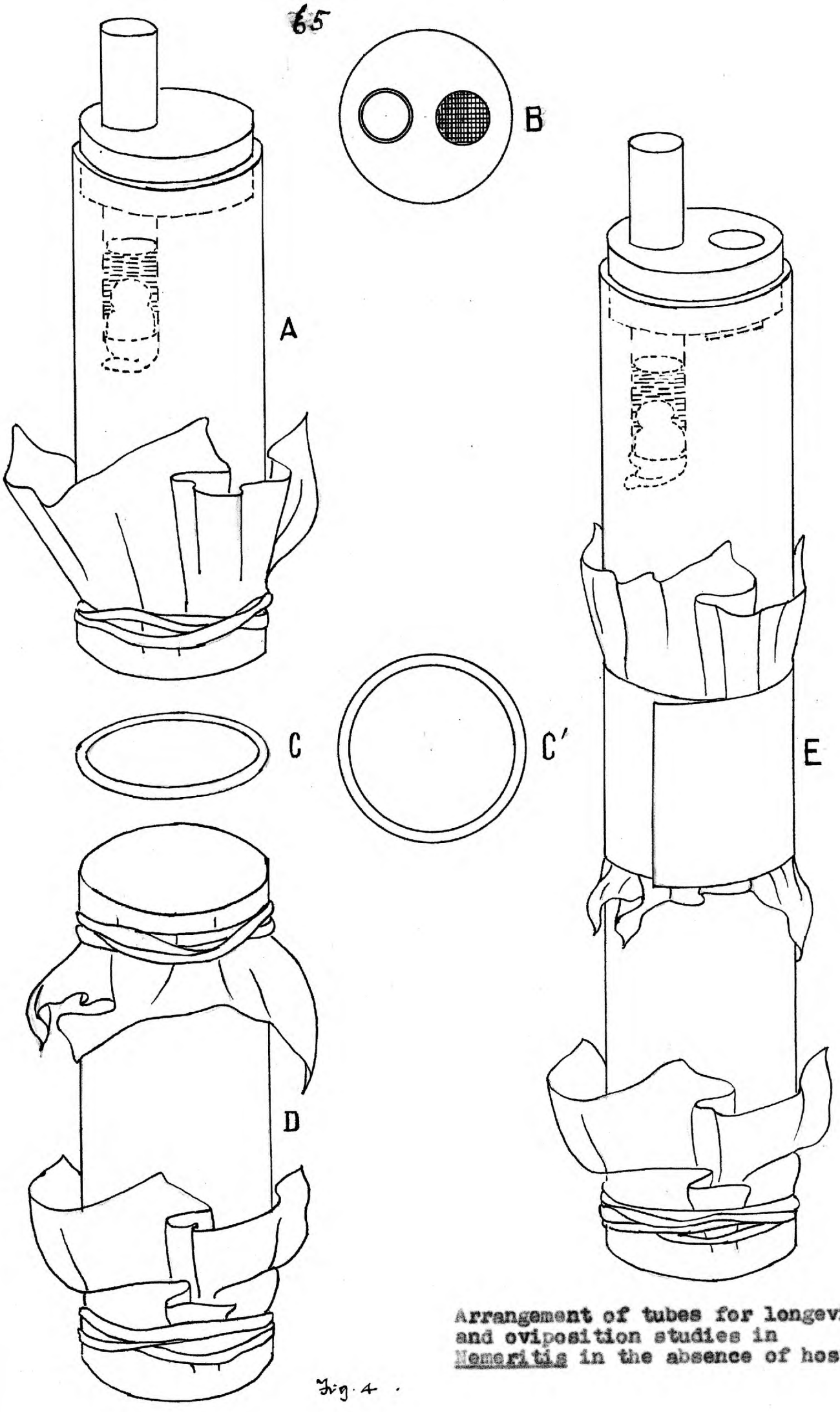
The technique employed was exactly the same as described in (a) except that two hundred Ephestia larvae were provided to start with so that the parasites could oviposit. When the parasites continued to live for more than three days additional larvae were given. When the number of parasites became small after a week or so, as in the case of sugars like glucose, fructose, sucrose and maltose the parasites were gently removed and put in fresh jars to facilitate the daily observations and to give the parasites the normal environment with which they started.

(c) In the absence of host but laying eggs inside the host through mualin.

The apparatus used for studying the longevity of

the parasite in the absence of host but laying eggs inside the host through muslin is given in Figure 4, and described below:

It consists of two tubes A and D four inches long and one and a half inches in diameter. One end of A is fitted with a cork with two holes. Through one passes an inverted specimen tube 2" long and ½" in diameter. Into this tube is poured a very small quantity of the appropriate sugar solution just enough to keep the cotton wick with which the mouth of the tube is plugged moist. The second hole is closed by pasting a small bit of muslin at the bottom as shown in B. The object of this is to provide ventilation and to keep the sides of the tube dry. The lower end of A is ~~closed~~ covered by a piece of muslin tightly stretched by an india rubber band. The tube D is closed at the top and bottom with muslin tightly stretched by india rubber bands. Into the tube A is put two freshly emerged parasites by opening the cork and then closing the mouth of the tube ~~closed~~. Into D is put 25 larvae by removing the muslin cover. The larvae are then pressed to the tightly stretched muslin of the other end with a ball of cotton covered with muslin. The mouth of the tube is then covered with muslin and india rubber bands. The tubes are then brought together with the muslin ends in A and that of tube D where the host



Arrangement of tubes for longevity and oviposition studies in Nemeritis in the absence of host.

Fig. 4.

larvae lie. In between the tubes a paper ring (Fig. 4. C, side view. C', as seen from above.) having the same diameter xx as the two tubes is placed. The width of this paper ring is equal to the thickness of the glass tube. The two tubes are then joint by sticking plaster as shown in B.

The muslin covering for the cotton ball was found very necessary by experience because without the muslin the larvae bored into the cotton and were out of reach of the parasite for oviposition. The paper ring was necessary because this prevented the parasite from feeding on the blood of any host that might stick to the muslin over which they lie through injury etc. 13 such tubes were prepared for these studies. In one there was one parasite and in the other 12 there were two each.

The observations regarding the longevity of the parasites fed on different sugars, polyhydric alcohols, and proteins with sugars were taken as follows:

For each of the feeds 25 freshly emerged parasites were liberated in a jar or tubes already described, and observations on the parasites were made every morning at about 10 till all the parasites died. The number of parasites that died on each day were noted and they were removed from the jar. From the data thus collected the minimum and the maximum longevity in days were recorded. The average was calculated

by taking the totals of the life periods of the 25 parasites and dividing it by 25.

B. In the absence of host and not laying eggs.

(a) No food, no water.

Hemeritis canescens lived for about two to three days only without any food. The minimum and maximum period of longevity were two and three days respectively and the average 2.64 days. The majority of them lived for three days.

(b) With water given for drinking.

The addition of water did not make any difference in the longevity of the parasite. In this case also the minimum and maximum duration of longevity were 2 and 3 with an average of 2.68 days. The majority lived for three days.

(c) Feeding with monosaccharides.

In this group of sugars glucose, fructose, galactose, mannose and sorbose were tried. Glucose and fructose were able to increase the longevity of the parasites to a much greater extent than the other sugars tried in this group. In the case of glucose the minimum and the maximum period of longevity were 12 and 55 days and the average was 27.96 days; while for fructose these values were 9, 25 and 12.36. In the case of fructose the majority of the parasites lived for 12 days. The minimum, the maximum and average longevity

of the parasites for galactose, mannose and sorbose were 2, 3, 2.68; 3, 4, 3.88; and 3, 4, 3.80 respectively. From the above figures it is clear that galactose is in no way better than water in increasing the longevity of the parasite. But mannose and sorbose have increased the longevity of Hemeritis by about one day.

(d) Feeding with disaccharides.

In this group the following sugars were used: sucrose, maltose, lactose and cellobiose. Sucrose, like glucose of the monosaccharides increased the longevity of the parasite to a marked extent. The minimum and the maximum duration of life were 10 and 63 days, the average being 31 days. In the case of maltose, like fructose of the previous group the minimum and the maximum life period were 8 and 16 days; the average was 11 days. Lactose and cellobiose more or less acted like mannose and sorbose of the previous group. The minimum and maximum values were 3 and 4 days for both. The averages were 3.08 and 3.88 days. In the case of lactose the majority lived for 3 days, while in cellobiose the majority lived for 4 days.

(e) Feeding with trisaccharides.

Raffinose was tried in this group and the minimum and the maximum period of longevity were 3 and 4; and the average was 3.76 days. The majority of the parasites lived for four days.

(f) Feeding with pentoses.

Xylose and arabinose were tried in this group. More than 90 % of the parasites lived for 4 days, in both these sugars and the averages were 3.96 and 3.92.

(g) Feeding with glucosides.

α methyl glucoside was the only sugar tried in this group. About 75 % of the parasites lived for three days and the remaining for 4 days. The average was 3.24 days.

(h) Feeding with polysaccharides.

Starch and dextrin were used . The minimum and the maximum period of longevity were 2 and 3 days in both. The majority of the parasites lived for 2 days only. The averages were 2.24 and 2.28.

(i) Feeding with polyhydric alcohols.

Mannitol and sorbitol were tried in this group. The minimum and the maximum period of longevity of the parasites were 3 and 4 days for both. The averages were 3.60 and 3.52 days.

(j) Summary of results obtained from (a) to (i):

The minimum, the maximum and the average period of longevity of Hemeritis nanescens for the various carbohydrates and polyhydric alcohol feeds in the absence of host and not laying eggs are given in table VI and represented in Fig. 5. It will be seen that the parasites lived from 2 to 3 days

Table VI.

CARBOHYDRATE FEEDING.

Longevity in days of adult female parasites at 27°C., and 68 % relative humidity.

Food given	Absence of host and not laying eggs			Presence of host and laying eggs			Absence of host but laying eggs through auslin inside the host		
	Min.	Max.	Average	Min.	Max.	Average	Min.	Max.	Average
1.No food, no water	2	3	2.64	2	2	2.00	2	3	2.04
2.Water alone given for feeding	2	3	2.68	2	2	2.00	2	3	2.04
MONOSACCHARIDES.									
3. Glucose	12	55	27.96	8	12	10.04	8	36	25.36
4. Fructose	9	25	12.36	7	8	7.72	7	15	11.28
5. Galactose	2	3	2.68	2	3	2.12	2	3	2.60
6. Mannose	3	4	3.88	2	3	2.04	2	3	2.56
7. Sorbose	3	4	3.80	2	3	2.08	2	3	2.60
DISACCHARIDES.									
8. Sucrose	10	63	31.00	8	12	9.60	8	45	19.00
9. Maltose	8	16	11.00	7	8	7.24	7	12	8.88
10. Lactose	3	4	3.08	2	2	2.00	2	3	2.16
11. Cellobiose	3	4	3.88	2	3	2.04	2	3	2.20

Table VI. (Contd.)

CARBOHYDRATE FEEDING.

Longevity in days of adult female parasites at 27°C., and 68 % relative humidity.

(Contd.)

Food given	Absence of host and not laying eggs			Presence of host and laying eggs			Absence of host but laying eggs through muslin inside the host		
	Min.	Max.	Average	Min.	Max.	Average	Min.	Max.	Average
TRISACCHARIDES.									
12. Raffinose	3	4	3.75	2	3	2.13	2	3	2.01
PENTOSES.									
13. Xylose	3	4	3.96	2	3	2.20	2	3	2.04
14. Arabinose	3	4	3.92	2	3	2.04	2	3	2.04
GLUCOSIDES.									
15. α methyl glucoside	3	4	3.24	2	3	2.12	2	3	2.08
POLYSACCHARIDES.									
16. Starch	2	3	2.34	2	3	2.04	2	3	2.04
17. Dextrin	2	3	2.28	2	2	2.00	2	3	2.04
POLYHYDRIC ALCOHOLS.									
18. Mannitol	3	4	3.60	2	2	2.00	2	2	2.00
19. Sorbitol	3	4	3.68	2	2	2.00	2	2	2.00

CARBOHYDRATE FEEDING.

Longevity of Nemeritis canescens at 27°C., and 68 % R.H., in the absence of host and not laying eggs, not feeding and feeding on different kinds of sugars.

Lower dark line ---------- Minimum
Upper dark line ---------- Maximum
Dotted line ---------- Average

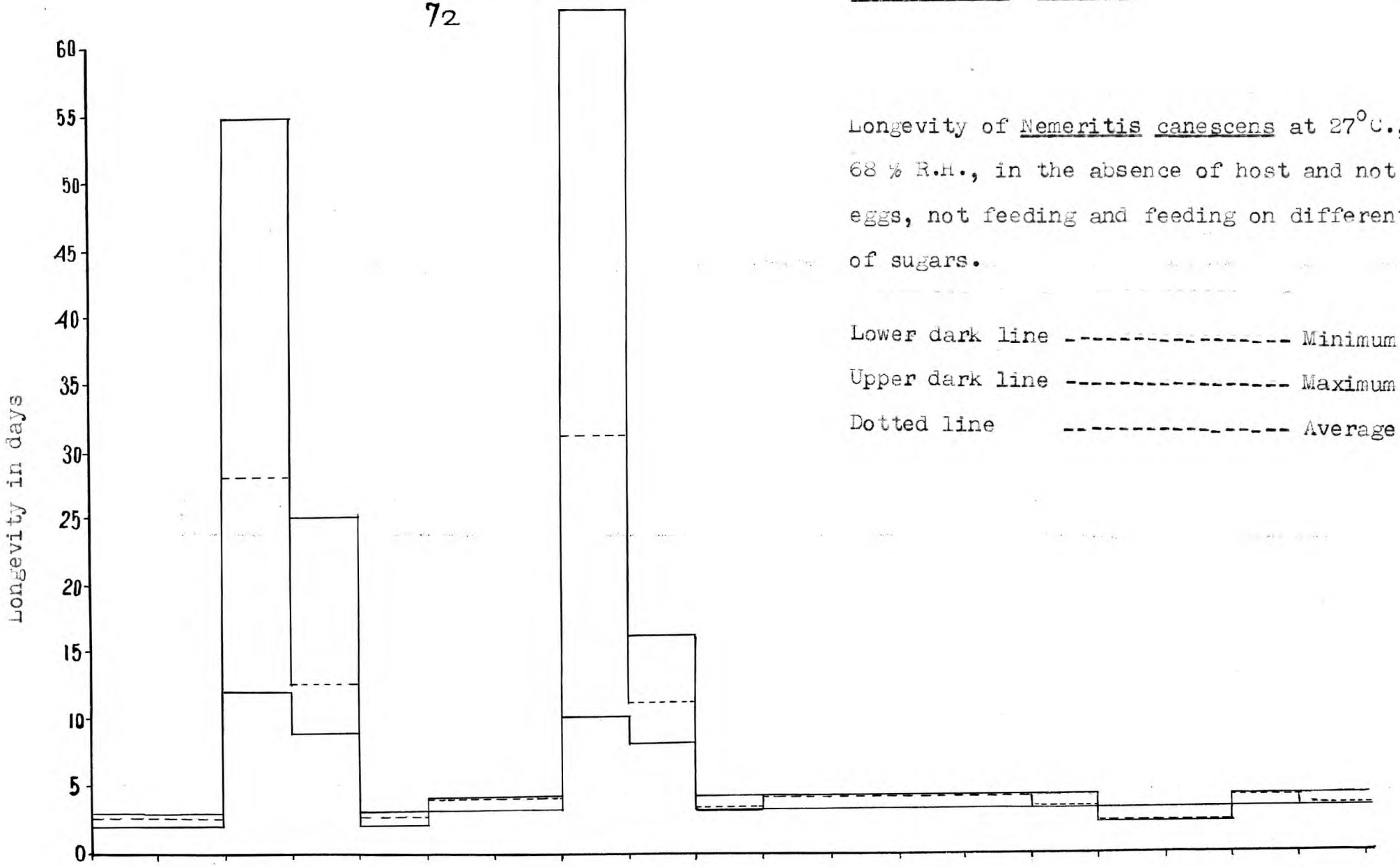


FIG. 5.

when not fed and fed with water, galactose, starch and dextrin, while they lived from 3 to 4 days when fed with mannose, sorbose, lactose, cellobiose, raffinose, xylose, arabinose, α methyl-d-glucoside, mannitol and sorbitol. With glucose and sucrose they lived for the maximum period from 12 to 55 and 10 to 63 days. The averages were approximately 28 and 31 days. With fructose and maltose they lived from 9 to 25 and 8 to 16 days, the averages being about 12 and 11 days. Thus the longevity with glucose and sucrose was about 7 to 12 times and that of fructose and maltose was about 3 to 4.5 times than that of the other sugars tried.

C. In the presence of host and laying eggs.

(a) No food, no water.

The parasite lived only for two days.

(b) Water given for drinking.

Here again Hemeritis lived for only 2 days.

(c) Feeding with monosaccharides.

In the case of glucose and fructose the parasites lived for 8 to 12 and 7 to 8 days respectively. The averages were 10 and 7.7 days. With galactose, mannose and sorbose the parasites lived only for 2 to 3 days, the average being near about 2 days in all the cases.

(d) Feeding with disaccharides.

The parasites fed with sucrose and maltose lived

8 to 12 and 7 to 8 days and the averages were 9.6 and 7.2 days; while in the case of lactose and cellobiose the parasites lived only for two days. In the case of cellobiose one solitary Nemeritis lived for three days.

(e) Feeding with trisaccharides.

By feeding with raffinose Nemeritis canescens lived 2 to 3 days; the average was 2.16 days.

(f) Feeding with pentoses.

Parasites fed with xylose and arabinose lived only for 2 to 3 days. The averages were 2.2 and 2.0.

(g) Feeding with glucosides.

Feeding with α methyl-d-glucoside Nemeritis was able to live two to three days, the average period of longevity being 2.1 days.

(h) Feeding with polysaccharides.

Starch and dextrin supported the life of Nemeritis for only 2 days. In the case of starch one solitary Nemeritis was able to live for 3 days.

(i) Feeding with polyhydric alcohols.

Mannitol and sorbitol likewise supported the life of Nemeritis for only two days.

(j) Summary of results obtained from (a) to (i).

The minimum, the maximum and the average life period of Nemeritis canescens for the different sugar foods in the

presence of host and laying eggs are given in Table VI and represented in Fig. 6. Excepting glucose and fructose among monosaccharides and sucrose and maltose in disaccharides the average life of the parasite for all the other foods was only about 2 days. In the case of glucose and saccharose the averages were 10 and 9.6 days while for fructose and maltose the averages were 7.7 and 7.2 days. Thus for glucose and saccharose the longevity of the parasites ~~is~~ increased by about five times as much as those of other foods excepting ofcourse fructose and maltose. The longevity was increased by three and a half times in the case of fructose and maltose.

D. In the absence of host but laying eggs inside the host through muslin.

(a) No food, no water.

The longevity of Nemeritis was only 2 days except one that lived for 3 days.

(b) With water given for drinking.

Here also the longevity was only 2 days and a single parasite lived for 3 days.

(c) Feeding with monosaccharides.

The sugars of this group excepting glucose and fructose, namely, galactose, mannose and sorbose maintain the life of the parasite for 2 to 3 days, the averages being 2.6 for all the three sugars. In the case of glucose the parasite lived for 8 to 36 days, the average being 25.4 days.

In the case of fructose Nemeritis lived for 7 to 15 days and the average was 11.3 days.

(d) Feeding with disaccharides.

By feeding on sucrose and maltose the parasites were able to live for 8 to 45 and 7 to 12 days, the average longevity being 19 and 8.8 days. Lactose and cellobiose were able to sustain the life of the parasite for 2 to 3 days. The majority of them lived only for 2 days.

(e) Feeding with trisaccharides.

Excepting one parasite that lived for 3 days the rest lived only for 2 days on raffinose.

(f) Feeding with pentoses.

Like raffinose, xylose and arabinose sustained the life of ~~the life of~~ the parasite for only 2 days. One solitary Nemeritis lived for 3 days in both.

(g) Feeding with glucosides.

Feeding the parasite with α methyl-d-glucoside enabled them to live only for 2 days. Two parasites lived for 3 days.

(h) Feeding with polysaccharides.

On starch and dextrin the parasites lived only for 2 days. One parasite, however, was able to live for 3 days in both.

(i) Feeding with polyhydric alcohols.

All the parasites fed with sorbitol and mannitol

CARBOHYDRATE FEEDING.

Longevity of Nemeritis canescens at 27°C., and 68 % R.H., in the presence of host and laying eggs, not feeding and feeding on different kinds of sugars.

Lower dark line ---------- Minimum

Upper dark line ---------- Maximum

Dotted line ---------- Average

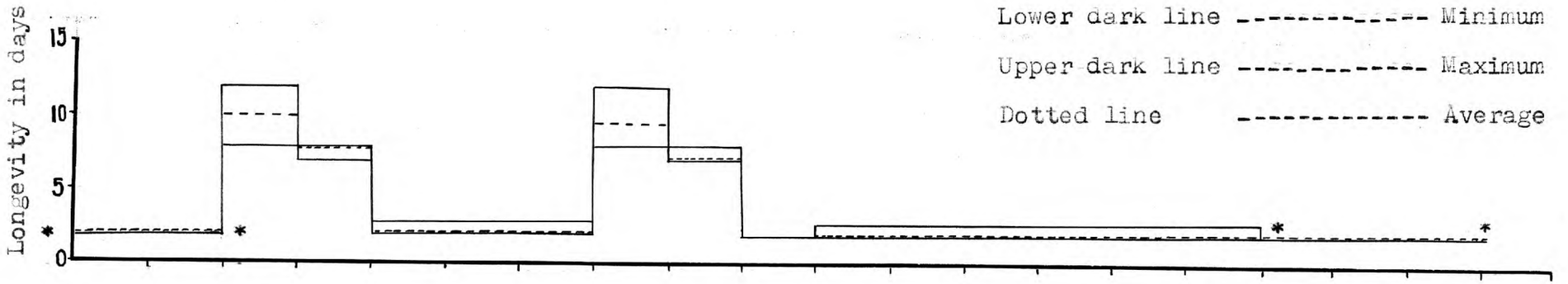


Fig-6.

No food, no water

Fed on water alone

MONOSACCHARIDES.

Glucose

Fructose

Galactose

Mannose

Sorbose

DISACCHARIDES.

Sucrose

Maltose

Lactose

Cellobiose

TRISACCHARIDES.

Raffinose

PENTOSES.

Xylose

Arabinose

GLUCOSIDES.

α methyl d glucoside

POLYSACCHARIDES.

Starch

Dextrin

POLYHYDRIC ALCOHOLS.

Mannitol

Sorbitol

* * The dotted and the black lines in this portion coincide. For the sake of representation the dotted line is shown very slightly above the black line.

lived only for 2 days.

(j) Summary of results obtained from (a) to (i).

The minimum, the maximum and the average life period of Hemeritis canescens for the different sugars and polyhydric alcohols and laying eggs through muslin inside the host but unable to feed on it are given in Table VI and represented in Fig. ~~VII~~ 7. As in section C, viz., laying eggs in the presence of host and feeding on different kinds of sugars, the parasites fed with all the sugars and polyhydric alcohols, except glucose, fructose, sucrose and maltose lived only for about 2 days. In the case of glucose and sucrose the parasites lived for an average period of 25.4 and 19 days. In the case of sucrose the maximum longevity was 9 days more than that of glucose, even though the average was less. For fructose and maltose the average longevity was 11.3 and 8.9 days respectively. It will be seen that the longevity of the parasites fed with glucose, fructose, sucrose and maltose was about 12.5, 5.5, 9.5, and 4.6 times as much as those of the other carbohydrates tried.

E. Protein and sucrose feeding.

(a) As for all practical purposes there was no difference between the two dilutions used in these longevity studies the discussions are confined only to the different kinds of proteins with sucrose used. In the absence of host

CARBOHYDRATE FEEDING.

Longevity of Nemeritis canescens at 27°C., and 68 % R.H., in the absence of host but laying eggs through muslin inside the host and not feeding and feeding on different kinds of sugars.

Lower dark line --------- Minimum

Upper adrk line --------- Maximum

Dotted line ------------ Average

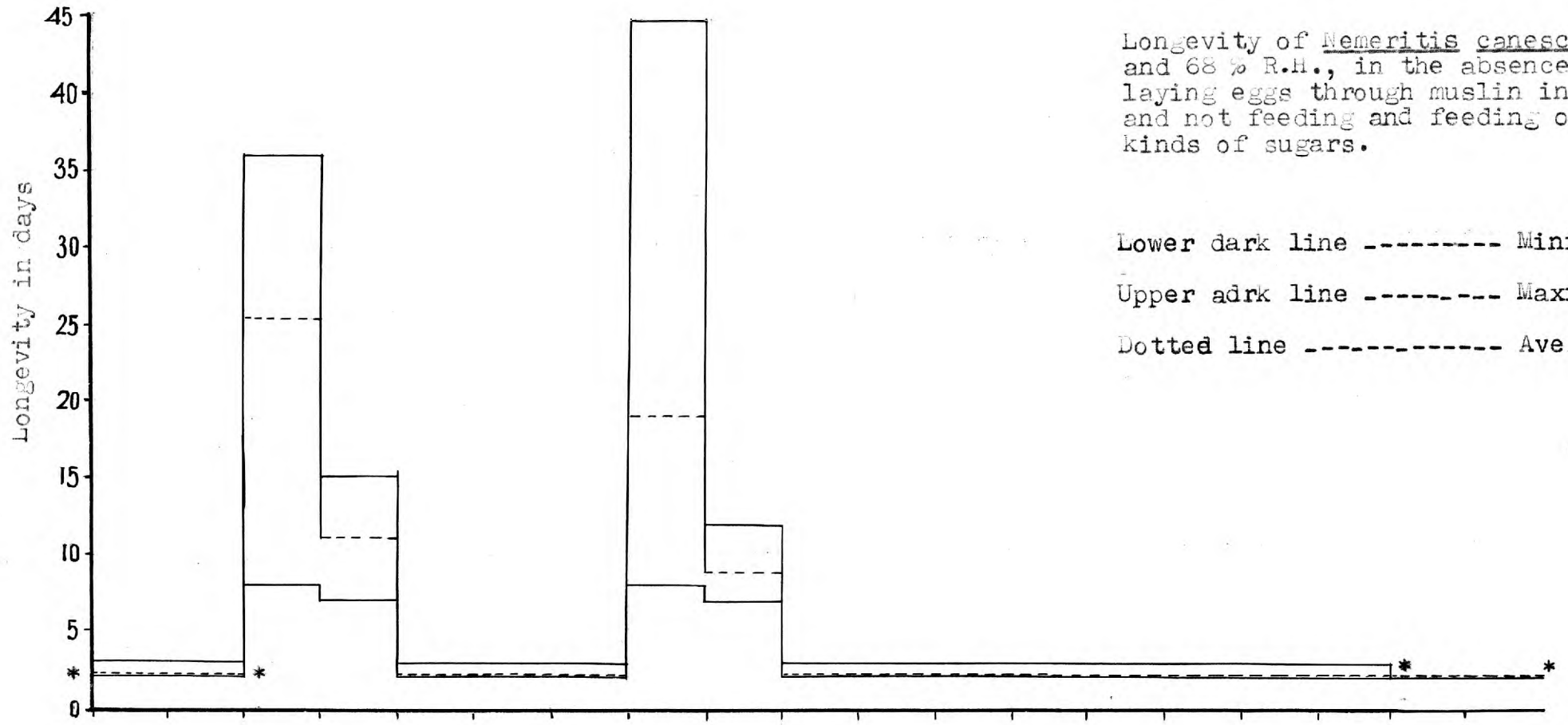


Fig. 7.

No food, no water

Fed on water alone

MONOSACCHARIDES.
Glucose
Fructose
Galactose
Mannose
Sorbose

DISACCHARIDES.
Sucrose
Maltose
Lactose
Cellobiose

TRISACCHARIDES.
Raffinose

PENTOSES.
Xylose
Arabinose

GLUCOSIDES.
α methyl-glucoside

POLYSACCHARIDES.
Starch
Dextrin

POLYHYDRIC ALCOHOLS.
Mannitol
Sorbitol

* * The dotted and the black lines in this portion coincide. For the sake of representation the dotted line is shown very slightly above the black line.

and not laying eggs:

(a) Feeding with centrifuged milk and sucrose.

The longevity of the parasites varied from 6 to 7 days; the average was about 6.4 days.

(b) Water extract of yeast.

The parasites fed on water extract of yeast and sucrose lived for 7 to 9 days; the average being 7.7 days. The majority of them lived for 8 days.

(c) Feeding with autolysed yeast and sucrose.

The longevity of the parasite on this food was 5 to 6 days. Majority of them lived only for 5 days. The average was about 5.3 days.

(d) Feeding with meat-juice and sucrose.

The longevity of the parasites fed on this protein with sucrose was the same as the autolysed yeast and varied from 5 to 6 days. The average was 5.2. The majority of them lived for 5 days.

(e) Feeding with larval extract and sucrose.

The parasite was able to live for a longer period of 11 to 12 days in this case. The average was 11.2 and the majority of them lived for 11 days.

(f) Feeding with peptones and sucrose.

In the case of peptones and sucrose Hemeritis lived for 6 to 7 days. The average was 6.4 and the majority of the parasites lived for 6 days.

(g) Summary of results obtained from (a) to (f).

The minimum, the maximum and the average life period in days of Nemeritis canescens for the various proteins with sucrose in the absence of host and not laying eggs are represented in Fig. 8 and given in Table VII. Centrifuged milk, autolysed yeast, meat-juice and peptone were able to sustain the life of the parasite for 5 to 6 days. The majority, however, lived only for 5 days. With water extract of yeast and the larval extract the parasites were able to increase their longevity to 7 to 9 days and 11 to 12 days respectively. The majority of parasites in the case of water extract of yeast lived for 7 days while for larval extract they lived for 11 days.

F. Feeding with different kinds of proteins with sucrose in the absence of host and laying eggs inside the host through muslin. As in E there was no difference in the longevity between the two dilutions: hence they are treated together

(a) Feeding with centrifuged milk.

The parasites fed on centrifuged milk lived for 5 to 6 days. The majority of them lived for 5 days.

(b) Feeding with water extract of yeast.

Nemeritis canescens lived for 6 to 8 days with this food. The majority of the parasites, however, lived for only 6 days.

(c) Feeding with autolysed yeast.

This food was able to support the parasite for

Table vii

PROTEIN FEEDING

Longevity in days of adult female parasites at 37°C., and 68 % relative humidity.

Food given	Absence of host & not laying eggs			Absence of host but laying eggs through muslin inside the host		
	Min.	Max.	Average	Min.	Max.	Average
1 part of centrifuged milk, 3 parts of water and 5 % sucrose	6	7	6.32	5	6	5.28
1 part of centrifuged milk, 10 parts of water and 10 % sucrose	6	7	6.40	5	6	5.28
Water extract of yeast and 5 % sucrose	7	8	7.64	6	7	6.20
Water extract of yeast and 10 % sucrose	7	9	7.08	6	8	6.28
Autolysed yeast and 5 % sucrose	5	6	5.28	4	5	4.16
Autolysed yeast and 10 % sucrose	5	6	5.20	4	5	4.20
1 part of meat juice, 3 parts of water and 5 % sucrose	5	6	5.20	5	6	5.20
1 part of meat juice, 10 parts of water and 10 % sucrose	5	6	5.24	5	6	5.24
1 part of larval extract, 3 parts of water and 5 % sucrose	11	12	11.24	10	12	10.92
1 part of larval extract, 10 parts of water and 10 % sucrose	11	12	11.24	10	12	10.84
Peptone and 5 % sucrose	6	7	6.36	5	6	5.20
Peptone and 10 % sucrose	6	7	6.36	5	6	5.20

PROTEIN FEEDING.

Longevity of Nemeritis canescens at 27°C., and 68 % R.H., in the absence of host and not laying eggs and feeding on a mixed diet of different proteins and sugar.

Lower dark line----------Minimum

Upper dark line----------Maximum

Dotted line ----------Average

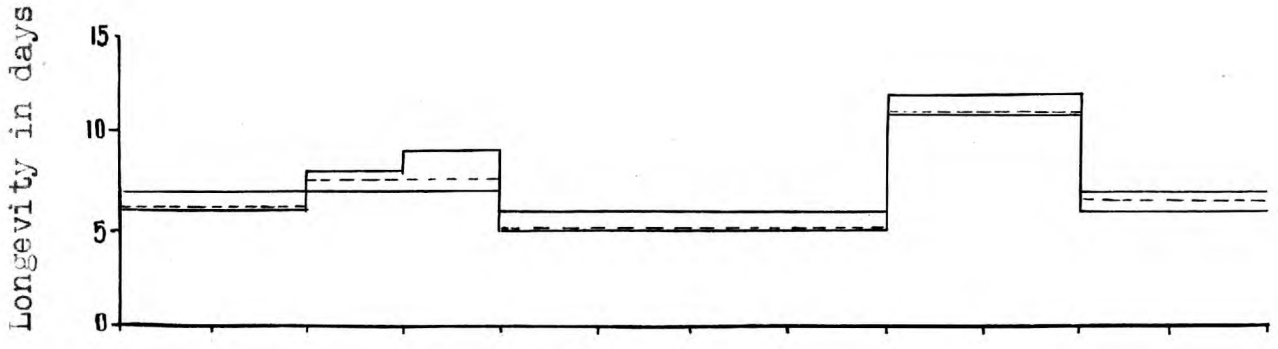


Fig. 8

One part of centrifuged milk,
3 parts of water and 5 % sucrose

One part of centrifuged milk,
10 parts of water and 10 % sucrose

Water extract of yeast and
5 % sucrose

Water extract of yeast and
10 % sucrose

Autolysed yeast and
5 % sucrose

Autolysed yeast and
10 % sucrose

One part of meat juice, 3 parts
of water and 5 % sucrose

One part of meat juice, 10 parts
of water and 10 % sucrose

One part of larval extract,
3 parts of water and 5 % sucrose

One part of larval extract,
10 parts of water and 10 % sucrose

Peptone and 5 % sucrose

Peptone and 10 % sucrose

4 to 5 days only. The majority of them lived for 4 days.

(d) Feeding with meat-juice.

With meat-juice the parasites were able to sustain themselves for 5 to 6 days; most of them lived for only 5 days.

(e) Feeding with larval extract.

With larval extract Hemeritis was able to live longest amongst the proteins with sucrose. The minimum and the maximum periods being 10 and 12 days. The average was 10.9 days.

(f) Feeding with peptones.

As in the majority of other protein feeds the parasite here was able to live only for 5 to 6 days; the average was 5.2 days.

(g) Summary of results obtained from (a) to (f).

The minimum, the maximum and the average longevity of the parasite in days for the various proteins with sucrose in the absence of the host but laying eggs inside the host through muslin are given in Table VII and represented in Fig. IX. Centrifuged milk, meat juice and peptone were able to support the life of the parasite for 5 to 6 days; the average being 5.2 and 5.3 days. In the case of larval extract and water extract the parasites lived for 10 to 12 and 6 to 8 days respectively. The averages were about 10.9 and

PROTEIN FEEDING.

Longevity of Nemeritis canescens at 27°, and 68 % R.H., in the absence of host, but laying eggs through muslin inside the host and feeding on a mixed diet of different proteins and sugar.

Lower dark line ---------- Minimum

Upper dark line ---------- Maximum

Dotted line ---------- Average

Fig. 9.

One part of centrifuged milk, 3 parts of water and 5 % sucrose

One part of centrifuged milk, 10 parts of water and 10 % sucrose

Water extract of yeast and 5 % sucrose

Water extract of yeast and 10 % sucrose

Autolysed yeast and 5 % sucrose

Autolysed yeast and 10 % sucrose

One part of meat juice, 3 parts of water and 5 % sucrose

One part of meat juice, 10 parts of water and 10 % sucrose

One part of larval extract, 3 parts of water and 5 % sucrose

One part of larval extract, 10 parts of water and 10 % sucrose

Peptone and 5 % sucrose

Peptone and 10 % sucrose

Sucrose in the presence of host

6.2 days. In the case of autolysed yeast the life period of the parasite was one day less than centrifuged milk, meat-juice and peptone. It will thus be seen that amongst the proteins the life period was a minimum for autolysed yeast and maximum for larval extract and intermediate for water extract of yeast.

C. A comparative account of results obtained in B, C, D, E and F.

Table VI gives the minimum, the maximum and the average longevity of the parasite for the various sugars and polyhydric alcohol feeding in the absence of host and not laying eggs; in the presence of host and laying eggs and in the absence of host but laying eggs inside the host through muslin.

The minimum, the maximum and the average longevity in days of the parasite for the various proteins with sucrose feeding in the absence of host and not laying eggs and laying eggs inside the host through muslin are shown in table VII. In the various sugar feeds excepting glucose, fructose, saccharose and maltose the parasites were able to live only from 2 to 4 days, whether not laying eggs or laying eggs in the presence or absence of host. In the case of glucose and sucrose the parasite was able to live for the maximum period when not laying eggs and in the absence of host . The

averages were 28.0 and 31.0 days respectively. In the case of fructose and maltose they lived for an average period of 12.4 and 11.0 days.

In the presence of host and laying eggs this longivity is considerably reduced with glucose, fructose, sucrose and maltose and the averages were 10.0, 7.7, 9.6 and 7.2 days respectively. It will be seen that this reduction was about 2/3 in the case of glucose and sucrose and about 1/3 in the case of fructose and maltose. In the absence of host but laying eggs inside the host through muslin this reduction is not so much as in the presence of host and laying eggs. The averages for glucose, fructose, sucrose and maltose were 25.4, 11.3, 19.0 and 8.9 days respectively. The reductions were only about 1/6, 1/12, 2/5 and 3/11 of the longevity in the absence of host and not laying eggs. It will be seen that the reduction is marked only in the case of sucrose but the variation in the maximum and the minimum values was considerably more in the case of sucrose feeding.

This difference in longevity could be explained as follows: in the first case the parasite did not lay any eggs at all. In the second case it laid most of the eggs (all the developed eggs and a good number of undeveloped eggs that matured as a result of feeding on the host.) In the last case, only the developed eggs in the ovaries were laid as the parasite could not get the necessary protein,

as the hosts were not allowed contact with the parasites. In the case of protein feeding excepting water extract of yeast and the larval extract the parasites were able to live for 5 to 7 days. Whether laying eggs or not laying eggs with larval extract the parasites live for an average period of 11 days. For water extract of yeast the average longevity period was about 7.7 days when not laying eggs and 6.2 days when laying eggs. Thus with water extract the longevity is reduced by 1.5 days when laying eggs. In autolysed yeast also the average longevity was reduced by about one day when laying eggs.

It may be of interest to note that feeding with sugar/larval extract with sugar and laying eggs inside the host through muslin (absence of host) is equivalent to the parasite laying eggs in the presence of the host and feeding on sucrose. Because in both cases the protein that the parasite gets is the blood of the host. (See Fig.8). The average longevity in both cases was also more or less the same.

8. THE FEEDING BEHAVIOUR AND REQUIREMENTS OF ADULT PARASITES.

The females of a number of parasites of the families Chalcidae, Braconidae, Ichneumonidae and Bethylidae feed on the host body fluids that exude from the punctures made by their ovipositors during the act of oviposition. Some parasites lacerate the soft body of their host by their ovipositor or mandibles solely for the purpose of feeding;

others simply lick the blood that exudes in the act of oviposition. In the former case feeding is the primary consideration while in the latter case it is only secondary. In Meseritia canescens oviposition is the primary consideration and feeding is only secondary. When feeding is the first consideration the parasite while destroying the host tissue might not lay any eggs in the host. Muesebeck and Dohanian (1927) observe that this phenomena is a common occurrence in all the parasites of Apanteles melanoscelus Ratz., which is itself a primary parasite of the gypsy moth Lymantria dispar. They further observe that this habit is so pronounced that sometimes the entire fluid content is consumed and if at this stage oviposition takes place the hyper-parasite larva oftentimes perish for want of sufficient nutriment. Sweetman (1936) observes that the Ichneumonid Ephialtes instigator bites holes in its host chrysalis and feeds on the body fluids. It is remarkable that sometimes this happens even after oviposition and the result is that the parasite destroys its own offspring as well as the host. Sweetman (1936) gives example of a remarkable manner of feeding on the host in the Chalcids (Pteromalidae) Dibrachoides dynastes (Foerst.) and Habrocytus cerealellae (Ash.) The former is a parasite of the alfalfa weevil,

Hypera postica (Gyll.) and the latter of the angoumois grain moth Sitotroga cerealella (Oliv.) These parasites erect a tube through which they suck the body fluids of their hosts. Sweetman (1936) observes that Trouvelot was the first worker to observe this most interesting habit in 1921 in the case of the Braconid Habrobracon johannseni (Viereck) that parasitises the potato tuber moth Phthorimaea operculella (Zell.). Faure (1924) has observed the same habit in two Chalcids, Pteromalus and Eurytoma which parasitise Apanteles glomeratus (L.). He concludes that this habit has arisen out of the necessity of extracting nutriment from hosts enclosed in cocoons.

As has already been stated once many Hymenopterous parasites feed on the nectar of flowers and exudations from ripe fruits etc. The significance of this feeding on the longevity and the influence of the latter on the reproductive capacity of the parasite demand close study not only from physiologists but ecologists as well; for ecology can only be appreciated from an understanding of the diverse physiological processes within the insect body.

It is also now accepted that though in the case of many insects a diet of sucrose can sustain and prolong the longevity of adult life to a considerable extent addition of protein is absolutely necessary for the development of

their genital products. In the examples of the parasites that were mentioned before the feeding on the host had perhaps something to do with the maturation of some, if not all the eggs in the ovaries of the parasites. There is, however, very little experimental evidence to confirm this view held by many workers in the case of parasites.

This aspect of the study of nutrition has been discussed by several workers in various entomological publications and nowhere more ably than by Uvarov (1928) in his excellent review on " Insect Nutrition and Metabolism". We may make a passing reference to some of the more important papers to get a proper appreciation of the problem. Roubaud (1922) observes that nitrogenous food is necessary for egg production in house-flies and that ~~it~~ they cease to lay eggs as soon as the nitrogenous food is withdrawn but begin to lay eggs again when this protein food is restored. Glaser (1923) has shown that adult houseflies can live only a very short time if kept without food or if fed on pure protein food. The longevity, however, considerably increases when the fly is fed on sucrose solution but no eggs are laid. The maximum longevity and oviposition are, however, obtained when the fly is given a diet including both sugars and protein. Kastner (1929) finds that the Onion Fly, Hylemyia antiqua Meigen can maintain life for a much longer period

on sugar solution than on water, but that maximum longevity and oviposition are only produced when protein in the form of casein is added to the diet. (Kastner includes nectar also as a protein food; but nectar is only a solution of sucrose). Howard, Dyar, and Knab (1912) observe that in the case of the yellow fever mosquito Aëdes "calopus" a blood meal is necessary for the eggs to ripen. The mosquito, however, can live for a long time on honey solution. Sometimes repeated meals of blood are necessary for the development of all the eggs in the ovaries. Richards (1927) observes as follows with regard to blood sucking flies: " In some Liponeuridae, in some Ceratopogonidae , in the Simuliidae, in most Culicidae, in some Psychodidae, in the Tabanidae, and certain Leptidae, only the females suck blood, the males taking honey or in some cases not feeding at all." This habit of the females of a species to take nitrogenous food to a far greater extent than the males has perhaps a good deal to do with egg production. Richards (1927) has summarised some of these interesting habits such as the eating of the spermatophore after mating by the females, the eating of the male by the female, the presentation to the female of prey by the male before mating and the regurgitation by the male of a drop of fluid which is eaten by the female during mating. Mackerras (1933) finds that females of

Lucilia require proteins for the maturation of their eggs but the males do not require them for spermatozoa formation. They lived normally on a diet of sugar and water. There is one interesting record by Larson and Fischer (1925) who working on Bruchus quadrimaculatus found that there was an increase in the number of eggs that were laid when the beetle was fed on sugar solution. This, however, is an exception. The evidence that have been adduced above by several workers point to the conclusion that while a sucrose diet can sustain and even prolong longevity nitrogenous food of some kind is necessary for egg production.

In the case of Hemeritis this is what we observe. The parasite has a number of developed eggs in its ovaries at the time of emergence. All these eggs are laid even when the parasite is not given any protein food. If on the other hand the parasite is allowed to feed on the host a large number of the remaining eggs in the ovaries attain maturity and these matured eggs are laid on successive days after all the developed eggs that were already there in the ovaries at the time of emergence ~~were~~ have been laid. In these investigations the longevity of the parasite has been studied in very great detail on a variety of sugars and polyhydric alcohols and an attempt has been made to correlate this longevity with the capacity of the parasite for oviposition.

9. FECUNDITY STUDIES IN MESERITIS CANESCENS WITH DIFFERENT SUGARS, POLYHYDRIC ALCOHOLS AND PROTEINS WITH SUCROSE.

The fecundity studies in Meseritis canescens were carried out at 27°C., and 68 % R.H., with the same sugars, polyhydric alcohols, and proteins with sucrose as in longevity studies. In the case of sugars and polyhydric alcohols they were studied in the presence of host and in the absence of host. (In the latter case the parasite laid eggs through muslin.) In the case of proteins these studies were confined to oviposition in the absence of host only as the object of these experiments was to find out whether the blood on which the parasite normally feeds could be replaced by all or any of the proteins listed.

A.. Technique of experimentation and observation.

The oviposition studies were conducted by repeating the experiments six and three times respectively for each of the carbohydrates and protein feeds. In the case of protein feeding, the experiments were repeated only three times because there was not much difference between the two dilutions used for each of the proteins with sucrose. A freshly emerged parasite was given 25 host larvae daily till the parasite died. The larvae given on the previous day were removed in a specimen tube of 2" X 1" wide and the mouth was carefully covered with muslin and filter paper by means of thin india rubber bands. The tube was carefully labelled as, " first lot

of 25, sucrose feeding, dated etc.) It was kept in the constant temperature room for about four days. (The incubation period of the egg at this temperature is three days.) On the fourth day these larvae were dissected and the number of eggs which by now had hatched in each of the larvae carefully counted. This was found to be the safer method, than counting the eggs because oftentimes the eggs were laid within the fat body that abounded in the host larvae. It was verified by actual experiments repeated several times that all the eggs laid normally hatched. In view of the prevalence of auto-parasitism in this parasite special precautions were taken to see that the parasite had not the opportunity to lay even a single egg after emergence. This was ensured by removing the parasitic pupae from the cultures by cutting the muslin around the pupae by a pair of scissors and putting each one of these pupae into a specimen tube and closing the mouth of the tube by cork. Only one parasite emerged in each tube and the parasites that emerged in this manner were used for oviposition studies. The apparatus used for the fecundity studies are described below:

(a) <u>In the presence of host</u>.

A small specimen jar 4" in height and 3.2" in diameter was used. (Fig. 10) The feeding arrangement was the same as used for longevity studies except that there was

Jar used for oviposition by Nemeritis canescens

(Presence of host)

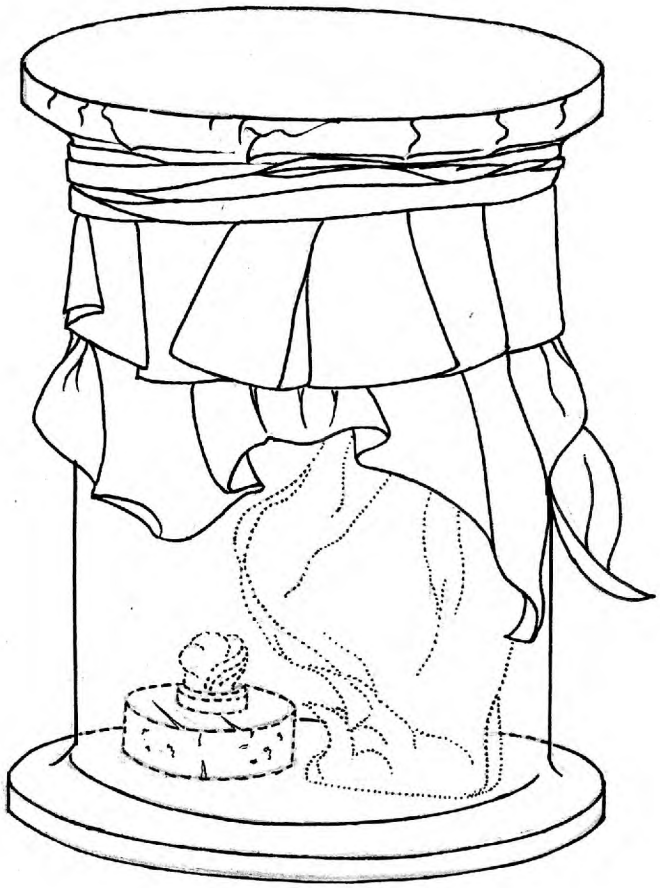


Fig. 10

only one feeding tube inserted in the cork as there was only one parasite to feed. The feed was renewed daily. Into this jar were released 25 Ephestia larvae and a freshly emerged parasite. A small 3" square of muslin was also introduced for the larvae to crawl and the parasite to walk on. The mouth of the jar was then covered with muslin as well as filter paper well secured by india rubber band.

(b) In the absence of host.

For carbohydrate and protein feeding the same apparatus used for longevity studies was used(Under the condition of absence of host but laying eggs inside the host through muslin). Six such tubes (Fig. 4) were used for the six replications.

B. Carbohydrate feeding: in the presence of host.

(a) The effect of not feeding on oviposition.

The primary data for the six replications are given in Table VIII. The total number of eggs laid from emergence till death varied from 96 to 109 and the average was 102.7. The percentage* of mean to the average number of eggs in the ovaries was 33.9. The parasite laid eggs for two days and died on the third day. The number of eggs laid on the

* In the succeeding paragraphs by percentages it is meant the percentage of the mean to the average number of eggs in the ovaries which has been found to be 303.12 ± 1.26. Vide (Table V)

Table VIII

RESULT OF OVIPOSITION WITHOUT FEEDING -- NOT EVEN WATER. (PRESENCE OF HOST.)

Serial No. of experiment.	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks.
I.	15.3.1938.	3 3 4 3 2 4 3 3 5 2 3 4 4 2 3 3 3 4 4 3 3 2 3 4 3	80)	109	Parasite died on 17.3.1938.
		2 2 1 0 2 1 1 1 2 3 2 1 0 0 2 2 0 0 1 1 2 0 2 0 1	29)		
II.	15.3.1938.	4 2 2 2 3 0 1 2 1 1 5 2 3 4 2 2 5 3 3 4 3 4 5 5 5	73)	102	Parasite died on 17.3.1938.
		2 1 0 0 1 1 2 3 1 1 2 0 2 3 0 1 2 1 1 0 2 0 1 2 0	29)		
III.	15.3.1938.	5 2 3 3 2 2 3 2 2 1 4 3 1 2 3 4 2 2 4 5 4 3 3 4 2	71)	96	Parasite died on 17.3.1938
		1 0 2 1 0 0 1 2 1 1 3 0 1 2 1 0 1 0 2 1 1 0 2 2 0	25)		
IV.	19.3.1938.	4 3 3 2 1 4 3 3 3 2 0 2 3 3 4 2 2 4 5 3 3 4 4 4 5	76)	104	Parasite died on 21.3.1938.
		2 1 2 0 0 1 3 2 2 1 0 1 2 2 0 1 1 1 1 1 1 2 0 0 1	28)		
V.	19.3.1938.	3 4 4 4 1 2 3 0 3 2 1 3 3 2 1 2 3 5 4 4 3 5 4 4 6	76)	96	Parasite died on 21.3.1938
		1 0 2 0 1 0 1 2 0 1 1 0 1 2 0 1 1 1 0 0 1 0 1 2 1	20)		
VI.	19.3.1938.	3 3 3 3 4 4 4 3 4 4 4 3 5 3 2 3 2 5 3 4 4 1 2 3 2	81)	109	Parasite died on 21.3.1938.
		2 1 2 1 2 2 0 1 3 1 1 0 2 1 1 0 2 1 1 0 1 1 1 0 1	28)		

first day ranged from 71 to 81. The mean and the percentage were 76.2 and 25.1 respectively. On the second day the parasite laid 20 to 29 eggs. The average was 26.5 and the percentage 8.7.

(b) The effect of water drinking on oviposition.

The primary data for the six replications are given in Table IX. The minimum and the maximum number of eggs laid by the parasite from emergence till death were 105 and 111. The average and the percentage were 108.0 and 35.6. As in the previous case the parasite laid eggs for two days and died on the third day. On the first day the parasite laid 89 to 95 eggs. The average and the percentage were 91.2 and 30.1. On the second day 16 to 18 eggs with an average of 16.8 were laid by the parasite. The percentage was 5.6.

(c) The effect of monosaccharides diet on oviposition:

The primary data are given in tables X , XI, XII, XIII, and XIV. The minimum and the maximum number of eggs laid by the parasite with glucose, fructose, galactose, mannose and sorbose from emergence till death were 241, 268; 219, 240; 104, 120; 113, 125; and 101, 111 respectively. The averages were 256.5, 228.8, 111.8, 120.3 and 108.0. The percentages of eggs laid were 84.6, 75.5, 36.9, 39.7 and 35.6. The percentage of eggs laid from emergence till

Table ix

RESULT OF OVIPOSITION WITH WATER GIVEN FOR DRINKING. (PRESENCE OF HOST.)

Serial No. of experiment.	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
I.	25.3.1938	6 5 4 4 3 2 5 4 4 1 3 2 1 3 4 4 5 5 6 4 5 3 3 1 4	91)	108	Parasite died on 27.3.1938.
		0 0 1 2 1 0 1 0 0 1 2 3 0 0 0 1 0 0 0 1 0 3 0 0 1	17)		
II.	25.3.1938	7 5 1 6 1 4 5 4 5 5 4 4 7 2 4 3 3 4 5 1 2 0 1 2 4	89)	105	Parasite died on 27.3.1938.
		1 1 0 0 0 2 3 1 0 0 0 1 1 0 1 0 0 0 1 2 0 0 0 1 1	16)		
III.	25.3.1938	5 5 5 4 3 5 5 4 4 3 5 2 1 6 5 4 3 1 5 4 3 1 1 1 5	90)	108	Parasite died on 27.3.1938
		1 1 0 0 0 1 1 0 0 2 1 0 0 1 1 2 0 0 3 0 0 0 3 0 1	18)		
IV.	29.3.1938	4 4 6 5 4 3 3 3 4 4 1 2 3 4 5 5 6 3 1 4 4 3 3 6 5	95)	111	Parasite died on 31.3.1938.
		1 0 0 0 3 1 3 0 0 2 0 0 0 1 1 0 0 0 0 1 0 0 0 2 1	16)		
V.	29.3.1938.	4 4 7 5 4 4 4 1 2 4 4 3 2 5 2 5 4 3 3 5 4 1 2 3 7	92)	109	Parasite died on 31.3.1938.
		1 1 0 1 0 0 1 1 0 0 1 0 2 2 0 1 0 0 0 2 0 0 0 2 2	17)		
VI.	29.3.1938.	6 6 4 5 4 5 4 3 3 2 3 1 6 3 2 3 6 5 4 5 2 2 1 1 4	90)	107	Parasite died on 31.3.1938
		1 1 2 0 1 2 0 0 0 0 3 0 0 0 0 2 1 1 1 0 1 0 0 0 1	17)		

Table X

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GLUCOSE. (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death.	Remarks
					Parasite died on
I.	2.4.1938.	3 3 3 6 2 1 4 3 3 4 1 2 2 2 1 2 2 2 1 2 2 2 3 1 3	60		
		4 3 2 4 2 1 4 3 2 6 1 1 3 2 1 2 3 1 1 3 1 2 2 1 1	56		
		1 2 1 1 2 2 1 1 0 2 1 2 0 1 1 2 1 1 1 1 2 1 1 0 0	28		
		2 1 1 1 1 1 2 1 0 0 1 1 1 1 0 2 0 1 1 2 0 1 1 1 1	24		
		1 1 2 1 1 1 2 0 1 1 1 1 1 0 1 2 0 1 1 1 2 1 1 1 1	26	245	11.4.1938
		2 0 1 2 2 2 3 0 0 0 1 1 1 1 1 0 2 0 0 2 0 1 1 0 1	24		
		1 2 1 1 0 2 0 0 1 2 1 0 0 1 1 0 2 0 0 1 0 0 0 1 1	18		
		1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 2 0 0 0 0	6		
		0 0 0 0 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1	3		

Table x (Contd)

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GLUCOSE. (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
II.	2.4.1938.	3 4 1 1 1 0 2 4 2 6 2 2 3 3 2 2 3 0 1 2 2 3 1 2 2	54		
		3 1 2 2 4 2 2 3 2 2 1 1 2 0 3 5 1 1 1 2 2 2 2 4 3	53		
		3 1 1 1 2 1 2 1 3 1 2 0 1 2 2 2 0 0 1 1 1 1 1 0 1	31		
		1 2 1 1 1 1 1 1 2 0 1 1 1 2 2 1 2 0 1 1 0 2 0 1 2 1	28		
		1 2 1 1 5 0 2 1 0 2 0 1 1 1 0 1 1 0 0 1 0 3 2 0 0	26		
		2 1 1 1 1 2 2 1 2 1 1 0 2 2 0 2 3 0 0 2 0 0 1 2 0	29		
		1 0 1 2 2 0 0 0 1 1 0 0 1 0 0 1 1 0 0 1 0 0 1 1 2	16	257	14.4.1938
		0 0 1 2 0 0 1 1 1 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0	8		
		2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 1	5		
		0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0	4		
		0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1		
		0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0	2		

Table X (contd)

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GLUCOSE. (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
III.	2.4.1938.	5 6 3 3 4 2 2 1 4 1 1 2 3 3 2 1 2 2 3 4 1 2 2 2 4	65		
		4 3 1 4 5 1 1 2 3 2 1 1 2 3 2 1 2 3 3 2 3 2 0 2 3	56		
		1 1 2 1 1 0 1 2 0 1 2 1 1 0 0 1 1 1 1 1 1 2 0 0 0	22		
		2 3 2 1 0 0 2 1 0 2 1 1 1 0 1 0 2 0 0 2 0 2 0 0 2	25		
		2 1 2 2 1 1 2 2 0 1 2 0 1 1 1 2 0 1 0 0 0 2 1 1 0	26		
		1 1 1 1 0 0 2 0 0 1 0 0 0 0 2 0 0 0 0 0 0 2 2 0 2	15	241	12.4.1938
		0 0 0 1 2 0 0 0 0 0 1 1 1 0 1 0 0 0 0 0 0 1 0 0 1	9		
		0 0 0 0 0 0 0 2 0 0 0 1 0 1 0 0 0 0 0 0 0 0 1 1 1	7		
		0 0 2 0 0 0 2 2 0 0 0 1 0 0 0 0 0 0 0 0 1 1 1 0 0	10		
		0 1 2 0 0 2 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6		

Table X (Contd)

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GLUCOSE. (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
IV.	18.4.1938.	6 3 3 3 2 1 2 3 2 2 3 2 3 5 4 4 3 3 1 1 2 1 1 2 2	64		
		3 3 3 2 2 3 3 2 1 2 2 2 4 3 2 1 0 2 4 1 2 1 2 1 5	56		
		3 2 1 1 2 1 0 1 2 0 1 0 2 1 1 0 0 2 2 1 1 1 1 0 3	29		
		2 1 1 1 2 1 0 1 0 0 0 1 0 2 3 0 0 0 1 2 2 1 2 1 3	27		
		2 1 1 0 0 0 1 0 0 0 2 0 0 0 0 0 3 2 2 2 3 0 2 1 3	28		
		2 1 1 0 1 1 2 0 1 1 2 1 1 2 1 1 0 1 1 1 1 0 0 2 2	26	262	28.4.1938
		2 3 2 1 0 0 0 0 2 0 0 0 0 3 0 0 1 0 0 0 2 2 0 0 3	21		
		0 2 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 1 2 0 0 0 0 0	7		
		0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 2 0 0 0 1 0 0 0 0	5		
		0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	2		

Table x (Contd)

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GLUCOSE. (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
V.	18.4.1938.	2 2 3 4 3 4 3 3 2 1 2 3 3 1 3 3 4 1 2 2 2 1 3 0 1	64	266	Parasite died on 26.4.1938
		4 2 2 3 1 1 2 2 3 4 4 1 2 3 2 2 4 2 4 1 1 2 2 2 3	59		
		1 1 2 1 0 1 1 2 1 1 1 2 3 1 2 0 1 2 2 1 1 1 1 2 1	32		
		2 1 1 1 1 2 0 2 2 4 0 0 0 1 0 2 1 2 0 1 1 0 2 1 1	28		
		3 3 2 1 1 3 1 0 2 2 1 0 1 0 0 1 2 0 1 2 1 1 0 0 2	30		
		2 2 1 2 2 0 1 2 2 1 1 1 0 1 2 0 0 1 1 1 0 0 1 1 1	26		
		0 2 2 2 0 0 0 1 1 1 1 0 0 0 1 1 1 0 0 1 0 0 1 1 1	17		
		0 1 1 0 0 0 0 2 0 0 1 0 0 0 0 0 1 1 0 1 0 0 0 0 2	10		

Table X (Contd)

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GLUCOSE. (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
VI.	18.4.1938	6 2 5 2 3 3 4 5 1 2 2 1 2 3 3 2 0 3 3 2 3 2 2 3 3	67		
		2 1 2 2 1 2 2 3 2 3 3 2 2 2 3 2 3 3 3 2 4 1 0 2 3	57		
		2 1 0 1 1 2 2 2 1 1 1 1 2 0 2 1 0 0 1 1 1 0 1 1 2	27		
		1 2 1 1 2 0 0 1 1 2 0 0 1 1 1 1 0 1 2 2 0 0 2 0 3	25		
		2 1 3 2 0 1 2 2 1 1 1 0 0 1 2 1 0 0 1 3 1 1 1 2 2	31		
		2 0 0 0 2 1 1 2 1 1 2 0 0 0 2 2 2 0 1 1 2 2 2 2 2	30	268	28.4.1938
		0 2 2 0 0 0 0 1 1 1 0 0 2 1 0 0 1 0 1 0 0 2 2 0 2	18		
		0 1 1 0 0 0 0 0 1 0 0 1 0 0 1 0 0 0 0 0 1 0 0 0 2	8		
		0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 1 0	3		
		0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2		

Table xi

RESULT OF FEEDING ON OVIPOSITION. MONOSACCHARIDES. FRUCTOSE (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	28.4.1938	1 2 3 2 1 1 2 3 3 2 3 7 4 3 1 2 2 3 2 2 2 4 1 2 2	60		
		2 4 2 3 1 1 1 2 3 2 3 3 3 2 1 1 2 4 1 1 2 3 3 2 2	54		
		2 2 1 0 2 2 1 2 1 0 2 2 0 3 1 1 2 1 1 1 2 1 0 2 0	32		
		2 2 1 1 1 2 1 2 0 1 2 1 1 3 1 1 1 0 1 1 1 1 0 0 0	27	237	5.5.1938
		1 0 2 1 1 1 2 1 2 1 0 2 1 1 1 1 1 1 3 2 1 1 1 2 0	30		
		0 2 1 2 0 1 1 1 0 0 1 1 2 1 0 0 1 1 0 2 0 1 0 0 2	20		
		2 0 2 2 1 0 0 0 0 0 0 1 0 1 0 0 1 0 0 0 1 1 2 0 0	14		
II.	28.4.1938	1 3 2 2 2 3 2 2 3 1 2 3 2 3 2 1 1 4 5 2 2 1 1 2 2	54		
		2 7 2 1 2 2 2 2 4 1 1 1 1 2 2 3 1 3 1 3 2 2 2 1 2	52		
		1 2 2 2 0 1 3 1 1 1 1 2 1 1 2 1 1 1 2 1 1 1 0 1 0	30		
		2 1 2 0 1 1 2 0 2 1 1 0 0 1 1 1 3 1 2 2 1 1 0 1 0	27	223	5.5.1938
		2 1 0 2 2 3 1 2 1 1 1 2 1 0 1 2 3 1 0 1 0 1 1 1 3	33		
		2 0 1 2 2 2 1 0 1 1 2 0 1 0 0 1 1 0 0 0 1 1 1 0 1	21		
		0 0 0 0 1 0 1 0 0 0 2 0 0 0 0 1 0 0 0 0 0 0 0 1 0	6		

Table XI (Contd)

RESULT OF FEEDING ON OVIPOSITION. MONOSACCHARIDES. FRUCTOSE (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
III.	28.4.1938	2 2 2 2 2 2 3 7 3 2 1 3 3 1 2 1 1 1 2 4 1 3 2 4 0	56		
		4 1 1 3 2 1 3 3 2 1 3 4 3 2 2 2 4 2 5 0 1 1 2 0 1	53		
		2 2 1 0 1 0 1 1 2 1 2 2 0 2 0 1 1 1 1 0 0 0 1 0 1	23		
		0 1 1 1 2 1 0 0 2 1 1 1 2 0 0 1 0 1 1 0 1 1 0 0 1	19		
		0 1 1 0 0 1 0 1 0 2 2 2 1 2 1 1 2 2 1 1 0 2 1 2 1	27	219	6.5.1938
		0 1 0 2 2 1 0 1 1 1 2 2 1 1 0 1 0 0 0 1 1 1 1 1 1	22		
		0 0 0 0 0 0 1 0 2 2 0 0 1 0 2 0 1 0 0 1 0 0 1 1 1	13		
		0 1 0 1 0 1 0 0 0 0 0 0 0 1 0 0 1 0 0 1 0 0 0 0 0	6		
IV.	5.5.1938	1 2 2 1 2 2 2 1 1 5 2 3 4 3 3 3 2 1 1 2 3 6 4 3 0	59		
		3 1 2 2 2 1 2 3 3 1 3 2 6 1 2 1 2 2 1 0 3 2 2 1 2	50		
		1 1 0 1 1 2 1 1 2 2 1 2 3 1 0 0 1 0 1 0 1 2 2 1 1	23		
		1 2 1 1 1 1 2 2 0 0 1 1 1 1 2 0 1 2 1 2 2 1 0 1 2	29	240	13.5.1938
		1 1 3 1 2 1 1 1 2 2 1 1 0 2 2 1 0 2 1 1 3 0 1 2 2	34		
		1 1 1 2 1 2 1 1 2 2 1 0 1 2 1 1 0 1 0 1 0 0 1 0 1	24		
		0 1 2 0 0 0 1 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 1 0 2	10		
		0 0 1 0 0 0 0 0 1 0 0 0 1 0 0 1 1 0 0 1 0 0 0 0 0	6		

Table XI (Contd)

RESULT OF FEEDING ON OVIPOSITION. MONOSACCHARIDES. FRUCTOSE (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death.	Remarks Parasite died on
V.	5.5.1938	4 2 1 2 2 3 2 3 2 7 3 4 1 2 4 3 1 1 2 2 1 2 1 2 1	58		
		3 1 3 2 3 2 3 4 1 1 3 2 3 2 4 2 1 1 2 2 1 1 2 0 1	50		
		1 2 3 2 1 0 1 0 1 2 2 1 1 2 0 1 0 1 1 2 0 1 2 1 1	29		
		1 1 0 1 1 2 3 1 1 2 1 1 2 2 1 1 0 1 1 0 1 2 0 2 2	30	230	12.5.1938
		2 0 0 1 1 1 2 2 0 1 1 0 1 0 1 1 1 2 1 2 1 1 2 1 0	25		
		1 2 2 1 0 1 2 0 1 1 1 0 0 1 1 2 0 0 0 1 2 3 1 0 1	24		
		0 1 0 2 1 0 0 0 0 1 1 1 0 1 0 0 0 0 0 1 2 0 1 1 1	14		
VI.	5.5.1938	2 2 3 5 1 2 4 3 2 3 2 1 4 2 4 0 1 2 2 3 1 3 3 1 2	58		
		4 2 2 2 2 2 2 2 3 2 4 1 1 1 3 0 4 3 3 1 3 1 1 2 1	52		
		2 3 1 1 1 1 2 1 1 1 2 2 0 1 2 1 2 1 2 1 3 1 2 1 1	36		
		2 1 0 1 3 0 2 1 1 1 1 0 0 2 1 0 1 1 2 0 1 0 2 1 1	25	224	12.5.1938
		2 2 1 1 1 2 0 0 1 0 1 2 1 1 0 1 1 0 0 0 1 0 1 2 0	21		
		1 2 1 1 1 0 0 0 0 0 1 2 1 2 2 2 1 0 0 0 0 0 0 0 0	17		
		0 0 0 1 1 1 0 0 2 0 0 1 2 0 1 2 0 0 1 0 0 0 0 2 1	15		

Table xii

RESULT OF FEEDING ON OVIPOSITION. MONOSACCHARIDES. GALACTOSE (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks Parasite died on
I.	8.5.1938	2 2 3 2 2 2 2 2 2 3 5 2 3 5 2 4 3 4 3 2 1 2 1 2 1	62	113	10.5.1938
		1 4 3 2 2 2 3 3 2 1 1 2 0 4 2 2 1 3 3 3 1 1 2 1 2	51		
II.	8.5.1938	3 4 3 1 3 1 2 1 2 3 2 1 1 2 2 6 2 0 3 2 3 4 3 3 2	59	111	10.5.1938
		2 1 4 2 3 3 6 4 2 1 1 3 0 1 2 3 1 2 2 1 1 2 2 2 1	52		
III.	8.5.1938	4 3 3 3 2 2 1 2 3 1 3 2 2 3 3 2 4 2 6 0 1 2 1 2 1	58	114	10.5.1938
		1 3 3 2 2 1 3 2 1 2 2 3 3 2 2 4 2 2 7 1 3 1 1 2 1	56		
IV.	14.5.1938	1 3 3 2 3 2 2 1 9 1 2 4 3 2 1 0 2 3 1 2 1 2 3 2 2	57	104	16.5.1938
		2 3 3 1 2 1 0 1 2 2 2 3 1 1 2 3 4 2 3 1 2 2 1 1 2	47		
V.	14.5.1938	2 3 2 2 3 3 2 1 2 3 4 4 1 2 3 2 2 1 1 1 2 1 2 3 2	60	109	16.5.1938
		4 3 2 1 1 2 2 0 1 2 1 2 3 1 3 2 1 2 4 3 3 1 2 1 2	49		
VI.	14.5.1938	2 3 5 4 7 2 1 1 3 4 2 5 1 4 3 1 3 3 3 1 1 2 1 1 2	66		
		3 1 3 1 0 2 2 1 3 6 2 2 1 2 2 1 2 3 2 1 1 2 2 4 2	51	120	17.5.1938
		0 0 1 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0	3		

Table xiii

RESULT OF FEEDING ON OVIPOSITION. MONOSACCHARIDES. MANNOSE (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	20.5.1938	2 3 1 2 2 3 2 7 3 2 2 3 2 2 3 4 2 1 1 3 1 3 4 2 2	62	118	22.5.1938
		3 2 1 2 2 2 3 3 4 2 2 2 1 3 3 1 2 2 3 3 1 2 3 2 2	56		
II.	20.5.1938	2 3 1 1 2 2 3 2 3 2 4 3 2 3 4 3 2 5 3 1 1 2 2 3 1	60	113	22.5.1938
		1 3 1 3 4 2 3 2 2 2 1 1 4 2 2 2 3 2 1 2 2 3 1 3 1	53		
III.	20.5.1938	2 2 3 3 3 1 1 3 2 2 2 2 3 1 4 4 2 1 2 9 2 3 2 2 1	62	125	22.5.1938
		1 2 2 3 3 2 3 2 6 2 3 4 2 2 2 3 4 1 3 2 2 3 2 2 2	63		
IV.	25.5.1938	3 1 3 2 2 1 3 1 3 2 2 2 3 2 4 2 2 2 3 8 2 2 3 2 3	63	123	27.5.1938
		2 2 1 3 1 2 3 3 1 4 2 2 3 3 2 2 2 3 0 1 2 5 4 4 3	60		
V.	25.5.1938	2 2 1 2 4 3 3 3 2 1 3 2 1 3 2 3 2 2 2 7 2 2 1 3 2	60	119	27.5.1938
		2 4 2 2 2 1 2 4 2 4 3 3 1 1 3 2 2 3 2 1 2 2 4 2 3	59		
VI.	25.5.1938	1 3 2 4 4 2 6 3 2 3 1 2 4 3 3 2 3 2 2 2 3 2 1 2 3	65	124	27.5.1938
		2 1 1 2 2 2 2 4 3 2 3 4 4 2 4 2 1 2 3 3 3 1 1 4 1	59		

Table xiv

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES). SORBOSE. (PRESENCE OF HOST).

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	29.5.1938	2 2 1 3 1 2 2 3 2 3 4 1 3 2 2 2 1 2 2 3 3 2 1 2 4	55)	101	31.5.1938
		2 2 1 1 1 2 3 1 3 1 2 4 1 2 1 1 2 0 1 4 3 2 3 1 2	46)		
II.	29.5.1938	4 1 3 2 2 3 3 2 1 6 2 1 2 1 2 3 4 3 1 1 2 1 2 1 5	58)	110	31.5.1938
		3 2 4 2 2 2 3 5 2 0 1 2 2 3 3 2 2 2 1 2 3 1 2 1 2	54)		
III.	29.5.1938	4 3 3 2 2 1 2 3 2 2 2 1 2 2 1 1 2 2 3 5 2 1 1 2 2	53)	109	31.5.1938
		3 2 3 4 2 6 2 1 2 2 2 1 2 2 2 1 2 2 2 2 2 1 4 2 2	56)		
IV.	3.6.1938	2 2 3 4 2 3 3 3 2 2 1 2 4 2 1 0 2 2 3 2 2 2 3 1 1	54)	109	5.6.1938
		2 1 1 2 3 3 2 6 2 2 1 4 1 3 2 3 2 3 3 2 2 1 1 1 2	55)		
V.	3.6.1938	4 3 1 2 4 3 2 2 3 3 3 2 1 1 2 2 2 5 1 2 2 2 1 1 2	56)	108	5.6.1938
		3 3 4 2 2 1 2 2 2 2 2 1 3 3 2 2 1 2 4 2 1 1 1 2 2	52)		
VI.	3.6.1938	3 1 2 3 3 1 2 3 3 3 3 2 2 2 3 4 2 2 3 2 2 2 1 1 3	58)	111	5.6.1938
		2 3 2 1 2 3 2 1 4 2 1 2 2 1 2 2 3 3 2 2 4 3 3 1 0	53)		

death was maximum for glucose, and was about 9 % less for fructose. With galactose and sorbose the percentages were more or less the same (near about 36 %) while with mannose the percentage was significantly more than those for galactose and sorbose. The parasite fed on glucose, fructose, galactose, mannose and sorbose in these oviposition studies survived and laid eggs for 8 to 12 days, 7 to 8 days, 2 to 3 days, 2 days, and 2 days respectively.

The number of eggs laid by the parasite with glucose feeding for the successive days (1st, 2nd, 3rd etc.) varied from 54 to 67; 53 to 59; 22 to 32; 24 to 28; 26 to 31; 15 to 30; 9 to 21; and 6 to 10. On the 9th, 10th, 11th and 12th days the parasites that survived laid 3 to 10, 2 to 6, and 1 to 2 eggs respectively. The averages and the corresponding percentages were 62.3, 56.2, 28.2, 26.2, 27.3, 25, 16.8, 7.7, 4.3, 2.3, 0.2 and 0.3; 20.6, 18.5, 9.3, 8.6, 9.0, 8.25, 5.44, 2.54, 1.42, 0.76, 0.1 and 0.1 respectively. In the case of fructose the eggs laid on successive days ranged from 54 to 60, 50 to 54, 23 to 36, 19 to 30, 21 to 34, and 17 to 24. On the 7th day the parasites that survived laid 6 to 15 eggs. On the 8th day they laid only 6 eggs. The averages and the corresponding percentages were 57.5, 51.8, 29.7, 26.2, 28.3, 21.3, 12.0, and 2.0; 19.0, 17.1, 9.8, 8.6, 9.4, 7.03, 3.96 and 0.66 respectively.

With galactose the minimum and the maximum number of eggs laid on successive days were 57, 66; 47, 56; and the solitary parasite that survived on the third day laid only 3 eggs. The averages for the 1st, 2nd and 3rd days were 60.3, 51.0 and 0.6. The corresponding percentages were 19.9, 16.8 and 0.2. With mannose the number of eggs laid on the 1st and 2nd days varied from 60 to 65 and 53 to 63; the averages were 62.0 and 58.3 and the corresponding percentages were 20.5 and 19.2. With sorbose the minimum and the maximum number of eggs laid on the 1st and 2nd days were 53, 58; 46, 56; the averages and the percentages were 55.7, 53.7; 18.4, and 17.4.

The results of feeding with monosaccharides show that 19 to 20.6 % of the eggs and 16.8 to 18.5 % of the eggs in the ovaries were laid on the first and the second days. With glucose the parasite continued to lay eggs upto the 12th day but laid only 8.25 to 9.3 % of the eggs on the 3rd, 4th, 5th and the 6th days and 5.4 % of the eggs on the 7th day. During the remaining periods the percentage of eggs laid was very low. In the case of fructose the parasite continued to live upto the 8th day and laid 7 to 10 % of the eggs on the 3rd, 4th, 5th and 6th days. On the 7th day it laid only 4 % of the eggs; on the 8th day the number of eggs laid was very small.

(d) The effect of disaccharides diet on oviposition.

The primary data are given in tables XV, XVI, XVII, and XVIII. The number of eggs laid from emergence till death with sucrose, maltose, lactose and cellobiose varied from 246 to 255; 192 to 240; 100 to 113; and 103 to 109 respectively. The averages were 250.7, 212.7, 106.7 and 103.7. The percentages were 82.7, 70.2, 35.2 and 34.9 respectively. The number of eggs laid by the parasite with sucrose feeding was the maximum. In the case of maltose it was 12.5 % less than that of sucrose. The percentage of eggs laid for lactose and cellobiose feeding was the least and the difference in the percentages was not significant. The parasites fed on sucrose, maltose, lactose and cellobiose and laying eggs lived for 9 to 11 days, 7 to 8 days, 2 to 3 days and 2 days respectively. The minimum and the maximum number of eggs laid by the parasite for sucrose feeding on the first, second, third etc., days were 58, 66; 51, 57; 29, 34; 23, 28; 25, 31; 17, 30; 10, 17; and 3, 10; the parasites that lived beyond the 8th day laid 2 to 8, 1 to 6, and 4 eggs for the 9th, 10th and 11th days. The averages and the corresponding percentages for the various days were 57.3, 47.0, 30.5, 26.3, 23.8, 17.8, 13.5, 6.2, 2.5, 1.2, and 0.7; 13.9, 15.5, 10.1, 8.7, 7.9, 5.9, 4.5, 2.1, 0.8, and 0.4 respectively. The number of eggs laid

Table xv

RESULT OF FEEDING ON OVIPOSITION. DISACCHARIDES. SUCROSE (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	10.6.1938	3 4 3 2 2 2 3 3 1 1 3 2 4 3 3 3 2 2 2 1 1 2 3 4 4	63		
		1 2 2 2 2 3 4 4 1 2 2 1 2 3 2 1 3 2 1 2 2 3 4 1 4	56		
		2 2 1 1 1 1 1 2 1 0 1 1 2 2 2 1 1 2 1 1 2 1 1 1 2	33		
		1 1 2 2 1 1 2 0 2 1 1 1 1 1 0 1 2 0 1 0 1 1 1 2 1	27	251	18.6.1938
		1 2 1 1 0 1 0 1 2 1 1 0 2 1 1 2 1 1 2 1 1 1 0 1 1	26		
		2 0 1 1 2 1 1 1 1 2 1 0 1 1 0 0 1 1 1 2 1 1 1 1 0	24		
		0 1 0 2 1 0 1 2 0 2 0 1 1 0 1 0 1 1 0 0 0 2 0 0 1	17		
		0 0 0 0 0 0 1 0 1 1 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0	5		
II.	10.6.1938	4 4 3 3 2 3 1 1 2 1 0 2 1 3 4 3 2 1 3 2 2 2 6 1 2	58		
		2 2 2 3 3 2 4 1 3 1 2 2 3 2 3 5 3 4 2 1 3 1 2 0 1	57		
		1 1 0 2 2 1 2 1 0 1 1 1 2 1 1 1 1 2 1 1 0 1 1 2 2	29		
		2 1 1 1 1 1 2 1 2 1 2 0 1 1 1 1 2 1 1 1 1 0 1 1 1	28		
		2 2 1 2 1 2 0 1 2 1 0 2 1 0 1 2 0 0 0 1 2 1 1 1 1	27	246	18.6.1938
		1 1 1 2 2 1 1 0 2 1 0 0 2 1 1 1 2 1 1 3 0 2 1 1 2	30		
		2 1 1 0 2 1 1 0 0 1 0 0 1 0 0 0 1 1 0 0 0 0 0 0 2	14		
		0 0 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3		

Table xv (Contd)

RESULT OF FEEDING ON OVIPOSITION. DISACCHARIDES. SUCROSE (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks: Parasite died on
III.	10.6.1938	2 1 3 3 4 2 2 3 3 3 3 3 2 4 4 2 3 1 3 2 4 2 1 4 2	66		
		2 2 2 2 1 3 3 1 2 2 2 6 4 4 2 4 2 1 1 1 2 1 2 2 2	56		
		1 1 2 1 1 1 2 2 1 1 1 2 2 1 1 1 1 1 1 1 2 1 1 0 1	30		
		1 1 1 2 1 2 0 1 1 1 1 2 1 1 2 1 1 1 1 1 1 1 1 0 1	27		
		1 1 1 2 2 1 2 2 1 1 1 1 0 1 2 1 2 1 1 2 1 1 1 1 1	31	253	18.6.1938
		1 1 1 2 1 1 1 1 2 1 1 1 1 1 1 2 1 0 1 1 1 1 2 1 1	28		
		0 0 2 1 1 2 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	10		
		0 0 0 0 0 1 0 0 0 0 1 0 0 1 1 1 0 0 0 0 0 0 0 0 0	5		
IV.	8.10.1938	2 3 2 3 3 5 2 4 1 3 1 3 1 4 2 4 4 3 1 3 2 2 2 1 1	62		
		1 3 1 2 2 2 1 4 4 3 2 2 1 2 2 4 3 2 2 1 3 1 2 2 5	57		
		1 2 1 1 2 1 1 2 1 2 2 2 1 1 1 1 1 2 1 1 1 2 1 0 1	32		
		0 1 1 2 1 1 1 1 1 2 0 2 3 0 0 1 2 1 1 1 2 2 0 1 1	28	247	17.10.1938
		1 1 1 2 1 1 2 2 1 0 1 1 1 1 1 1 0 1 1 1 0 1 1 1 1	25		
		1 1 0 1 1 2 0 0 0 1 0 1 0 1 0 0 0 1 2 1 0 1 1 1 1	17		
		1 0 0 1 2 0 0 1 0 0 0 2 2 1 0 1 0 0 0 0 0 0 0 0 0	11		
		0 0 0 2 1 0 2 0 0 2 2 0 0 0 1 0 0 0 0 0 0 0 0 0 0	10		
		0 0 0 0 0 1 0 0 0 2 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0	5		

RESULT OF FEEDING ON OVIPOSITION. DISACCHARIDES. SUCROSE (PRESENCE OF HOST) Table xi (Contd)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
V.	8.10.1938	3 2 2 3 1 3 3 3 2 2 4 4 2 3 2 3 2 3 1 3 1 2 1 4 2	61		
		3 2 2 4 4 2 2 2 2 2 3 1 4 1 1 2 2 3 0 2 2 1 3 2 2	54		
		1 2 1 2 1 2 1 1 1 2 1 1 2 1 2 1 1 2 1 1 1 1 0 1 1	31		
		1 0 1 1 1 2 0 0 2 1 1 0 0 1 1 1 1 2 2 1 1 1 1 1 0	23		
		2 1 0 0 2 1 1 1 0 1 1 1 0 1 1 1 2 2 0 1 1 2 1 2 2	27	255	19.10.1938
		0 2 0 0 0 1 2 0 1 1 1 1 1 1 2 0 1 1 1 0 1 1 1 1 2	22		
		0 1 0 0 2 0 0 0 1 1 0 0 0 0 0 1 0 2 0 1 0 2 1 0 0	12		
		0 0 0 2 0 0 0 0 1 1 0 0 0 1 0 0 0 0 0 1 0 0 1 0 0	7		
		0 0 0 1 0 1 0 0 1 1 0 0 0 0 1 0 0 0 2 0 0 0 0 1 0	8		
		0 0 0 1 2 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6		
		0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 1 0 0 0 0 1 0 0 0	4		
VI.	8.10.1938	2 3 2 4 4 1 4 2 4 3 3 1 2 3 3 2 3 2 1 1 2 3 1 3 1	60		
		4 1 4 3 1 1 2 2 1 1 3 2 4 2 2 3 3 1 2 2 2 1 1 2 1	51		
		2 2 2 1 1 1 0 2 1 1 0 1 1 1 2 3 1 2 2 2 1 0 2 1 2	34		
		2 1 1 1 1 2 0 1 2 0 1 2 2 0 1 1 0 0 1 1 2 1 0 1 2	26		
		2 1 1 2 1 2 2 2 1 1 1 2 3 1 1 0 1 0 0 1 1 0 0 2 1	29	252	19.10.1938
		1 2 2 1 1 1 0 1 2 2 1 1 1 0 1 1 0 2 2 1 1 1 0 1 0	26		
		0 0 0 2 0 1 0 1 1 1 1 0 2 0 1 1 0 0 1 1 0 2 0 0 1	16		
		0 0 0 1 0 0 0 1 1 0 0 0 1 0 1 1 0 0 0 1 0 0 0 0 0	7		
		0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0	2		
		0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1		

Table xvi

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) MALTOSE (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death.	Remarks: Parasite died on
I	25.10.1938	2 2 4 1 3 2 2 2 2 3 2 1 4 4 2 4 1 3 2 1 2 1 2 3 2	57		
		2 2 1 3 1 2 2 2 2 4 2 2 1 1 5 2 1 2 3 1 1 1 0 2 1	46		
		1 2 2 1 1 1 0 2 1 1 1 1 2 0 1 1 1 1 2 1 1 2 1 0 1	28		
		2 1 2 1 1 1 1 0 1 1 1 2 1 1 1 1 0 1 1 1 1 2 1 1 0	26	205	1.11.1938
		2 1 1 1 1 1 0 1 0 1 2 1 1 0 2 1 0 1 1 2 1 1 1 2 0	25		
		1 1 2 0 0 1 1 2 0 1 1 1 2 0 0 0 0 2 0 2 1 1 0 0 0	19		
		0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0	4		
II	25.10.1938	2 2 4 1 3 2 2 3 2 2 1 4 3 2 3 2 1 3 1 2 2 2 1 4 1	55		
		1 2 4 1 2 2 0 1 2 2 1 2 3 1 2 1 1 2 1 2 2 1 1 5 1	43		
		2 1 1 1 1 1 2 3 1 2 2 1 2 1 1 1 1 1 1 1 2 1 1 0 1 0	31		
		1 2 1 2 1 1 1 1 2 1 1 1 2 1 1 0 1 2 1 0 1 0 0 0 0	24	192	1.11.1938
		0 1 1 2 1 1 1 2 1 1 0 0 1 0 2 0 1 0 0 2 0 2 0 1 0	20		
		0 1 1 1 0 1 0 1 1 1 0 0 2 0 0 0 1 1 1 1 1 0 0 1 1	16		
		0 0 0 1 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	3		

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) MALTOSE (PRESENCE OF HOST) Table XVI (Contd)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks Parasite died on
III.	25.10.1938	3 4 5 3 2 1 1 4 1 2 3 1 2 2 1 3 2 1 2 2 1 3 1 2 3	55		
		2 2 1 3 6 1 2 1 3 1 4 1 1 2 1 1 3 3 1 2 1 1 2 2 2	49		
		1 2 2 1 1 2 1 1 1 2 2 1 1 1 0 0 2 2 1 2 1 1 1 0 1	29		
		1 2 1 1 1 1 1 1 2 1 1 1 1 1 0 1 1 2 1 2 1 1 1 0 2	28		
		2 0 1 1 0 1 0 1 1 1 1 0 2 0 1 1 1 0 1 1 1 1 1 0 3 2	23	214	2.11.1938
		0 2 1 1 0 0 1 2 1 0 1 0 0 2 1 1 0 1 1 0 0 1 0 0 1	14		
		0 1 1 0 1 1 0 1 0 1 1 0 0 1 0 1 0 0 0 0 0 0 1 0 0	10		
		0 0 0 1 0 0 1 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 1 1	6		
IV.	12.11.1938	3 2 3 4 5 2 3 2 1 1 6 2 3 4 1 3 3 1 2 3 2 1 1 1 2	61		
		0 6 2 1 3 1 2 4 3 1 2 2 2 1 2 3 4 3 1 2 1 1 0 3 1	51		
		1 2 2 2 1 1 2 4 0 1 3 1 1 2 2 1 0 1 1 1 2 0 1 1 1	34		
		1 1 1 2 1 1 1 1 1 2 1 1 0 1 1 1 1 0 1 1 1 1 2 2 2	28	240	19.11.1938
		1 2 1 0 1 1 1 1 2 2 1 0 2 2 2 0 1 1 0 1 0 1 1 0 1	25		
		1 1 2 0 2 1 2 0 0 1 1 1 2 1 1 1 0 1 2 1 1 0 1 0 1	24		
		0 1 1 2 0 1 1 1 1 0 0 0 1 2 0 0 1 2 0 0 1 0 0 0 2	27		

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) MALTOSE (PRESENCE OF HOST) Table XVI (Contd)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
V.	12.11.1938	2 3 2 1 2 3 3 0 3 3 2 2 2 1 4 5 1 2 3 1 4 3 2 2 3	59		
		2 2 3 1 2 2 1 1 1 3 2 2 4 3 3 1 3 2 2 1 2 0 2 0 0	45		
		1 2 2 1 2 2 3 2 0 1 1 1 1 2 2 1 1 1 1 1 0 1 1 2 1	33		
		1 1 1 1 2 0 2 1 0 0 2 1 2 2 2 0 0 1 1 1 1 1 2 0 1	26	220	20.11.1938
		1 1 2 1 0 1 1 1 1 2 0 1 0 1 1 2 1 2 2 1 1 2 0 1 2	28		
		0 1 1 0 1 0 0 0 1 2 2 0 0 1 1 1 1 1 1 0 0 0 2 0 2	18		
		0 1 1 0 0 0 1 1 0 1 1 0 0 0 0 0 0 0 0 0 2 0 0 0 0	8		
		0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0	3		
VI.	12.11.1938	3 4 **3** 2 2 1 3 5 3 1 2 0 4 1 3 3 1 2 4 0 3 3 1 2 1	57		
		0 4 2 2 1 1 3 1 2 2 0 2 1 1 1 2 3 4 5 2 **3 3 2** 1 1	48		
		1 1 0 1 2 2 0 1 2 1 1 2 0 1 1 2 0 2 2 1 1 1 1 1 1	28		
		2 1 0 2 1 1 1 1 1 1 1 1 1 1 1 2 0 0 1 2 2 1 1 1 0	26	205	20.11.1938
		0 2 1 1 1 2 0 1 1 0 3 0 1 1 0 0 0 3 0 1 2 0 1 1 0	22		
		0 1 2 1 2 1 0 1 1 0 1 1 0 1 1 0 1 1 1 1 0 1 1 0 1	20		
		0 0 0 0 1 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	4		

Table xiii

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) LACTOSE (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	28.11.1938	4 3 4 3 2 2 2 1 0 1 2 2 3 3 2 1 4 1 2 3 3 3 2 1 0	54	100	30.11.1938
		2 1 1 3 2 2 3 2 2 2 1 2 2 4 2 1 3 2 2 3 1 2 1 0 0	46		
II.	28.11.1938	4 4 1 3 3 5 2 2 1 1 2 1 0 2 1 2 5 2 2 4 4 1 2 1 2	57	102	30.11.1938
		1 3 3 2 4 7 3 1 0 0 2 1 3 2 1 0 0 2 2 2 1 1 1 2 1	45		
III.	28.11.1938	3 4 5 3 4 5 2 2 1 3 3 2 1 2 1 1 1 2 2 1 1 1 4 2 2	58	113	1.12.1938
		2 2 3 1 2 0 2 2 1 2 3 3 6 2 1 1 1 2 2 3 4 1 1 2 0	49		
		0 2 2 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0	6		
IV.	2.12.1938	3 3 4 5 3 2 2 1 2 3 1 4 2 2 3 2 1 2 3 3 2 2 1 1 1	58	112	4.12.1938
		3 2 2 1 2 3 3 1 2 2 2 3 1 2 2 1 1 0 3 4 6 0 4 2 2	54		
V.	2.12.1938	1 2 3 3 2 0 2 1 0 2 5 2 5 2 2 4 4 3 4 3 1 2 2 2 2	59	108	4.12.1938
		2 3 3 2 3 2 2 3 1 3 2 0 2 2 7 1 3 2 1 0 1 2 0 1 1	49		
VI.	2.12.1938	4 3 3 2 3 2 1 1 2 1 3 1 1 1 5 0 2 2 4 4 2 1 2 2 1	53	105	4.12.1938
		2 2 3 2 4 1 3 3 2 2 3 2 6 1 1 2 0 1 2 0 2 1 2 2 3	52		

Table xviii

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) CELLOBIOSE (PRESENCE OF HOST.)

Serial No. of experiment.	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	8.12.1938	3 3 2 2 3 2 3 6 3 4 2 2 1 3 2 1 2 1 1 3 2 0 1 2 1	55	103	10.12.1938
		1 1 2 1 1 1 2 3 7 1 2 1 3 3 1 2 3 0 2 1 1 2 4 1 2	48		
II.	8.12.1938	6 2 5 2 3 3 0 2 2 1 3 3 2 4 2 1 3 1 1 2 2 1 1 2 1	55	109	10.12.1938
		1 1 3 2 2 2 3 1 3 3 4 1 2 2 0 0 2 3 2 4 3 3 1 3 3	54		
III.	8.12.1938	2 3 3 2 4 0 2 2 2 3 2 3 6 4 2 3 1 1 2 0 0 2 2 3 3	57	108	10.12.1938
		3 2 2 3 0 4 2 2 0 2 3 2 4 3 2 1 1 1 2 0 1 2 5 2 2	51		
IV.	12.12.1938	5 3 2 3 2 1 3 2 3 3 2 1 6 0 2 3 2 1 2 1 2 2 1 2 2	56	106	14.12.1938
		0 5 3 0 2 2 2 2 1 0 3 1 3 3 2 4 3 3 2 1 2 2 1 0 3	50		
V.	12.12.1938	3 4 3 1 3 5 2 1 2 2 3 4 3 2 2 1 2 1 4 3 2 1 2 1 1	58	103	14.12.1938
		1 1 3 2 1 3 3 0 3 2 0 5 0 3 2 1 2 1 2 1 4 1 2 1 1	45		
VI.	12.12.1938	2 1 1 2 3 3 4 6 2 2 3 0 1 2 2 4 1 3 2 3 1 2 2 1 2	55	105	14.12.1938
		2 1 2 3 1 1 2 3 2 3 4 3 2 2 4 3 0 0 1 2 2 2 1 2 2	50		

with maltose feeding for the successive days varied from 58 to 61, 43 to 51, 28 to 34, 24 to 28, 20 to 28, 10 to 24, and 3 to 17. The two parasites that were alive on the 8th day laid 3 and 6 eggs. The averages for the various days were 57.3, 47.0, 30.5, 26.3, 23.8, 17.8, 7.7, and 1.5 eggs. The corresponding percentages were 18.9, 15.5, 10.1, 8.7, 7.9, 5.9, 2.5, and 0.5.

For lactose feeding the minimum and the maximum values for the 1st and 2nd days were 53, 59; 45, 54. The solitary parasite that was alive on the 3rd day laid 6 eggs. The averages and the percentages of eggs laid on these days were 56.5, 49.2; and 1.0; 18.6, 16.2 and 0.3 respectively.

In the case of cellobiose the minimum and the maximum for the 1st and 2nd days were 55, 58; 46, 54; the averages were 56.0 and 49.9. The corresponding percentages were 18.5 and 16.4.

The results of feeding on disaccharides show that 18.5 to 18.9 % and 15.5 to 16.4 % of the eggs in the ovaries were laid on the 1st and 2nd days with maltose, lactose and cellobiose feeding. In the case of sucrose feeding the percentage of eggs laid on the 1st and 2nd days were slightly more than those of the other sugars. (About 1.5 and 2 %). For the 3rd and 4th days the percentages of eggs laid for maltose and sucrose feeding were the same for the respective days. For the remaining period the percentage of eggs laid

by sucrose feeding was slightly more than that for maltose.

(e) The effect of trisaccharide diet on oviposition.

The primary data for the six replications with raffinose feeding are given in Table XIX. The number of eggs laid from emergence till death varied from 101 to 121 with an average of 111.0. The percentage of eggs laid was 36.6. The parasites continued to lay eggs for two to three days and laid 56 to 61 eggs on the 1st day, 44 to 57 on the 2nd day, and the solitary parasite that survived on the 3rd day laid 11 eggs. The averages for the 1st, 2nd and 3rd days were 57.5, 51.3 and 1.8. The corresponding percentages were 19.1, 16.9, and 0.6.

(f) The effect of pentoses diet on oviposition.

The primary data are given in Tables XX and XXI. The number of eggs laid from emergence till death in the case of xylose and arabinose varied from 114 to 130; and 106 to 110 respectively. The averages were 123.0 and 108.0. The corresponding percentages were 40.6 and 35.6 respectively. In the case of xylose the parasite continued to lay eggs till the 3rd day, while with arabinose it laid eggs for 2 days only. The number of eggs laid with xylose feeding on the 1st and 2nd days varied from 61 to 67 and 39 to 59. One parasite that lived on the 3rd day laid 27 eggs. The averages and the percentages for the various days were

RESULT OF FEEDING ON OVIPOSITION TRISACCHARIDE (RAFFINOSE) (PRESENCE OF HOST.)

Table XIX

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks Parasite died on
I.	16.12.1938.	3 4 3 5 2 1 2 1 1 1 2 3 4 3 3 2 2 3 2 2 3 2 2 0 2	58	115	18.12.1938
		1 2 2 0 4 3 2 0 5 4 3 3 0 3 4 3 3 3 1 1 2 3 2 1 2	57		
II.	16.12.1938.	4 3 2 2 1 2 2 4 2 1 1 2 3 2 2 2 3 1 4 1 2 2 3 4 2	57	111	18.12.1938
		2 4 4 2 1 3 2 0 2 2 1 2 2 0 4 2 2 1 3 2 3 3 0 6 1	54		
III.	16.12.1938.	4 5 3 3 2 2 1 3 2 1 4 4 2 2 2 4 3 1 1 0 5 2 1 1 3	61	121	18.12.1938
		3 3 1 2 2 4 0 3 1 0 2 4 0 3 1 2 3 1 3 3 2 2 1 1 2	49		
		0 0 0 1 2 0 2 0 0 1 1 0 1 0 1 0 0 2 0 0 0 0 0 0 0	11		
IV.	20.12.1938.	3 5 3 2 2 1 3 2 4 2 1 4 3 3 0 1 3 2 4 3 3 2 0 1 1	58	108	22.12.1938
		2 2 3 3 2 2 4 1 3 1 6 2 2 0 2 2 0 4 4 2 0 2 0 0 1	50		
V.	20.12.1938.	3 2 3 4 1 2 2 0 4 2 2 1 2 3 1 2 1 0 3 2 2 2 6 4 2	56	110	22.12.1938
		4 2 3 2 3 1 2 2 3 2 6 0 0 1 2 2 1 1 1 0 4 2 3 3 2	54		
VI.	20.12.1938.	2 3 5 6 2 2 3 3 3 1 1 0 2 1 4 1 2 3 3 1 2 1 2 2 2	57	101	22.12.1938
		1 2 3 2 1 1 2 1 7 1 1 0 2 1 2 1 1 2 3 3 2 1 0 2 2	44		

Table xx

RESULT OF FEEDING ON OVIPOSITION (PENTOSES) XYLOSE (PRESENCE OF HOST).

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	2.1.1939	2 3 3 8 3 4 2 3 1 2 2 2 3 1 1 3 0 4 3 2 2 1 2 3 3	63)	121	4.1.1939
		4 3 2 2 1 3 2 1 4 0 2 6 3 2 1 2 3 2 2 3 2 2 3 3 0	58)		
II.	2.1.1939	4 5 4 3 3 2 1 1 2 3 3 4 3 2 2 3 1 4 3 2 2 2 3 3 1	66)	125	4.1.1939
		3 4 3 2 2 3 1 2 4 3 2 2 1 1 2 2 3 2 3 2 2 1 2 4 3	59)		
III.	2.1.1939	4 4 3 3 5 6 3 2 1 4 3 2 2 3 1 2 3 4 1 1 2 0 3 1 2	65)	124	8.1.1939
		3 2 3 5 2 3 2 2 2 1 4 3 4 1 2 3 1 7 2 2 0 2 1 1 1	59)		
IV.	6.1.1939	5 6 3 2 2 2 3 1 2 2 4 3 2 3 3 4 2 4 2 3 1 0 3 2 3	67)	124	8.1.1939
		4 4 3 2 1 3 5 3 2 1 1 3 4 3 4 2 2 2 1 1 0 1 1 2 2	57)		
V.	6.1.1939	4 5 2 3 6 3 4 0 3 2 2 1 0 3 3 2 1 2 3 4 2 2 1 1 2	61)	114	8.1.1939
		2 3 1 2 2 2 1 3 2 2 4 1 3 1 2 3 3 1 2 6 1 1 2 1 2	53)		
VI.	6.1.1939	3 3 2 3 1 3 2 4 0 3 4 2 4 6 2 3 1 1 2 3 1 3 4 3 1	64)		
		2 3 1 2 2 1 2 1 3 3 2 1 1 2 1 2 1 1 2 0 1 1 1 2 1	39)	130	9.1.1939
		1 3 0 2 1 1 2 2 1 0 0 1 2 2 1 1 0 0 1 2 1 1 0 1 1	27)		

Table xxi.

RESULT OF FEEDING ON OVIPOSITION (PENTOSES) ARABINOSE (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	10.1.1939	4 2 2 2 1 2 3 1 1 3 1 4 2 1 1 2 3 4 4 1 2 2 6 2 2	58	107	12.1.1939
		2 1 2 4 0 3 1 4 2 3 2 1 1 0 1 2 2 1 1 2 4 2 4 3 1	49		
II.	10.1.1939	2 4 2 3 2 5 0 6 2 1 3 1 2 3 1 2 2 2 2 3 4 4 1 2 0	59	108	12.1.1939
		2 4 2 2 1 1 1 0 1 2 2 2 2 4 2 3 4 2 4 1 1 2 1 2 1	49		
III.	10.1.1939	2 1 1 4 3 2 1 7 1 1 4 2 2 2 3 4 2 2 2 3 2 2 1 1 3	58	109	12.1.1939
		4 1 3 2 2 7 1 1 1 0 4 2 2 1 1 3 1 2 1 3 1 2 3 0 3	51		
IV.	15.1.1939	3 3 4 3 2 2 1 9 2 3 1 2 0 5 1 2 3 2 2 2 1 1 2 2 1	59	110	17.1.1939
		2 3 3 2 1 4 3 4 5 1 0 0 2 1 1 7 0 2 1 1 1 1 3 1 2	51		
V.	15.1.1939	3 3 2 4 4 2 2 2 1 2 5 2 2 4 1 0 6 3 1 2 2 1 3 1 1	59	106	17.1.1939
		1 2 2 3 3 1 4 3 1 5 2 2 0 2 1 3 4 1 2 2 0 1 2 0 0	47		
VI.	15.1.1939	4 3 2 1 2 6 4 5 2 2 2 3 1 3 2 2 2 3 4 0 1 2 0 1 1	58	108	17.1.1939
		2 4 2 2 2 1 2 1 5 2 1 0 4 1 2 3 1 1 2 1 3 3 2 2 1	50		

64.3, 54.2 and 4.5; and 21.2, 17.9 and 1.5 respectively. With arabinose feeding the parasites lay 53 to 59 eggs on the 1st day and 47 to 51 eggs on the 2nd day. The averages and the percentages were 55.5 and 49.5; 19.3 and 16.3 respectively. The result of feeding with pentoses show that the parasite was able to lay a larger number of eggs both total and on successive days with xylose feeding than with arabinose.

(g) The effect of glucosides diet on oviposition.

The primary data for α methyl-d-glucoside feeding are given in Table XXII. The total number of eggs laid from emergence till death varied from 130 to 127. The average was 120.7, the percentage being 39.8.

The parasites continued to lay eggs only for two days. The number of eggs laid on the 1st and 2nd days varied from 60 to 67 and 53 to 60. The averages were 63.5 and 57.2. The corresponding percentages were 21.0 and 18.9.

(h) The effect of polysaccharide diet on oviposition.

The primary data for starch and dextrin are given in Tables XXIII and XXIV. The total number of eggs laid from emergence till death for starch and dextrin varied from 104 to 108 and 104 to 116 respectively. The averages were 106.7 and 110.0; the percentages being 35.2 and 36.3. The

Table XXII

RESULT OF FEEDING ON OVIPOSITION (GLUCOSIDE) d-METHYL d-GLUCOSIDE (PRESENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	20.1.1939	3 1 3 2 3 1 1 2 5 4 4 2 2 2 2 4 2 1 2 2 4 1 1 5 3	62)	120	22.1.1939
		1 3 3 5 1 0 3 1 1 2 4 3 6 4 3 2 1 1 2 3 2 2 2 1 2	58)		
II.	20.1.1939	4 2 1 2 2 2 2 3 5 2 4 7 1 4 2 4 2 1 2 3 1 2 0 1 4	63)	122	22.1.1939
		4 3 4 2 2 2 3 3 2 4 2 2 4 6 1 1 2 1 2 2 1 2 1 1 2	59)		
III.	20.1.1939	2 4 3 2 4 2 2 1 8 5 6 4 3 2 1 3 2 3 1 1 2 1 3 1 1	67)	127	22.1.1939
		3 2 3 2 1 3 2 1 4 4 2 2 2 2 1 6 3 2 1 4 5 1 1 2 1	60)		
IV.	25.1.1939	5 4 3 3 2 2 1 6 4 5 3 0 4 3 2 2 4 1 4 1 1 2 1 0 1	64)	123	27.1.1939
		1 3 3 2 2 7 1 3 2 1 2 5 1 3 2 2 0 2 0 2 2 4 2 1 6	59)		
V.	25.1.1939	1 3 3 2 5 4 3 2 1 1 3 2 3 6 2 2 4 4 3 3 1 2 3 1 1	65)	119	27.1.1939
		1 2 2 7 1 2 2 3 3 2 1 2 3 5 2 1 2 3 1 1 2 2 3 0 1	54)		
VI.	25.1.1939	3 1 3 1 1 2 1 2 3 3 4 6 5 4 4 3 1 1 2 3 2 2 2 1 0	60)	113	27.1.1939
		1 3 2 1 2 2 4 1 4 2 2 1 2 6 1 3 3 1 0 0 4 3 2 1 2	53)		

Table XXIII

RESULT OF FEEDING ON OVIPOSITION (POLYSACCHARIDES) STARCH (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	1.2.1939	4 1 2 3 1 2 3 1 0 3 2 2 3 2 3 6 3 4 2 2 1 2 2 1 1	56	106	3.2.1939
		1 3 2 2 3 1 2 1 0 1 2 2 1 2 2 5 1 2 2 0 2 7 2 2 2	50		
II.	1.2.1939	3 1 5 3 2 1 0 4 4 3 2 3 3 1 2 3 4 2 4 3 2 2 1 1 0	59	108	3.2.1939
		1 2 8 2 1 1 2 4 0 1 2 2 1 2 2 1 2 5 1 2 3 3 0 1 0	49		
III.	1.2.1939	2 3 4 3 3 5 3 0 4 2 2 2 1 2 3 2 1 1 2 2 1 2 3 2 1	56	106	3.2.1939
		1 2 2 3 4 2 2 1 2 2 3 3 2 2 4 1 2 0 1 1 5 1 0 3 1	50		
IV.	6.2.1939	4 3 3 0 1 5 2 3 1 2 0 3 2 3 4 3 3 4 3 2 1 1 0 1 1	55	104	7.2.1939
		1 3 2 2 1 3 6 1 0 3 1 4 3 0 1 2 2 3 1 2 1 4 1 1 1	49		
V.	6.2.1939	3 5 0 2 3 4 1 3 1 3 3 2 1 3 2 1 1 2 3 3 1 2 3 3 2	57	108	7.2.1939
		2 2 4 0 3 0 1 6 3 2 3 4 1 1 2 2 1 2 3 1 1 2 3 1 1	51		
VI.	6.2.1939	1 3 3 4 2 1 1 3 3 1 2 4 2 2 2 3 3 2 2 1 3 2 5 1 1 1	58	106	7.2.1939
		1 2 3 1 3 2 3 1 4 1 2 2 1 3 2 1 2 2 2 1 3 1 1 1 2 1	48		

Table XXIV

RESULT OF FEEDING ON OVIPOSITION (POLYSACCHARIDES) DEXTRIN (PRESENCE OF HOST)

Serial No. of experiment.	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	8.2.1939	0 6 2 2 3 5 4 1 2 2 2 3 3 2 2 1 3 5 4 2 1 2 1 1 1	60	116	10.2.1939
		2 1 3 1 1 6 4 3 2 2 1 1 2 2 4 2 3 2 2 2 1 2 3 2 2	56		
II.	8.2.1939	3 4 2 2 2 3 3 3 1 2 3 2 2 3 1 3 4 3 1 2 2 3 4 1 2	61	111	10.2.1939
		3 1 2 2 4 1 2 3 1 2 2 1 2 2 2 4 3 2 2 1 1 2 2 2 1	50		
III.	8.2.1939	2 1 2 3 3 1 2 2 3 1 1 2 3 3 4 5 6 2 2 1 3 3 4 1 2	62	113	10.2.1939
		0 3 1 2 2 3 4 1 1 1 2 4 0 2 2 3 1 2 1 2 3 5 1 2 3	51		
IV.	12.2.1939	4 3 5 2 1 2 4 3 3 0 3 2 2 1 2 2 2 3 1 1 3 3 1 3 1	57	109	14.2.1939
		3 3 3 4 2 2 1 3 2 3 3 2 1 3 6 1 2 0 2 2 1 0 1 0 2	52		
V.	12.2.1939	3 2 2 3 4 3 1 4 3 1 3 2 3 4 2 3 2 2 2 3 2 2 2 1 0	59	107	14.2.1939
		2 2 1 2 2 3 1 2 3 1 2 2 2 3 1 1 2 2 3 2 3 3 2 0 1	48		
VI.	12.2.1939	3 4 2 1 1 3 3 2 1 3 0 6 2 3 2 3 4 3 2 1 1 2 1 2 3	58	104	14.2.1939
		3 3 2 4 1 1 2 2 3 1 1 0 1 1 2 2 1 1 2 2 2 1 1 4 3	46		

differences between the averages for starch and dextrin were not significant. In both the feeds the parasites laid eggs only for two days. The number of eggs laid with starch for the 1st and 2nd days varied between 55 and 59; and 49 and 51; for dextrin the figures were 57 to 62 and 46 to 56. The corresponding averages for the 1st and 2nd days for starch were 56.8, 49.8; and for dextrin these figures were 59.5 and 50.5. The percentages for starch for the 1st and 2nd days were 18.8 and 16.4; those for dextrin being 19.6 and 16.7.

It wil be seen that the difference between the averages for starch and dextrin ~~were~~ was not significant either for the first or the second day. For both the feeds the number of eggs laid on the 1st day was significantly more than that laid on the 2nd day.

(i) The effect of polyhydric alcohol diet on oviposition.

The primary data are given in Tables XXV and XXVI. By feeding with mannitol and sorbitol the parasite laid 107 to 118 and 103 to 112 from emergence till death. The averages were 111.0 and 108.5, the percentages being 36.6 and 35.8 respectively. The difference between the averages for sorbitol and mannitol was not significant. The parasite continued to lay eggs for only two days. The number of

Table xxv

RESULT OF FEEDING ON OVIPOSITION (POLYHYDRIC ALCOHOLS) MANNITOL (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence	Total No. of eggs	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	16.2.1939	4 3 2 3 2 3 2 3 4 2 3 1 3 2 2 1 1 2 2 1 2 2 1 7 2	60	118	22.2.1939
		3 2 2 3 2 2 4 4 5 3 2 2 2 3 3 1 4 2 2 1 1 2 1 1 1	58		
II.	16.2.1939	3 4 4 3 2 5 0 1 2 2 2 3 2 1 2 2 0 2 2 2 4 3 3 1 3	58	110	22.2.1939
		2 1 3 3 1 2 4 2 2 3 1 2 1 1 2 2 3 4 1 3 2 1 2 2 2	52		
III.	16.2.1939	3 1 1 2 3 2 2 1 2 3 2 3 3 4 5 2 1 2 3 3 0 1 2 3 3	57	113	22.2.1939
		2 1 2 3 1 3 1 2 4 2 5 0 3 2 7 1 2 3 1 3 2 2 0 2 2	56		
IV.	20.2.1939	2 1 4 3 3 2 1 1 2 1 2 1 1 1 4 1 2 5 1 3 3 3 5 2 1	55	107	22.2.1939
		1 2 3 1 4 2 1 1 5 1 2 1 2 4 1 2 2 3 1 2 4 1 2 0 4	52		
V.	20.2.1939	2 1 3 3 2 4 4 5 3 2 3 3 2 2 1 2 1 4 2 1 2 4 1 2 1	60	111	22.2.1939
		2 1 2 2 3 1 2 7 0 3 1 3 4 1 2 1 4 3 2 1 1 0 1 3 1	51		
VI.	20.2.1939	1 3 5 4 2 3 1 2 3 3 3 1 0 2 1 2 2 4 4 3 2 2 2 3 0	58	107	22.2.1939
		1 2 2 3 2 1 4 0 5 2 1 1 3 1 2 1 4 1 2 2 1 2 2 2 2	49		

Table xxvi

RESULT OF FEEDING ON OVIPOSITION (POLYHYDRIC ALCOHOLS) SORBITOL (PRESENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	24.2.1939	4 2 2 1 1 3 4 3 6 2 2 5 2 1 1 1 3 1 7 1 2 0 1 2 1	58	109	26.2.1939
		2 1 2 5 1 3 3 1 2 4 3 1 2 2 1 1 2 1 3 4 2 1 1 2 1	51		
II.	24.2.1939	1 3 2 1 2 3 4 2 3 6 2 1 2 3 3 1 2 3 4 3 3 2 2 1 0	59	110	26.2.1939
		2 3 1 1 2 3 5 2 4 1 1 0 2 1 1 3 3 2 2 4 1 2 1 2 2	51		
III.	24.2.1939	3 1 4 5 6 2 1 2 1 5 2 2 1 1 2 4 1 2 2 2 5 1 2 2 1	60	112	26.2.1939
		1 2 1 2 3 1 2 2 1 2 1 2 2 2 1 3 4 3 1 2 4 1 3 3 3	52		
IV.	28.2.1939	2 1 2 3 1 2 2 1 4 7 1 2 3 2 1 3 4 1 2 2 1 2 2 3 3	57	103	2.3.1939
		2 1 2 3 1 2 2 1 3 1 2 1 7 1 2 1 1 1 1 1 0 2 1 1 6	46		
V.	28.2.1939	1 2 1 2 2 2 1 6 4 3 2 3 3 1 3 2 2 1 2 3 4 3 1 2 3	59	109	2.2.1939
		3 1 1 6 2 1 2 2 4 1 2 1 0 1 5 2 1 1 1 2 3 3 1 2 2	50		
VI.	28.2.1939	3 1 3 4 0 7 5 4 4 3 2 1 1 1 2 3 1 2 2 2 2 1 2 2 2	60	108	2.2.1939
		1 2 2 3 1 1 2 2 4 3 3 2 2 2 1 1 1 2 2 3 1 2 2 1 2	48		

eggs laid on the 1st and 2nd days ranged from 55 to 60 and 49 to 58 eggs respectively for mannitol while for sorbitol these figures were 57 to 60 and 46 to 52. The averages for mannitol for the 1st and 2nd days were 58.0 and 53.0 while for sorbitol they were 58.8 and 49.7. The percentages were 19.1 and 17.6 for the 1st and 2nd days for mannitol while for sorbitol they were 19.4 and 16.4.

These results show that the number of eggs laid on each of the days was more or less the same for mannitol and sorbitol feeding. It should, however, be noted that the number of eggs laid on the 1st day is more than that laid on the 2nd day in both mannitol and sorbitol.

(j) Summary of results obtained from (a) to (i).

The minimum, the maximum, the average and the percentage number of eggs laid by Hemeritis senescens from emergence till death and for the various days, i.e., 1st, 2nd, 3rd, 4th, 5th, 6th and 7th days are given in Tables XXVII and XXVIII and represented in figures 11, 12, 13, 14, 15 and 16. The number of eggs laid during the remaining days was very low and have not been represented graphically. They have, however, been discussed in the text.

The total number of eggs laid from emergence till death with no food and water, with water given for drinking, with galactose, sorbose, lactose, cellobiose, raffinose,

Table XXVII

Number of eggs laid by Nemeritis Canescens from emergence till death for different feeds and the percentage of the mean to the average number of eggs in the ovaries.

Food Given	Presence of host from emergence till death of parasite					Absence of host from emergence till death				
	Min.	Max.	Mean	%	Remarks regarding death of parasite	Min.	Max.	Mean	%	Remarks regarding death of parasite
1. No food and no water	96	109	102.7	33.9	All died on 3rd day	84	103	98.2	32.4	All died on 3rd day
2. Water given for drinking	105	111	108.0	35.6	-do-	104	109	106.8	35.2	-do-
MONOSACCHARIDES										
3. Glucose	241	268	256.5	84.6	1 on 9th day, 1 on 10th day) 3 on 11th day, 1 on 13th day)	137	159	147.3	48.6	1 on 11th day, 3 on 21st day) 1 on 31st day, 1 on 35th day)
4. Fructose	219	240	228.8	75.5	4 on 8th day, 2 on 9th day	147	159	154.2	50.9	1 on 8th day, 2 on 13th day 2 on 15th day, 1 on 16th day
5. Galactose	104	120	111.8	36.9	5 on 3rd day, 1 on 4th day	109	116	112.7	37.2	3 on 3rd day, 3 on 4th day
6. Mannose	113	125	120.3	39.7	All died on 3rd day	107	124	115.5	38.1	4 on 3rd day, 2 on 4th day
7. Sorbose	101	111	108	35.6	-do-	102	109	105.7	34.9	5 on 3rd day, 1 on 4th day
DISACCHARIDES										
8. Saccharose	246	255	250.7	82.7	3 on 9th day, 1 on 10th day 1 on 11th day, 1 on 12th day	153	162	158.2	52.2	1 on 11th day, 2 on 13th day 1 on 28th day, 2 on 36th day
9. Maltose	192	240	212.7	70.2	4 on 8th day, 2 on 9th day	139	157	147.8	48.8	1 on 7th day, 2 on 8th day 2 on 10th day, 1 on 12th day
10. Lactose	100	113	106.7	35.2	5 on 3rd day, 1 on 4th day	104	116	109.0	36.0	4 on 3rd day, 2 on 4th day
11. Cellobiose	103	109	103.7	34.9	6 on 3rd day	106	109	108.3	35.7	5 on 3rd day, 1 on 4th day
TRISACCHARIDES										
12. Raffinose	101	121	111.0	36.6	5 on 3rd day, 1 on 4th day	109	116	112.5	37.1	5 on 3rd day, 1 on 4th day
PENTOSES										
13. Xylose	114	130	123.0	40.6	5 on 3rd day, 1 on 4th day	107	119	114.0	37.6	6 on 3rd day
14. Arabinose	106	110	108.0	35.6	6 on 3rd day	105	113	108.5	35.8	5 on 3rd day, 1 on 4th day
GLUCOSIDES										
15. α Methyld Glucoside	113	127	120.7	39.8	6 on 3rd day	111	120	115.2	38.0	6 on 3rd day
POLYSACCHARIDES										
16. Starch	104	108	106.7	35.2	6 on 3rd day	101	108	104.0	34.3	6 on 3rd day
17. Dextrin	104	116	110.0	36.3	6 on 3rd day	106	114	110.2	36.4	6 on 3rd day
POLYHYDRIC ALCOHOLS										
18. Mannitol	107	118	111.0	36.6	6 on 3rd day	107	113	110.0	36.3	5 on 3rd day, 1 on 4th day
19. Sorbitol	103	112	108.5	35.8	6 on 3rd day	105	109	107.3	35.4	6 on 3rd day
Standard error of mean			2.57					1.72		
Standard error of mean difference			3.64					2.43		

Table XXVIII

Number of eggs laid by Nemeritis Canescens on successive days and the percentage of the mean to the average number of eggs in the ovaries.

Food given	Presence of host																					
	1st day				2nd day				3 day				4th day				5th day				6th day			
	Min	Max	Mean	%	Min	Max	Mean	%	Min		Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%
1. No food and no water	71	81	76.2	25.1	20	29	26.5	8.7																
2. Water given for drinking	89	95	91.2	30.1	16	18	16.8	5.6																
MONOSACCHARIDES																								
3. Glucose	54	67	62.3	20.6	53	59	56.2	18.5	22	32	28.2	9.3	24	28	26.2	8.6	25	31	27.3	9.0	15	30	25	8.25
4. Fructose	54	60	57.5	19.0	50	54	51.8	17.1	23	36	29.7	9.8	19	30	26.2	8.6	21	34	28.3	9.4	17	24	21.3	7.03
5. Galactose	57	66	60.3	19.9	47	56	51.0	16.8	3	3	.5	0.2												
6. Mannose	60	65	62.0	20.5	53	63	58.3	19.2																
7. Sorbose	53	58	55.7	18.4	46	56	53.7	17.4																
DISACCHARIDES																								
8. Saccharose	58	66	61.7	20.3	51	57	55.2	18.2	29	34	31.5	10.4	23	28	26.5	8.7	25	31	27.5	9.1	17	30	24.5	8.08
9. Maltose	55	61	57.3	18.9	43	51	47.0	15.5	28	34	30.5	10.1	24	28	26.3	8.7	20	28	23.8	7.9	10	24	17.8	5.87
10. Lactose	53	59	56.5	18.6	45	54	49.2	16.2	6	6	1	0.3												
11. Cellobiose	55	58	56.0	18.5	45	54	49.9	16.4																
TRISACCHARIDES																								
12. Raffinose	56	61	57.8	19.1	44	57	51.3	16.9	11	11	1.8	0.6												
PENTOSES																								
13. Xylose	61	67	64.3	21.2	39	59	54.2	17.9	27	27	4.5	1.5												
14. Arabinose	58	59	58.5	19.3	47	51	49.5	16.3																
GLUCOSIDES																								
15. α Methyl-d-Glucoside	60	67	63.5	21.0	53	60	57.2	18.9																
POLYSACCHARIDES																								
16. Starch	55	59	56.8	18.8	49	51	49.8	16.4																
17. Dextrin	57	62	59.5	19.6	46	56	50.5	16.7																
POLYHYDRIC ALCOHOLS																								
18. Mannitol	55	60	58.0	19.1	49	58	53.0	17.5																
19. Sorbitol	57	60	58.8	19.4	46	52	49.7	16.4																
Standard error of mean			0.98				1.35				1.31				1.00				1.35				1.82	
Standard error of mean difference			1.39				1.91				1.86				1.42				1.91				2.57	

The minimum and the maximum figures given in this table refer only to the parasites that survived. The averages have been calculated on the basis of all the six replications.

Table XXVIII (Contd.)

Number of eggs laid by Nemeritis canescens on successive days and the percentage of the mean to the average number of eggs in the ovaries.

Food given	Presence of host.																				
	7th day				8th day				9th day				10th day				11th day *			12th day *		
	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	Min	Max	Mean
MONOSACCHARIDES																						
3. Glucose	9	21	16.5	5.44	6	10	7.7	2.54	3	10	4.3	1.42	2	6	2.3	.76	1	1	.2	2	2	.3
4. Fructose	6	15	12.0	3.96	6	6	2.0	0.66														
DISACCHARIDES.																						
8. Saccharose	10	17	13.5	4.45	3	10	6.2	2.05	2	8	2.5	..82	1	6	1.2	.40	4	4	.7			
9. Maltose	3	17	7.7	2.54	3	6	1.5	0.49														
Standard error of mean			1.64				0.99				1.36											
Standard error of mean difference			2.32				1.40				1.92											

* The percentages for the 11th and 12th days are very low and hence not given.

CARBOHYDRATE FEEDING.

Total number of eggs laid (minimum, maximum, average and the percentage of the average to the total number of eggs in the ovaries) by Nemeritis canescens from emergence till death at 27°C., and 68 % R.H., in the presence of host.

Upper black line ---- Maximum
Lower black line ---- Minimum
Dotted line --------- Average
Red line ------------ Percentage

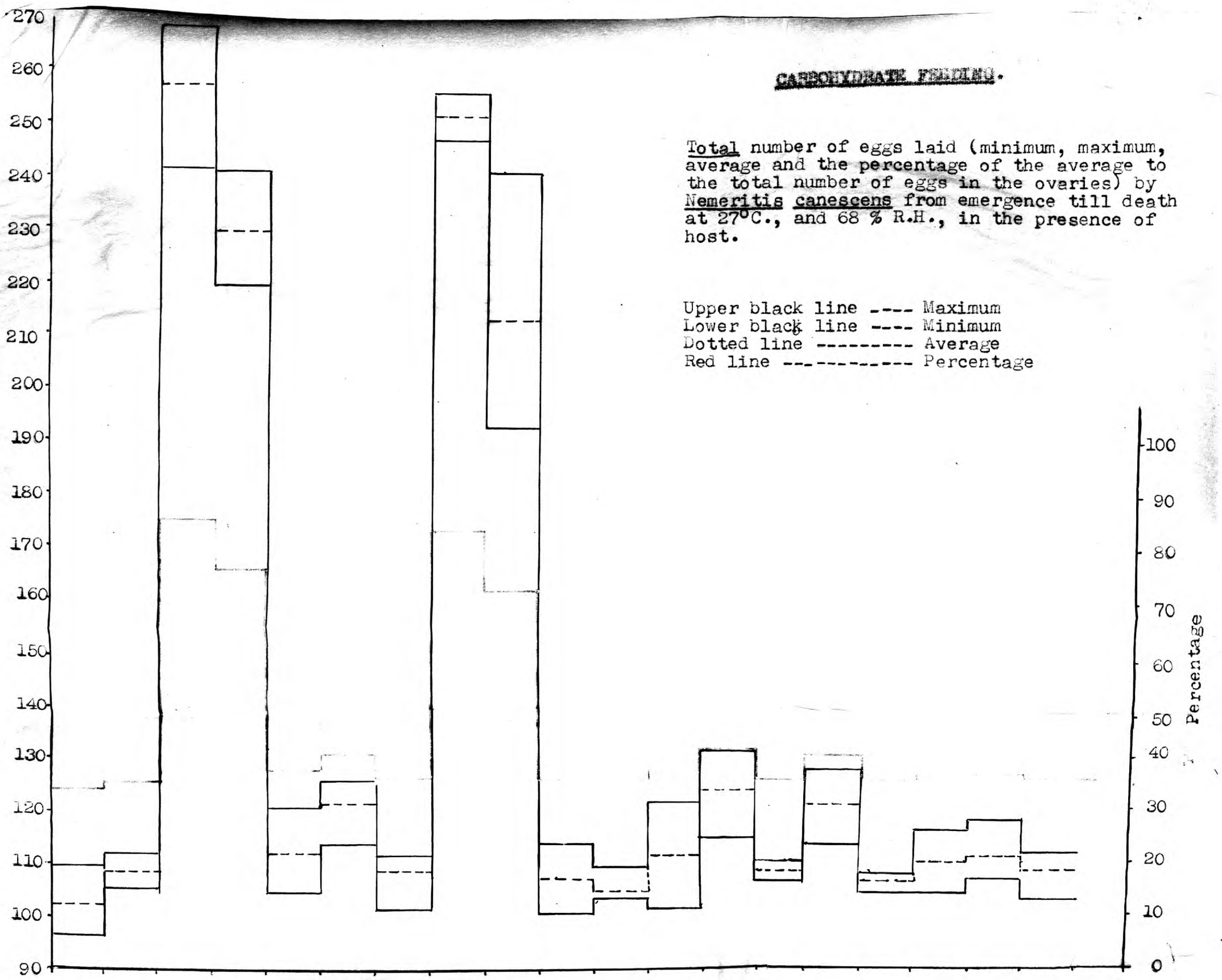


Fig. 11.

No food, no water

Fed on water alone
MONOSACCHARIDES.

Glucose

Fructose

Galactose

Mannose

Sorbose
DISACCHARIDES.

Sucrose

Maltose

Lactose

Cellobiose
TRISACCHARIDES.

Raffinose
PENTOSES.

Xylose

Arabinose
GLUCOSIDES.

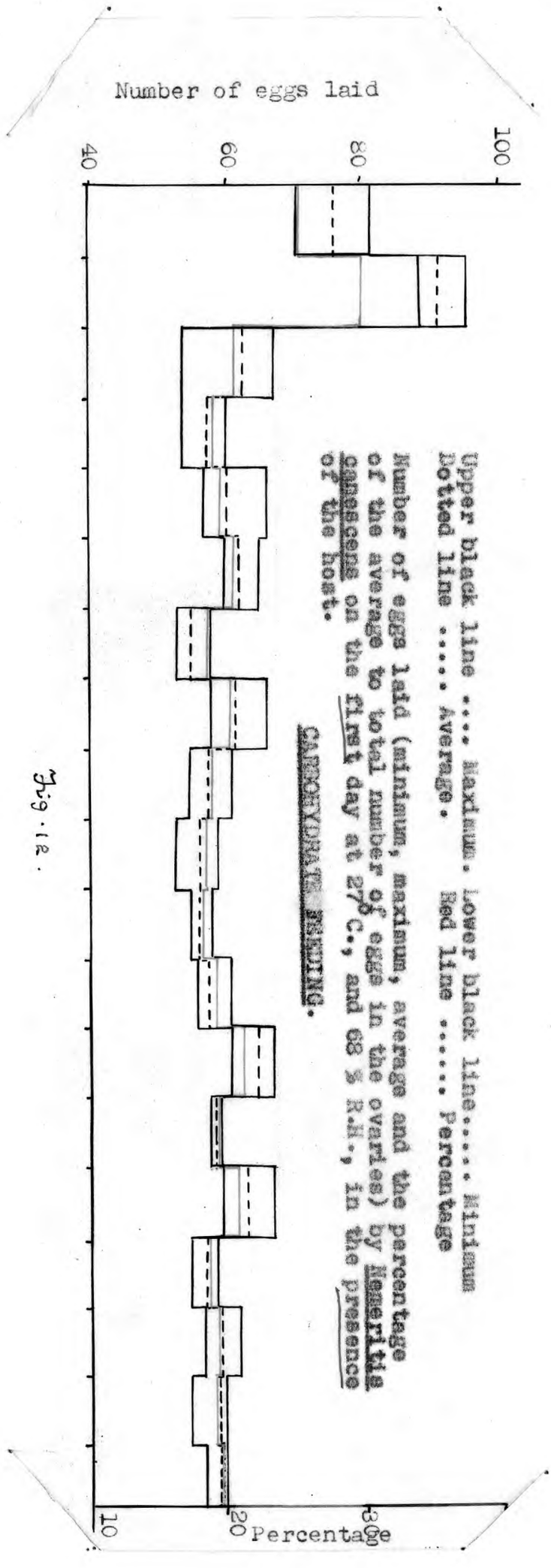
∝ methyl d glucoside
POLYSACCHARIDES.

Starch

Dextrin
POLYHYDRIC ALCOHOLS.

Mannitol

Sorbitol

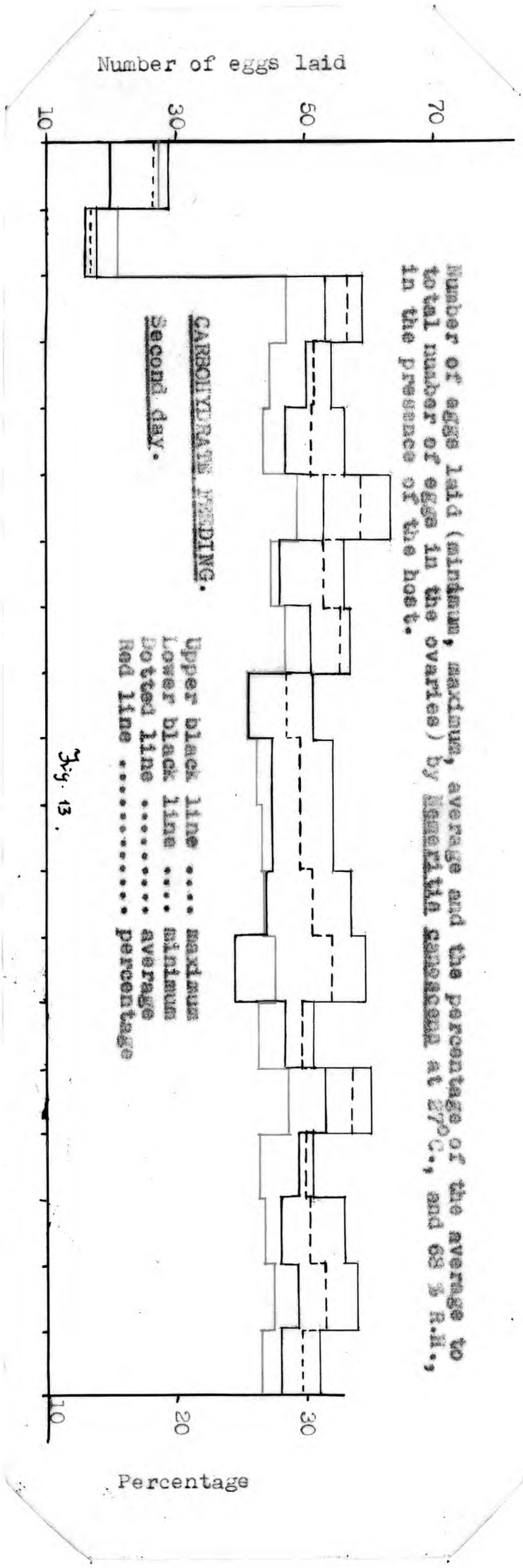


Upper black line .... Maximum. Lower black line..... Minimum
Dotted line ..... Average. Red line ..... Percentage

Number of eggs laid (minimum, maximum, average and the percentage of the average to total number of eggs in the ovaries) by Nemeritis canescens on the first day at 27° C., and 68 % R.H., in the presence of the host.

CARBOHYDRATE FEEDING.

Fig. 12.



No food, no water

Fed on water alone

MONOSACCHARIDES.

Glucose

Fructose

Galactose

Mannose

Sorbose

DISACCHARIDES.

Sucrose

Maltose

Lactose

Cellobiose

TRISACCHARIDES.

Raffinose

PENTOSES.

Xylose

Arabinose

GLUCOSIDES.

α methyl glucoside

POLYSACCHARIDES.

Starch

Dextrin

POLYHYDRIC ALCOHOLS.

Mannitol

Sorbitol

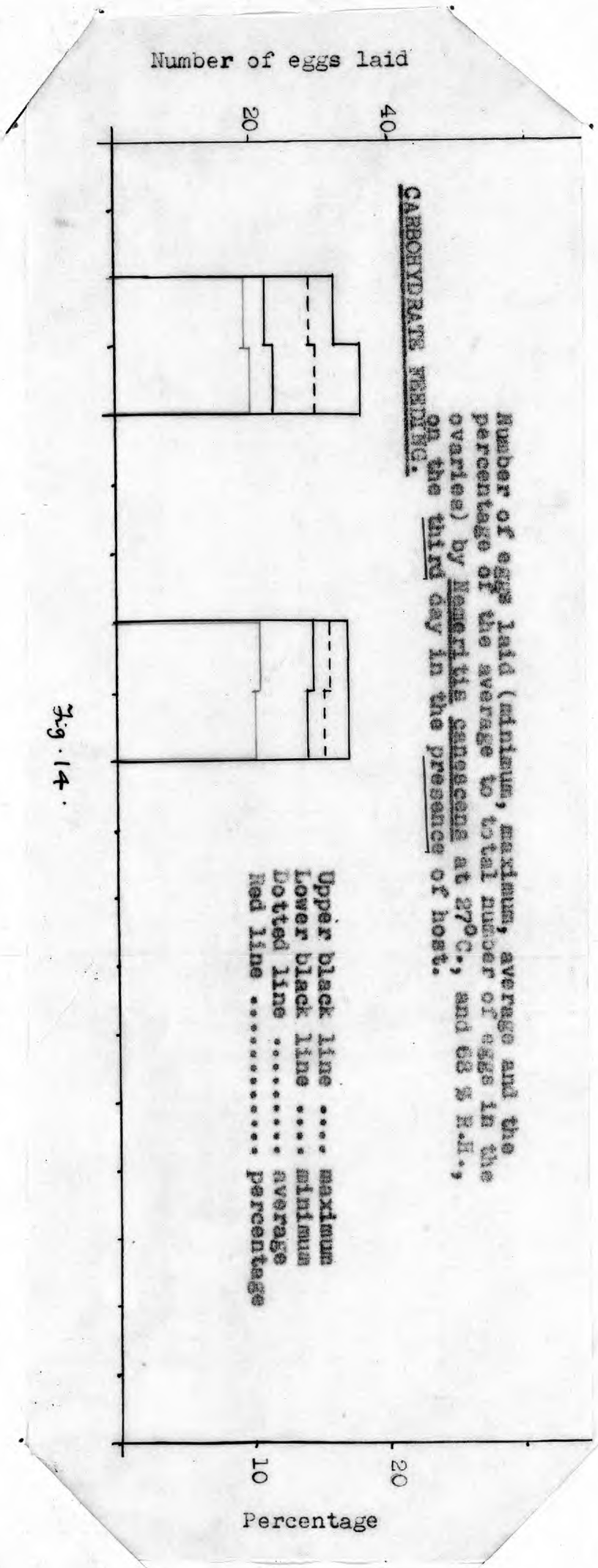


Fig. 14.

Number of eggs laid (minimum, maximum, average and the percentage of the average to total number of eggs in the ovaries) by Nemeritis canescens at 27°C., and 68 % R.H., on the third day in the presence of host.

CARBOHYDRATES TESTED.

No food, no water

Fed on water alone

MONOSACCHARIDES.

Glucose

Fructose

Galactose

Mannose

Sorbose

DISACCHARIDES.

Sucrose

Maltose

Lactose

Cellobiose

TRISACCHARIDES.

Raffinose

PENTOSES.

Xylose

Arabinose

GLUCOSIDES

α methyl d glucoside

POLYSACCHARIDES.

Starch

Dextrin

POLYHYDRIC ALCOHOLS.

Mannitol

Sorbitol

No food, no water

Fed on water alone
MONOSACCHARIDES.

Glucose

Fructose

Galactose

Mannose

Sorbose
DISACCHARIDES.

Sucrose

Maltose

Lactose

Cellobiose
TRISACCHARIDES.

Raffinose
PENTOSES.

Xylose

Arabinose
GLUCOSIDES

α methyl d glucoside
POLYSACCHARIDES.

Starch

Dextrin
POLYHYDRIC ALCOHOLS.

Mannitol

Sorbitol

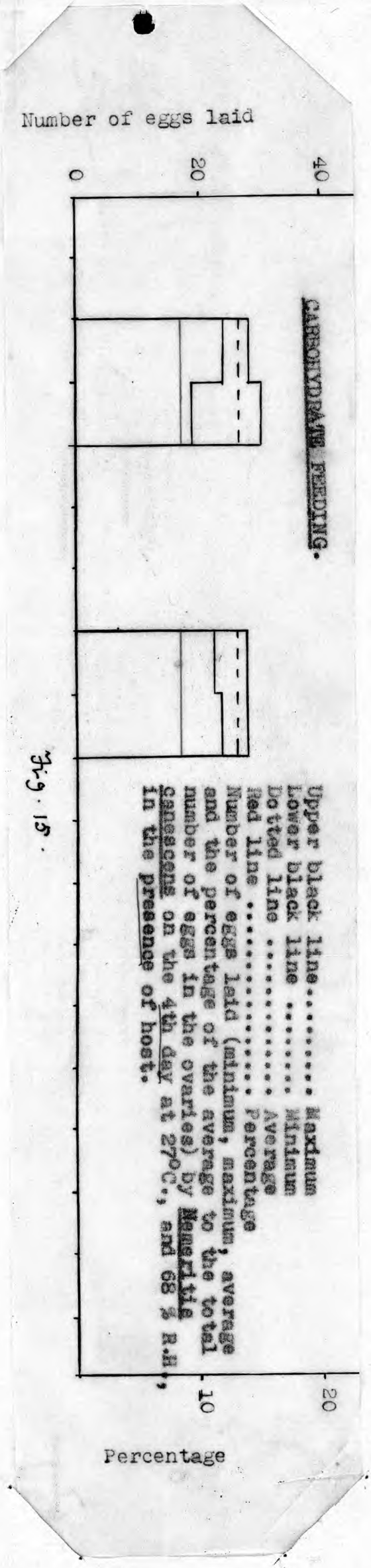
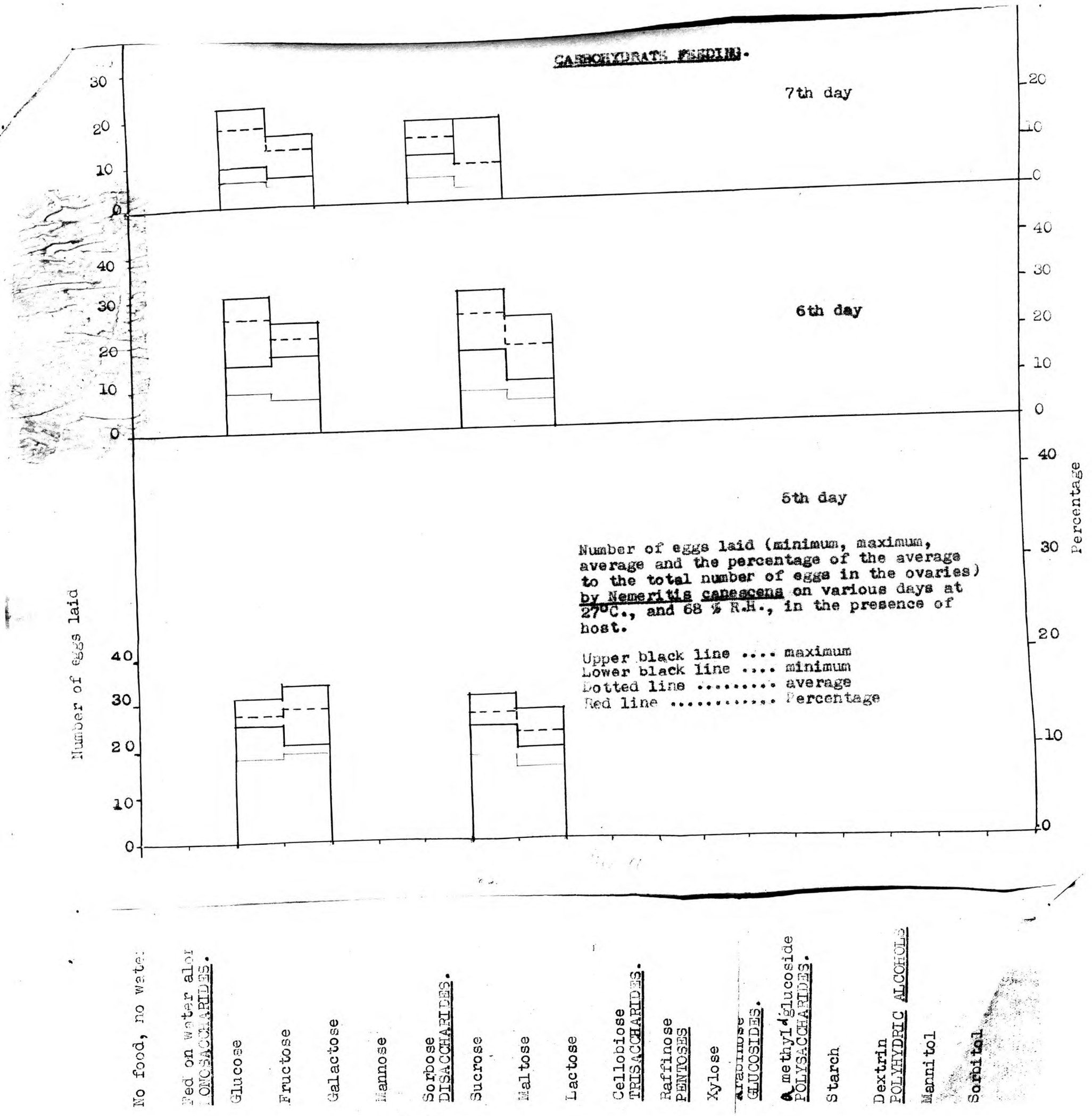


Fig. 15.


CARBOHYDRATE MEDIUM.
7th day
6th day
5th day
Number of eggs laid
Percentage
0
10
20
30
40
Number of eggs laid (minimum, maximum, average and the percentage of the average to the total number of egge in the ovaries) by Nemeritis canescens on various days at 27°C., and 68 % R.H., in the presence of host.
Upper black line .... maximum
Lower black line .... minimum
Dotted line ..... average
Red line ..... Percentage
No food, no wate
Fed on water alor
MONOSACCHARIDES.
Glucose
Fructose
Galactose
Mannose
Sorbose
DISACCHARIDES.
Sucrose
Maltose
Lactose
Cellobiose
TRISACCHARIDES.
Raffinose
PENTOSES
Xylose
Arabinose
GLUCOSIDES.
Amethyl d'glucoside
POLYSACCHARIDES.
Starch
Dextrin
POLYHYDRIC ALCOHOLS
Mannitol
Sorbitol

arabinose, starch, dextrin, mannitol and sorbitol was for all practical purposes the same. The average for the various feedings ranged from 102.7 to 111.8. The variation in the percentage was 33.9 to 36.9. The number of eggs laid with glucose and sucrose feeding was maximum and the averages were 256.5 and 250.7 respectively. The difference between these two averages was not significant. The number of eggs laid with fructose feeding was significantly lower than those of glucose and sucrose feeding, and was slightly more than with maltose feeding and the other carbohydrate feedings mentioned above. The average number of eggs laid with fructose feeding was 228.8 while with maltose this was only 212.7. The average number of eggs laid from emergence till death with mannose, xylose and α methyl-d-glucoside was about the same and ranged from 120.3 to 123.0.

Thus the various carbohydrate feedings could be arranged in the following descending order in respect of fecundity: glucose and saccharose; fructose; maltose; xylose, α methyl-d-glucoside and mannose; galactose, mannitol, dextrin, sorbitol, arabinose, and water given for drinking; starch and lactose; cellobiose, and no food and water. There was no significant difference in respect of fecundity between the foods included in the group formed by the semi-colons shown above. The various groups themselves were significantly

different from one another.

The parasites continued to lay eggs for two days only for the following feeds: 1. No food, no water, 2. Water given for drinking, 3. mannose, 4. sorbose, 5. cellobiose, 6. arabinose, 7. ~~x~~ methyl-d-glucoside, 8. starch, 9. dextrin, 10. mannitol, 11. sorbitol. With galactose, lactose, raffinose, and xylose one parasite in each laid eggs on the third day also. With glucose and sucrose the parasite laid eggs till the 11th and 12th days respectively. With fructose and maltose the parasite laid eggs till the 8th day.

It has already been pointed out that there was no significant difference in the number of eggs laid from emergence till death when the parasite was not fed and fed with water, galactose, sorbose, lactose, cellobiose, raffinose, arabinose, starch, dextrin, mannitol and sorbitol and that in the majority of cases they laid eggs only for two days. Comparing the number of eggs laid on the 1st and 2nd days with the feedings mentioned above it will be seen that a greater proportion of eggs were laid on the 1st day in conditions of no food and no water and water alone given for drinking. When the parasite was not fed it laid 26.1 % of the eggs on the 1st day and when it was fed with water it laid 30.1 % of the eggs. With the other feeds including those not mentioned above this percentage varied from 18.4 to

21.2 %. Thus it will be seen that even though the total number of eggs laid for the various foods mentioned above were the same the maximum proportion of these eggs were laid on the 1st day when water was given for drinking while with no feeding this proportion was higher than the other foods.

With the other foods also the proportion of the eggs laid on the first day was more than that laid on the second but this difference was not so high as in the case of not feeding and feeding with water only. This difference in the percentages varied from about 1 to 3, while with no food and with water alone given for drinking the differences in the percentage of eggs laid on the 1st and 2nd days were 16.4 and 24.5 respectively.

With mannose, xylose and a methyl-d-glucoside the average number of eggs laid from emergence till death varied from 120.3 to 123.0. The parasite continued to lay eggs for two days. In xylose only one solitary parasite laid eggs on the 3rd day also. The difference in the percentage of eggs laid on the 1st and 2nd days for these three feeds were 1.3, 3.3 and 2.1 respectively. For mannose this difference was not significant, while for xylose and a methyl-d-glucoside they were significant. Thus it will be seen that the number of eggs laid on the second day with xylose and a methyl-d-glucoside was significantly less than that laid

on the 1st day.

In the case of maltose the parasites continued to lay eggs till the 8th day. The percentage of eggs laid on the 1st and 2nd days did not differ considerably from the other feeds discussed before in the first group. (No food and no water, water alone and sorbose excepted). The percentages, however, were much less than those mannose, xylose and a methyl-d-glucoside. The percentage of eggs laid on the 3rd, 4th, 5th and 6th days steadily decreased from 10.1 to 5.87; on the 7th and 8th days the percentage of eggs laid was very low, being 2.5 and 0.5.

With fructose the parasite continued to lay eggs till the 8th day. On the 1st and 2nd days the percentages of eggs laid were 19.0 and 17.1 respectively. These figures were more or less the same as those for most of the other feeds discussed before. On the 3rd, 4th and 5th days the percentage of eggs were more or less steady and varied from 9.8 to 8.6 %. On the 6th day this percentage was only about 7. For the remaining days i.e., 7th and 8th days the percentages were 4.0 and 0.7.

In the case of glucose and saccharose the parasites continued to lay eggs till the 12th and 11th day respectively. The percentage of eggs laid on the first 2 days was slightly more than that of the other feeds excepting no food, no water, water given for drinking, mannose, xylose and

a methyl-d-glucoside, and were 20.6 and 18.5; and 20.3 and 18.2 respectively. From the 3rd till the 6th day the percentage varied from 8.1 to 10.4 and was almost steady. The percentage of eggs laid on the 7th day was near about 5, while on the 8th day this was about 2. For the remaining days the percentage was less than 1.

Thus in general it may be stated that when the parasites are not fed or fed with water only the majority of the eggs are laid on the 1st day, while when they were fed a fairly large proportion of the eggs were laid on the 1st and 2nd days. With glucose, fructose, sucrose and maltose about half as much as the eggs laid on any one of these days were laid upto the 5th day. With glucose and sucrose the same rate of oviposition was continued on the 6th day also. During the remaining days the percentage of oviposition steadily declined.

C. <u>In the absence of host and laying eggs inside the host through muslin. (Carbohydrate feeding)</u>.

(a) <u>The effect of not feeding on oviposition</u>.

The primary data are given in Table XXIX. The total number of eggs laid from emergence till death varied from 84 to 103. The average and the percentage were 98.2 and 32.4. The parasite laid eggs for 2 days and died on the 3rd day. The number of eggs laid on the 1st and 2nd days

Table. XXIX

RESULT OF OVIPOSITION WITHOUT FEEDING – NOT EVEN WATER. (ABSENCE OF HOST.)

Serial No. of experiment.	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death.	Remarks
I.	15.3.1938.	8 4 11 3 0 0 7 0 7 5 1 1 0 0 0 6 5 0 0 4 8 0 0 0 6	76	103	Parasite died on 17.3.1938.
		5 4 1 0 0 0 0 0 0 1 2 1 0 5 0 0 0 0 2 0 0 4 0 1 1	27		
II.	15.3.1938.	5 10 0 0 0 9 3 1 1 0 0 0 12 4 5 1 0 1 0 0 0 7 0 0 5	64	84	Parasite died on 17.3.1938
		2 0 1 1 1 0 0 0 2 8 0 0 0 0 0 0 1 0 0 0 0 0 4 0 0	20		
III.	15.3.1938.	0 10 12 1 0 0 4 7 8 0 1 2 2 3 0 0 4 0 10 0 0 4 0 2 4	74	102	Parasite died on 17.3.1938.
		3 0 2 5 0 0 0 0 0 4 0 1 5 0 0 4 0 0 0 0 0 1 1 0 2	28		
IV.	19.3.1938	4 3 5 4 4 0 4 1 2 5 0 1 5 0 4 2 2 4 6 9 0 1 2 0 3	71	97	Parasite died on 21.3.1938.
		4 0 0 2 0 1 0 0 2 0 0 0 8 0 1 1 2 0 0 0 0 1 3 0 1	26		
V.	19.3.1938	5 5 0 6 1 3 5 4 4 0 6 1 0 0 8 0 9 2 3 0 4 0 0 0 12	78	100	Parasite died on 21.3.1938.
		3 1 1 1 0 0 0 8 0 0 2 0 0 0 4 0 0 0 0 0 0 1 0 1 0	22		
VI.	19.3.1938.	10 5 4 6 1 2 0 0 0 0 6 4 0 5 8 0 0 8 0 7 7 0 10 1 1	85	103	Parasite died on 21.3.1938
		0 1 2 6 0 0 0 1 2 0 0 0 2 0 0 0 1 0 1 0 1 0 0 1 0	18		

varied between 64 to 85 and 18 to 28. The averages were 74.7 and 23.5; the percentages being 24.6 and 7.8. It will be seen that a greater proportion of the eggs laid from emergence till death i.e., about 75 % was laid on the 1st day.

(b) The effect of water drinking on oviposition.

The primary data are given in Table XXX. 104 to 109 eggs were laid from emergence till death, the average and the percentage being 106.8 and 35.2. The parasite laid eggs for only 2 days. On the 1st and 2nd days the parasite laid 88 to 92 and 16 to 19 eggs. The averages were 89.8 and 17.0. The percentages were 29.6 and 5.6 . As in the previous cases most of the eggs laid from emergence till death i.e., about 85 % were laid on the 1st day.

(c) The effect of monosaccharide diet on oviposition.

The primary data are given in Tables XXXI, XXXII, XXXIII, XXXIV, and XXXV. By feeding the parasite with glucose, fructose, galactose, mannose and sorbose the parasite laid 137 to 169, 147 to 169, 109 to 115, 107 to 124 and 102 to 109 eggs respectively. The respective averages and the percentages were 147.3, 154.2, 112.7, 115.8, 105.7; 48.6, 50.9, 37.2, 38.1, and 34.9. It will be seen that the average number of eggs from emergence till death was more or less the same in the glucose and fructose feeding. In

Table xxx

RESULT OF OVIPOSITION WITH WATER GIVEN FOR DRINKING. (ABSENCE OF HOST.)

Serial No. of experiment.	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death.	Remarks
I.	25.3.1938.	10 5 4 4 5 0 8 10 4 5 0 0 2 3 6 1 1 4 8 5 0 1 1 2 3	92	108	Parasite died on 27.3.1938
		0 0 1 1 2 0 6 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 1 2	16		
II.	25.3.1938.	9 8 11 4 0 1 1 5 0 1 2 3 8 0 0 6 1 5 8 8 0 0 7 0 1	89	105	Parasite died on 27.3.1938.
		0 0 1 1 2 0 6 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 1 2	16		
III.	25.3.1938.	8 7 5 4 8 1 3 4 5 2 2 3 4 4 0 5 8 0 1 2 1 8 0 0 3	88	106	Parasite died on 27.3.1938.
		2 1 1 1 0 1 1 2 3 0 0 1 0 0 0 1 1 0 1 0 0 0 1 0 1	18		
IV.	29.3.1938.	5 5 4 4 5 5 4 4 4 6 1 0 10 4 4 5 2 3 4 2 3 0 0 3 3	90	109	Parasite died on 31.3.1938.
		4 0 0 1 1 0 2 0 2 0 1 1 0 1 2 0 0 1 1 1 0 0 0 1 0	19		
V.	29.3.1938.	13 6 1 7 4 2 4 4 4 7 1 3 2 3 4 5 5 3 2 4 2 0 1 3 2	92	109	Parasite died on 31.3.1938.
		1 0 0 0 6 0 0 1 1 0 2 1 1 0 0 0 0 0 1 0 0 0 1 0 2	17		
VI.	29.3.1938.	7 6 8 2 7 2 5 8 5 4 3 3 4 2 3 0 0 5 0 2 3 5 0 0 4	88	104	Parasite died on 31.3.1938.
		0 0 0 4 2 1 1 0 1 2 0 0 1 1 1 0 0 0 0 0 1 0 0 0 1	16		

Table xxxi

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GLUCOSE. (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death.	Remarks
					Parasite died on
I.	2.4.1938	5 3 4 1 3 1 3 4 0 4 1 3 2 3 1 0 1 2 2 1 0 1 1 1 2	49		
		3 2 1 2 2 1 2 5 0 0 1 2 2 0 1 3 1 2 2 2 1 0 4 1 3	38		
		1 2 2 3 0 1 1 1 1 1 1 1 2 2 0 0 1 0 0 3 1 2 1 2 1	30	152	22.4.1938
		2 2 1 0 0 1 1 1 2 2 2 0 1 0 1 1 1 0 2 2 2 1 0 2 1	28		
		0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2		
II.	2.4.1938	2 3 4 1 1 1 4 3 1 3 1 5 4 0 1 1 0 2 1 1 2 1 1 1 1	45		
		3 1 2 3 1 2 2 2 2 3 1 2 1 0 1 1 0 1 1 0 2 1 1 1 2	36		
		1 2 2 2 1 1 2 2 1 2 1 2 1 0 1 0 1 2 1 1 1 0 1 1 1	30	137	12.4.1938
		1 1 1 2 1 1 1 2 0 0 0 1 2 1 1 2 1 2 0 1 1 1 1 0 2	26		
III.	2.4.1938	2 5 1 2 1 3 2 2 4 1 3 3 1 2 2 3 1 2 1 2 2 3 1 2 0	51		
		0 2 2 2 1 3 2 2 1 3 3 3 2 0 2 1 0 1 2 2 2 1 1 1 1	40		
		1 0 2 1 1 1 1 1 0 1 1 0 2 2 1 2 1 1 2 2 1 1 1 2 1	29	149	22.5.1938
		1 1 1 2 1 1 2 2 1 1 2 1 1 1 1 2 1 0 0 1 1 2 1 1 0	28		
		0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1		

Table xxxi (Contd)

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GLUCOSE. (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death.	Remarks
					Parasite died on
IV.	18.4.1938.	2 2 3 3 5 1 1 2 1 4 0 1 2 1 1 0 3 2 3 6 2 2 0 2 0	49		
		2 2 1 0 2 3 1 1 3 3 1 1 2 2 2 2 1 2 1 1 1 2 0 0 3	39		
		1 1 0 1 1 2 1 1 1 1 2 1 2 1 2 0 1 2 1 2 0 1 2 1 0	28	148	8.5.1938
		2 1 2 2 1 0 1 1 2 0 1 1 1 0 2 1 2 2 0 2 1 2 1 2 2	32		
V.	18.4.1938.	2 1 1 4 2 2 6 2 2 3 2 1 3 3 2 2 2 1 0 0 3 3 2 1 3	53		
		3 2 2 3 1 1 2 1 0 4 1 2 0 2 0 3 1 3 1 1 2 2 2 1 2	42		
		1 2 1 0 1 1 1 2 1 1 0 1 1 1 2 2 1 2 2 1 1 0 2 1 3	31	149	22.5.1938
		1 0 1 1 1 1 1 2 1 1 1 2 0 2 2 2 1 0 0 0 1 0 1 1 0	23		
VI.	18.4.1938.	2 2 0 4 2 4 2 0 2 2 6 1 2 0 3 2 3 3 4 1 1 3 2 2 1	54		
		2 0 4 0 2 0 2 3 4 2 1 2 0 3 2 2 2 0 3 2 6 0 3 0 2	47		
		2 1 0 1 2 1 0 1 1 1 0 1 1 1 1 2 0 2 1 2 1 2 1 1 1	27	159	18.5.1938
		1 2 1 1 1 1 2 1 0 1 2 1 2 2 2 2 1 0 1 1 1 2 1 1 1	31		

Table xxxii

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) FRUCTOSE (ABSENCE OF HOST)

Serial No. of experiment.	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death.	Remarks Parasite died on
I.	28.4.1938	3 2 1 2 3 1 0 0 2 2 2 4 3 1 6 0 3 2 3 3 3 0 3 2 4	55		
		2 7 3 1 2 3 3 2 1 1 4 2 3 0 1 2 0 1 3 0 0 0 7 0 0	48		
		2 1 1 2 0 1 1 3 0 1 1 1 1 1 1 0 1 2 2 0 1 1 2 0 0	26	156	3.5.1938.
		0 2 3 0 1 0 0 2 1 3 1 0 0 1 1 1 0 1 2 0 0 0 1 0 1	21		
		0 0 0 0 1 2 0 0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6		
II.	28.4.1938	3 2 0 7 3 3 1 1 0 0 3 2 3 4 1 2 1 4 6 0 0 4 0 1 0	51		
		2 3 2 3 9 0 4 0 0 3 2 0 3 0 0 3 3 5 0 1 1 1 2 2 1	50		
		1 1 2 0 0 3 1 1 2 2 1 0 2 0 1 2 1 3 0 0 0 2 1 1 1	28	151	10.5.1938.
		1 1 2 1 1 0 0 0 1 1 0 1 1 0 1 1 1 1 1 1 0 2 1 1 0	20		
		0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2		
III.	28.4.1938	0 1 3 1 4 1 1 6 4 5 7 0 0 1 3 2 1 6 0 2 2 0 1 1 1	53		
		3 1 2 3 0 4 7 0 0 0 2 1 0 0 6 2 3 1 2 3 3 0 1 1 1	46		
		0 1 1 2 3 1 1 2 1 2 1 0 1 2 1 0 1 1 0 0 0 2 0 2 2	27	155	5.5.1938.
		1 1 1 1 0 0 0 2 2 2 2 0 2 1 1 1 1 1 1 0 2 3 1 1 2	29		

Table xxxii (Contd)

T. 32

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) FRUCTOSE (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks: Parasite died on
IV.	5.5.1938	3 6 1 2 2 4 2 2 3 1 0 1 3 7 3 0 0 5 2 1 3 2 3 3 0	59	159	19.5.1938
		1 3 2 4 3 1 3 2 2 3 4 4 1 3 3 2 2 1 2 2 2 1 0 0 5	56		
		1 2 0 0 1 2 2 1 1 1 1 1 3 0 1 1 1 2 0 0 0 1 0 0 3	25		
		0 1 1 1 1 2 0 0 1 1 1 1 2 0 0 0 2 1 0 0 0 0 1 1 2	19		
V.	5.5.1938	2 2 4 1 6 0 0 4 5 2 2 1 1 1 2 3 2 3 3 3 4 1 2 3 2	59	157	20.5.1938
		3 0 2 3 3 2 2 4 0 0 1 3 1 6 4 2 3 1 3 2 1 0 0 6 0	52		
		1 2 1 1 0 3 2 1 1 1 2 2 1 1 0 0 1 1 0 0 0 0 0 1 2	24		
		1 2 1 1 1 2 1 0 1 1 2 1 0 1 0 0 1 1 1 2 0 0 0 1 1	22		
VI.	5.5.1938	3 1 2 2 3 3 2 1 0 0 3 6 1 3 2 4 1 2 2 4 5 1 3 1 1	56	147	19.5.1938
		4 4 1 2 3 2 2 4 6 0 0 1 1 3 1 2 0 1 1 2 4 0 0 0 1	45		
		2 3 1 1 1 0 0 0 2 0 1 1 1 2 2 0 1 1 1 0 2 1 1 1 1	26		
		2 2 0 1 1 0 1 1 0 1 0 0 1 1 1 0 1 1 2 1 3 0 0 0 1	20		

Table xxxiii

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) GALACTOSE (ABSENCE OF HOST.)

Serial No. of experiment.	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death.	Remarks Parasite died on
I.	8.5.1938.	0 2 2 2 3 6 0 0 4 1 1 1 1 2 3 5 2 2 0 8 4 0 1 1 1	52	110	11.5.1938.
		3 3 3 3 2 2 0 0 0 8 0 0 0 2 1 9 3 2 0 2 4 3 1 2 0	53		
		0 0 1 0 0 1 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	5		
II.	8.5.1938.	1 0 7 2 2 2 3 3 3 3 9 0 4 2 1 3 1 0 0 2 1 2 1 1 1	54	109	10.5.1938.
		3 2 2 2 3 1 3 3 3 3 0 0 0 6 0 0 1 2 7 0 4 0 0 4 6	55		
III.	8.5.1938.	7 1 0 3 2 2 0 9 1 6 1 4 0 3 3 1 0 4 2 3 2 2 3 2 2	63	115	10.5.1938.
		0 4 0 2 1 2 2 7 0 0 4 3 1 1 2 1 1 3 2 2 2 3 3 3 3	52		
IV.	14.5.1938.	3 1 2 3 3 1 2 2 2 3 0 0 0 1 2 7 6 4 2 4 0 0 5 0 4	57	115	17.5.1938.
		2 2 2 2 0 0 9 0 3 4 2 1 3 2 2 1 1 3 0 3 0 0 3 1 3	49		
		0 2 0 0 1 0 0 1 0 0 1 1 1 0 2 0 0 0 0 0 0 0 0 0 0	9		
V.	14.5.1938.	2 3 2 6 0 0 8 4 5 0 0 1 2 3 3 3 0 2 0 3 1 2 2 1 3	56	114	17.5.1938.
		3 3 8 0 0 3 3 1 2 2 2 3 4 3 1 2 2 2 2 1 3 0 0 0 1	51		
		0 0 0 1 2 0 0 1 2 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0	7		
VI.	14.5.1938.	3 3 3 2 2 8 0 0 0 3 3 4 3 2 1 2 7 1 3 2 0 1 1 1 2	57	113	16.5.1938.
		4 3 3 5 6 2 2 1 1 2 0 2 3 3 4 1 1 2 2 1 2 2 2 2 0	56		

Table XXXIV

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) MANNOSE (ABSENCE OF HOST.)

Serial No. of experiment.	Date of emergence of parasite.	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	20.5.1938.	4 2 3 1 0 0 5 6 2 1 6 2 1 3 4 0 0 0 2 2 3 2 2 2 1	54	114	22.5.1938
		1 2 2 1 2 7 0 0 0 0 4 3 2 4 5 3 2 2 4 4 4 2 3 3 0	60		
II.	20.5.1938.	4 4 3 0 1 2 0 3 3 1 2 2 4 2 3 5 0 4 5 3 0 4 0 1 2	58	114	22.5.1938
		3 2 2 4 0 3 0 4 1 3 3 2 0 0 0 6 2 2 3 2 2 2 3 1 6	56		
III.	20.5.1938.	3 4 2 2 2 0 0 7 5 2 2 6 3 2 2 2 3 1 6 0 0 0 2 1 3	60	124	23.5.1938
		2 1 2 2 2 4 2 3 1 3 4 3 2 3 1 4 0 0 0 7 0 0 4 3 3	56		
		0 0 0 1 0 2 2 0 0 0 1 0 0 0 0 0 1 0 0 0 1 0 0 0 0	8		
IV.	25.5.1938.	2 3 1 4 0 4 6 2 0 8 0 1 3 1 2 1 2 2 2 2 1 5 4 6 0	62	119	28.5.1938
		3 1 2 3 5 6 4 2 0 1 3 0 6 0 1 1 2 2 2 1 1 1 2 2 1	52		
		0 0 0 0 1 0 2 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0	5		
V.	25.5.1938.	4 2 1 3 4 2 1 2 4 3 2 1 3 2 2 0 0 6 0 0 4 3 5 1 4	59	107	27.5.1938
		3 0 2 0 0 6 0 0 4 4 5 0 3 2 2 0 3 2 2 0 0 2 3 3 2	48		
VI.	25.5.1938.	2 3 0 6 0 2 3 2 1 0 4 2 2 3 2 4 4 0 5 3 1 2 2 4 1	58	115	27.5.1938
		2 4 1 3 4 2 4 3 1 2 1 2 2 1 2 4 1 0 0 0 0 6 4 4 4	57		

Table xxxv

RESULT OF FEEDING ON OVIPOSITION (MONOSACCHARIDES) SORBOSE. (ABSENCE OF HOST).

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	29.5.1938	1 3 0 4 0 0 6 4 3 2 3 3 2 2 3 0 3 5 2 2 1 1 2 1 3	56)	109	31.5.1938
		3 3 2 0 0 3 4 3 0 2 3 4 0 2 3 3 1 3 2 2 1 3 3 1 2	53)		
II.	29.5.1938	2 3 5 4 4 5 2 0 2 3 0 0 2 3 4 1 1 1 2 2 3 1 2 2 1	55)	102	31.5.1938
		0 1 8 0 0 6 0 4 3 2 1 1 7 0 0 0 2 1 1 1 5 0 0 3 1	47)		
III.	29.5.1938	4 4 3 0 0 5 6 0 0 4 3 3 3 1 0 2 1 3 3 4 3 2 1 1 2	58)	107	31.5.1938
		0 3 2 1 1 3 2 2 2 3 4 3 3 2 2 1 1 2 3 1 1 2 2 1 2	49)		
IV.	3.6.1938	1 4 3 2 2 5 0 0 3 0 0 7 0 5 4 0 3 1 1 4 2 6 2 1 2	58)	104	5.6.1938
		2 3 1 2 3 0 3 0 2 1 1 3 1 4 0 2 1 0 0 1 3 3 4 1 5	46)		
V.	3.6.1938	4 3 5 2 0 0 3 3 3 2 2 2 2 1 2 0 4 3 2 2 2 2 2 3 1	55)	105	5.6.1938
		3 2 1 3 1 1 4 1 2 1 2 0 1 3 3 2 1 2 4 1 1 1 3 2 0	45)		
		0 0 0 1 0 0 0 0 1 0 1 0 1 0 0 0 1 0 0 0 0 0 0 0 0	5)		
VI.	3.6.1938	0 6 3 2 0 0 10 4 3 2 1 0 0 4 3 3 3 2 2 2 1 0 0 0 2	53)	107	5.6.1938
		4 2 3 0 6 3 4 0 2 2 1 3 2 2 1 2 2 3 0 1 0 4 3 2 2	54)		

the case of galactose and mannose the number of eggs laid is less than that of either glucose or fructose by 10.5 to 13.7 %. In the monosaccharides the number of eggs laid with sorbose feeding was minimum. The parasite laid eggs for 4 to 5 days with glucose and fructose and 2 to 3 days with galactose, mannose, and sorbose. It may, however, be mentioned that ~~unlike in the case of presence of host~~ in contrast to where the host is present the parasite lived from 10 to 34 days with glucose, 7 to 15 days with fructose and 2 to 3 days with galactose, mannose and sorbose. The number of eggs laid with glucose varied from 48 to 54; 36 to 47; 27 to 31; 26 to 32; and 0 to 2 respectively on the 1st, 2nd, 3rd, 4th and 5th days. The correspondings averages were 50.2, 40.3, 28.7, 27.7 and 0.5. The percentages were 16.6, 13.3, 9.5, 9.1 and 0.2. With fructose the parasite laid from 51 to 59 eggs on the 1st day, 45 to 56 eggs on the 2nd day, 24 to 28 eggs on the 3rd day, 19 to 29 eggs on the 4th day and 0 to 6 eggs on the 5th day. The average number of eggs laid on the successive days were 55.5, 49.5, 26.0, 21.8 and 1.3. The percentages were 18.3, 16.3, 8.6, 7.2, and 0.4. With galactose the parasite laid 52 to 63 eggs on the 1st day, 49 to 56 eggs on the 2nd day and 5 to 9 eggs on the 3rd day. The averages for the corresponding days were 56.5, 52.7 and 3.5; the percentages being 18.6, 17.4 and 1.2.

In the case of mannose the number of eggs laid on the 1st, 2nd and 3rd days varied from 54 to 62, 48 to 60 and 5 to 8 eggs respectively. The averages and the percentages were 58.5, 54.8 and 2.2; 19.3, 18.1, and 0.7.

The parasite fed with sorbose laid 53 to 58 eggs on the 1st day and 45 to 54 eggs on the 2nd day. The single parasite that survived on the 3rd day laid 5 eggs. The averages for the ~~corresponding~~ corresponding 1st, 2nd and 3rd days were 55.8, 49.0 and 0.8; the percentages were 18.4, 16.2 and 0.3.

The results of feeding with monosaccharides show that 16.6 to 19.3 % of the eggs in the ovaries were laid on the 1st day. On the 2nd day 13.32, 18.1 % of the eggs were laid. The percentage of the eggs laid on the 3rd and the 4th days with glucose and fructose alone was about half as much as the 1st and 2nd days. In the remaining days the number of eggs laid was very small.

(d) The effect of disaccharide diet on oviposition.

The primary data are given in Tables XXXVI, XXXVII, XXXVIII and XXXIX. The total number of eggs laid from emergence till death with sucrose, maltose, lactose and cellobiose feeding varied from 153 to 162, 139 to 157; 104 to 116 and 106 to 109 respectively. The respective averages and the percentages were 158.2, 147.8, 109.0, 108.3; 52.2, 48.8, 36.0 and 35.7. In the disaccharide group the maximum

Table XXXVI

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) SUCROSE. (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	10.6.1938.	2 3 4 5 2 1 2 4 0 2 1 2 3 2 2 2 3 2 2 2 3 3 0 0 2	54		
		2 1 2 2 1 2 2 2 2 3 2 0 2 3 2 2 3 3 5 2 3 2 0 1 0	49		
		1 2 3 1 1 1 1 2 0 2 2 0 1 1 3 0 0 4 0 0 0 1 0 1 1	28	153	20.6.1938
		2 1 2 2 0 2 2 2 0 0 1 1 3 0 0 0 0 2 1 0 0 0 0 1 0	22		
II.	10.6.1938.	0 4 3 2 1 0 3 0 2 3 2 2 3 0 1 1 3 1 2 2 4 4 6 4 3	56		
		0 3 3 4 3 2 3 0 0 7 2 0 3 4 1 1 2 1 0 0 5 0 3 2 1	50		
		2 0 0 1 5 1 1 0 2 0 0 1 1 1 2 0 0 2 2 0 1 1 2 0 1	26	162	22.6.1938
		1 2 1 1 0 0 0 0 0 0 2 0 0 1 2 2 2 1 1 2 1 2 0 0 1	22		
		0 0 1 2 0 0 1 1 0 0 0 3 0 0 0 0 0 0 0 0 0 0 0 0 0	8		
III.	10.6.1938.	5 4 0 3 2 3 3 0 4 2 2 1 1 0 7 0 0 4 4 3 0 2 1 1 3	55		
		3 0 2 0 3 6 0 4 1 1 1 2 0 3 1 0 3 5 0 2 0 0 4 2 2	45		
		2 1 2 1 1 1 3 2 1 1 1 1 2 1 1 0 0 4 0 1 2 0 1 0 0	29	156	22.6.1938
		0 3 2 3 0 0 0 6 4 1 1 2 2 0 0 0 0 2 0 1 0 0 0 0 0	27		

Table xxxvi (Contd)

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) SUCROSE. (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
IV.	8.10.1938.	5 0 3 2 5 0 0 0 6 3 2 0 3 4 0 3 2 2 1 1 1 2 1 1 6	53		
		9 0 3 5 1 0 1 2 0 0 3 3 2 4 3 3 0 1 2 2 1 2 4 3 1	55		
		2 1 1 0 0 1 0 1 0 0 2 0 1 0 1 1 2 0 1 1 0 1 3 3 1	23	159	4.11.1938
		1 2 1 1 1 2 0 1 2 0 1 2 1 1 0 0 1 1 1 1 0 2 0 1 1	24		
		0 1 1 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4		
V.	8.10.1938.	6 3 2 4 3 0 3 0 2 3 1 3 2 2 4 3 3 3 2 2 1 2 1 0	55		
		2 3 3 0 4 3 3 2 3 1 1 1 1 3 2 2 3 0 5 0 3 2 1 0 1	49		
		2 1 1 1 1 0 0 1 1 2 1 0 1 2 1 0 1 2 3 2 0 1 3 0 0	27	159	12.11.1938
		3 0 3 2 1 0 1 2 3 2 0 0 0 4 0 0 1 0 1 1 1 2 0 1 0	28		
VI.	8.10.1938.	5 0 5 3 2 4 2 9 0 0 4 0 3 2 3 1 2 3 1 1 2 1 1 0 2	56		
		1 3 2 2 7 1 3 3 2 1 2 3 1 1 0 0 2 0 4 2 2 1 0 1 2	46		
		2 1 1 1 0 1 3 0 1 1 2 5 1 1 0 0 1 1 2 0 0 1 1 1 1	28	160	12.11.1938
		2 1 1 1 2 0 1 1 3 2 0 0 1 1 3 0 0 1 1 1 2 0 1 0 0	26		
		0 0 0 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0	4		

Table xxxvii

RESULT OF FEEDING ON OVIPOSITION. DISACCHARIDES MALTOSE (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	25.10.1938	4 3 3 2 2 2 6 0 0 8 4 3 2 2 2 3 2 1 1 2 1 1 2 1 1	58		
		1 3 3 2 4 5 3 1 2 2 1 2 1 0 1 2 1 2 2 2 0 0 0 1 1	42		
		1 1 0 1 2 2 1 1 1 0 1 1 2 2 1 2 1 2 2 1 1 1 1 0 0	28	151	1.11.1938
		0 1 0 0 1 1 2 1 1 0 1 1 2 3 0 0 6 0 1 1 0 1 0 0 0	23		
II.	25.10.1938	1 4 3 3 2 0 7 0 1 1 2 3 3 1 2 2 3 2 2 2 3 4 2 3 0	56		
		3 1 0 3 2 1 1 3 1 2 0 8 0 0 1 2 3 0 2 2 5 0 0 0 0	40		
		2 1 1 1 1 0 0 1 0 5 2 0 0 1 0 0 0 1 0 1 1 2 1 1 1	23	141	3.11.1938
		2 1 0 0 0 0 3 0 0 1 2 0 3 0 1 3 0 0 0 1 0 0 0 0 0	17		
		0 1 1 0 1 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	5		
III.	25.10.1938	0 4 3 5 7 0 0 0 3 2 1 2 2 4 2 2 0 0 2 1 1 2 1 1 0	45		
		2 2 0 0 6 0 5 0 1 2 1 1 2 2 1 3 5 0 0 4 3 2 2 0 0	44		
		3 3 0 1 0 1 2 2 0 0 3 2 0 0 0 0 2 2 0 3 2 0 0 0 0	26	147	31.10.1938
		2 1 0 1 2 1 2 1 0 0 0 3 0 0 0 2 1 1 2 2 0 1 2 0	24		

Table xxxvii (Contd)

RESULT OF FEEDING ON OVIPOSITION. DISACCHARIDES MALTOSE (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
IV.	12.11.1938	1 2 1 0 3 5 8 0 0 0 2 1 3 2 1 3 2 4 4 0 1 2 1 1 0	47		Parasite died on
		2 2 3 3 1 1 2 0 4 1 6 0 3 1 2 2 1 2 3 0 1 2 1 1 2	46		
		1 2 0 0 3 3 0 2 2 1 1 2 0 1 2 1 1 2 2 1 1 0 2 1 1	32	147	23.10.1938
		0 0 2 1 0 0 2 1 1 2 0 0 0 1 0 1 0 2 0 1 4 0 0 0 0	18		
		0 0 1 2 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4		
V.	12.11.1938	0 4 3 1 2 3 8 0 0 4 3 2 3 2 2 2 4 3 3 2 1 2 3 1 0	58		
		1 2 2 1 4 2 3 0 1 6 1 0 3 0 0 3 4 1 2 0 2 1 0 1 3	43		
		2 1 2 3 0 4 0 2 1 1 4 0 2 0 0 2 1 0 0 3 0 3 0 0 0	31	157	19.11.1938
		2 0 2 0 1 1 0 0 1 2 0 0 0 1 2 1 1 0 0 1 2 2 0 3 3	25		
VI.	12.11.1938	4 5 0 0 2 3 3 0 0 2 1 7 3 2 2 3 1 1 4 4 3 0 0 3 2	55		
		3 0 3 0 0 2 5 0 4 0 4 1 2 3 3 2 2 1 3 2 2 0 2 1 1	47	152	21.11.1938
		2 0 1 1 2 0 1 3 0 0 1 2 0 2 2 3 1 1 0 0 2 0 0 1 2	27		
		1 2 4 2 4 0 0 0 0 0 0 1 1 1 2 0 0 1 2 0 1 1 0 0 0	23		

Table xxxviii

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) LACTOSE. (ABSENCE OF HOST).

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	28.11.1938	2 2 2 1 0 6 0 5 0 6 0 4 3 3 2 2 3 2 2 3 2 2 0 4 1	57)	116	30.11.1938
		3 0 2 3 2 3 0 0 6 4 2 2 2 2 4 3 1 2 2 3 0 0 2 3 2	53)		
		0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 1 0 1 0 0 1 1 0	6)		
II.	28.11.1938	2 2 2 4 0 6 0 5 3 4 0 0 2 3 1 3 3 3 0 0 2 1 3 3 5	57)	112	30.11.1938
		3 3 2 3 2 2 2 3 2 3 4 2 4 3 2 2 1 2 2 3 2 0 1 0 2	55)		
III.	28.11.1938	4 3 2 0 5 0 2 4 3 3 3 2 3 2 2 2 3 2 1 2 2 3 3 0 0	56)	106	30.11.1938
		2 2 2 4 0 3 1 0 5 0 6 2 0 3 3 3 0 2 1 2 1 3 2 3 0	50)		
IV.	2.12.1938	2 4 2 1 2 2 1 1 3 2 1 0 0 6 3 0 7 5 3 3 4 3 0 1 1	57)	108	5.12.1938
		2 2 3 2 4 0 0 6 3 0 6 1 2 0 1 1 2 1 2 3 0 2 1 1 2	47)		
		0 0 0 0 0 1 0 1 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0	4)		
V.	2.12.1938	1 4 6 0 3 2 2 4 0 3 0 4 3 0 0 2 3 3 4 1 4 2 3 1 1	56)	104	4.12.1938
		4 3 2 2 0 6 0 0 0 3 2 2 1 2 2 3 1 1 1 2 4 1 1 2 3	48)		
VI.	2.12.1938	1 4 0 0 5 2 2 4 4 2 2 1 2 3 4 3 7 1 2 2 0 0 3 2 2	58)	108	4.12.1938
		3 1 2 1 1 0 0 6 4 2 2 0 5 0 2 3 1 2 2 4 4 0 0 1 4	50)		

Table xxxix

RESULT OF FEEDING ON OVIPOSITION (DISACCHARIDES) CELLOBIOSE. (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	8.12.1938	5 4 3 0 4 6 4 5 0 0 4 4 3 2 0 0 3 2 1 1 2 0 2 1 0	56	108	10.12.1938
		3 0 3 4 3 0 0 7 0 0 9 2 1 4 0 2 3 1 2 1 3 0 1 3 0	52		
II.	8.12.1938	5 3 4 0 6 0 0 1 3 3 5 3 3 1 3 2 1 4 3 0 5 0 0 0 0	55	111	10.12.1938
		3 6 3 0 3 7 1 4 0 8 4 1 1 3 2 3 0 3 2 2 0 0 0 0 0	56		
III.	8.12.1938	4 4 0 0 7 5 0 6 4 2 3 3 1 4 3 0 0 4 3 0 2 1 0 2 1	59	107	10.12.1938
		3 1 2 3 0 0 3 3 1 4 3 1 2 1 3 0 0 9 0 2 3 3 1 0 0	48		
IV.	12.12.1938	4 3 5 6 3 0 2 1 3 2 0 1 3 0 4 0 3 3 3 1 2 0 4 0 1	54	109	15.12.1938
		3 1 3 4 2 1 2 4 3 1 3 0 3 1 2 0 1 3 2 0 1 0 2 4 0	46		
		0 1 0 0 0 0 1 2 0 0 1 0 0 0 0 0 0 1 0 1 0 1 1 0 0	9		
V.	12.12.1938	3 2 3 2 3 1 2 9 1 2 1 3 1 3 3 1 6 0 0 4 0 0 1 2 4	57	106	14.12.1938
		1 2 1 2 2 2 2 1 2 5 9 3 0 3 3 0 2 0 0 6 0 2 0 1 0	49		
VI.	12.12.1938	4 1 2 2 1 3 3 1 2 0 0 6 3 5 0 3 1 2 2 3 2 2 2 1 1	52	109	14.12.1938
		2 1 1 2 0 1 6 1 2 1 2 0 1 2 0 1 7 3 4 2 2 4 0 1 1	47		

number of eggs was laid with sucrose feeding and maltose following it. The number of eggs laid with lactose and cellobiose feeding was more or less the same and was about 13 to 16 % less than those of sucrose and maltose. The parasite continued to lay eggs till the 5th day with sucrose and maltose while with lactose and cellobiose it laid eggs for 3 days. It may, however, be noted that with sucrose the parasite continued to live from 10 to 35 days. With maltose the parasite survived for 6 to 7 days. With lactose and cellobiose the majority of the parasites survived only for 2 days. The number of eggs laid on the 1st, 2nd, 3rd, 4th and 5th days with sucrose feeding varied from 53 to 66, 46 to 56, 23 to 29, 22 to 28 and 0 to 8 respectively. The corresponding averages were 54.8, 49.0, 26.8, 24.8, and 2.7. The percentages were 18.1, 16.2, 8.8, 8.2 and 0.9. With maltose the number of eggs laid on the successive days i.e., 1st, 2nd, 3rd, 4th and 5th days varied from 45 to 68, 40 to 47, 23 to 32, 17 to 25, and 0 to 5, with 53.2, 43.7, 27.8, 21.7 and 1.5 as the averages. The percentages were for the 1st, 2nd, 3rd, 4th and 5th days ~~were~~ 17.5, 14.4, 9.2, 7.2 and 0.5, In the case of lactose feeding the number of eggs varied from 56 to 58 on the 1st day; 47 to 55 on the 2nd day. Two parasites that lived on the 3rd day laid 4 and 6 eggs. The averages for the successive days were 56.8, 50.5, and 1.7, the percentages being 18.8, 16.7 and 0.6. Feeding

with cellobiose the parasites laid 52 to 59 eggs on the 1st day and 46 to 56 eggs on the 2nd day. The one parasite that survived on the 3rd day laid 9 eggs. The averages for the 1st, 2nd and 3rd days were 55.5, 49.7 and 1.5 respectively, the percentages being 18.3, 16.4, and 0.5.

The results obtained by feeding the parasites with disaccharides show that 17.5 to 18.8 % of the eggs in the ovaries were laid on the 1st day for the various sugars in the disaccharide group tried. On the 2nd day this percentage varied from 14.4 to 16.7. As with glucose and fructose of the monosaccharide group the percentage of the eggs laid on the 3rd and 4th days were half as much as those laid on the 1st and 2nd days. The number of eggs laid on the 5th day with sucrose and maltose and on the third day with lactose and cellobiose was not significant.

(e) <u>The effect of trisaccharide diet on oviposition</u>.

The primary data are given in Table XL. In this group raffinose was tried. The total number of eggs laid from emergence till death with this feeding was between 109 to 116. The average was 112.5, the percentage being 37.1. The parasites survived and laid eggs for 2 days. One solitary parasite lived and laid eggs for 3 days. The number of eggs laid on the 1st day varied from 54 to 63, while on the 2nd day it varied from 51 to 56. One parasite that lived

Table XL

RESULT OF FEEDING ON OVIPOSITION. (TRISACCHARIDES) RAFFINOSE (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	16.12.1938	3 2 3 4 2 2 3 3 3 2 0 2 4 0 7 0 4 3 3 5 2 1 0 0 1	59	113	18.12.1938
		5 5 0 9 4 0 0 0 3 2 3 3 2 2 0 1 3 0 3 4 0 1 2 2 0	54		
II.	16.12.1938	6 3 4 0 0 0 9 4 5 3 2 2 3 2 1 1 3 3 5 0 3 2 1 1 0	63	116	18.12.1938
		2 3 3 4 4 2 0 0 3 3 4 3 2 6 1 0 0 3 2 0 0 6 0 0 2	53		
III.	16.12.1938	0 5 2 3 6 4 8 3 2 1 0 0 0 3 2 4 4 3 1 2 2 2 1 1 1	60	111	18.12.1938
		3 2 2 3 2 0 2 4 0 3 3 0 1 2 4 2 2 3 2 1 4 4 1 0 1	51		
IV.	20.12.1938	4 3 3 2 0 0 6 0 0 5 4 3 2 0 1 2 4 6 0 0 3 4 0 0 2	54	109	22.12.1938
		3 3 0 0 5 4 2 0 1 3 2 0 0 2 2 3 2 3 4 5 3 1 3 3 0 2	55		
V.	20.12.1938	6 3 3 0 4 2 2 3 0 6 0 0 4 0 8 0 3 2 0 1 3 3 0 0 1	54	114	22.12.1938
		3 2 2 3 0 4 4 2 3 0 2 2 5 0 2 2 0 3 1 1 2 2 4 0 3	52		
		0 0 1 2 0 0 0 0 1 0 0 0 1 0 0 1 0 1 0 0 1 0 0 0 0	8		
VI.	20.12.1938	2 1 3 3 2 1 2 1 3 2 1 7 0 0 4 3 3 3 2 2 5 2 3 3 3	61	112	22.12.1938
		0 0 5 2 4 3 2 0 3 0 2 6 3 0 1 1 1 3 2 4 0 3 2 2 2	51		

on the third day laid 8 eggs. The averages for the 1st and 2nd days were 58.6 and 52.7 with 19.3 and 17.4 as the respective percentages.

(f) The effect of pentoses diet on oviposition.

The primary data are given in Tables XLI and XLII. The number of eggs laid from emergence till death was 107 to 119 for xylose and 105 to 113 for arabinose. The respective averages were 114.0 and 108.5; the percentages being 37.6 and 35.8. The parasite in general lived and laid eggs for two days for both the feeds. With arabinose one parasite, however, lived and laid eggs for 3 days.

The difference between the total number of eggs laid with xylose and arabinose feeding was not significant. The number of eggs laid with xylose/~~xxx~~ on the first and second days varied from 56 to 63 and 47 to 57, with 60.0 and 54.3 as the respective averages. The percentages were 19.8 and 17.9. The number of eggs laid with arabinose feeding was 52 to 59 for the 1st day and 51 to 55 for the 2nd day, the respective averages being 55.3 and 52.7. The percentages were 19.3 and 17.4. One parasite that lived on the 3rd day laid 3 eggs. There was no difference in the rate of oviposition with xylose and arabinose feeding for each of the 2 days when the parasite laid eggs. It may, however, be stated that the number of eggs laid on the 1st day was slightly more

Table XLI

RESULT OF FEEDING ON OVIPOSITION (PENTOSES) XYLOSE (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	2.1.1939	5 4 3 3 0 9 0 0 3 2 2 3 1 4 3 1 0 2 2 2 4 3 3 2 2	63)	119	4.1.1939
		0 3 5 0 0 4 2 2 3 3 3 0 4 2 2 3 2 0 3 3 4 2 2 3 1	56)		
II.	2.1.1939	4 0 3 3 5 6 3 3 3 3 2 1 7 3 0 0 0 0 4 2 1 3 1 1 2	60)	117	4.1.1939
		2 1 3 3 2 4 4 2 2 4 3 3 0 2 1 2 3 3 0 3 1 3 2 2 2	57)		
III.	2.1.1939	5 0 3 2 2 1 3 0 2 3 3 1 0 2 3 7 0 0 6 0 4 4 3 2 2	58)	114	4.1.1939
		3 3 3 0 6 2 0 0 1 2 3 0 0 4 4 4 2 1 5 0 4 4 2 1 2	56)		
IV.	6.1.1939	4 3 3 2 3 3 5 7 0 2 1 3 0 0 0 4 4 3 3 4 3 1 2 1 0	61)	118	8.1.1939
		2 3 0 0 9 3 0 2 0 0 2 2 4 3 3 2 3 2 2 3 4 2 1 2 3	57)		
V.	6.1.1939	0 4 3 3 4 3 3 2 4 3 2 2 1 1 3 4 2 3 0 0 0 3 2 3 1	56)	109	8.1.1939
		3 2 2 1 0 4 3 2 0 3 5 2 1 1 3 0 3 2 0 1 6 2 1 3 3	53)		
VI.	6.1.1939	3 1 4 1 4 3 2 3 3 5 0 0 0 4 3 2 2 2 0 5 6 3 3 3 0	62)	109	8.1.1939
		2 2 1 2 1 4 0 0 3 0 2 3 7 1 2 3 2 0 1 3 0 1 2 2 3	47)		

Table XLII

RESULT OF FEEDING ON OVIPOSITION (PENTOSES) ARABINOSE (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks Parasite died on
I.	10.1.1939	4 0 5 0 4 0 3 2 2 2 3 0 3 1 4 3 3 2 4 1 4 4 1 2 2	59	110	12.1.1939
		2 3 2 1 2 2 3 1 2 3 0 0 1 2 2 3 1 2 3 3 1 4 2 3 3	51		
II.	10.1.1939	3 2 2 1 3 3 4 3 2 1 1 1 2 4 3 9 1 0 0 0 3 2 2 1 2	55	107	12.1.1939
		1 2 3 3 4 3 4 2 2 6 3 0 0 3 2 1 1 0 0 1 2 2 3 1 3	52		
III.	10.1.1939	3 1 3 2 2 3 3 2 1 2 3 3 1 2 3 4 1 3 2 3 3 0 1 1 2	54	105	12.1.1939
		3 1 6 0 0 3 2 2 1 0 3 3 2 1 2 3 3 3 4 4 1 1 0 1 2	51		
IV.	15.1.1939	3 3 4 2 2 3 1 0 7 0 2 2 3 2 1 1 3 3 4 1 3 2 2 2 2	58	113	17.1.1939
		2 3 3 4 1 3 1 3 3 5 2 2 2 0 2 3 1 2 3 4 3 0 0 1 2	55		
V.	15.1.1939	3 1 3 1 2 3 4 6 2 2 3 1 2 2 4 5 1 3 1 0 0 2 1 0 0	52		
		1 3 2 0 9 0 0 4 2 3 1 4 3 2 2 2 1 2 0 3 1 1 2 6 0	54	109	18.1.1939
		0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0	3		
VI.	15.1.1939	4 2 3 0 1 2 3 1 2 2 0 6 0 0 8 1 3 4 2 2 1 3 0 0 4	54	107	17.1.1939
		2 2 1 1 2 3 3 0 1 2 2 1 0 0 4 3 6 1 4 0 8 2 2 0 3	53		

than that laid on the 2nd day.

(g) The effect of glucoside diet on oviposition.

The primary data are given in Table XLIII. With α methyl-d-glucoside diet the total number of eggs laid from emergence till death varied from 111 to 120. The average and the percentage were 115.2 and 38.0. The parasite lived and laid eggs for 2 days. The number of eggs laid on the 1st and 2nd days were 58 to 64 and 51 to 58. The averages were 60.8 and 54.3, the percentages being 20.1 and 17.9. As in the other cases the number of eggs laid on the 1st day was slightly more than that laid on the 2nd day.

(h) The effect of polysaccharide diet on oviposition.

The primary data are given in Tables XLIV and XLV. The total number of eggs laid with starch and dextrin feeding from emergence till death varied from 101 to 108 and 106 to 114, the respective averages being 104.0 and 110.2. The percentages were 34.3 and 36.4. The parasites lived and laid eggs for only 2 days for both the feeds. The difference in the total number of eggs laid with starch and dextrin feeding was not significant. With starch 52 to 57 eggs were laid on the 1st day and 46 to 55 on the 2nd day. The averages and the percentages were 54.7 and 49.3; 18.0 and 16.3. The number of eggs laid with dextrin feeding varied from 53 to 61 on the 1st day and 51 to 59 on the

Table XLIII

RESULT OF FEEDING ON OVIPOSITION. GLUCOSIDES (α-METHYL GLUCOSIDE) (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks: Parasite died on
I.	20.1.1939	4 3 3 4 5 6 0 0 0 8 3 2 0 1 3 3 4 3 2 0 3 1 2 2 2	64	118	22.1.1939
		3 3 2 3 1 3 2 2 0 4 3 2 5 4 4 3 0 3 0 0 2 2 1 1 1	54		
II.	20.1.1939	3 3 4 3 10 0 0 0 0 4 3 3 3 4 2 3 2 2 2 1 1 2 2 2 1	60	112	22.1.1939
		2 3 1 2 3 1 3 3 2 2 1 1 2 4 2 2 3 1 1 0 0 7 0 4 2	52		
III.	20.1.1939	3 2 1 6 3 1 2 4 1 9 3 3 1 2 3 1 3 1 2 0 3 3 1 0 0	58	114	22.1.1939
		4 4 1 3 2 1 5 2 2 4 3 2 0 4 3 1 6 0 0 1 1 4 1 1 1	56		
IV.	25.1.1939	4 3 4 6 4 3 3 2 3 0 0 2 1 1 3 2 2 1 4 3 3 3 1 2 2	62	120	27.1.1939
		3 1 2 2 3 4 3 3 1 2 2 2 1 4 3 3 3 2 2 1 2 3 2 2 2	58		
V.	25.1.1939	5 3 3 2 1 2 3 3 1 2 3 3 4 5 0 0 2 1 3 3 2 3 3 4 0	61	116	27.1.1939
		3 2 3 3 4 3 3 3 1 2 4 0 0 6 0 2 2 3 1 3 1 0 0 6 0	55		
VI.	25.1.1939	4 4 3 3 2 1 3 7 1 1 4 2 4 0 0 1 3 2 2 2 1 2 3 1 4	60	111	27.1.1939
		3 3 1 2 3 3 0 0 2 1 2 3 4 0 0 3 1 2 4 0 5 1 2 3 3	51		

Table XLIV

RESULT OF FEEDING ON OVIPOSITION (POLYSACCHARIDES) STARCH (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	1.2.1939	3 2 3 2 3 4 0 2 2 3 3 2 1 3 2 2 2 2 0 3 2 2 1 3 4	56	108	3.2.1939
		2 3 3 2 3 3 1 2 2 2 3 2 4 2 2 3 0 6 0 0 1 2 2 2 0	52		
II.	1.2.1939	4 4 3 1 3 3 0 5 0 2 2 3 3 0 4 3 2 2 0 1 2 3 0 2 2	54	101	3.2.1943
		3 2 1 0 2 3 3 2 2 1 3 3 1 2 8 2 4 0 0 2 2 1 1 2 2	47		
III.	1.2.1939	5 4 3 0 4 0 3 6 2 2 0 0 4 2 2 0 1 3 2 1 2 3 4 0 0	53	108	3.2.1939
		3 3 1 2 3 1 2 1 3 2 3 4 1 2 2 2 0 1 3 4 1 2 2 7 0	55		
IV.	5.2.1939	3 2 3 4 3 3 4 4 3 3 0 8 0 2 2 0 1 0 0 0 4 0 0 3 0	52	100	7.2.1939
		2 1 0 1 3 3 2 3 4 3 2 1 2 3 3 2 0 1 2 2 1 4 0 3 0	48		
V.	5.2.1939	4 6 3 0 2 3 0 3 3 2 2 3 3 3 1 2 2 4 2 3 0 0 2 1 2	56	104	7.2.1939
		3 2 2 3 1 3 2 2 2 4 3 3 2 2 4 1 1 2 1 1 1 0 1 0 1	48		
VI.	5.2.1939	1 2 0 4 3 3 5 6 0 2 0 4 3 2 1 2 1 2 3 4 3 3 0 1 2	57	103	7.2.1939
		3 1 3 1 2 1 2 2 1 2 3 4 1 0 4 0 5 0 0 4 1 2 1 1 2	46		

Table XLV

RESULT OF FEEDING ON OVIPOSITION (POLYSACCHARIDES) DEXTRIN (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	8.2.1939	1 1 4 3 3 4 0 3 5 4 3 3 4 3 0 4 1 3 1 1 0 1 2 1 2	57)	111	10.2.1939
		2 2 1 3 5 2 1 4 3 2 0 0 6 4 4 0 3 2 0 2 2 4 0 1 1	54)		
II.	8.2.1939	2 1 3 1 2 3 4 0 0 6 5 4 4 2 2 1 2 4 1 1 1 3 5 2 2	61)	114	10.2.1939
		3 2 1 0 1 3 2 2 1 4 3 3 7 2 1 2 2 3 1 2 1 1 2 2 2	53)		
III.	8.2.1939	3 2 5 4 3 1 3 6 3 2 2 1 2 0 4 3 1 2 1 2 2 2 1 0 1	56)	107	10.2.1939
		4 1 2 2 1 3 2 6 0 0 1 3 3 2 2 1 2 3 1 0 4 1 2 3 2	51)		
IV.	12.2.1939	5 3 0 4 0 2 3 3 1 3 3 2 1 1 4 0 6 3 3 1 2 2 1 0 0	53)	106	14.2.1939
		4 3 2 3 1 2 2 2 2 4 6 1 2 1 0 0 4 3 3 1 2 2 3 0 0	53)		
V.	12.2.1939	0 1 3 5 2 3 1 1 2 3 4 3 3 2 1 1 5 4 3 0 7 3 0 0 0	57)	110	14.2.1939
		1 2 3 3 3 4 2 2 2 1 2 3 9 0 0 0 1 2 3 3 2 2 1 1 1	53)		
VI.	12.2.1939	4 4 3 2 2 2 1 0 0 3 0 2 2 3 2 4 3 3 1 2 2 1 0 4 4	54)	113	14.2.1939
		2 6 3 1 2 3 3 2 0 3 4 1 0 3 2 2 2 4 3 2 2 4 1 2 2	59)		

2nd day. The respective averages were 56.3 and 53.8; the percentages being 18.6 and 17.8. The number of eggs laid on the 1st and 2nd days were almost the same for both the feedings for each day. As in the other feeds discussed before on the 1st day the parasite laid a few more eggs than on the 2nd day.

(i) The effect of polyhydric alcohols diet on oviposition.

The primary data are given in Tables XLVI and XLVII. With mannitol and sorbitol the total number of eggs laid from emergence till death varied from 107 to 113 and 105 to 109. The respective averages were 110.0 and 107.3; the percentages being 36.3 and 35.4. The difference between the averages for mannitol and sorbitol was not significant. The parasite lived and laid eggs for 2 days. With mannitol, however, one parasite lived and laid eggs on the 3rd day also.

The number of eggs laid on the first and second days with mannitol varied from 54 to 59 and 47 to 55. The averages were 57.0 and 51.8 with 18.8 and 17.1 as the respective percentages. The one parasite that lived on the 3rd day laid 7 eggs. With sorbitol feeding the number of eggs laid on the 1st and 2nd days varied from 51 to 58 and 49 to 56. The respective averages were 55.0 and 52.3 with 18.1 and

Table XLVI

RESULT OF FEEDING ON OVIPOSITION (POLYHYDRIC ALCOHOLS) MANNITOL (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	16.2.1939	4 5 3 0 2 0 6 0 6 3 2 2 4 0 3 0 2 3 1 1 2 4 3 3 1	59	110	18.2.1939
		2 1 2 2 1 9 2 3 1 2 1 2 2 1 2 6 3 3 1 0 0 0 0 1 4	51		
II.	16.2.1939	3 1 2 0 0 1 2 2 4 2 3 6 4 2 2 3 2 3 2 0 7 0 3 0 1	55	108	18.2.1939
		1 2 3 1 0 4 3 2 3 3 5 4 2 1 3 3 3 0 0 0 1 1 0 8 0	53		
III.	16.2.1939	0 2 2 5 3 2 3 2 2 3 3 4 0 0 3 2 0 0 6 0 5 2 4 4 0	57	112	18.2.1939
		3 1 2 3 4 3 3 1 1 0 2 2 2 3 2 0 3 2 3 1 4 2 3 5 0	56		
IV.	20.2.1939	1 3 2 3 1 4 0 6 0 4 3 5 0 6 3 2 1 3 0 4 3 3 0 0 2	59	113	23.2.1939
		1 2 3 0 0 9 0 4 0 7 0 0 3 2 2 1 3 2 1 1 0 0 0 0 6	47		
		0 0 0 1 1 0 1 2 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0	7		
V.	20.2.1939	4 5 4 3 0 0 9 3 2 0 2 2 0 0 3 4 5 0 0 3 2 1 0 1 1	54	107	22.2.1939
		3 3 2 4 3 3 0 2 2 1 3 3 4 3 0 2 1 0 1 2 3 1 1 3 3	53		
VI.	20.2.1939	6 0 0 4 5 3 0 3 5 0 3 2 4 3 3 3 1 2 2 4 3 1 0 0 1	58	110	22.2.1939
		3 2 3 3 0 3 0 6 1 2 4 4 3 2 1 1 1 3 3 1 2 0 1 1 2	52		

Table XLVII

RESULT OF FEEDING ON OVIPOSITION (POLYHYDRIC ALCOHOLS) SORBITOL (ABSENCE OF HOST.)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I.	24.2.1939	4 3 4 0 2 5 0 1 2 0 0 4 3 2 1 3 7 3 2 0 1 0 4 2 2	55	106	26.2.1939
		1 2 3 3 1 2 4 1 3 1 2 1 2 0 0 6 2 2 3 3 2 2 3 1 1	51		
II.	24.2.1939	3 3 1 6 2 1 4 1 1 0 0 9 0 4 2 2 2 1 0 4 3 3 2 1 2	57	109	26.2.1939
		4 3 3 8 0 0 3 2 3 0 5 4 0 2 1 3 1 0 2 0 3 2 1 1 1	52		
III.	24.2.1939	5 4 3 3 0 0 8 2 1 3 3 0 0 0 4 2 3 0 4 1 1 3 2 0 1	53	109	26.2.1939
		4 2 2 3 1 3 2 0 1 3 2 4 3 3 2 0 0 5 3 2 1 3 3 2 2	56		
IV.	28.2.1939	3 1 3 2 0 3 2 1 1 2 3 0 2 1 3 5 1 3 2 1 9 1 3 2 2	56	105	2.3.1939
		2 1 2 1 3 2 1 1 1 4 3 2 0 2 2 4 6 3 0 0 3 0 1 2 3	49		
V.	28.2.1939	2 4 3 3 0 5 3 3 2 1 4 3 4 2 3 3 0 0 5 2 4 1 1 0 0	58	108	2.3.1939
		1 2 3 1 1 2 3 0 0 5 4 0 0 7 2 3 0 3 4 0 3 0 2 2 2	50		
VI.	28.2.1939	3 2 0 0 9 3 2 1 1 2 2 1 3 1 2 2 4 3 1 1 2 1 3 1 1	51	107	2.3.1939
		2 0 4 5 3 3 2 1 3 3 2 1 1 2 2 2 0 1 2 3 3 4 3 2 2	56		

17.3 as the percentages. The difference between the averages for mannitol and sorbitol was not significant for both the 1st and 2nd days.

(j) Summary of results obtained from (a) to (i).

The minimum, the maximum, the average and the percentage of eggs laid from emergence till death and on the 1st, 2nd, 3rd and 4th days are given in Tables XXVII and XLVIII and Figs. 17, 18, 19, 20 and 21. The average number of eggs laid from emergence till death was maximum for sucrose and was slightly less for glucose, fructose and maltose, the total being about 150, which is the same as the number of developed eggs in the ovaries at the time of emergence. In the case of mannose, xylose and a methyl-d-glucoside about 115 eggs were laid. In the case of galactose and raffinose the number laid was about 112. With the other foods excepting no food and no water this number varied from 105 to 110. With no food and no water the parasite laid only 98 eggs. Thus it will be seen that the parasite was able to lay almost all the developed eggs with glucose, fructose, sucrose and maltose, while with galactose, mannose, raffinose, xylose and a methyl-d-glucoside the parasite was able to lay only about 75 % of the developed eggs. In the case of the other foods excepting no food and no water the parasite laid about 70 % of the developed eggs. When the

Table XLVIII

Number of eggs laid by Nemeritis Canescens on successive days and the percentage of the mean to the average number of eggs in the ovaries.

Food given	Absence of host																			
	1st day				2nd day				3rd day				4th day				5th day			
	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%
1. No food and no water	64	85	74.7	24.6	18	28	23.5	7.8												
2. Water given for drinking	88	92	89.8	29.6	16	19	17.0	5.6												
Monosaccharides																				
3. Glucose	45	64	50.2	16.6	36	47	40.3	13.3	27	31	28.7	9.5	26	32	27.7	9.1	1	2	.5	.2
4. Fructose	51	59	55.5	18.3	45	56	49.5	16.3	24	28	26.0	8.6	19	29	21.8	7.2	2	6	1.3	.4
5. Galactose	52	63	56.5	18.6	49	56	52.7	17.4	5	9	3.5	1.2								
6. Mannose	54	62	58.5	19.3	48	60	54.8	18.1	5	8	2.2	0.7								
7. Sorbose	53	58	55.8	18.4	45	54	49.0	16.2	5	5	.8	.3								
Disaccharides																				
8. Saccharose	53	56	54.8	18.1	45	56	49.0	16.2	23	29	26.8	8.8	22	28	24.8	8.2	4	8	2.1	.9
9. Maltose	45	58	53.2	17.5	40	47	43.7	14.4	23	32	27.8	9.2	17	25	21.7	7.2	4	5	1.5	.5
10. Lactose	56	58	56.8	18.8	47	55	50.5	16.7	4	6	1.7	0.6								
11. Cellobiose	52	59	55.5	18.3	46	56	49.7	16.4	9	8	1.5	.5								
Trisaccharides																				
12. Raffinose	54	63	58.5	19.3	51	55	52.7	17.4	8	8	1.3	.4								
Pentoses																				
13. Xylose	56	63	60.0	19.8	47	57	54.3	17.9												
14. Arabinose	52	59	55.3	18.3	51	55	52.7	17.4	÷	5	.5	.2								
Glucosides																				
15. ∝ Methyl-Glucoside	58	64	60.8	20.1	51	58	54.3	17.9												
Polysaccharides																				
16. Starch	52	57	54.7	18.0	46	55	49.3	16.3												
17. Dextrin	53	61	56.3	18.6	51	59	53.8	17.8												
Polyhydric Alcohols																				
18. Mannitol	54	59	57.0	18.8	47	55	51.8	17.1	÷	7	1.2	.4								
19. Sorbitol	51	58	55.0	18.1	49	56	52.3	17.3												
Standard error of mean			1.30				1.30				1.16				1.33					
Standard error of mean difference			1.84				1.84				1.64				1.88					

The minimum and the maximum figures given in this table refer only to the parasites that survived. The averages have been calculated on the basis of all the six replications.

No food, no water

Fed on water alone

MONOSACCHARIDES.

Glucose

Fructose

Galactose

Mannose

Sorbose

DISACCHARIDES.

Sucrose

Maltose

Lactose

Cellobiose

TRISACCHARIDES.

Raffinose

PENTOSES.

Xylose

Arabinose

GLUCOSIDES.

α methyl ^{d} glucoside

POLYSACCHARIDES.

Starch

Dextrin

POLYHYDRIC ALCOHOLS.

Mannitol

Sorbitol

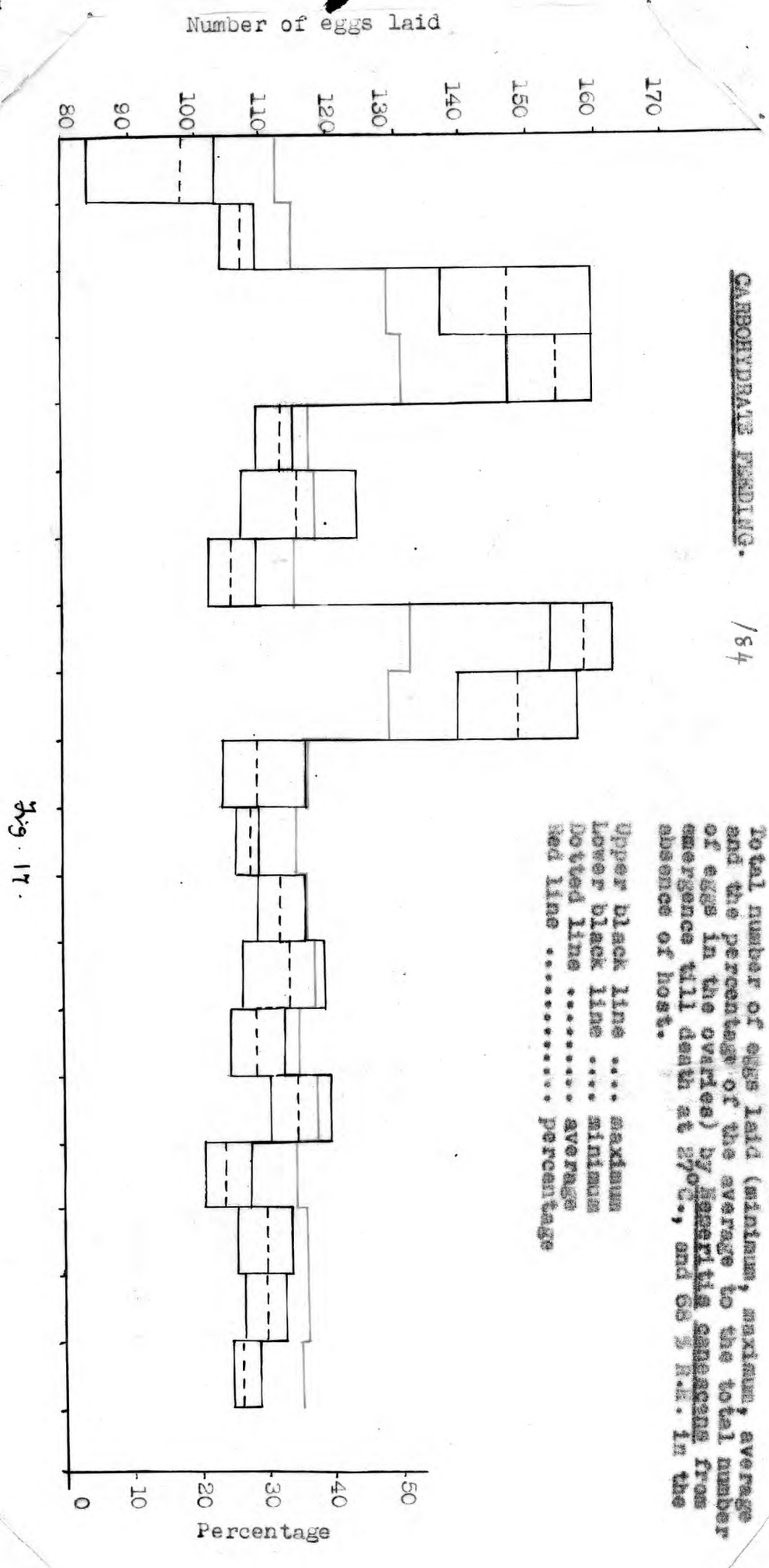
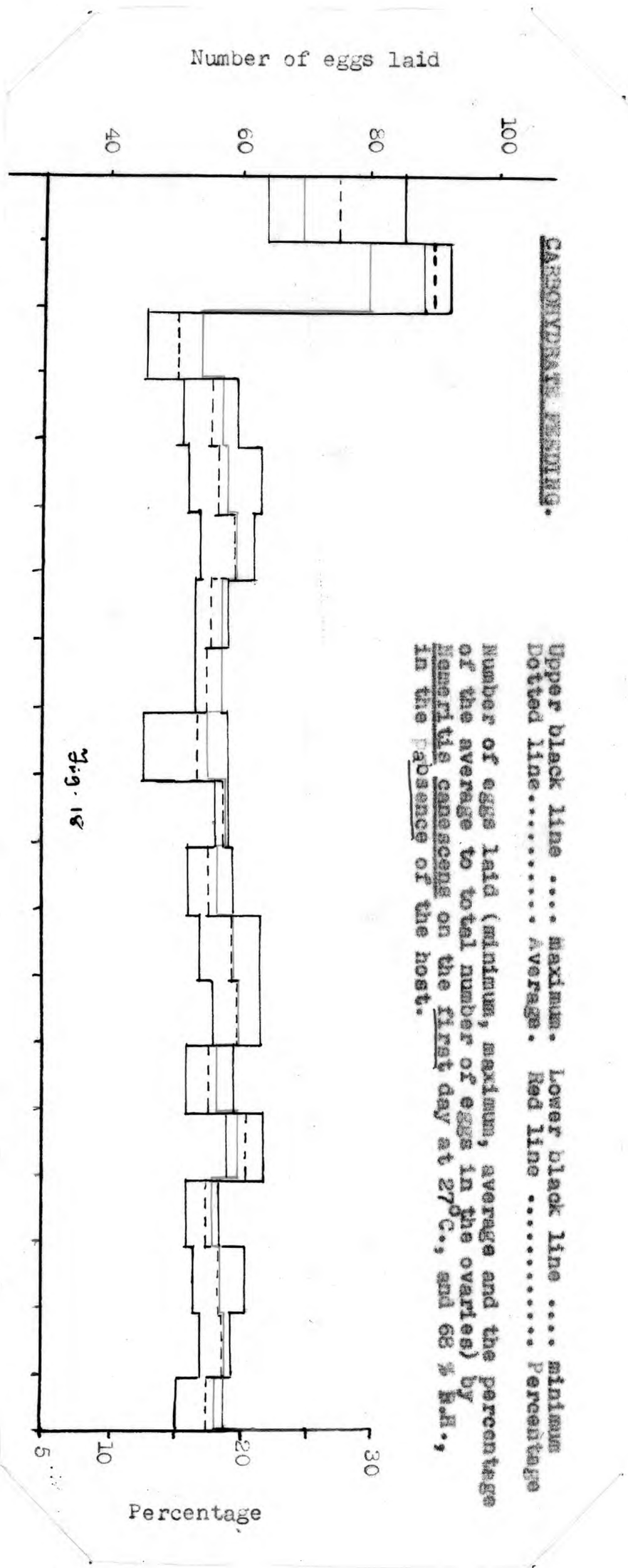


Fig. 17.

CARBOHYDRATE FEEDING. /84

Total number of eggs laid (minimum, maximum, average and the percentage of the average to the total number of eggs in the ovaries) by Heteritis senegens from emergence till death at 27°C., and 68 % R.H. in the absence of host.

Upper black line .... maximum
Lower black line .... minimum
Dotted line ..... average
Red line ..... percentage



CARBOHYDRATE FEEDING.

Upper black line .... Maximum. Lower black line .... minimum
Dotted line..... Average. Red line ..... Percentage

Number of eggs laid (minimum, maximum, average and the percentage of the average to total number of eggs in the ovaries) by Haemaphysalis cinnabarina on the first day at 27°C., and 68 % R.H., in the absence of the host.

Fig. 18

No food, no water

Fed on water alone

MONOSACCHARIDES.

Glucose

Fructose

Galactose

Mannose

Sorbose

DISACCHARIDES.

Sucrose

Maltose

Lactose

Cellobiose

TRISACCHARIDES.

Raffinose

PENTOSES.

Xylose

Arabinose

GLUCOSIDES.

α methyl-d-glucoside

POLYSACCHARIDES.

Starch

Dextrin

POLYHYDRIC ALCOHOLS.

Mannitol

Sorbitol

CARBOHYDRATE FEEDING.

Second day.

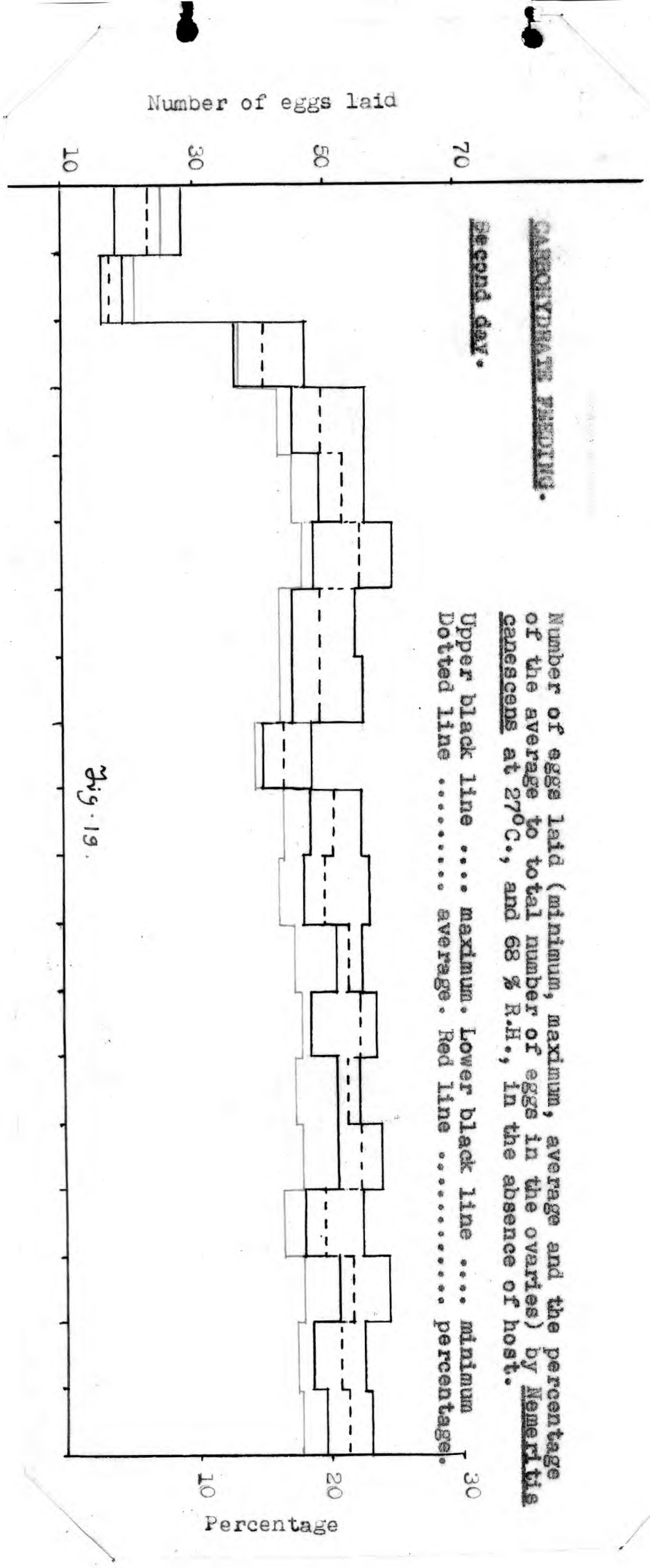


Fig. 19.

Number of eggs laid (minimum, maximum, average and the percentage of the average to total number of eggs in the ovaries) by Nemeritis canescens at 27°C., and 68 % R.H., in the absence of host.

Upper black line .... maximum. Lower black line .... minimum
Dotted line ..... average. Red line ..... percentage.

CARBOHYDRATE FEEDING.

Number of eggs laid (minimum, maximum, average and the percentage of the average to total number of eggs in the ovaries) by Nemeritis canescens at 27°C., and 68 % R.H., on the third day in the absence of host.

Upper black line .... maximum
Lower black line .... minimum
Dotted line ..... average
Red line ..... percentage

Fig 28.

No food, no water

Fed on water alone

MONOSACCHARIDES.

Glucose

Fructose

Galactose

Mannose

Sorbose

DISACCHARIDES.

Sucrose

Maltose

Lactose

Cellobiose

TRISACCHARIDES.

Raffinose

PENTOSES.

Xylose

Arabinose

GLUCOSIDES.

methyl glucoside

POLYSACCHARIDES.

Starch

Dextrin

POLYHYDRIC ALCOHOLS.

Mannitol

Sorbitol

CARBOHYDRATE FEEDING.

Upper black line..... maximum. Lower black line.... minimum
Dotted line..... Average. Red line ..... Percentage

Number of eggs laid (minimum, maximum, average and the percentage of the average to the total number of eggs in the ovaries) by Nemeritis canescens on the fourth day at 27°C., and 68 % R.H., in the absence of host.

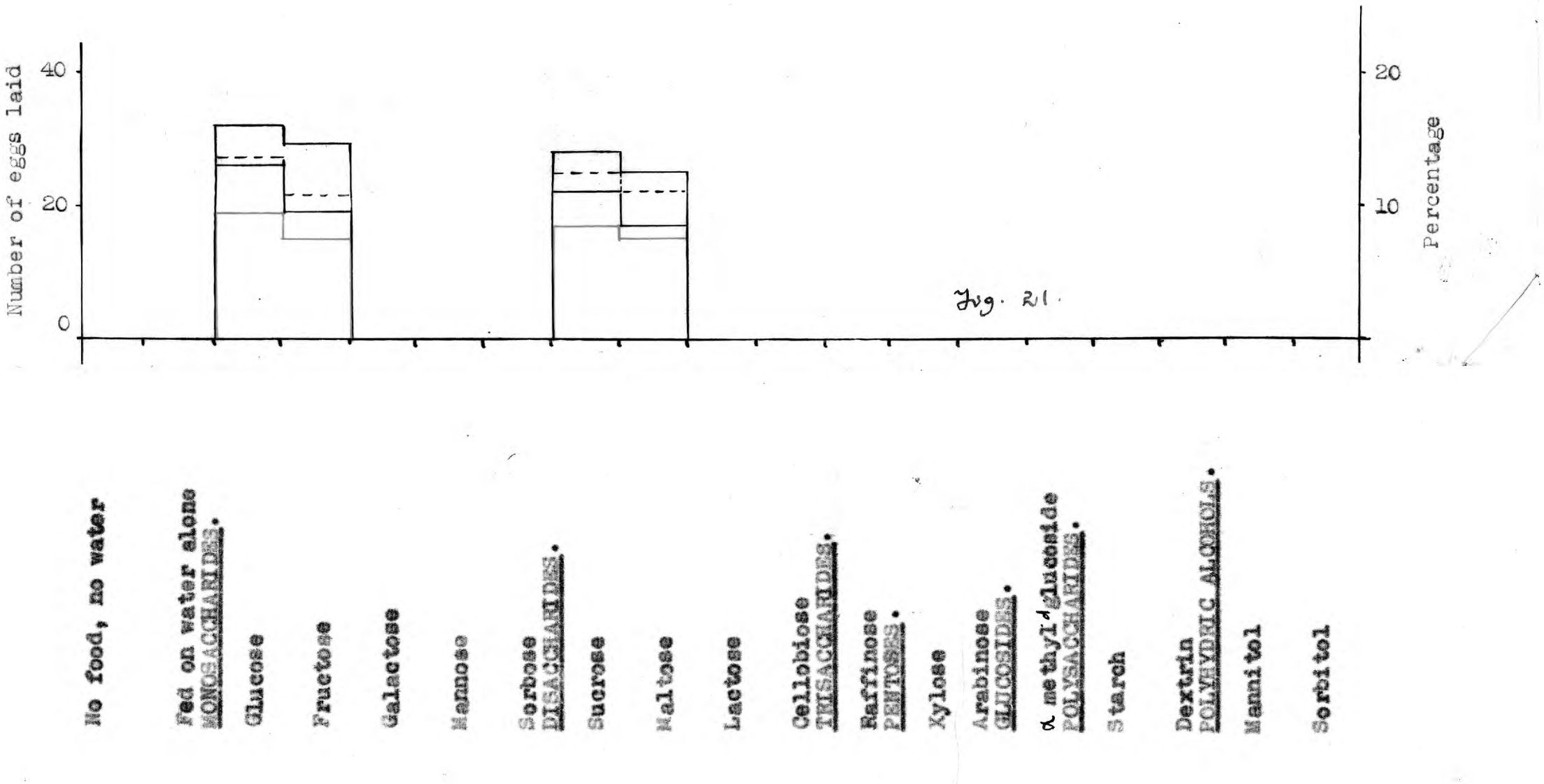


Fig. 21.

parasite was not fed it laid only about 65 % of the developed eggs in the ovaries. With all the foods excepting glucose, fructose, sucrose and maltose the parasite lived and laid eggs only for 2 to 3 days. In the case of glucose, fructose, sucrose and maltose the parasite lived for a considerably longer period but laid eggs only for 4 to 5 days. With glucose, fructose, sucrose and maltose feeding the parasites were able to live for a much longer period than they do in the presence of the host. This might be attributed to the fact that the number of eggs laid in the absence of host was much smaller than in the presence of host. These were mostly the developed eggs in the ovaries at the time of emergence. The undeveloped eggs did not mature as the parasite could not feed on the host and thus get the necessary protein. Comparing the number of eggs with various foods on different days it will be seen that the maximum number of eggs was laid with no food and no water and water given for drinking on the 1st day. With w water given for drinking the parasite was able to lay more eggs on the 1st day than with no food and no water. The percentage of eggs laid with these foods was 24.6 and 29.6 on the 1st day. The percentage of eggs laid on the 2nd day was considerably less than that of the 1st day and was 7.8 and 5.6 respectively. With the other foods the percentage

of eggs laid on the 1st day varied from 16.6 to 20.1. On the 2nd day the percentage varied from 13.3 to 17.9. With glucose, fructose, saccharose and maltose the percentage of eggs laid on the 3rd and 4th day varied from 7.2 to 9.5. The number of eggs laid during the remaining days was very low.

Thus it will be seen that the rate of oviposition on the 1st day was considerably more when the parasite was either not fed or fed with water alone. The greater proportion of the eggs was laid on the 1st day itself. With the other feeds the rate of oviposition was fairly high on both the 1st and 2nd days. As in the presence of host the rate of oviposition on the second day was slightly less than that on the 1st day. For the third and fourth days the oviposition rate for glucose, fructose, saccharose and maltose was only half as much as those for the 1st and 2nd days. This finding was more or less similar to that made in the presence of host.

D. <u>Protein with sucrose feeding: in the absence of host but laying eggs inside the host through muslin</u>.

(a) <u>The effect of centrifuged milk with sucrose diet on oviposition</u>.

(i) Milk + 3 parts of water + 5 % sucrose.

(ii) Milk+ 10 parts of water + 10 % sucrose.

The primary data are given in Tables XLIX and L. There was no significant difference in the fecundity of the parasite either in the total or at any stage during its life-period by feeding the parasite with milk and sucrose in the above strengths. Therefore (i) and (ii) have been dealt with together.

The number of eggs laid from emergence till death for milk with sucrose feeding varied from 173 to 180. The average and the percentage were 177.4 and 88.5. The parasite lived and laid eggs for 5 days. One parasite, however, lived for 6 days.

The number of eggs laid on the 1st, 2nd, 3rd, 4th and 5th days varied from 53 to 59, 46 to 51, 24 to 30, 23 to 28 and 13 to 23. The averages were 57.0, 48.2, 27.2, 25.7 and 18.4 respectively. The corresponding percentages were 18.8, 15.9, 9.0, 8.5 and 6.1. One parasite that was alive on the 6th day laid 6 eggs.

(b) <u>The effect of water extract of yeast with sucrose diet on oviposition</u>.

(i) Water extract of yeast + 5 % sucrose

(ii) Water extract of yeast + 10 % sucrose

The primary data are given in Tables LI and LII.

As in the case of milk the difference in the percentage of sucrose did not make any difference either in the total number of eggs laid or in the number of eggs laid

Table XLIX

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) 1 PART CENTRIFUGED MILK + 3 PARTS WATER + 5% SUCROSE.
(ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks Parasite died on
I	5.3.1939	3 4 3 4 0 0 0 4 4 7 6 0 3 2 2 0 3 1 2 0 2 2 1 0 5	58		
		1 2 2 3 0 1 5 1 3 0 1 3 0 0 3 1 2 2 2 1 2 2 2 3 4	46		
		2 1 1 2 2 1 3 1 2 2 0 3 3 1 1 1 0 1 1 0 1 0 1 0 0	30	179	10.3.1939
		1 1 0 1 1 2 0 1 2 0 1 2 0 0 1 2 1 0 1 2 0 0 1 2 2	24		
		0 1 2 2 3 0 1 2 0 1 0 1 1 0 1 0 0 1 1 1 0 1 1 0 1	21		
II	5.3.1939	3 3 3 2 2 0 0 6 4 5 0 3 3 3 2 0 2 1 3 2 1 2 2 3 4	59		
		2 2 4 3 3 2 0 0 4 1 2 5 1 3 2 0 1 2 0 4 3 0 1 1 2	48		
		2 1 2 0 0 2 0 0 1 0 3 2 1 2 1 2 1 2 0 0 3 2 0 0 2	29		
		1 1 2 0 1 2 2 1 1 0 0 2 0 2 1 0 0 1 2 0 2 0 1 1 0	23	176	10.3.1939
		0 1 2 0 0 0 0 1 1 2 0 1 2 0 1 1 1 1 2 0 0 0 1 0 0	17		
III	5.3.1939	5 4 4 3 5 3 0 0 4 3 3 0 2 0 0 4 3 5 2 2 1 1 2 0 1	57		
		1 0 3 6 3 2 5 1 0 2 0 4 0 3 1 0 4 4 4 0 4 2 0 0 1	50		
		1 2 2 1 0 0 3 1 1 2 2 0 2 2 1 0 0 1 2 0 0 0 0 0 0	25	173	10.3.1939
		0 1 2 2 2 0 3 3 0 0 1 0 1 2 2 2 2 0 2 2 1 1 0 0 0	28		
		0 1 1 2 0 1 0 1 0 1 0 0 0 0 1 1 1 0 1 2 0 0 0 0 0	13		

Table L.

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) ONE PART OF MILK + 10 PART OF WATER + 10% SUCROSE

(ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I	15.3.1939	6 0 0 3 4 3 2 4 3 3 3 0 2 1 2 1 1 2 2 4 1 2 5 3 1	58)		
		2 0 0 7 2 1 1 0 0 0 0 0 3 1 0 4 1 1 2 2 1 2 4 4 3 1	51)		
		1 2 1 2 0 3 1 1 2 2 1 0 1 2 1 0 0 1 2 0 0 1 1 2 2	29)	179	20.3.1939
		1 2 1 1 2 1 1 1 2 0 1 0 1 0 0 0 0 1 2 2 0 1 1 1 1	23)		
		0 1 1 1 0 2 2 1 0 0 0 0 0 0 1 2 0 0 2 1 0 0 2 1 1	18)		
II	16.3.1939	2 0 3 4 1 3 2 0 1 1 3 3 5 2 6 5 0 1 2 4 2 0 0 1 2	53)		
		0 2 2 1 4 2 0 3 0 6 2 2 2 2 3 1 3 2 1 2 3 2 0 1 0	46)		
		0 0 0 1 2 1 0 1 0 0 1 0 2 3 0 2 0 0 2 3 3 2 1 1 1	26)	177	20.3.1939
		0 0 1 0 2 0 1 0 0 2 2 1 0 2 0 2 2 1 2 2 1 3 1 2 1	28)		
		0 1 1 2 0 1 0 1 2 0 2 0 1 1 2 0 0 0 1 0 1 1 0 0 1	18)		
		0 0 0 1 0 0 0 1 0 1 0 0 0 1 0 0 0 1 0 0 0 0 0 1 0	6)		
III	16.3.1939	0 3 4 4 4 1 1 3 0 1 6 0 0 6 2 6 0 0 3 2 2 1 2 3 4	57)		
		1 0 2 4 2 0 2 0 6 1 1 0 3 2 2 2 0 3 3 2 1 2 2 3 4	48)		
		2 2 0 2 0 1 0 0 1 2 1 0 1 0 2 3 0 1 1 2 0 0 1 2 0	24)	180	20.3.1939
		2 3 2 0 0 0 2 2 0 1 0 1 2 2 1 2 1 2 2 0 0 0 1 2 0	28)		
		0 0 1 0 1 2 1 0 0 2 2 2 0 2 1 1 0 0 2 1 2 0 0 3 0	23)		

Table LI

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) WATER EXTRACT OF YEAST AND 5% SUCROSE (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks Parasite died on
I.	27.3.1939	5 6 0 3 2 2 0 2 0 2 1 1 3 2 1 0 4 4 4 3 1 1 3 4 1	56		
		0 3 4 3 2 5 0 0 0 0 3 4 4 3 2 2 1 2 2 1 2 3 0 0 2	53		
		1 2 1 1 2 2 0 1 2 2 2 0 1 2 1 2 0 0 1 2 0 0 2 0 0	27		
		2 2 0 0 1 0 1 0 0 1 2 1 0 1 2 2 0 0 0 0 2 0 1 2 2	22		
		0 1 1 2 0 0 1 2 1 2 0 1 1 2 0 2 0 0 0 0 0 1 0 0 0	17	193	3.4.1939
		0 1 2 0 1 0 2 1 1 0 1 0 0 1 0 1 0 0 0 0 0 1 0 0 0	12		
		0 0 0 1 0 2 0 0 0 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6		
II.	27.3.1939	2 4 4 9 0 0 6 0 4 0 4 4 4 3 2 2 3 4 0 0 0 0 2 1 1	59		
		0 3 2 3 4 0 3 2 2 3 0 0 2 1 1 5 0 3 2 3 3 3 1 2 1 0	47		
		0 1 2 2 1 0 1 2 0 1 1 1 2 0 0 0 2 2 0 1 1 0 1 1 1	23		
		0 2 1 1 0 2 0 0 1 2 2 1 0 1 1 2 2 0 0 3 0 0 1 1 1	24	189	3.4.1939
		0 2 1 1 0 1 2 0 1 1 2 0 1 0 0 0 1 2 2 0 1 1 0 0 0	19		
		0 0 0 1 2 0 0 0 1 4 0 0 0 0 1 2 0 0 1 0 0 0 0 0 0	12		
		0 0 1 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0	5		
III.	27.3.1939	5 1 3 1 4 0 6 0 2 2 2 0 4 3 1 0 4 2 3 1 3 2 0 1 1	51		
		0 4 4 0 2 2 1 0 2 3 3 7 0 1 2 0 3 4 0 0 1 3 0 1 1	44		
		2 3 1 2 1 1 2 0 2 1 1 2 1 1 2 0 0 2 1 0 1 0 1 0 0	27		
		1 2 0 1 1 1 2 0 1 0 1 1 2 2 0 1 0 0 1 0 0 1 2 2 1	23		
		2 0 1 1 0 2 0 1 0 1 0 1 0 1 2 0 0 1 0 0 1 0 0 0 0	14	173	3.4.1939
		0 1 0 0 0 0 0 1 1 0 1 2 0 0 1 0 0 1 1 0 0 0 1 0 0	10		
		0 0 0 1 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0	4		

Table LII

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) WATER EXTRACT OF YEAST AND 10% SUCROSE (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks Parasite died on
I	10.4.1939	4 1 4 0 3 0 2 3 4 1 0 1 5 1 2 2 0 7 3 2 3 0 1 2 1 6 2 0 2 2 1 0 3 2 3 1 0 3 5 4 0 3 3 1 0 3 4 1 4 0 2 0 2 2 0 1 3 1 0 2 0 1 0 1 2 2 2 1 0 2 1 0 1 1 2 2 1 2 0 2 0 1 0 0 0 1 1 1 0 2 1 3 1 0 3 2 2 2 1 2 0 1 0 2 2 0 1 2 0 1 0 1 0 0 0 1 0 0 1 0 1 1 1 0 0 0 0 0 1 0 0 1 1 0 0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0	52) 53) 29) 30) 15) 6) 3)	188	17.4.1939
II	10.4.1939	3 3 0 4 0 2 3 0 1 0 0 4 3 2 1 4 0 1 5 1 2 0 2 6 1 5 2 3 0 3 2 1 3 1 3 0 3 6 0 0 2 2 1 3 0 1 0 1 2 2 2 2 1 2 0 1 2 0 2 0 0 2 2 2 0 1 0 1 1 0 0 1 1 0 1 1 2 0 1 1 2 1 2 1 1 2 2 0 1 2 0 1 1 2 0 0 1 2 0 0 0 1 2 0 0 1 0 1 2 1 1 0 0 1 0 1 0 2 1 0 1 0 0 1 1 0 0 1 0 0 1 0 0 2 0 1 0 0 2 0 0 0 1 0 0 2 0 0 1 1 0 0 0 0 0 1 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0	53) 46) 24) 26) 18) 12) 4) 3)	186	18.4.1939
III	10.4.1939	2 4 1 3 0 0 5 2 1 0 4 6 0 3 3 2 1 0 4 2 3 4 3 2 1 3 2 1 0 3 0 4 4 2 2 5 3 4 0 3 0 1 1 2 2 3 0 1 1 2 1 1 2 0 1 3 0 1 1 4 0 1 1 1 1 1 2 2 0 1 2 0 0 1 2 0 0 1 1 1 0 0 2 0 2 0 2 2 2 1 1 1 1 0 2 0 1 2 2 1 0 2 1 0 0 0 2 0 0 1 0 0 0 1 0 1 1 2 1 1 0 1 1 1 1 0 1 1 0 0 2 1 0 0 1 0 1 0 1 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 1 0 0	56) 49) 29) 25) 17 11) 5)	192	17.4.1939

on various days. Therefore (i) and (ii) are discussed together.

The total number of eggs laid from emergence till death varied from 173 to 193; the averages and the percentages being 186.9 and 61.6. The parasite lived and laid eggs till the 7th day. One parasite survived and laid eggs on the 8th day also.

The parasite laid 51 to 59 eggs on the 1st day, 44 to 53 eggs on the 2nd day, 23 to 29 eggs on the 3rd day, 22 to 30 eggs on the 4th day, 14 to 19 eggs on the 5th day, 6 to 12 eggs on the 6th day and 3 to 6 eggs on the 7th day. The one parasite that survived on the 8th day laid 3 eggs. The averages for the respective days were 54.5, 48.7, 26.5, 25.0, 16.7, 10.5, and 4.7; the corresponding percentages were 18.0, 16.1, 8.8, 8.3, 5.6, 3.5 and 1.6.

(c) <u>The effect of autolysed yeast with sucrose diet on oviposition</u>.

(i) Autolysed yeast and 5 % sucrose

(ii) Autolysed yeast and 10 % sucrose.

The primary data are given in Tables LIII and LIV. Here also the difference in the total number of eggs laid from emergence till death or the number laid on successive days between the two strengths tried was not significant and hence (i) and (ii) have been discussed together.

Table LIV

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) AUTOLYSED YEAST AND 10% OF SUCROSE (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks Parasite died on
I	5.5.1939	0 2 4 1 2 0 3 5 3 2 3 0 3 4 3 3 2 2 4 0 3 3 0 2 2 3 1 3 0 3 0 2 3 0 0 3 4 3 2 3 2 3 0 0 2 4 0 4 3 3 1 2 2 1 2 3 0 1 0 0 1 1 1 2 2 0 0 2 1 1 2 2 0 0 1 0 1 2 2 2 1 1 1 1 2 1 0 1 1 1 0 1 1 0 0 2 1 1 1 1	56) 51) 28) 25)	160	9.5.1939
II	5.5.1939	3 4 0 2 3 2 0 3 3 2 0 3 1 2 3 3 2 3 4 3 4 0 3 1 1 1 2 1 3 2 0 1 1 2 2 3 1 0 3 4 7 2 1 2 2 2 3 1 1 3 0 1 1 1 2 0 1 2 2 2 1 1 0 1 2 1 1 2 2 0 0 1 1 1 0 2 1 1 0 1 2 1 2 2 1 1 0 2 0 1 0 0 2 2 2 1 2 2 0 0	55) 50) 26) 28)	159	9.5.1939
III	5.5.1939	3 2 6 2 0 4 3 0 4 2 1 2 2 0 5 0 1 0 1 4 4 3 0 2 1 4 3 4 0 0 0 5 0 6 3 2 4 0 0 3 1 2 0 0 0 8 2 0 1 0 2 1 0 2 2 0 2 2 0 2 0 1 0 2 2 2 1 3 1 0 0 1 1 2 0 1 0 1 0 2 3 1 2 1 2 3 0 0 2 0 1 1 0 1 1 2 1 0 2 2	52) 48) 29) 29)	158	9.5.1939

Table L III

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) AUTOLYSED YEAST AND 5% SUCROSE (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I	25.4.1939	4 0 3 0 3 0 0 2 3 5 4 3 0 3 2 3 4 2 3 0 2 0 2 1 0 2 2 0 0 1 1 2 3 4 6 0 0 2 3 4 3 0 3 2 2 3 4 0 0 1 2 3 2 0 2 0 1 1 2 0 2 2 0 1 1 3 1 0 2 1 0 1 0 1 1 0 2 2 2 0 3 1 1 1 2 0 1 1 2 0 0 1 1 1 1 2 1 2 0 0	49) 48) 29) 27)	153	29.4.1939
II	25.4.1939	4 3 4 0 0 5 3 2 0 3 3 0 3 0 3 3 4 3 0 0 2 3 1 1 2 3 3 2 4 0 2 2 3 3 3 0 2 2 2 1 3 0 0 3 4 3 5 0 0 0 0 2 0 2 1 0 0 3 0 2 1 2 1 0 0 1 1 2 1 2 1 2 1 2 0 1 2 1 1 2 1 2 2 1 0 1 1 2 0 0 1 0 2 2 2 0 1 1 1 1	52) 50) 27) 28)	157	29.4.1939
III	25.4.1939	4 2 2 1 3 3 2 0 2 5 4 0 3 0 1 1 2 3 4 3 1 2 4 1 1 2 2 2 2 1 0 2 2 0 1 2 0 1 2 0 3 4 3 3 3 2 0 3 4 3 2 2 1 2 1 0 0 2 2 0 1 2 3 0 2 0 2 2 1 1 0 0 2 0 0 2 0 1 2 2 2 2 0 0 1 2 0 0 1 1 1 1 2 1 2 0 0 3 0 4	54) 47) 28) 30)	159	29.4.1939

The number of eggs laid from emergence till death varied from 153 to 160. The average and the percentage were 157.7 and 82.1. The parasite lived and laid eggs for 4 days.

It laid 49 to 56 eggs on the 1st day, 47 to 51 eggs on the 2nd day, 26 to 29 eggs on the 3rd day and 25 to 30 eggs on the 4th day. The averages for the respective days were 53, 49, 27.9, and 27.8. The corresponding percentages were 17.5, 16.2, 9.2, and 9.2.

(d) <u>The effect of meat-juice with sucrose diet on oviposition</u>.

(i) Meat-juice + 3 parts of water + 5 % sucrose

(ii) Meat-juice + 10 parts of water + 10 % sucrose.

The primary data are given in Tables LV and LVI. The difference in the fecundity of the parasite fed in these two strengths was not significant at any time and hence as in the previous cases (i) and (ii) are dealt together.

The number of eggs laid during the life of the parasite varied from 153 to 164. The average and the percentage were 158.7 and 82.4 respectively. The parasite lived and laid eggs for 5 days. One parasite, however, lived and laid eggs on the 6th day also.

The number of eggs laid on the 1st, 2nd, 3rd, 4th and 5th days varied from 53 to 57, 44 to 52, 24 to 29, 12 to 28 and 3 to 12 respectively. The respective averages

Table LV

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) ONE PART MEAT JUICE, THREE PARTS OF WATER & 5% SUCROSE (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks: Parasite died on
I	15.5.1939	4 1 4 6 0 2 1 0 3 9 4 0 1 2 0 2 3 3 2 2 0 0 1 3 2	55)		
		3 4 1 2 0 3 0 3 4 2 3 1 0 2 3 0 1 4 0 2 3 3 1 0 2	47)		
		2 0 0 2 2 2 2 2 1 0 3 2 2 2 1 0 1 0 1 0 0 0 1 0 1	27)	157	20.5.1939
		1 2 0 0 2 0 1 1 0 0 2 1 0 0 2 2 1 2 0 0 2 0 1 0 0	20)		
		0 1 2 0 0 1 1 1 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0	8)		
II	15.5.1939	2 1 0 4 3 3 5 0 4 4 0 3 3 2 3 0 1 2 2 4 3 3 0 1 0	56)		
		0 3 1 1 2 3 1 4 2 0 3 1 1 2 4 2 2 0 3 0 0 1 5 0 3	44)		
		2 0 2 0 2 0 0 2 0 1 0 1 0 2 2 1 1 1 2 0 1 2 1 1 0	24)	155	20.5.1939
		1 2 0 1 2 2 0 1 2 0 2 2 1 0 0 1 2 2 1 0 0 1 1 1 0	25)		
		0 0 1 0 1 0 1 0 1 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0	6)		
III	15.5.1939	2 3 1 2 5 3 1 2 3 3 0 4 1 2 0 6 3 2 0 1 5 4 0 2 2	57)		
		0 3 0 3 2 0 0 2 4 0 4 3 0 2 3 2 2 1 2 2 3 4 2 0 2	52)		
		2 0 3 0 0 1 1 2 2 2 2 0 2 0 2 0 0 2 0 1 1 1 1 0 1	26)	153	20.5.1939
		1 1 2 0 0 1 1 0 0 0 0 1 2 0 0 0 1 0 0 1 0 0 0 0 1	12)		
		0 0 0 0 1 0 0 0 0 0 0 0 1 1 1 0 0 0 1 0 0 1 0 0 0	6)		

Table LVI

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) ONE PART OF MEAT JUICE, TEN PARTS OF WATER & 10% SUCROSE (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I	25.5.1939	5 1 3 4 2 6 3 0 3 1 0 2 0 2 2 4 0 0 4 0 3 2 3 2 2	54)		
		4 3 3 0 9 0 3 2 0 1 3 2 0 5 0 4 3 0 0 2 2 1 0 0 0	47)		
		2 1 0 1 2 1 0 0 1 2 2 1 2 1 2 2 1 0 1 2 0 1 1 0 1	27)		
		0 1 2 1 0 1 2 2 1 2 0 1 0 1 2 2 2 2 1 1 1 1 0 1 1	28)	164	31.5.1939
		0 0 1 0 1 0 1 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0	5)		
		0 0 0 0 1 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	3)		
II	25.5.1939	3 3 4 0 2 1 3 4 5 2 0 3 0 5 0 3 3 2 2 0 0 2 3 1 2	53)		
		1 2 3 0 4 0 4 3 2 3 2 2 3 3 3 4 0 0 3 0 0 4 3 1 0	49)		
		2 1 2 0 1 2 2 3 0 1 1 1 2 0 0 1 0 1 2 2 2 0 1 2 0	29)	162	30.5.1939
		1 0 0 1 0 0 1 0 0 1 0 0 2 2 0 2 0 2 0 0 1 2 2 2 0	19)		
		0 1 0 1 0 2 1 1 0 1 1 0 1 1 1 0 0 0 0 1 0 0 0 0 0	12)		
III	25.5.1939	1 2 1 3 2 1 4 2 4 3 3 0 0 3 5 3 3 0 4 3 2 2 0 0 2	56)		
		3 0 4 0 3 0 6 3 4 3 2 2 0 0 2 1 3 4 3 0 3 2 3 0 0	51)		
		2 1 2 0 0 0 0 0 1 1 2 2 1 1 2 1 0 1 0 2 1 2 1 0 1	24)	161	30.5.1939
		1 1 2 1 1 2 2 1 0 2 1 0 2 2 2 0 1 3 1 0 0 0 1 1 1	28)		
		0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0	3)		

were 56.0, 48.4, 26.2, 22.0, and 6.7. The percentages were 18.2, 16.0, 8.7, 7.3, and 2.2. The one parasite that lived on the 6th day laid 3 eggs on that day.

(e) <u>The effect of larval extract with sucrose diet on oviposition</u>.

(i) 1 part of larval extract + 3 parts of water + 5 % sucrose.

(ii) 1 part of larval extract + 10 parts of water + 10 % sucrose.

The primary data are given in Tables LVII and LVIII. Taking the total number of eggs from emergence till death the parasite fed with (ii) (where protein strength was less and sucrose strength more) was able to lay slightly larger number of eggs than with (i) . The number for (i) varied from 200 to 204 and that for (ii) varied from 210 to 218. The averages were 202.3 and 215.0, the percentages being 66.8 and 70.9. There was no significant difference in the number of eggs laid on the successive days for the two strengths tried. Therefore the data pertaining to the successive days have been dealt together. The parasite lived and laid eggs upto the 11th day. One parasite lived and laid eggs on the 12th day also.

The number of eggs laid varied from 52 to 56 on the 1st day, 42 to 52 on the 2nd day, 19 to 26 on the 3rd day,

Table LVII

RESULT OF Feeding ON OVIPOSITION (PROTEIN FEEDING) ONE PART LARVAL EXTRACT + 3 PARTS OF WATER + 5% SUCROSE
(ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks Parasite died on
I	5.6.1939	3 2 3 0 0 4 5 3 3 2 0 2 3 3 2 3 6 4 3 0 1 0 0 1 0	54		
		2 1 0 2 3 0 3 0 3 4 3 2 2 0 3 0 0 1 3 2 1 2 3 2 0	42		
		1 2 1 0 1 2 2 1 0 1 0 0 2 0 0 1 0 0 0 2 1 1 1 2 1	22		
		1 0 2 0 1 2 0 1 1 0 0 1 1 0 0 1 2 2 2 0 1 1 0 1 1	21		
		0 2 1 0 0 1 2 0 1 0 0 1 1 1 1 1 0 1 1 0 0 0 0 0 1	15	204	15.6.1939
		0 1 1 1 0 1 0 1 1 0 1 1 1 1 0 1 0 1 0 2 0 1 1 0 0	16		
		0 1 1 1 0 0 1 0 1 0 0 1 0 1 1 1 1 0 0 1 0 0 0 1 0	12		
		0 1 1 1 0 0 1 1 1 0 1 1 0 1 1 0 0 0 0 0 0 0 0 0 0	10		
		0 0 0 1 0 0 1 0 0 0 0 0 1 1 1 0 0 1 0 0 0 1 0 1 0	8		
		0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 1 0 0 1 0 0 0 0 0 0	4		
II	5.6.1939	0 5 6 3 0 0 1 4 0 2 2 2 0 4 5 3 0 4 1 2 1 3 3 0 1	52		
		3 2 0 6 3 3 2 0 4 3 2 1 0 5 0 0 2 3 3 0 2 2 2 1 0	49		
		1 1 1 2 1 2 1 1 1 1 2 0 1 2 0 0 1 1 0 0 1 0 0 2 0	22		
		2 1 0 0 1 2 0 0 1 1 1 1 1 1 1 2 0 1 1 0 1 0 2 2 1 1	23		
		0 0 1 1 1 0 2 1 1 1 1 0 1 1 2 0 1 0 0 0 0 0 1 0 0	15		
		0 1 1 0 2 0 0 0 1 0 1 0 1 1 1 1 1 1 1 0 0 0 0 0 1 1	14	203	16.6.1939
		0 0 0 1 0 0 0 0 0 0 0 2 0 1 0 0 0 0 1 0 0 0 0 1 1 1	8		
		0 0 0 0 1 1 0 0 0 1 0 0 0 1 1 1 0 1 0 0 0 0 0 0 0	7		
		0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 1 0 0 2 0 0 0 0 1 0 0	6		
		0 0 1 0 1 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0	4		
		0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0	3		

Table LVII (Contd)

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) ON 1 PART LARVAL EXTRACT + 3 PARTS OF WATER + 5% SUCROSE (ABSENCE OF HOST)

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
III	5.6.1939	0 3 4 3 0 4 2 2 0 3 3 4 5 0 4 3 0 0 2 7 0 1 2 2 1	55)		
		4 3 3 0 2 1 3 4 3 3 4 0 0 4 0 0 0 0 0 0 1 2 2 3 1	43)		
		0 2 1 1 1 0 2 1 1 0 1 1 1 1 0 0 1 0 1 1 1 1 1 0 0	19)		
		1 0 1 2 0 3 0 1 1 2 0 0 1 0 0 1 2 0 1 0 1 1 2 1 1	22)		
		0 1 1 1 0 1 1 1 0 0 0 0 1 1 1 2 0 0 0 1 0 0 0 0 0	12)	200	16.6.1939
		0 1 1 2 0 0 3 0 0 1 0 1 0 0 0 0 0 0 1 2 0 0 1 0 0 0	13)		
		0 0 0 1 2 0 0 0 0 0 0 1 1 1 0 0 0 1 0 0 0 2 0 0 0	9)		
		1 1 2 0 1 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 1 2 0 0	10)		
		1 0 0 1 1 0 0 0 1 0 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0	7)		
		0 1 0 0 0 0 0 0 0 0 0 0 2 0 1 0 0 0 0 1 0 0 1 0 0 0	6)		
		0 1 2 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4)		

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING) ONE PART OF LARVAL EXTRACT, 10 PARTS OF WATER AND 10% SUCROSE (ABSENCE OF HOST)

Table. L viii

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks Parasite died on
I	25.6.1939	7 0 4 0 3 5 3 0 0 2 0 0 2 0 3 2 3 3 3 4 2 3 0 1 2	52)		
		0 2 0 4 3 3 0 2 2 3 3 3 0 4 1 2 0 2 2 5 0 1 1 2 2	47)		
		0 2 0 1 2 1 0 0 2 1 1 0 1 1 1 0 2 0 2 0 0 1 1 0 1	20)		
		1 2 1 2 3 0 0 2 0 2 1 1 0 1 0 0 1 0 2 1 2 1 0 1 0	24)		
		0 2 1 0 1 0 2 0 1 2 0 2 2 3 0 0 0 0 0 1 0 1 0 0 0	18)	217	7.7.1939
		2 0 1 2 0 0 0 0 1 0 0 2 1 0 0 0 1 1 2 0 3 0 0 0 0	16)		
		0 0 0 1 0 0 0 0 0 1 1 1 0 1 0 0 0 2 2 0 0 0 0 0 0	9)		
		0 0 0 1 0 0 1 1 2 0 0 1 1 0 1 0 1 0 0 1 0 0 1 0 0	11)		
		0 0 0 0 0 1 0 1 0 1 0 0 0 0 0 1 0 2 0 0 0 0 1 0 0	7)		
		0 0 0 0 0 0 0 0 2 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 0	6)		
		0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 1 0 0	5)		
		0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2)		
II	25.6.1939	5 0 3 4 0 0 2 0 3 4 0 3 3 2 2 3 3 0 0 0 0 6 0 0 3	53)		
		4 3 3 0 5 3 4 0 0 4 0 2 2 2 8 0 0 0 2 1 1 2 2 2 1	51)		
		0 1 2 1 1 1 2 0 0 3 0 0 1 0 1 0 0 1 0 2 0 1 1 1 4	23)		
		1 0 0 0 3 0 0 4 2 2 1 1 1 2 0 1 0 1 1 2 2 0 0 1 1	26)		
		0 0 1 1 0 1 2 0 0 3 0 0 0 1 1 1 1 1 1 2 0 0 1 0 2 0	18)	218	6.7.1939
		0 1 2 0 1 1 1 0 0 0 0 2 1 0 1 0 1 1 0 2 0 0 0 0 0	14)		
		0 0 1 0 1 0 0 0 1 1 1 0 1 0 1 1 0 1 1 0 1 0 1 0 0	12)		
		0 0 0 0 1 0 0 0 0 0 2 1 0 1 0 1 1 1 0 0 0 0 0 0 0	8)		
		0 0 0 0 0 1 0 0 1 0 0 0 0 1 1 0 1 1 0 0 0 0 0 0 0	6)		
		0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 0	4)		
		0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0	3)		
III	25.6.1939	3 4 0 3 2 0 4 0 3 3 3 4 3 3 3 3 0 0 6 0 0 2 2 2 3	56)		
		6 0 1 0 1 2 3 4 5 0 9 4 2 3 0 0 2 2 3 0 4 0 0 1 0	52)		
		2 2 1 0 0 1 2 0 0 1 1 0 2 2 1 2 1 2 0 1 2 0 1 1 1	26)		
		0 1 1 1 0 2 0 0 1 0 0 2 0 1 1 2 2 0 1 1 2 1 0 1 2	22)		
		0 2 0 1 0 0 1 0 1 1 0 1 1 1 1 0 1 1 0 0 1 2 0 1 1	17)	210	5.7.1939
		0 0 1 0 2 1 1 1 0 1 0 2 1 0 0 1 0 1 0 0 0 0 0 1 0	13)		
		0 0 1 0 0 1 2 0 0 1 1 1 0 1 0 0 1 1 1 0 1 0 0 0 0	12)		
		0 0 0 1 0 0 1 0 0 0 0 2 0 1 0 0 0 0 0 0 0 0 0 0 0	5)		
		0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 1 0 0 0 1 0	4)		
		0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0	3)		

21 to 26 on the 4th day, 12 to 18 on the 5th day, 13 to 16 on the 6th day, 8 to 12 on the 7th day, 5 to 11 on the 8th day, 4 to 8 on the 9th day, 3 to 6 on the 10th day, and 3 to 5 on the 11th day. The averages for the respective days were 53.7, 47.4, 22.0, 23.0, 15.9, 14.3, 10.4, 8.5, 6.4, 4.5 and 2.5. The corresponding percentages were 17.7, 15.6, 7.3, 7.6, 5.2, 4.7, 3.4, 2.8, 2.1, 1.5, and 0.9. The one parasite that survived on the 12th day laid 2 eggs. It may, however, be mentioned that the number of eggs laid on the 2nd, 3rd, 4th and 5th days with (ii) was slightly more than with (i) though not statistically significant.

(f) <u>The effect of peptone with sucrose diet on oviposition</u>.

(i) Peptone + 5 % sucrose.

(ii) Peptone + 10 % sucrose.

The primary data are given in Tables LIX and LX. The difference in the percentage of sucrose did not make any difference in the fecundity of the parasite at any stage. Therefore (i) and (ii) have been considered together.

The total number of eggs laid during the life period varied from 165 to 171. The average and the percentage were 167.5 and 55.2. The parasite lived and laid eggs for 5 days. One parasite laid eggs on the 6th day also and died on the 7th day.

Table LIX.

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING). PEPTONE + 5 % SUCROSE. (ABSENCE OF HOST).

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence.	Total No. of eggs.	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I	15.7.1939.	2 4 5 3 3 2 3 3 0 0 0 3 3 3 0 3 2 0 3 2 2 3 4 0 0	53)		20.7.1939
		3 3 4 3 3 2 2 0 0 0 4 0 3 2 6 0 0 0 2 4 0 5 0 0 0	46)		
		1 1 2 0 1 2 1 2 0 2 1 1 2 0 2 0 1 1 1 0 2 3 1 0 0	27)	169	
		2 1 2 1 0 1 2 0 1 0 1 0 2 0 0 1 0 0 2 1 2 1 2 2 0	24)		
		0 1 1 2 0 2 0 2 0 0 1 0 1 0 0 2 0 0 1 0 2 0 2 0 2	19)		
II	15.7.1939.	4 3 2 0 3 3 3 4 4 3 2 2 3 0 6 2 0 3 0 0 2 1 2 4 2	58)		
		3 2 0 0 3 7 4 0 5 3 2 0 3 2 4 2 2 0 2 0 0 2 1 2 0	49)		
		2 1 2 0 0 2 1 1 2 1 1 2 1 2 0 0 1 1 2 0 0 1 2 0 1	26)	165	20.7.1939
		2 1 1 2 0 0 2 0 0 1 2 0 2 0 0 0 1 0 0 2 0 0 1 1 2	20)		
		0 1 0 0 0 1 2 0 1 0 0 1 0 1 0 1 1 1 0 0 0 0 2 0 0	12)		
III.	15.7.1939.	2 7 3 0 4 3 0 3 4 2 3 2 0 3 2 2 5 0 3 0 1 0 3 0 2	54)		20.7.1939
		0 4 2 3 4 0 2 2 0 3 4 1 3 3 0 2 0 8 2 1 0 2 3 0 1	50)		
		2 1 2 2 2 2 0 0 1 0 0 0 0 2 1 1 3 0 1 0 2 0 0 0 1	23)	166	
		0 0 1 0 0 0 1 2 2 2 1 1 1 0 1 2 0 2 1 1 1 0 1 0 1	21)		
		1 2 0 0 0 1 2 0 1 1 0 2 0 1 2 2 0 1 1 0 0 0 0 0 1	18)		

Table LX

RESULT OF FEEDING ON OVIPOSITION (PROTEIN FEEDING). PEPTONE + 10 % SUCROSE. (ABSENCE OF HOST).

Serial No. of experiment	Date of emergence of parasite	No. of eggs laid in each of the twenty-five larvae every twenty-four hours after emergence	Total No. of eggs	Total No. of eggs from emergence to death	Remarks
					Parasite died on
I	24.7.1939	3 3 4 3 2 0 8 2 0 3 0 0 4 2 3 2 3 2 0 3 0 3 2 1 0 2 2 4 3 6 0 0 2 3 3 0 0 4 3 5 0 2 0 3 2 0 1 0 1 2 0 2 2 0 2 0 2 0 2 2 0 1 2 0 1 3 2 0 1 0 1 1 2 0 1 2 1 0 2 0 2 0 1 2 2 2 0 1 1 2 1 2 0 2 0 0 0 0 1 1 2 0 1 2 0 0 1 0 2 1 0 0 1 0 0 1 2 0 0 0 0 0 1 0 0	53) 48) 27) 25) 14)	167	29.7.1939
II	24.7.1939	5 0 2 1 0 2 0 0 4 5 3 3 0 3 0 4 2 2 2 4 1 3 0 1 4 3 2 2 1 2 3 8 0 0 3 4 5 2 3 3 3 0 2 2 0 0 0 1 2 0 0 1 2 0 2 2 0 2 2 1 2 0 1 2 0 0 3 2 2 1 0 1 0 0 0 2 0 2 2 0 2 0 0 1 0 2 0 1 1 1 2 0 0 1 0 0 2 0 1 0 1 0 0 2 1 0 1 2 0 0 1 0 0 0 2 1 1 1 2 0 1 1 0 0 0 0 0 0 1 0 0 1 0 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0	51) 51) 26) 20) 17) 6)	171	30.7.1939
III	24.7.1939	5 0 7 3 4 3 0 3 2 0 5 3 2 2 0 0 3 5 2 3 1 2 0 1 1 9 2 0 0 3 0 0 2 4 5 0 3 3 2 2 2 0 4 2 0 1 0 1 1 1 1 2 3 1 0 1 0 0 1 2 2 1 0 2 0 1 2 0 0 2 0 0 0 0 1 2 0 1 1 0 2 2 2 1 2 0 3 2 0 1 2 2 0 2 0 0 0 0 0 0 0 0 0 2 1 0 1 1 0 0 2 2 0 0 1 0 1 0 2 0 1 1 1 0 0	57) 47) 22) 25) 16)	167	29.7.1939

The parasite laid 51 to 58 eggs on the 1st day, 46 to 51 on the 2nd day, 22 to 27 on the 3rd day, 20 to 25 on the 4th day, 12 to 19 on the 5th day. The solitary parasite that lived on the 6th day laid 6 eggs. The averages for these days were 54.4, 48.5, 25.2, 22.5 and 16.0. The respective percentages were 18.0, 16.0, 8.4, 7.5 and 5.3.

(g) Summary of results obtained from (a) to (f).

The minimum, the maximum, the average and the percentage number of eggs laid from emergence till death and the number of eggs laid for the various days are given in Tables LXI and LXII and represented in Figs. 22, 23, 24 and 25. The proteins tried can be arranged in the following descending order in respect of fecundity from emergence till death; larval extract, water extract of yeast, milk, peptone, meat-juice and autolysed yeast. The differences in the number of eggs laid with autolysed yeast, meat-juice and peptone feeding were not significant. The number of eggs laid in these two cases was only slightly more than the number of developed eggs in the ovaries at the time of emergence. With larval extract and sugar this number was maximum for the proteins tried. The average number of eggs laid was between 202 to 216. In the case of water extract of yeast the number of eggs laid was about 35 more than the developed eggs in the ovaries at the time of emergence., and was about 10 to

1 part of centrifuged milk, 3 parts of water & 5 % sucrose

1 part of centrifuged milk, 10 parts of water & 10 % sucrose

Water extract of yeast and 5 % sucrose

Water extract of yeast and 10 % sucrose

Autolysed yeast and 5 % sucrose

Autolysed yeast and 10 % sucrose

1 part of meat juice, 5 parts of water and 5 % sucrose

1 part of meat juice, 10 parts of water and 10 % sucrose

1 part of larval extract, 3 parts of water and 5 % sucrose

1 part of larval extract, 10 parts of water and 10 % sucrose

Peptone and 5 % sucrose

Peptone and 10 % sucrose

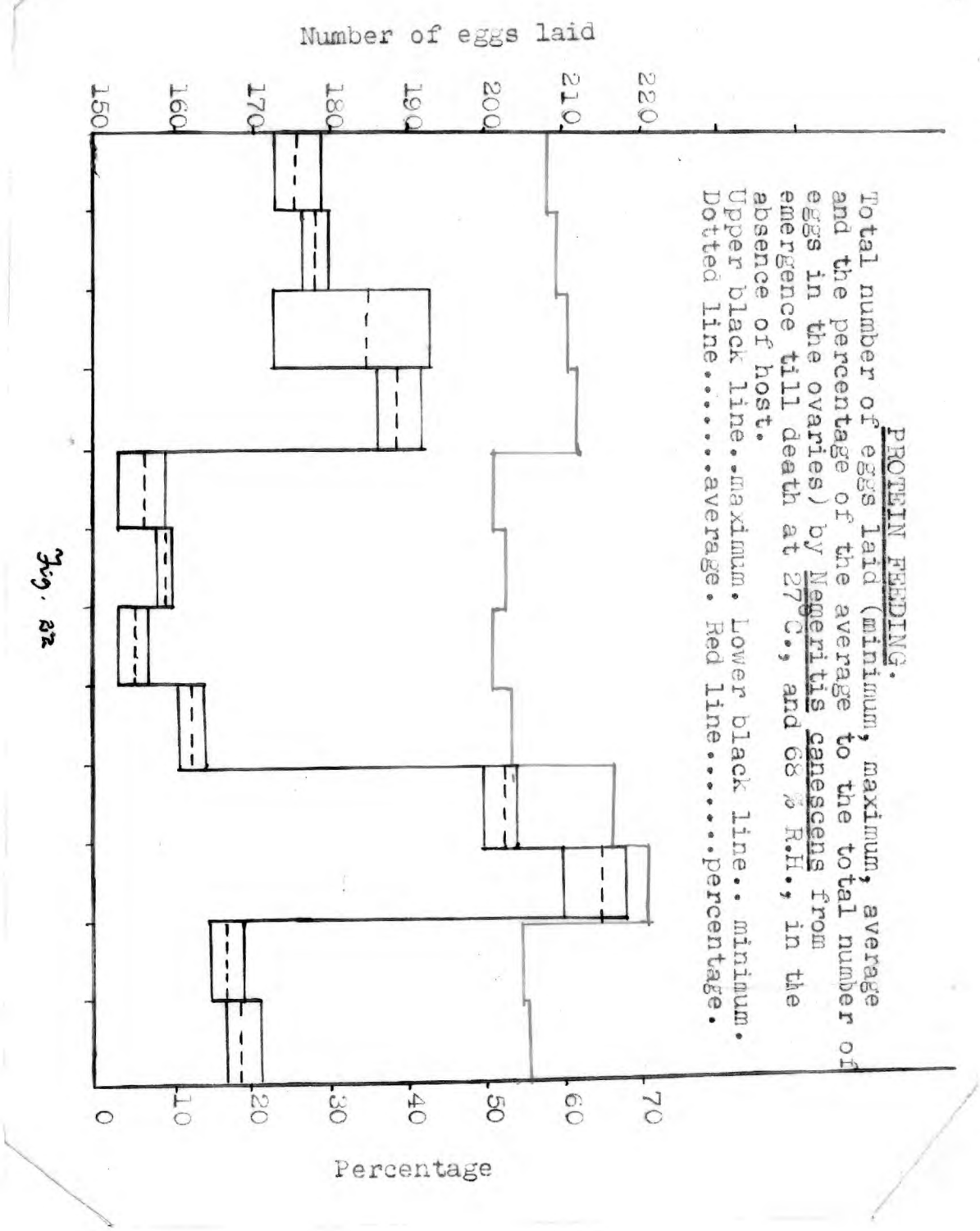


Fig. 32

PROTEIN FEEDING.

Total number of eggs laid (minimum, maximum; average and the percentage of the average to the total number of eggs in the ovaries) by Nemeritis canescens from emergence till death at 27° C., and 68 % R.H., in the absence of host.

Upper black line.. maximum. Lower black line.. minimum. Dotted line.....average. Red line.....percentage.

PROTEIN FEEDING.

Number of eggs laid (minimum, maximum, average and the percentage of the average to total number of eggs in the ovaries) by Nemeritis canescens at 27°C., and 68 % R.H., on the 1st and 2nd days in the absence of host.

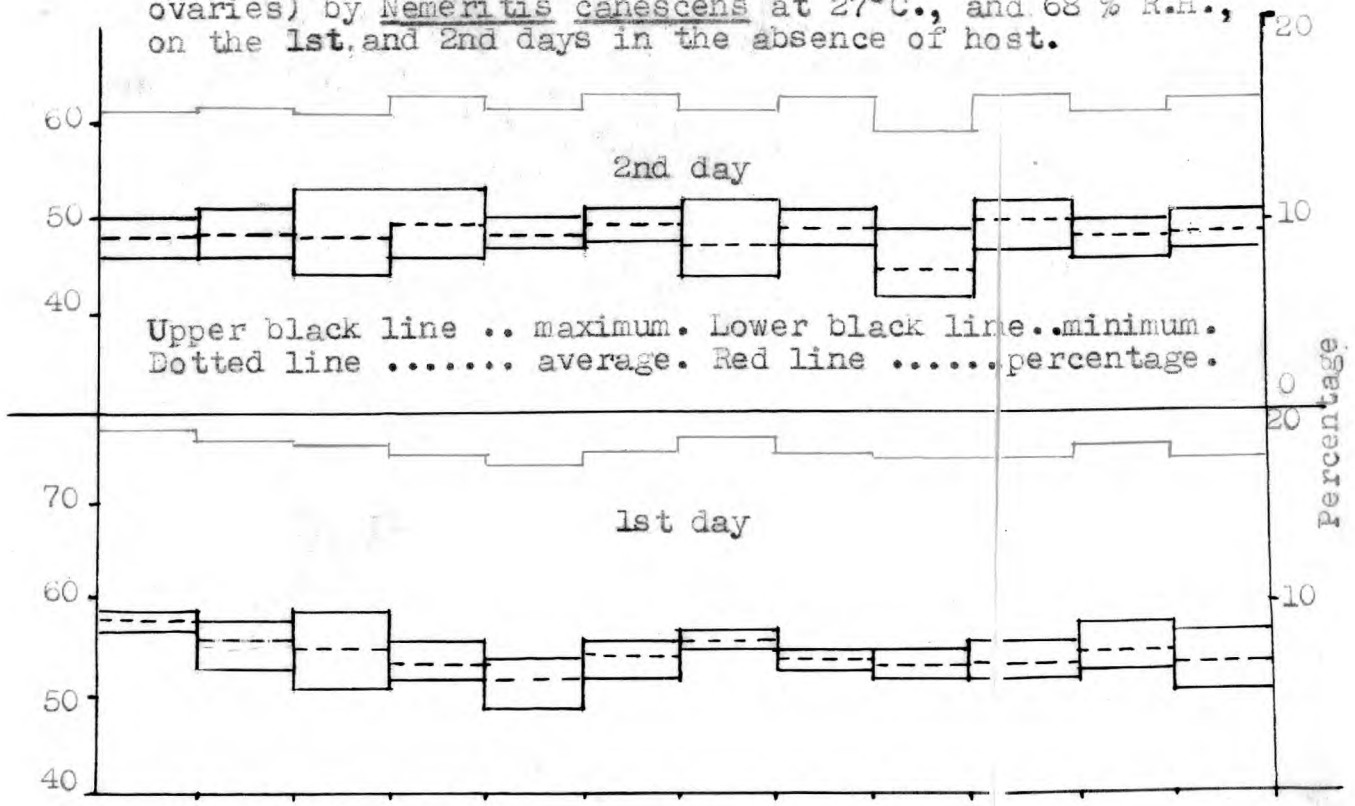


Fig. 23.

1 part of centrifuged milk, 3 parts of water & 5 % sucrose

1 part of centrifuged milk, 10 parts of water and 10 % sucrose

Water extract of yeast and 5 % sucrose

Water extract of yeast and 10 % sucrose

Autolysed yeast and 5 % sucrose

Autolysed yeast and 10 % sucrose

1 part of meat juice, 5 parts of water and 5 % sucrose

1 part of meat juice, 10 parts of water and 10 % sucrose

1 part of larval extract, 3 parts of water and 5 % sucrose

1 part of larval extract, 10 parts of water and 10 % sucrose

Peptone and 5 % sucrose

Peptone and 10 % sucrose

PROTEIN FEEDING.

Number of eggs laid (minimum, maximum, average and the percentage of the average to total number of eggs in the ovaries) by Nemeritis canescens at 27°C., and 68% R.H., on the 3rd, 4th and 5th days in the absence of host.

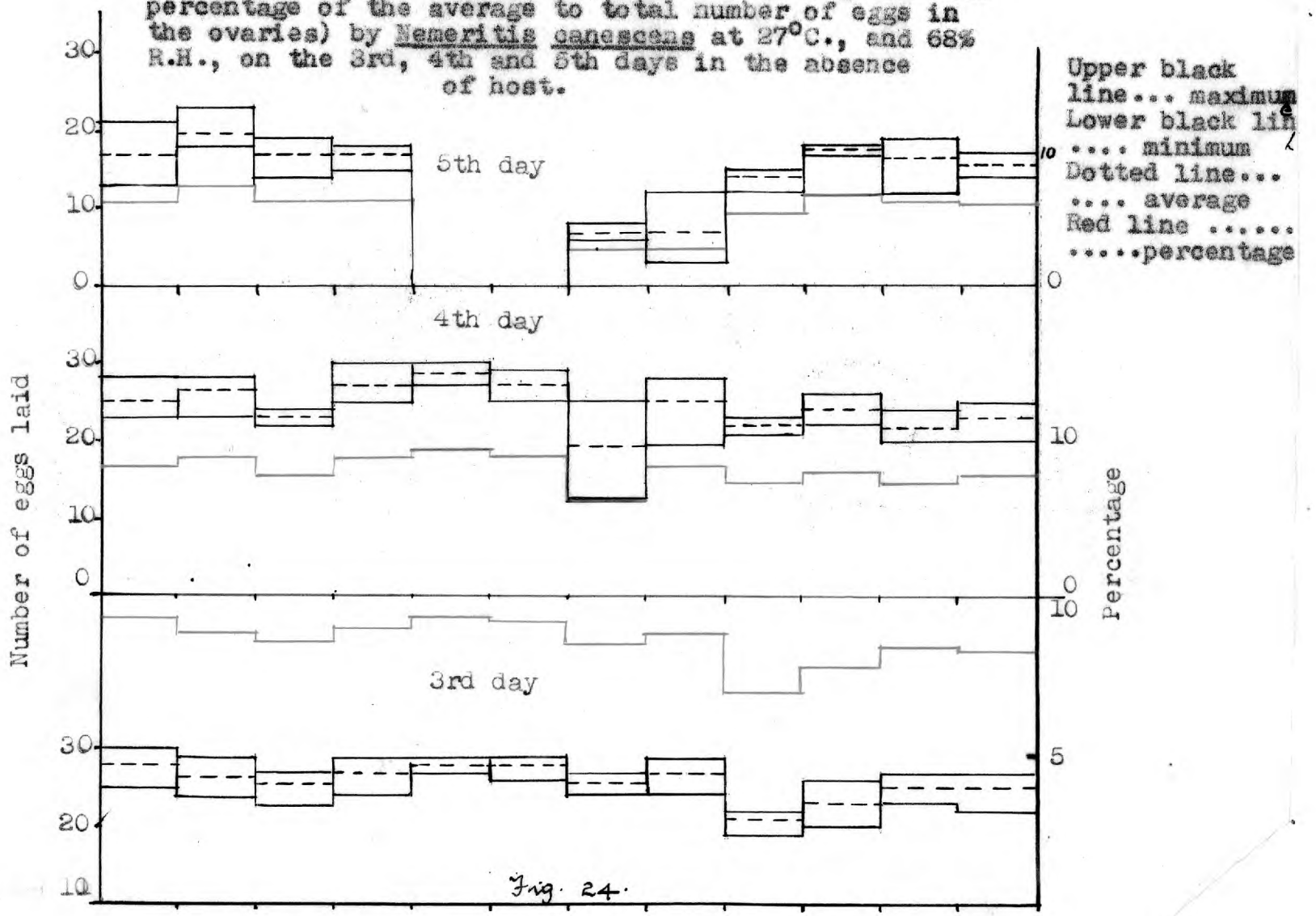


Fig. 24.

1 part of centrifuged milk, 3 parts of water & 5 % sucrose

1 part of centrifuged milk, 10 parts of water & 10 % sucrose

Water extract of yeast and 5 % sucrose

Water extract of yeast and 10 % sucrose

Autolysed yeast and 5 % sucrose

Autolysed yeast and 10 % sucrose

1 part of meat juice, 5 parts of water and 5 % sucrose

1 part of meat juice, 10 parts of water and 10 % sucrose

1 part of larval extract, 3 parts of water and 5 % sucrose

1 part of larval extract, 10 parts of water and 10 % sucrose

Peptone and 5 % sucrose

Peptone and 10 % sucrose

1 part of centrifuged milk, 3 parts of water & 5 % sucrose

1 part of centrifuged milk, 10 parts of water & 10 % sucrose

Water extract of yeast and 5 % sucrose

Water extract of yeast and 10 % sucrose

Autolysed yeast and 5 % sucrose

Autolysed yeast and 10 % sucrose

1 part of meat juice, 5 parts of water and 5 % sucrose

1 part of meat juice, 10 parts of water and 10 % sucrose

1 part of larval extract, 3 parts of water and 5 % sucrose

1 part of larval extract, 10 parts of water and 10 % sucrose

Peptone and 5 % sucrose

Peptone and 10 % sucrose

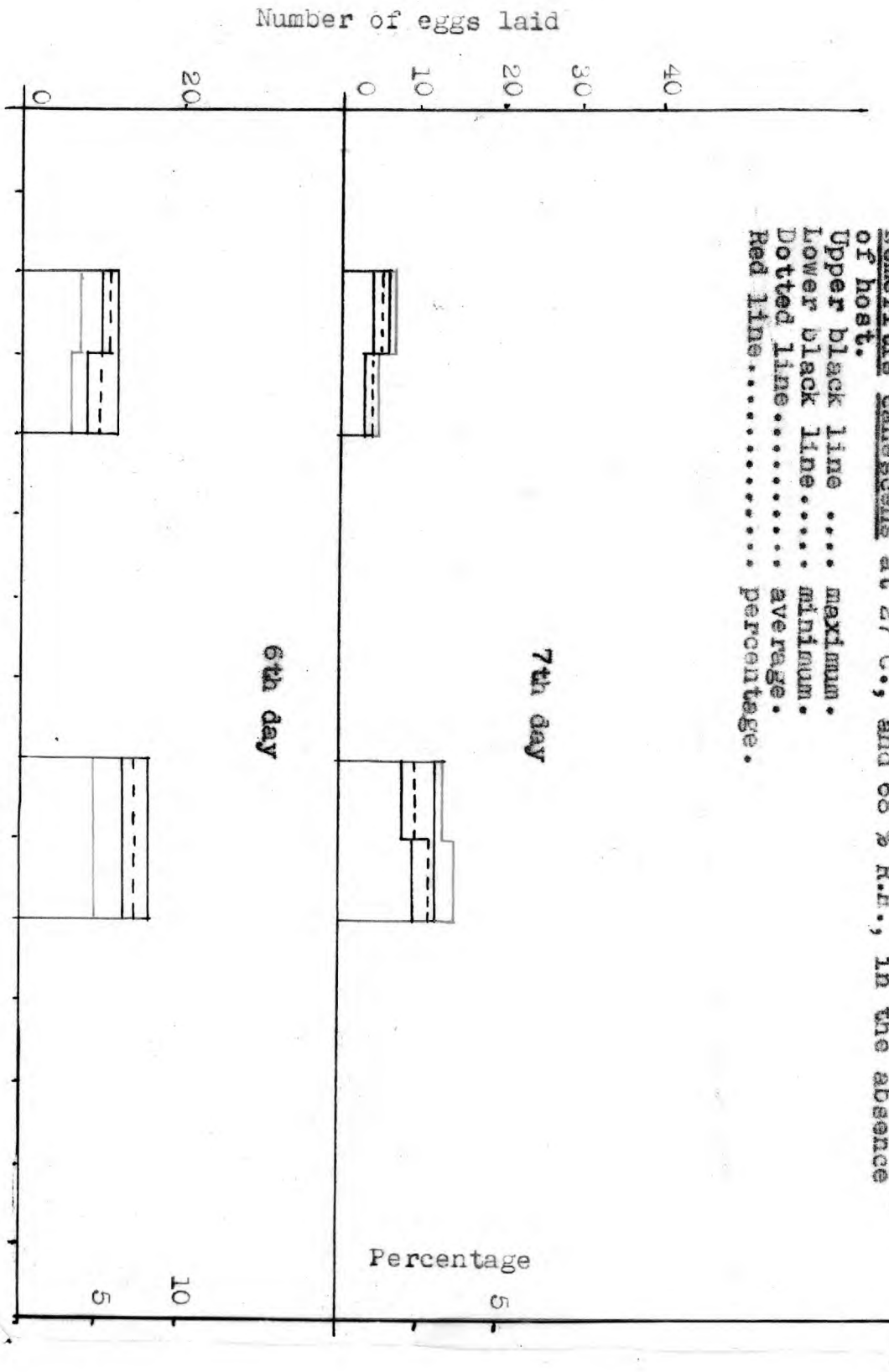


Fig. 25.

Number of eggs laid (minimum, maximum, average and the percentage of the average to the total number of eggs in the ovaries) by Nemeritis canescens at 27°C., and 65 % R.H., in the absence of host.

Upper black line ..... maximum.
Lower black line ..... minimum.
Dotted line ..... average.
Red line ..... percentage.

PROTEIN FEEDING.

Table. LXI.

Number of eggs laid by Nemeritis canescens from emergence till death for different feeds and the percentage of the mean to the average number of eggs in the ovaries.

Food given	ABSENCE OF HOST. Min.	Max.	Mean	%	Remarks regarding death of parasite
1. Milk* + 3 parts of water + 5 % sucrose	173	179	176.0	58.1	All died on 6th day
2. Milk* +10 parts of water +10 % sucrose	177	180	178.7	58.9	2 on 6th day and 1 on 7th day
3. Water extract of yeast + 5 % sucrose	173	193	185.0	61.0	All died on 8th day
4. Water extract of yeast + 10 % sucrose	186	192	188.7	62.2	2 on 8th day and 1 on 9th day
5. Autolysed yeast + 5 % sucrose	153	159	156.3	51.6	All died on the 5th day
6. Autolysed yeast + 10 % sucrose	158	160	159.0	52.5	All died on the 5th day
7. Meat juice + 3 parts of water + 5% sucrose	153	157	155.0	51.1	All died on the 6th day
8. Meat juice+10 parts of water+10% sucrose	161	164	162.3	53.6	2 died on the 6th day and 1 on 7th day
9. Larval extract+ 3 parts of water + 5 % sucrose	200	204	202.3	66.8	1 on 11th day and 2 on 12th day
10. Larval extract + 10 parts of water + 10 % sucrose	210	218	215.0	70.9	1 died on 11th day, 1 on 12th day and 1 on 13th day
11. Peptone + 5 % sucrose	165	169	166.7	55.0	All died on 6th day
12. Peptone + 10 % sucrose	167	171	168.3	55.3	2 died on 6th day and 1 on 7th day
Standard error of mean			2.38		
Standard error of mean difference			3.36		

* Centrifuged milk was used. Fat was rejected.

Trable. LXII

PROTEIN FEEDING

Number of eggs laid by Nemeritis Canescens on successive day [illegible] ercentage of the mean to the average number of eggs in the ovaries.

	Absence of host																							
	1st day				2nd day				3rd day				4th day				5th day				6th day				7th day			
	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%	Min	Max	Mean	%
1. 1 Part of milk+3 parts of water+5% sucrose	57	59	58.0	19.1	46	50	48.0	15.8	25	30	28.0	9.2	23	28	25.0	8.3	13	21	17.0	5.6								
1 Part of milk+10 parts of water+10% sucrose	52	53	56.0	18.5	48	51	48.3	15.9	24	29	26.3	8.7	23	28	26.3	8.7	18	23	19.7	6.5	-	6	2	.7				
3. Water extract of yeast + 5% sucrose	51	59	55.3	18.3	44	53	48.0	15.8	23	27	25.7	8.5	22	24	23.0	7.6	14	19	16.7	5.5	10	12	11.3	3.7	4	6	5.3	1.7
4. Water extract of yeast + 10% sucrose	52	56	53.7	17.7	46	53	49.3	16.3	24	29	27.3	9.0	25	30	27.0	8.9	15	18	16.7	5.5	6	12	9.7	3.2	3	5	4.0	1.3
5. Autolysed yeast + 5% sucrose	49	54	51.7	17.1	47	50	48.3	15.9	27	29	28.0	9.2	27	30	28.3	9.4												
6. Autolysed yeast + 10% sucrose	52	56	54.3	17.9	48	51	49.7	16.4	26	29	27.7	9.1	25	29	27.3	9.0												
7. Meat juice+3 parts of water+5% sucrose	55	57	56.0	18.5	44	52	47.7	15.7	24	27	25.7	8.5	12	25	19.0	6.3	6	8	6.7	2.2								
8. Meat juice+10 parts of water+10 percent sucrose	53	55	54.0	17.8	47	51	49.0	16.2	24	29	26.7	8.8	19	28	25.0	8.3	3	12	6.7	2.2	-	3	1	.3				
9. Larval extract+3 parts of water + 5% sucrose	52	55	53.7	17.7	42	49	44.7	14.7	19	22	21.0	6.9	21	23	22.0	7.3	12	15	14.0	4.6	13	16	14.3	4.7	8	12	9.7	3.2
10. Larval extract+10 parts of water+10% sucrose	52	56	53.7	17.7	47	52	50.0	16.5	20	26	23.0	7.6	22	26	24.0	7.9	17	18	17.7	5.8	13	16	14.3	4.7	9	12	11.0	3.6
11. Peptone+5% sucrose	53	58	55.0	18.2	46	50	48.3	15.9	23	27	25.3	8.4	20	24	21.7	7.2	12	19	16.3	5.4								
12. Peptone+10% sucrose	51	57	53.7	17.7	47	51	48.7	16.1	22	27	25.0	8.3	20	25	23.3	7.7	14	17	15.7	5.2	-	6	2	.7				
Standard error of mean			1.34				1.66				1.32				1.81				1.60				1.17				0.82	
Standard error of mean difference			1.89				2.34				1.86				2.56				2.26				1.65				1.25	

(CONTD.)

	8th day				9th day			10th day				11th day				12th day			
9. Larval extract+3 parts of water+5% sucrose	7	10	9	3.0	6	8	7	2.3	4	6	4.7	1	3	4	2.3	.8				
10. Larval extract+10 parts of water+10% sucrose	5	11	8	2.6	4	7	5.7	1.9	3	6	4.3	1	3	5	2.7	.9	2	-		.7
Standard error of mean			1.08				0.75				0.78				1.33					
Standard error of mean difference			1.53				1.05				1.11				1.89					

11 % less than that laid with larval extract feeding. The number of eggs laid with milk was less than that laid with water extract of yeast by about 5 %. Excepting water extract of yeast and larval extract, with the other proteins the parasite was able to live and lay eggs for 5 to 6 days. With water extract of yeast it lived and laid eggs for 7 to 8 days. With larval extract it lived and laid eggs for 11 to 12 days. Comparing the number of eggs laid on different days it will be seen that with all the proteins the number of eggs laid on the 1st day was about 1.4 to 3.3 % more than that laid on the 2nd day. (This percentage has been calculated on the basis of the total number of eggs in the ovaries.) The number of eggs laid on the 3rd and 4th days was about half as much as laid on the 1st and 2nd days. The number of eggs laid on the 5th day with milk, water extract of yeast, larval extract and peptone was about 2 to 3 % less than that laid on the 4th day, while on the remaining days it was about 3 % or less.

E. <u>A comparative account of the results obtained in B, C & D.</u>

The number of eggs laid from emergence till death in the presence of host with glucose, fructose, sucrose and maltose was considerably more than the number of developed eggs in the ovaries at the time of emergence. In the absence of host this number was considerably less than that laid in the presence of host and was more or less equal to the number

of developed eggs in the ovaries at the time of emergence. With the other carbohydrate foods and polyhydric alcohols the total number of eggs laid both in the presence and absence of host did not differ much. It may, however, be mentioned that this number was lower than the number of developed eggs in the ovaries at the time of emergence. These observations could be explained as follows: in the presence of host the parasite is allowed contact with the host caterpillar and is thus able to feed on the blood that oozes out of its body as a result of oviposition. This feeding ensures the maturation of the undeveloped eggs in the ovaries provided the longevity of the parasite is prolonged by some sugar that the parasite is able to utilise. When the parasite has finished laying all the eggs that are developed in the ovaries at the time of emergence then it starts laying these undeveloped eggs that have by now become mature. This is what happens when the parasite feeds on glucose, fructose, saccharose and maltose in the presence of the host. These sugars are utilised by the parasite and the latter gets a feed of the blood and thus gets the necessary nitrogenous food for the maturation of atleast of a fairly large number of undeveloped eggs and is able to live for a much longer period than when fed on the other sugars and the polyhydric alcohols. It takes about 4 to 5 days for the parasite

to lay all the developed eggs in the ovaries at the time of emergence.

In the case of absence of host though the longevity of the parasite is as ~~much as~~ great or indeed even ~~more~~ greater than in the presence of host for glucose, fructose, sucrose and maltose she is not able to lay as many eggs as in the presence of host because the parasite is denied the necessary nitrogenous food. In the case of other sugars and polyhydric alcohols it is not able to survive for more than 2 to 3 days and therefore she is not even able to lay the developed eggs in the ovaries.

Coming to the proteins it will be seen that feeding the parasite with larval extract and sucrose gives the best results. The conditions here are more or less similar to that existing when the parasite oviposits in the presence of the host and feeding on sucrose. It must, however, be stated that due to the artificial conditions of feeding with larval extract the parasite is not able to lay as many eggs as she is able to do under natural conditions. It is also interesting to note that the parasite is able better to utilise ~~better~~ water extract of yeast than autolysed yeast.

10. ENZYMES IN THE ALIMENTARY CANAL OF NEMERITIS CANESCENS.

Though Nemeritis is too small a parasite for a study of this nature an attempt was made to investigate the

more important enzymes in the alimentary canal of the parasite. The tissue suspension for each test was prepared in the following manner: the alimentary canals of 25 parasites were dissected out and removed to a watch glass. A few drops of distilled water were added and the guts were well ground up with a glass rod. About 0.75 suspension was thus obtained. This was divided into two equal halves in two small tubes of 2" X 1/4". One of the tubes was carefully heated in a boiling water bath for a few minutes to kill all the enzymes that the suspension might contain. This was marked A and was the control. The other tube was the experimental and was marked B. Equal quantities of the substrate was added to each of the tubes. A drop of toluene was added to each tube. Both the tubes were then corked and kept in an incubator at 37°C., for 48 hours. The following experiments were carried out:

1. Saccharase.

2 % sucrose solution was used as a substrate. Tested by boiling the digest with Benedict's solution.

2. Maltase.

2 % maltose solution was used as substrate. Ozazone test described by Cole (1933) was carried out with the digest as well as the control.

3. Amylase.

2 % starch solution was used as substrate. The

digest was tested with a drop of iodine solution.

4. Peptase.

(a). A little carmine fibrin was added to the tissue suspension. 5 drops of deci-normal Hydrochloric acid were added. Colour released if digestion took place.

(b) 10 drops of acid casein were added to a suspension. After incubation 10 % Sodium acetate was added drop by drop. If there was any digestion a precipitate would appear later in the test.

5. Tryptase.

(a). Congo-red fibrin was added to the suspension and 5 drops of 5 % Sodium carbonate were also added. Colour was released if there was digestion.

(b). 10 drops of alkaline casein were added to the suspension. After incubation 1 % Acetic acid was added drop by drop. There was digestion if no precipitate was obtained.

6. Peptidase.

2 % peptone solution was used as substrate. After incubation one drop of 1 % Copper sulphate and 1 c.c., of 5 % Sodium bicarbonate solution were added to the suspension. When warmed a violet colour would appear if there was no digestion.

The following enzymes were present: saccharase, maltase, tryptase (weak), peptidase(weak).

Amylase and peptase were absent.

11. SUMMARY.

1. The number of eggs in the ovaries of a newly emerged parasite has been found to vary between 280 to 320 eggs. The average was found to be 303.12 ± 1.26. About 50 % or half of this total number of eggs were fully developed eggs which the parasite was ready to oviposit within half an hour after emergence. The percentage of undeveloped eggs was found to be slightly higher than the developed eggs.

2. A series of experiments has been carried out which show that when super-parasitism occurs an inhibitory factor engendered by the larva that hatches out first suppresses the growth of the rest. The latter do not grow beyond the 1st instar stage. This inhibitory factor does not act in the haemocoel of the Ephestia pre-pupa. It also does not act in the body cavity of Hemeritis senescens.

3. Longevity studies with various sugars and polyhydric alcohols show that the parasite lives longest with sucrose and glucose in the absence of host and not laying eggs. Next comes fructose and maltose. The averages for these various sugars were 28.0, 31.0, 12.4 and 11.0 days. When laying eggs the longevity was considerably reduced. This reduction was 2/3 in the case of glucose and sucrose and 1/3 in the case of fructose and maltose. The longevity studies with protein and sucrose feeding showed that the

parasite was able to live for the longest period of 11 days both in the presence and absence of host with larval extract and sucrose. There was no difference in the longevity of the parasite when not laying eggs and when laying eggs.

4. Fecundity studies show that when the parasite is not allowed to feed on the host body only the developed eggs in the ovaries are laid. Even for this the parasite should be fed with some sugar that will prolong its ~~longevity~~ life for atleast 4 days. When the parasite is allowed contact with the host body it lays the largest number of eggs with glucose (about 256), then comes sucrose (about 250). With fructose feeding the parasite lays about 228 eggs and with maltose feeding it lays on an average 212 eggs. It has been found that the protein that the Nemeritis normally gets from feeding on the host can to a certain extent be replaced by yeast, milk and peptone. The larval extract with sugar, however, gave the best results. It laid on an average 202 to 215 eggs.

5. The enzymes in the alimentary canal of Nemeritis has been investigated.

12. ACKNOWLEDGMENTS.

These investigations were carried out in the Huxley laboratory of the Royal College of Science and in the entomological laboratory of the Imperial College of Science and

Technology Biological Field Station, Slough and I wish to express my deep gratitude to Professor J.W. Munro for generously placing at my disposal all the necessary facilities and for his kindly interest and encouragement throughout the course of the work. I wish to record my indebtedness to Drs. Richards and Frankel for advice and helpful criticism received at every stage during the course of these investigations.

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