# THE BEDBUG, *CLINOCORIS* (=*CIMEX*=*ACANTHIA*=*KLINOPHILOS*) *LECTULARIA* LINNÆUS.

## Part I. Life-history at Paris, Texas, with Biological Notes, and Some Considerations on the Present State of Our Knowledge Concerning It.

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Although the habits and life of this abominable inhabitant of the dwellings of man are now tolerably well known, yet, there remain certain points in its economy which are still open questions to us. The writer does not intend to go into these very fully, but first offers some detailed notes obtained from observations made from time to time on this insect, and then tries to point out certain important, neglected phases in its life-history.

Hitherto, authors, excepting a few, have seemed inclined to rush hurriedly over the discussion of this insect, as if ashamed, and hence it has been, comparatively speaking, much neglected. It is *the* insect most directly affecting man, and the one, if any, which should be thoroughly studied, and yet, not until as late as 1896 (Marlatt, 1896 a) was its true life-history made known. After giving the following detailed notes, which may be of interest, the writer will enter a little more fully into this subject. The observations, unless otherwise stated, were made at Paris, Texas, about 33° 45′ north latitude, and though of secondary importance, they are thus detailed because definiteness on all points in the life-history of the bedbug is evidently lacking.

As the food-supply is the factor directly determining the lengths of the instars in this insect, it is *apparently* true that climatic conditions have very little significance in this respect; for any single instar in its postembryonic development may be indefinitely prolonged by the total absence of food, or may be varied at will by giving food at variable time-periods in the different instars. But, under what may be called normal conditions, in which the insect is attending a constant host, and hence, is having an optimum amount of food, the climatic conditions must necessarily influence the length of the different instars, and therefore a life-history to be at all representative must be taken when under such conditions.[a] For it is well known that the preparatory stages of ecdyses are much lengthened by cold, and much shortened by heat, most easily seen in lepidopter-

a. Compare foot-note in seq.

ous larvæ. Under so-called normal conditions, then, climate would noticeably influence the length of the instars.

*Egg.*

1. *External development.* Five (5) eggs deposited during the evening 22nd June, showed no external changes until the morning of June 24th, when they were shaded by the yolk mass. At 8 A. M., 25th June, the embryo was plainly visible, showing buds of the appendages, the body segments, and the reddish eyes. On morning of 28th June they hatched without further changes.

2. *Length of instar.* Two observations made on a total number of thirty (30) eggs during the last two weeks in June averaged 5 days, 12 hours. Eggs confined indoors.

3. *Number deposited.* See adults.

*Nymph.*

1. Description of stages.

I. Length, 1.45 mm. Whole body pale, sordid yellowish-white, much paler at exclusion; eyes bright red; a dark, transverse, sub-arcuate dash on dorsum of caudal abdomen, sometimes confused; head and portions of thorax darker, subfuscous. Deep red after feeding. Antennæ 4-jointed. From many specimens, 12 hours after exclusion.

II. Length, 2.10 mm., variable. The same; sordid yellow, discus of abdomen dark from food; eyes darker; abdomen flat, depressed, wider than in I.

III. Length, 2.50 mm., variable. The same; uniformly luteus, the discus of abdomen darker from food, its margins lighter; eyes dark; abdomen oval (dorsal aspect), depressed, much wider. Exuvium entire, sordid white.

IV. Length, 3.00 mm., variable. The same; body slightly darker.

V. Length, 3.80 mm., variable. The same; body entirely fuscous. Description from 3 specimens, made immediately after ecdysis.

2. Development.

*A.* A single nymph or larva hatching during the morning of June 24th and

isolated in a small glass vial, was fed at once. It was very active after hatching, and at first made attempts to escape, though in a few minutes readily took food. Just as soon as the least bit of blood entered the body it could be traced to its destination, and as more was sucked in, the body became stained a very beautiful, deep, purplish red. The abdomen, at first flat and round in outline, soon became distended, lengthened, and cylindric, and the nymph then measured 2.00 mm.[a]

On the afternoon of the next day (25th), the nymph was again fed, and the abdomen was much darker, not stained as previously. Again on the morning of July 1st, it was fed. It had not changed. On the morning of July 6th, it fed long and eagerly, until the abdomen became so large and distended that it was all out of proportion to the rest of the body; it was then stained purplish red, as after the first meal. The insect after this gluttonous meal did not lose its usual activity. The first molt then occurred about 7 P. M., 7th July. It had thus fed four (4) times during the first instar.

In the second instar, it was fed for the first time at 9 P. M., 9th July but took but very little food, showing an inclination to wander and hide, and was evidently much disturbed by the strong lamp-light in the laboratory. But at 4 P. M., 13th July, it went eagerly to food, remaining as before, until the abdomen became immensely swollen, and deep cherry red. It measured after this meal, 2.5 mm. The following night, it refused to feed, and afterwards, molted for the second time at 4 P. M. July 16th.

During the third instar, the nymph was offered food at 9 P. M., 18th July, but took little or nothing. At 8 P. M., 22nd July, however, it was finally induced to feed until gorged. It then measured 3.00 mm. The third ecdysis occurred at noon, 29th July.

At 9 P. M., 29th July, it was fed for the only time in the fourth instar, measuring after this meal 3.85 mm. The fourth ecdysis occurred at 7 P. M., 2nd August, and in the fifth instar, the single meal was given at 9 P. M., 6th August. After this very long meal, the insect measured 4.85 mm.

It became adult about 6 A. M., 11th August, much smaller than its parent, and lived in confinement with food until October 8th following.

*B.* Another nymph hatching during the morning of 28th June, and confined as in foregoing, was fed for the first time on July 9th, or ten days after

a. The measurements of this insect agree with those given under description of the stages, and therefore the increase in size from feeding can be calculated.

exclusion. It then molted during the evening of July 12th, and was again fed at 8 P. M., 14th July. Length after ecdysis, 2.1 mm.; after feeding, 2.5 mm. The second molt occurred at 4 P. M. 14th of July, and food was again taken at 10 P. M.; 18th July, for the only time in the third instar. Length after ecdysis, 2.75 mm.; after feeding, 3.2 mm. The third molt occurred at 6 P. M., 22nd July, and food was given three (3) hours afterwards, though with much trouble, for attempts to escape were persistently made, the insect being annoyed by the strong lamp-light. When shaded from the light, it soon went to food; this was repeated a second time. Once at food, the presence of light, apparently, did not annoy it. Length after third ecdysis, 3.25 mm; after feeding, 4.3 mm. It was showing signs of approaching ecdysis at noon, 26th July, and molted a fourth time at 7 A. M., 28th July.

In the fifth instar, it was fed at 9 P. M., 29th July. Length after ecdysis, 4.3 mm.; after feeding, 5.00 mm. The final (fifth) ecdysis occurred on the morning of August 3rd. Length after ecdysis, 5.00 mm. It died in confinement without food on 13th September.

It is apparent from this, that measurements of length after a full meal, approximate the length of the insect after the ecdysis following this meal. For example, a nymph measuring 5.0 mm. after a full meal in instar V, would measure approximately 5.0 mm. when adult. It is also indicated that more food is needed in the first instar, than in the rest. A single meal suffices, apparently for all instars after the first, a conclusion drawn from four (4) individuals reared during different periods throughout the season of 1904.

3. Length of instars.

The following table, summarizing the instars of four individuals, represents durations of stages under optimum conditions, under fair conditions, and under adverse conditions, when the food supply is highly inconstant and variable. A, under optimum conditions, having a constant host, was fed as soon as possible after each ecdysis, as the nymphs naturally do, if possible. B and C, under so-called fair conditions, were fed at shortly varying time periods, representing an intermittent host; they were fed at the same time, until in instar III, C refused food, and thus dropped behind. D, under adverse conditions having a periodical host, was fed at greatly varying time-periods, at first, more for the purpose of causing very unequal instars to show the relation of food supply to development, than for anything else, and was afterwards included in this table.

Table of instars of four individuals, the food-supply variable.

| Instars | Hatched A. M., 24th June. | | | | Hatched A. M., 28th June. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A* | | | | B† | | | | C | | | | D | | | | Ecdysis |
| | Days | Hours | Molts | Meals | Days | Hours | Molts | Meals | Days | Hours | Molts | Meals | Days | Hours | Molts | Meals | |
| First | 13 | 10 | 7 p. 7 July | a. 24 June<br>p. 25 June<br>a. 1, 6 July | 14 | 12 | 10 p. 12 July | 9 July | 14 | 12 | 10 p. 12 July | 9 July | 35 | 0 | a. 2 Aug. | 9 p. 14 July<br>9 p. 29 July | 1 |
| Second | 8 | 21 | 4 p. 16 July | 9 p. 9 July<br>4 p. 13 July | 3 | 18 | 4 p. 16 July | 8 p. 14 July | 3 | 20 | 6 p. 16 July | 8 p. 14 July | 6 | 0 | a. 8 Aug. | 9 p. 6 Aug. | 2 |
| Third | 11 | 20 | Noon 28 J'y | 9 p. 18 July<br>8 p. 22 July | 6 | 2 | 6 p. 22 July | 10 p. 18 July | 9 | 18 | Noon 26 J'y | 10 p. 18 July<br>9 p. 22 July | 36 | 12 | 10 p. 13 Sep. | 9 p. 8 Sep. | 3 |
| Fourth | 5 | 7 | 7 p. 2 Aug. | 9 p. 29 July | 5 | 13 | 7 a. 28 July | 9 p. 22 July | 22 | 0 | 17 Aug. | 9 p. 13 Aug. | 13 | 20 | 6 p. 27 Sep. | 10 p. 23 Sep. | 4 |
| Fifth | 8 | 11 | 6 a. 11 Aug. | 9 p. 6 Aug. | 6 | 0 | a. 3 Aug. | 9 p. 29 July | 28 | 0 | 14 Sept. | 9 p. 8 Sep. | 66‡ | 18‡ | Noon 3 Dec. | 9 a. 17 Nov. | 5 (adult) |
| Sums | 48 | 8 | | 10 | 35 | 21 | | 5 | 78 | 2 | | 6 | 156 | 2 | | 6 | |

* Cf. A. ante.
† Cf. B. ante.
‡ Approximated.
Note.—a. and p. stand for A. M. and P. M. respectively.

A, although under optimum conditions, and cared for better than the others, did not reach its full growth until thirteen (13) days after B, which was fed less frequently. This serves to show, that no matter what the conditions, even if uniform for many individuals, the instars would vary considerably for the individuals. If comparisons are made with the foregoing, however, it will be seen quite readily, that the difference between A and B is due to difficulty in feeding A, owing to the latter's individual incapability of taking sufficient food at a single meal[a].

4. Feeding habits; some considerations.

The nymphs are very voracious, and at a single meal gorge themselves until unable to hold more. The time therefore given to each meal is limited by the capacity or size of the nymph at the time of any one meal, the capacity of course depending upon, or rather being more or less bounded by, the different instars. Hence, in each instar, the time taken for any single meal is more or less definite, shorter in the earlier, longer in the later instars, as the capacity is less in the earlier, greater in the later instars.

For its first meal after hatching, in instar I, it requires on the average, about three (3) minutes to glut itself, and if another meal is taken in this instar, a slightly longer period. In instar II, five (5) minutes; in instar III, six (6) minutes; in instar IV, eight (8) minutes; in instar V, ten (10) minutes, and when adult, from ten (10) to fifteen (15) minutes. These may be taken as averages, as the time for individuals varies somewhat.

As the nymphs very rarely take more than a single meal during an instar, probably being unable to do so, in many cases, before developmental processes hurry them on to another ecdysis, and as the adults are apparently unable to feed again after a full meal for at least forty-eight (48) hours, it is strongly indicated that visits to the host are limited in point of time to that consumed in obtaining a full meal. This varies, as has been shown, from three (3) to fifteen (15) minutes according to age.

Limited observations covering a period of three years would seem to confirm this comforting fact, but it cannot be stated as a definite certainty. It is, however, in the writer's opinion, highly probable. But if the bugs are at all

a. The length of time required to rear these two nymphs compares favorably in regard to climate, with the 49 days required for those reared at Washington, D. C. See Howard (1901.)

numerous, the generations being considerably mixed, the host would doubtless have visitors each night.

As the writer could not conveniently obtain a suitable substitute-host to supply the necessary amount of blood upon which to rear these insects, he was forced himself to feed them from portions of the forearms, and from the hand and tips of the fingers.

When punctures were made on the upper portion of the forearm near the wrist, neither pain nor swelling resulted. But in the case of the adult, and nymph V, a distinct itching sensation was felt, somewhat like prickly heat but the other symptoms of inflammation did not appear. The itching was hardly noticable, even though the cause was certain. As far as the writer is concerned, therefore, no indications of attack are present. And this is so with others.

On the other hand, many persons know at once when these insects are present, from the intolerabble itching which ensues from their attack, and from the inflamed spots which afterwards appear. It is evident that this latter class forms but a small proportion to the whole, a conclusion drawn from the known prevalence of this pest in really respectable places, and from the indifference which is shown to its presence.

5. Length of life in confinement without food.

Thirty (30) nymphs, hatching on the morning of June 24th, and at once confined in a dry glass vial, cork-stoppered, measuring 2.5 cm. long by 1 cm., lived until the 2d of August, or thirty-nine (39) days. Two (2) nymphs hatching during the night of 22nd of June, and confined in a larger glass vial (4.5 cm. by 1.cm.) lived until the 26th of August, or sixty-five (65) days. Both lots were confined in the laboratory, where the temperature ranged a few degrees lower than natural.

*Adults.*

1. History and oviposition.

Two fully fed females, taken from an old wooden bedstead, in an apartment house, were confined at 10 P. M., 17th June, separately, in small pill-boxes. One was fed, the other not. The first gave rise to the nymphs in foregoing. The other deposited but very few eggs and soon died.

The record of deposition, and the effect of feeding on the number of eggs deposited, is tabulated for convenience, as follows.

Record of oviposition of two females, confined at 10 P. M., June 17th, when fully fed.

| A—Fed | | | | B—Unfed | | |
|---|---|---|---|---|---|---|
| Date | No. Eggs | Meals | Length life | Date | No. Eggs | Length life |
| 18–21 June | 34 | | | 18–21 June | 2 | |
| 21 " | 1 | | | 21–22 " | 2 | |
| 22 " | 5 | 22 June | | 22 " | 1 | |
| 24 " | 1 | | | 23–27 " | 2 | |
| 29 " | 2 | 29 June | | | | |
| 1–6 July | 5 | 6 July | | | | |
| 7–9 " | 7 | 9 July | | | | |
| 9–12 " | 18 | | | | | |
| 12 " | 5 | | | | | |
| 13–16 " | 3 | | | | | |
| 18–22 " | 2 | 18 July | | | | |
| 22–24 " | 8 | | | | | |
| 28 " | 11 | | | | | |
| 30 July–5 Aug. | 3 | 29 July | | | | |
| 8–12 " | 3 | 6 August | | | | |
| 19 " | 3 | 13 August | | | | |
| 6 Sept. Died | 111 eggs | 8 | 81 days | 12 July died | 7 eggs | 24 days |

Thus, the effect of food on the rate of ovisposition and also on the length of life is plainly indicated, but from the fact that but two individuals were used, nothing conclusive can be drawn.

It would also seem to indicate that but one principal brood occurs through the season, or that the females continue to lay at periods during the main breeding season, as in the case of *Anasa tristis*. It may be noted that these females when captured had already deposited some of their eggs.

2. Length of life in confinement with and without food.

It is often mentioned that these insects can survive for months without known food. This has been established by confining single specimens in closed vials or boxes, and leaving them undisturbed. Writers disagree on this subject, and extended breeding experiments are necessary before it can be definitely settled.

But few observations were made bearing on this, but it may be well to put them on record in this connection. A fully fed female, confined after capture, in a closed pill-box, lived twenty-four (24) days without food, during June and

July. Another; full-fed in instar V, but starved after the final molt on August the 3rd, died on September 13th after living forty-one (41) days. At Blacksburg, Virginia, in 1902 an adult confined in an ordinary pill-box, as in the foregoing, and kept in a cool room in a laboratory, live seventy-five (75) days without food, from August to November. Here, low, fall temperatures doubtless lengthened its life.

With food, a single (1) fertile female lived in confinement eighty-one (81) days, from June to September; it was captured in an an infested bed, and had evidently been adult for several weeks prior to capture. Another, reared in confinement, lived as adult with food, from August 11th to October 8th, or fifty-nine (59) days.

At Blacksburg, Virginia, an adult confined as usual, and fed once at the end of the first thirty (30) days, and from thence unfed, lived two hundred and fifty-nine (259)days or about eight and a half months. This was from August, 1902, to May, 1903. Low temperatures, again, doubtless account for this great increase in length of life. The insect was numb for a greater part of the time, and several weeks before its death declined food, apparently unable to take it. (Cf. DeGeer, 1773, pp. 304–305).

From these records, though meagre, and from other considerations, the writer cannot help thinking that this insect lives normally but a single season as adult, or that it is single brooded in habit. Professor Herbert Osborn, in a letter, informs me that this is also his belief.[a] The important fact apparently indicated, is that the activly reeproducing males and females survive but the actual breeding season and do not live over the following season, at least to continue reproduction. These of course, are but suggestions, and cannot be at present fully substantiated.

3. Feeding habits in confinement; general notes.

Nothing of importance was noted in regard to feeding habits, excepting perhaps that females when once full-fed, were unable or unwilling to feed again within thirty-six (36) hours, or longer.

As very many *definite* statements have not been published concerning the general habits of the bedbug, a few notes in this respect may not be amiss in this connection. The writer had some very unpleasant experiences with these

a. January 30th, 1905. Others have also stated this (Lugger, 1896) though giving no data upon which it is based.

insects during a summer's stay in a small town in Virginia. The whole place was thoroughly infested, and it was not an uncommon thing to see mattresses and bed-slats turned out to air, which were literally white with the insect's eggs. The writer's room was as bad as the rest; the old-fashioned bedstead was full of them, while during the day scores of them could be detected hiding in the walls. The place was almost unbearable, for the insects were not satisfied in staying indoors, but were frequently found secreted in one's clothes. One night, returning to the room from outside, two were found beneath the collar, while occasionally, one would be found hiding within a pamphlet which was carried in my pocket. Wherever they were very numerous, many could be found frequenting privy-houses or other similar places, where they would be sure to obtain an occasional meal, visiting the host at every chance, night or day. That these insects are very active and freely move from place to place, that is to say, not necessarily confining themselves to certain rooms or houses, and hence not directly dependent upon any one host, is evidently true. Mr. William F. Fiske informed me that when stationed at Tryon, North Carolina, while working in the laboratory at night, bedbugs would crawl along the under sides of the edges of the table and stealthily approaching his bared arms, would attempt to feed.

At Washington, D. C., bedbugs were active during December, 1904, until January, 1905. Nymphs in instar I, were found concealed within clothing hanging in a closet; they were active and had been feeding. Adults and large nymphs, recently fed, were also found during those months[a]. During the last week in December, 1904, adults were observed in the middle of the night crawling from their hiding-places in the walls of a brightly lighted room, evidently in search of a host. On another occasion, about the same time, an adult was surprised in the act of visiting a host at 7 P. M., in a warm and very brightly lighted room. It was feeding from the side of the face, and darted quickly away when the host stirred in his sleep; it was found to be well gorged with blood. These observations were made in supposedly respectable boarding-houses, where the presence of this insect was unknown, or at least not commented upon, by the other guests.

*Some important neglected points in its life-history.*

1. Its relation to Man from medical and sanitary points of view.

Professor Herbert Osborn, in a letter dated January 30th, 1905, says,

a. Southall (1730) makes the following, original observation: "And I have seen, and do assert, they do bite in the cold as well as hot seasons." p. 28.

"It is quite remarkable that so little accurate and positive knowledge is available regarding an insect that is so universally distributed. I have brought out in class lectures the probability of the transmission of diseases by this insect, but do not recall references or definite recorded instances proving any such distribution."

The inoculation of the host with virulent blood diseases by this insect, seems to the writer to be of the highest possible degree of probability, and of the greatest importance to the people at large; and yet up to the present time nothing very definite is known, or has been done (excepting negative experiments) in the way of clearing up this point. But comparatively few references to anything of the kind could be found. A most interesting article was published in the Medical Record (Dewèvre, 1892) and is quoted in Insect Life (Riley and Howard, 1893 a).[a] The baccilli of tuberculosis were found in bedbugs attending a tuberculous host, who slept in a bed formerly occupied by his brother who died of the disease The host was observed to have been bitten by the insects in question. The room excepting the bed had been throughly disinfected. Although suspicious, nothing conclusive is proven by this, as the second host may have contracted the disease in other ways under such circumstances, as for instance from dried sputum on the bed, or from direct association with his brother.

It is not the writer's intention to go further into such considerations, but simply to call attention to the great importance of this question from medical and sanitary points of view. It is just as easy, if not easier, to conceive of the transmission and inoculation of highly dreaded blood diseases by bedbugs, as it is to conceive of the transmission of yellow-fever and malaria by mosquitos (*Culicidæ*), or of the spread of disease germs by houseflies (*Musca*). And these latter have been definitely proven. Then is it not fair to suppose that, taking into consideration the much closer interrelations of insect and host and the former's great abundance, universal occurrence, and constant presence[b], bedbugs have a much greater part to play in the spread of highly contagious diseases than do either mosquitoes or flies? That is a question that should be answered as soon as possible, and especially by the medical profession[c].

2. Other unknown, neglected, or indefinite points in its life-history.

For the sake of brevity, these will be passed over as rapidly as possible. The number of annual generations has not been definitely settled, and very little

a. And also stated by Alleger (1894).

b. As for instance, in the slums of cities and in brothels.

c. Vide Craig (1898), Titkin (1897), and the references given by them, and cf. the very important historical and original papers by Nuttall on this subject.

is apparently known in this respect. It will be a rather difficult point to decide from the nature of the case, and is not of great importance, economically.

Adult length of life, and especially in regard to the two sexes, is a much mooted question, and is always confused with longevity or mere existence without known food. It is used here to include actively breeding adults under normal conditions. The male is supposed to take no food (Curtis, 1835), or at least no blood. Nothing is known of this.

In regard to longevity, many theories have been promulgated to explain or account for it. Food other than human blood is supposed to account for it, and also cannibalism. Yet, how did the specimens which DeGeer (1773) confined for over a year in a "sealed bottle,"[a] obtain juices upon which to subsist? Or those confined in closely-fitting paper boxes, such as ordinary pill-boxes? All authors[b] agree in stating that they can exist for many months without known food, but when citing instances, as for example, their supposed occurrence in large colonies in houses which have been long unoccupied, always theorize in regard to some food in order to account for it.

The lack of definite statements in regard to such occurrences, precludes further discussion. It is obvious that such infested houses would have to be isolated, or else the insects would move to others. It is also obvious that such occurrences can be accounted for by confusion with other closely allied species of *Cimex*, or in the case of new-comers, by unconscious transportation of the bed-bugs themselves. DeGeer (1773) has proven that the insects can exist for many months without food, and this is an easy way in which to explain the matter. If the insects were cannibalistic, obviously, large colonies would not thus be found. The confusion exists because of the lack of details. Their food-habits are thus left in obscurity, under the conditions spoken of, together with the question of longevity.

It may be of interest to quote Lintner (1885) as a case in point. A correspondent wrote as follows: " 'Will you tell us something about the bed-bug, what its habits are, when it "spawns," what it eats, how long it lives, and if it ever dies? I ask because I have moved into a house that I find was already occupied by several colonies of the pest. The room in which I have my library

a. Quoted from authors. In reality, the insects were kept in a sand-box (*un poudrier*) presumably those used DeGeer's time to sprinkle writing with sand in order to dry it. It should also be noticed that the insects lived most of the time during the winter or cold months. Southall (1730) states that they feed on oak, walnut, cedar, etc., and in his recommendations, tells us that such woods should be avoided about dwellings.

b. Excepting Dufour (1833).

has the most. They are in my files of papers and periodicals. They seem to grow fatter every day, but for the life of me, I cannot tell what they live on. * * * * * * *. Can it be that they live on the paste on the wall paper? As for remedies, * * * * * *. The latter (red pepper), I have sifted through my papers and books, and wherever I could get it; but instead of driving them off, they seem to fatten on it; * * * * * * * * * * * * * *. * * * *.' " pp. 16–17.

This appearance of the insect in an unoccupied (i. e., not a sleeping) apartment, is apparently explained by Lintner, by the fact that they obtained nourishment from moisture in the paste on the wall, or, and so forth. But as the insects were stated to be fat,[a] it is evident that they were merely hiding in the books and papers by day, and visiting the hosts by night, or whenever a chance offered. Their occurrence in an unoccupied house may be explained in many ways, and may not have been of long duration. Lack of details, such as the appearance of the insects when found, whether fat or thin, dark or light, the conditions under which found, and so forth, makes positive conclusions impossible.

An appropriate quotation also may be taken from Dr. Howard (1901), in which it is to be noticed that no reference is made to a questionable supply of food when referring to longevity. He says: "It has gained the power of subsisting almost indefinitely without food, waiting for its meals with a patience far surpassing that of Job." p. 289. And then again: "And then, too, from the ability which the bedbug has of undergoing prolonged fasts, it may be found alive not only in houses hich have been deserted for a long time, but about old deserted camps in the woods." p. 290.

The period of oviposition and the number of eggs deposited are also unknown, especially the latter. Southall (1730) stated that eggs were deposited about four (4) times during the year in batches of fifty (50), and he has evidently been followed up to the present time. Riley (1887), a century and a half later, states that the female deposits about fifty (50) eggs in March, May, July and September, but does not give a more definite statement, aud is apparently following Southall. Butler (1893) says the same, indirectly quoting Southall, and this statement has been copied quite generally. Further than this, nothing has been done.

It may be well to call attention to the fact that no true parasites have been recorded as attacking the bedbug, though it would not be at all surprising if

a. It can hardly be believed that these insects would be fat, if nourished on moisture alone. When deprived of blood for long periods, they become thin and transparent, or at least much lighter in color, even in the presence of moisture.

such were found attacking the egg, which are more exposed than the later stages. It has been a long accepted fact that none were present, and later writers, under such circumstances, may have easily overlooked minute egg-parasites. Its anatomy has been well worked up(Landois, 1868; D'Herculais, 1886; and others.)

The trouble then is, that definitely stated facts are wanting concerning much of the life-history of this pest. This has doubtless been caused, partly on account of its being so common everywhere, and having an extensive literature, thus causing modern writers to believe it at first glance to be well studied, and partly because of its odious character and abominable nature. The last cause seems to have the most to do with it.

For those who may want to look fully into the questions suggested, a full bibliography of the literature is appended to this paper. This has been made as complete as possible, and on account of its length, will follow as part II. It is hoped that the list of titles given, will be found very complete and accurate, the writer having made it a point to correct the many erroneous references existing and to verify those which have been found to be correct. The bibliography will be explained, the titles criticised and credit given in their proper places.

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