STUDIES IN INTRASPECIFIC VARIATION, XI*.

MORPHOMETRIC CHARACTERS, SEX-RATIOS AND EYE-STRIPES IN THE 1955-POPULATION OF DESERT LOCUST IN INDIA

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* For earlier parts, see ROONWAL, M. L. (*et. al*), 1946 *et seq.* :—

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Parts II, VI, VII, VIII, *Indian J. Ent.*, New Delhi, 1946, 7 (1-2) [1945], pp. 77-84 ; 1952, 14 (2), pp. 95-152 ; 1955, 17 (1), pp. 6-10 ; 1955, 17 (2), pp. 155-158.

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CONTENTS—*contd.*

I—INTRODUCTION

1. *General*

This is a continuation of a series of studies (Roonwal, 1936 *et seq.*) on the population characteristics of the Desert Locust, *Schistocerca gregaria* (Forskal), in India in relation to swarming cycles. The present study deals with the morphometrical and other characters of the Desert Locust population for the year 1955 in India, and is based on the collections made during that year (which was the last year of the known Locust Cycle of 1949-55 in India, *vide* also Roonwal, 1954). Misra (1952) has given an account of the initial Kakko concentration of the year 1949 in the Bikaner District, Rajasthan, with which that swarming cycle started. In the present account, various aspects of the 1955-population (the last year of the cycle) with relation to population densities, morphometric characters, eye-stripes and sex-ratios are discussed. The present data has also been compared with those of the other known populations in India as given by Roonwal (1945, 1949, 1952), Roonwal & Nag (1951), Roonwal & Misra (1952), Misra (1952, 1953), and Misra, Nair and Roonwal (1952).

2. *History of the 1955-population*

The year 1955 was a critical year for the Ninth (known) Locust Cycle in India, and the most critical *periods* were those when the individual locust activity was at its minimum, thereby causing an unstability in the phase characters. The evidence of this phase transformation was seen in the variability in eye-stripe composition, proportion of sex-ratios and the abundance of extreme *solitaria* forms (7- and 8- eye-striped) in the earlier and later periods of that year.

The locust population remained fluctuating throughout the year. In the first period of 1955 (January to April), the population density (40—480 locusts per square mile) remained very low and was almost zero in April. Except in January, the samples of which were taken from a swarm (1st January), the remaining individuals were collected singly or from scattered population. The specimens were pink and grey in colour. The weather, on the whole, remained less humid, and the temperature was low to moderate.

In the second period (May to August), there was a sudden increase in the population density owing to the usual seasonal influx of immigrants from the western regions (Sind, Baluchistan, southern Iran and southern Arabia). Depending on the movements of swarms, the density was zero to very fairly high* in various places. The individual samples were collected from fairly high densities and form loose swarms. The population in this period was of a mixed nature, *i.e.*, comprising of individuals both from swarms as well as from the scattered local populations. The specimens were pink and grey in colour. The population resembles intermediates tending towards phase *gregaria*. The weather during the period was generally hot and dry, with gusty hot winds. The population in the third period (September to December) remained low (40—1,333 per square mile), but in two localities (Manaksar-Bajju, Bikaner District ; and Basra, Barmer District) it was moderate (3,600 and 8,400 per square mile respectively). Collections were obtained either from solitary specimens or from relatively concentrated populations.

* The expression used in the data supplied by the Plant Protection Adviser was " countless ".

We may regard this period as one in which the population was fizzling out ultimately into phase *solitaria*. The weather during the period was cold, and no swarm activity was reported.

It may be pointed out that the individuals of the first two periods (January-April and May-August) had swarming antecedents.

3. *Abbreviations used*

The following abbreviations have been used :—

A, Length of eye.

B, Width of eye.

C, Width of head at the genal level.

O, Width of head at the ocular region.

P, Length of pronotum.

H, Height of pronotum.

M, Width of pronotum at the constriction.

K, Broadest width of metasternal interspace.

L, Narrowest width of metasternal interspace.

E, Length of elytron.

W_1, Restricted width of elytron.

F, Length of hind-femur. (This should not be confused with the variance-ratio of F statistic of Fisher.)

S.D.P., Sexual dimorphism percentage.

5-, 6-, 7-, 8-striped, 5—8-eye-striped.

6-*gregaria*, or 6-*greg.*, or 6-*gr.*, Typical 6-eye-striped phase *gregaria* individuals.

6-*solitaria*, or 6-*sol.*, Typical 6-eye-striped phase *solitaria* individuals.

ph. greg., Phase *gregaria* population.

ph. sol., Phase *solitaria* population.

Gr. I, Group I of 1955-population (January-April).

Gr. II, Group II of 1955-population (May-August).

Gr. III, Group III of 1955-population (September-December).

C.V., Coefficient of variation.

S.D., Standard deviation.

S.E., Standard error.

N.S., Not significant.

S, Significant.

*, Significant at 5% level of probability.

**, Significant at 1% level of probability.

***, Significant at 0·1% level of probability.

ex., exs., Number of example(s) or individuals.

Inl. conc., see Kakko Concentration below.

Kakko Concentration (or *Kakko Conc.* or *Inl. conc.*), Initial concentration of locusts in 1949 in Kakko (Rajasthan) which initiated the 1949-55 swarming cycle in India (*vide* Misra, 1952).

Ajmer Swarm (or *Ajmer Sw.*), The swarm in Ajmer (Rajasthan) in 1950 (the second year of the 1949-55 swarming cycle in India (*vide* Roonwal & Misra, 1952).

4. *Acknowledgements*

This work was carried out, in part, under the Locust coordinated Scheme of the Ministry of Food and Agriculture of the Government of India. Under this arrangement, the Plant Protection Adviser to the Government of India supplied us the locust material for the year 1955 collected by his Locust Control Organisation. Shri S. Guha Roy, Senior Statistical Assistant, and Shri G. D. Mukerjee, Computor, in the Zoological Survey of India, made the statistical calculations of various parameters and their significance tests, and their assistance is acknowledged with thanks.

II—MATERIAL AND METHODS

1. *General*

The material for the present study was collected from various localities in Rajasthan (western India) and southern Punjab during the year 1955. A total of 1,179 specimens were measured. They were obtained from 8 districts of Rajasthan and one of the Punjab, as follows, the number available from each district being given within brackets :— RAJASTHAN : Jaisalmer (112) ; Jodhpur (110) ; Nagaur (63) ; Barmer (8) ; Churu (104) ; Bikaner (713) ; Sri Ganganagar (27) ; Jhunjhunu (19) ; PUNJAB : Mohindergarh (23).

Measurements.—The morphometrical measurements were taken as given in earlier accounts in this series (Roonwal, 1949 *et seq.* ; and Misra, Nair & Roonwal, 1952). In the present account, three new measurements and two new ratios have also been taken, *viz.*, A and B (length and width respectively of the compound eyes) and W_1 (restricted width of elytron) and the ratios E/C (elytron-length/width of head at the genal level) and E/W_1 (elytron-length/width of elytron). In addition, the phase differences in the metasternal interspace and its ratio *w/n* (here called K/L, broadest/narrowest width of the interspace), discovered by Roonwal, 1946) has also been utilised.

Statistical procedure.—Various statistical parameters, namely, mean, standard deviation, coefficient of variation, range and their standard errors, etc., were estimated. Where the sample-size was very small it was not worthwhile to calculate the standard error, and in such cases comparisons with other populations, were also not easy to make. Tests of significance were employed to study the difference between two objects. The tests for homogeneity of estimated variances were performed by constructing the variance-ratio (F) statistic (Fisher, 1925). The mean differences were studied for significance, generally by making use of the Large Sample Normal Theory test (Fisher, 1925). Where sample sizes were small and standard deviations equal, the *t*-statistic ("Student", 1908) was computed. In samples having different variances, the more exact test due to Behrens (1925 ; also *vide* Fisher, 1941) was employed. The standard error for Sexual Dimorphism Percentage (S.D.P.) was calculated following the formula employed for the standard error of quotients, ignoring correlation. The difference in Sexual Dimorphism Percentage and in coefficient of variation was also tested for significance by using the Large Sample Normal Theory test.

2. *Statistical characteristics of the 1955-population*

Random sampling and its reliability.—No selection was made while collecting the samples from the field, and all collections were random. The smallest representative populations were collected between the two periods January-April and September-December, with sample range 1-38 and 1-59 respectively. The maximum number of samples (range 110-335) was collected between May-August.

Homogeneity of the population.—The present population is a homogenous one in the sense that : (*a*) The entire collection was made in a single year ; and (*b*) from contiguous localities of the desert region of Rajasthan and southern Punjab (India).

III—EYE-STRIPE COMPOSITION AND SEX-RATIOS

1. *Groupings of the random samples* (Tables 1 and 2)

For statistical analysis the 1,179 specimens of the 1955-population were grouped into three natural groups (corresponding with the three periods of the year) as follows, based on considerations of the chronological position of the generation and the well-known seasonal periodicity and immigrations that are known to occur in the Desert Locust in western India :—

(i) *Group I* (44 specimens).—First-generation individuals. Collected between the period January-April, from the over-wintered swarms of 1954 which over-stayed in Rajasthan.

(ii) *Group II* (948 specimens).—Second-generation individuals. Collected during the period May-August when fresh incursions started invading India from the western regions. Population very high.

(iii) *Group III* (150 specimens).—Collected during the period September-December when solitary breeding on a small scale was reported from various "pockets" in Rajasthan.

2. *Eye-stripes*

(Tables 1 and 2)

Except two individuals which had 5 eye-stripes and two which had 8 eye-stripes, the remainder were either 6- or 7-striped. The eye-stripe composition in the three population-groups is discussed below.

(i) *6 and 7 eye-stripes.*—

The proportion of the 6- and 7-eye-striped individuals was as follows :—

	Percentage of :		
Group	6-striped	7-striped	Remarks
I (44 exs.)	93·0±4	7·0±4	—·—
II (948 exs.)	98·9±0·3	1·1±0·3	Also 2 exs. 5-striped.
III (150 exs.)	56·0±4	44·0±4	Also 2 exs. 8-striped.

(ii) *5 eye-stripes.*—

In Group II, two 5-striped individuals, both females, were found and had the following collection data : (i) Reg. No. 545, ♀, Kharda Rajeran, 14-vii-55. (ii) Reg. No. 677, ♀, Siasar, 9-viii-55. Their morphometry given in the above order, was as follows :—

Size of body-parts (mm.)	Ratios
A, 3·75, 3·75	E/F, 2·37, 2·26
B, 2·25, 2·50	E/W_1, 7·99, 7·81
O, 6·5, 6·4	E/C, 7·67, 7·48
C, 7·5, 7·1	F/C, 3·24, 3·31
P, 10·0, 9·8	P/C, 1·33. 1·38
H, 8·2, 8·0	M/C, 0·813, 0·873
M, 6·1, 6·2	H/C, 1·09, 1·13
E, 57·5, 53·2	K/L, 1·25, 1·25
W_1, 7·2, 6·8	
K, 1·25, 1·25	
L, 1·0, 1·0	
F, 24·3, 23·5	

(iii) *8 eye-stripes.*—

In Group III, two 8 eye-striped individuals, both females were found, and had the following collection data : (i) Reg. No. 771, ♀, Kumbarwala,

15-ix-55. (ii) Reg No. 774, ♀, Pilab, 16-ix-55. Their morphometry given in the above order, was as follows :—

Size of body-parts (mm.)	Ratios
A, 4·75, 4·50	E/F, 1·98, (?)
B, 3·0, 3·0	E/W_1, 7·55, (?)
O, 7·4, 7·4	E/C, 8·02, (?)
C, 8·0, 8·0	F/C, 4·05, (?)
P, 12·0, 12·6	P/C, 1·50, 1·58
H, 10·2, 10·6	M/C, 0·925, 0·950
M, 7·4, 7·6	H/C, 1·28, 1·32
E, 64·2, (?)	K/L, 1·20, 1·25
W_1, 8·5, 8·6	
K, 1·50, 1·25	
L, 1·25, 1·0	
F, 32·4, (?)	

(iv) *An asymmetrical eye.*—

In Group II, a female was found (Bhanotar, 1959) which was asymmetrical—the left eye had 7 and the right one 8 stripes. In the 8-striped eye the two most posterior stripes are separated in the top half, but fused together for the rest of the length. The morphometry as well as actual field population indicate that this specimen is a phase *solitaria* one.

3. *Sex-ratios*

(Tables 1 and 2)

Irrespective of the eye-stripes, the lumped sex-ratios in three population-groups were as follows :—

Group	Sex-ratio (%)	
	Male	Female
I	59	41
II	47	53
III . . .	62	68

The distribution of the sex-ratios in the various eye-stripe groups given below :—

Group	Sex-ratio (%) (with S. E.)			
	6-eye-striped		7-eye-striped	
I	♂ 56 ± 7	♀ 44 ± 7	♂ 100	♀ 0
II	♂ 47·5 ± 2	♀ 52·5±2	♂ 9± 9	♀ 91±9
III .	♂ 84 ± 4	♀ 16± 4	♂ 33± 5	♀ 67 ± 5

4. *Discussion*

The phase-position may now be discussed in relation to the actual population as well as the Hypotheses of Roonwal (1945). In Groups I and II the high proportion (above 80%) of 6-eye-striped individuals as well as the near 50% sex-ratio among the 6-eye-striped individuals indicate the *gregaria* nature of the population ; this is supported by other morphometrical measurements.

In Group III the low proportion (much below 80%) of the 6-eye-striped individuals and the high proportion of males (much above 50%) in the 6-eye-striped forms indicate a phase *solitaria* facies. This is supported by the occurrence of two 8-eye-striped forms (both females) which is an extreme *solitaria* feature, as well as by other morphometrical characters.

Position of 5-eye-striped individuals.—Individuals with 5 eye-stripes have been recorded in laboratory breedings earlier. But the first record of their occurrence in nature is by Misra (1952, pp. 101-102) who found a single 5-striped form (a male) in the initial Kakko (Rajasthan) concentration of 1949 which initiated the 1949-55 swarming cycle in India. Due to paucity of data the phase-position of the 5-striped form has remained doubtful. Roonwal (1954, p. 516) tentatively placed it in the *solitaria* phase, and remarked as follows :—

"The position of the 5-striped forms is not quite clear. Misra (1952) has reported the first and only example of a 5-striped form taken wild in 1949 which was the first year of a new swarming cycle ; previous records are all from breeding cages. Tentatively I am inclined to place the 5-striped forms with the *solitaria* group and as having evolved from the 'basic type' (6-striped *solitaria*) rather than from the 6-striped *gregaria*."

In view of other morphological characters and their ratios in *5-striped* females of the 1955-population and considering the period of its occurrence —in the high initial *Kakko Concentration of 1949* (Misra, 1952) and in the almost swarming period of Group II (present account) — it would appear that the 5-striped forms are in some manner related with the most unstable and critical periods of phase-transformation when the equilibrium of stability in the various biometrical characters, sex-ratios and eye-stripe composition are most shaken in a locust cycle.

IV—MORPHOMETRY (A) — SIZE OF BODY-PARTS

1. *General*

The following twelve morphometrical characters and their ratios were studied for the three Groups (Gr. I—III) of the 1955-population (the methods of measurements being largely those which will be found defined and illustrated in Rao (1960, pp. 295—300) :—

1. Length of compound eye including the ocular sclerite (A).
2. Width of compound eye including the ocular sclerite (B).
3. Width of head at the ocular region (O).
4. Maximum width of head at the genal level (C).
5. Width of pronotum at the constriction (M).
6. Length of pronotum at the keel (P).

7. Maximum height of pronotum in the distal half (prozona) (H).
8. Broadest width of metasternal interspace (K).
9. Narrowest width of metasternal interspace (L).
10. Length of elytron, from the hollow of the angle formed by costa-subcosta veins to the distal tip of the elytron (E).
11. Restricted width of elytron (in the level of the apex of the >— shaped medio-cubital cross vein, lying roughly about the middle of the elytron-length) (W_1).
12. Length of hind-femur (F).

The following eight ratios of the above mentioned characters were also studied :—E/F, E/W_1, E/C, F/C, P/C, M/C, H/C and K/L.

The Sexual Dimorphism Percentage (S. D. P.), first utilised by Roonwal (1949) and subsequently used by Misra (1952), in a population was calculated by the formula :—

$$\left[\left(\frac{\text{Value in } ♀}{\text{Value in } ♂} - 1\right) \times 100\right]$$

For inter-population comparison, the three Groups, I—III, of the 1955-population are first compared among themselves (Tables 3A-D), and then each one of them with the following other populations in India in various degrees of phase-transformations whose data are available in the literature (Tables—4A-C) :—

(i) 6-striped males and females of typical *phase solitaria*, 1936-47 (Roonwal, 1949).

(ii) 7-striped males and females of typical *phase solitaria*, 1936-47 (Roonwal, 1949 ; and Roonwal & Nag, 1951).

(iii) 6-striped males and females of typical *phase gregaria*, 1936-47 (Roonwal, 1949 ; and Roonwal & Nag, 1951).

(iv) 6-striped males and females of *Kakko Concentration*, 1949 (first year of the 1949-55 swarming cycle in India). (Misra, 1952).

(v) 7-striped females of *Kakko Concentration*, 1949 (first year of 1949-55 swarming cycle in India). (Misra, 1952).

(vi) 6-striped males and females of *Ajmer Swarm*, 1950 (second year of the 1949-55 swarming cycle in India). (Roonwal & Misra, 1952).

(vii) Groups I, II and III of the 1955-population (last year of the 1949-55 cycle in India). (Present account).

2. *Length of compound eye (A)*

(Tables 3A-D)

(a) *Mean length (in mm.)*

The mean length of eye (A) varies, as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)*	3·76±0·04	3·93±0·03
2. Gr. I (7)*	3·83±0·08	——
3. Gr. II (6)*	3·81±0·01	3·99±0·01
4. Gr. II (7)*	3·75	4·25±0·06
5. Gr. III (6)*	3·88±0·02	4·06±0·09
6. Gr. III (7)*	4·00±0·03	4·41±0·03

* Throughout this paper the figure in brackets, *e.g.*, "(6)", "(7)", indicates the number of eye-stripes.

(b) *Inter-group comparison* (Table 3D)

(i) *6-striped males and females.—Males :* The values in Gr. I (3·76 ±0·04 mm.) and Gr. II (3·81±0·01 mm.) are significantly lower than in Gr. III (3·88±0·02 mm.) at the 5 per cent and 1 per cent levels of probability but not so at the 0·1 per cent level. The values in Groups I and II are not significantly different from each other. *Females :* The values in Groups I, II and III are not significantly different from each other.

(ii) *7-striped males and females.—Males :* The value in Gr. I (3·83 ±0·08) is not significantly different from that in Gr. III (4·00±0·03). In Gr. II only one 7-striped male occurred. *Females :* The value in Gr. II (4·25±0·06) is significantly lower than in Gr. III (4·41±0·03) at the 5 per cent level only and not so at the 1 per cent and 0·1 per cent levels. No females occurred in Gr. I.

(c) *Inter-sex comparison*

In each Group, the mean value (in mm.) in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	3·76±0·04	3·93±0·03	0·17±0·05
2. Gr. II (6)	3·81±0·01	3·99±0·01	0·18±0·013
3. Gr. III (6)	3·88±0·02	4·06±0·09	0·18±0·09
4. Gr. III (7)	4·00±0·03	4·41±0·03	0·41±0·04

(d) *Inter-population comparison*

No comparison could be made due to lack of data in other populations.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (± S.E.) in the 1955-population varies as follows :—

Gr. I (6)	4·52±1·36
Gr. II (6)	4·72±0·35
Gr. II (7)	13·33
Gr. III (6)	4·64±2·29
Gr. III (7)	10·25±1·19

Within the same eye-stripe category, the values in Gr. I(6), Gr. II (6) and Gr. III (6) are not significantly different from one another, but they are significantly lower than in Gr. III (7) (10·25±1·19) at all levels.

3. *Width of compound eye (B)*
(Tables 3A-D)

(a) *Mean width (in mm.)*

The mean width of eye (B) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	2·40±0·03	2·47±0·02
2. Gr. I (7)	2·50±0·0	—
3. Gr. II (6)	2·46±0·004	2·54±0·01
4. Gr. II (7)	2·50	2·70±0·05
5. Gr. III (6)	2·54±0·015	2·65±0·06
6. Gr. III (7)	2·65±0·026	2·88±0·02

(b) *Inter-group comparison* (Table 3D)

(i) *6-striped males and females.—Males :* The values in Gr. I (2·40 ±0·03 mm.) and Gr. II (2·46±0·004) are significantly lower than in Gr. III (2·54±0·015) at all levels of probability. Between Groups I and II the value in the latter is significantly lower at the 5 per cent level only. *Females* : The value in Gr. I (2·47±0·02) is significantly lower than in Gr. II at all levels and from Gr. III at the 5 per cent level only. The value in Gr. II (2·54±0·01) is not significantly different from that in Gr. III (2·65±0·06) at all levels.

(ii) *7-striped males.*—There is no significant difference between the three groups.

(iii) *7-striped females.*—The value in Gr. II (2·70±0·05) is significantly lower than in Gr. III (2·88±0·02) at the 5 per cent and 1 per cent levels only.

(c) *Inter-sex comparison*

In each Group, the mean value (in mm.) in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	2·40±0·03	2·47±0·02	0·07±0·04
2. Gr. II (6)	2·46±0·004	2·54±0·01	0·08±0·01
3. Gr. III (6)	2·54±0·015	2·65±0·06	0·11±0·07
4. Gr. III (7)	2·65±0·03	2·88±0·02	0·23±0·03

(d) *Inter-population comparison*

No comparison could be made due to lack of data in other populations.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) in the 1955-population varies as follows :—

Gr. I (6)	2·92±1·52
Gr. II (6)	3·25±0·35
Gr. II (7)	8·00
Gr. III (6)	4·33±2·60
Gr. III (7)	8·68±1·30

In the 6-eye-striped category, there is no significant difference between Groups I—III. The values in Grs. I (6) and II (6) are significantly lower than in Gr. III (7) at all levels, but there is no significant difference between Gr. III (6) and Gr. III (7).

4. *Width of head at the ocular region (O)*

(Tables 3A-D)

(a) *Mean length (in mm.)*

The width of head at the ocular region (O) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	6·30±0·05	6·71±0·07
2. Gr. I (7)	6·27±0·09	—
3. Gr. II (6)	6·40±0·01	6·79±0·01
4. Gr. II (7)	6·10	6·94±0·10
5. Gr. III (6)	6·24±0·025	6·75±0·013
6. Gr. III (7)	6·46±0·05	7·14±0·05

(b) *Inter-group comparison* (Table 3D)

(i) *6-striped males and females.—Males :* The mean value in Gr. I (6·30±0·05) is not significantly different from those in Gr. II (6·40±0·01) and Gr. III (6·24±0·025 mm.) at all levels of probability. The value in Gr. II is significantly higher than in Gr. III at all levels. *Females :* The value in Gr. I (6·71±0·07) is not significantly different from those in Gr. II (6·79±0·01) and Gr. III (6·75±0·013) at all levels of probability. The value in Gr. II is significantly higher than in Gr. III at the 5 per cent level only but not significantly different at the 1 per cent and 0·1 per cent levels.

(ii) *7-striped males and females.—Males :* The value in Gr. I (6·27 ±0·09) is not significantly different from that in Gr. III (6·46±0·05) at all levels. Only one male occurred in Gr. II. *Females :* The value in Gr. II (6·94±0·10) is not significantly different from that in Gr. III (7·14 ±0·05) at all levels of probability. No females occurred in Gr. I.

(c) *Inter-sex comparison*

In each Group, the mean value (in mm.) in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	6·30±0·05	6·71±0·07	0·41±0·08
2. Gr. II (6)	6·40±0·01	6·79±0·01	0·39±0·02
3. Gr. III (6)	6·24±0·02	6·75±0·013	0·51±0·14
4. Gr. III (7)	6·46±0·05	7·14±0·05	0·68±0·07

(d) *Inter-population comparison*

No comparison could be made due to lack of data in the other populations.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) in the 1955-population varies as follows :—

Gr. I (6)	6·51±1·36
Gr. II (6)	6·09±0·31
Gr. II (7)	13·77
Gr. III (6)	8·17±2·19
Gr. III (7)	10·53±1·16

In the 6-eye-striped category, the values in Groups I—III are not significantly different from one another. The values in Gr. I (6) and Gr. II (6) are significantly lower than in Gr. III (7) at all levels, but Gr. III (6) and Gr. III (7) are not different from each other.

5. *Width of head at the genal level (C)*

(Plates 2, 5 and 7 ; and Tables 3A-D & 4A-C)

(a) *Mean length (in mm.)*

The width of head at the genal level (C) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	7·31±0·07	7·83±0·07
2. Gr. I (7)	6·63±0·14	—
3. Gr. II (6)	7·20±0·02	7·88±0·02
4. Gr. II (7)	6·30	7·63±0·15
5. Gr. III (6)	6·55±0·04	7·42±0·16
6. Gr. III (7)	6·67±0·05	7·70±0·05

(b) *Inter-group comparison* (Table 3D)

(i) 6-*striped males and females.*—*Males :* The mean value in Gr. I (7·31±0·07) and Gr. II (7·20±0·02) are significantly higher than in Gr. III (6·55±0·04) at all levels. Between Groups I and II, the value in the latter is significantly higher at all levels. *Females :* The value in Groups I and II (7·83±0·07 and 7·88±0·02 respectively) are significantly higher, at the 5 per cent and 1 per cent level, than in Gr. III (7·42±0·16). The values in Groups I and II are not significantly different from each other at all levels.

(ii) 7-*striped males and females.*—*Males :* The value in Gr. I (6·63±0·14) is not significantly different from that in Gr. III (6·67±0·05). Only one male occurred in Gr. II. *Females :* The value in Gr. II (7·63±0·15) is not significantly different from that in Gr. III (7·70±0·05). No females occurred in Gr. I.

(c) *Inter-sex comparison*

In each Group, the mean value (in mm.) in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	7·31±0·07	7·83±0·07	0·52±0·03
2. Gr. II (6)	7·20±0·02	7·88±0·02	0·67±0·02
3. Gr. III (6)	6·55±0·04	7·42±0·16	0·87±0·17
4. Gr. III (7)	6·67±0·05	7·70±0·05	1·05±0·07

(d) *Inter-population comparison* (Tables 4A-C)

The mean values in Groups I, II and III compared with the mean values of other populations are as follows :—

(i) 6-*striped males.*—The mean value in Gr. I (7·31±0·07) is significantly lower than those in 6-*gregaria* (7·55±0·04) and the *Ajmer Swarm* (7·53±0·08), but is significantly higher than in the *Kakko Concentration* (6·60±0·03 mm.). Similarly, the value in Gr. II (7·20±0·02 mm.) is significantly lower than in 6-*gregaria* and *Ajmer Swarm*, but is higher than in the *Kakko Concentration* at all levels. The value in Gr. III (6·55±0·04 mm.) is not significantly different from that in the *Kakko Concentration*, but is significantly lower from other populations.

(ii) 6-*striped females* (Grs. I, II and III).—The values in Gr. I (7·83±0·07) and Gr. II (7·88±0·02) are not significantly different from those in 6-*gregaria* (7·89±0·07) and the *Ajmer Swarm* (7·90±0·25) but are significantly higher than in the *Kakko Concentration* (7·41±0·04) The value in Gr. III (7·42±0·16) is not significantly different from those in the *Kakko Concentration* and the *Ajmer Swarm*, but is significantly lower than in 6-*gregaria* at the 5 per cent and 1 per cent levels of probability.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) of the 1955- and other populations varies as follows :—

1955-population		Other populations	
Gr. I (6)	7·11±1·46	*6-greg.*	4·50±1·50
Gr. II (6)	9·44±0·40	*Ajmer Sw.* (1950)	4·91
Gr. II (7)	21·11	*Kakko Conc. 1949*	12·27±0·84
Gr. III (6)	13·28±2·62		
Gr. III (7)	15·44±1·18		

Within the three Groups for 1955, in 6-eye-striped individuals the value in Gr. I is significantly lower from those in Gr. III at the 5 per cent level, and from the *Kakko Concentration* at the 5 per cent and 1 per cent levels. The value in Gr. II is significantly higher than in *6-gregaria* but is significantly lower than in the *Kakko Concentration.* The value in Gr. III is not significantly different from that in the *Kakko Concentration* but is higher than in *6-gregaria.* In the 1955-population, the values in Gr. I (6) and Gr. II (6) are significantly lower than in Gr. III (7), but Gr. III (6) is not different from Gr. III (7).

6. *Width of pronotum at the constriction (M)*

(Tables 3A-D)

(a) *Mean length (in mm.)*

The width of the head at constriction (M) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	5·80±0·05	6·52±0·07
2. Gr. I (7)	5·80±0·15	—
3. Gr. II (6)	5·91±0·01	6·63±0·02
4. Gr. II (7)	5·70	6·78±0·12
5. Gr. III (6)	5·84±0·03	6·67±0·15
6. Gr. III (7)	5·98±0·05	7·09±0·04

(b) *Inter-group comparison* (Table 3D)

(i) *6-striped males and females.—Males :* The value in Gr. I (5·80 ±0·05) is significantly lower than in Gr. II (5·91±0·01) at the 5 per cent level only, and is not significantly different from that in Gr. III (5·84± 0·03 mm.) at all levels. Between Groups II and III, the value

in the former is significantly higher at the 5 per cent level only. *Females :* The values in the three Groups are not significantly different from one another at all levels.

(ii) *7-striped males and females.—Males :* The value for males in Gr I (5·80±0·15) is not significantly different from that in Gr. III (5·98±0·05). Only one male occurred in Gr. II. *Females :* The value in Gr. II (6·78±0·12) is significantly lower than in Gr. III (7·09±0·04) at the 5 per cent level only. No females occurred in Gr. II.

(c) *Inter-sex comparison*

In all the Groups, the mean value (in mm.) in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	5·80±0·05	6·52±0·07	0·72±0·08
2. Gr. II (6)	5·91±0·01	6·63±0·02	0·72±0·02
3. Gr. III (6)	5·84±0·03	6·67±0·15	0·83±0·15
4. Gr. III (7)	5·98±0·05	7·09±0·04	1·11±0·07

(d) *Inter-population comparison*

The mean values in Groups I—III compare with 6-*gregaria* (data for other populations are not available) as follows :—

(i) *6-striped males.*—The mean value in Gr. I (5·80±0·05) is significantly lower than in 6-*gregaria* (5·86±0·04) at the 5 per cent and 1 per cent level only, but the values in Gr. II (5·91±0·01) and Gr. III (5·84±0·03) are not significantly different from that in *6-gregaria* at all levels.

(ii) *6-striped females.*—The values in Gr. I (6·52±0·07) and Gr. III (6·67±0·15) are not significantly different from that in *6-gregaria* (6·36±0·08), but the value in Gr. II (6·63±0·02) is significantly higher than in 6-*gregaria* at all levels.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) in the 1955-population varies as follows :—

Gr. I (6)	12·41±1·56
Gr. II (6)	12·18±0·40
Gr. II (7)	18·95
Gr. III (6)	14·21±2·58
Gr. III (7)	18·56±1·21

Within the 6-striped category, Groups I, II and III are not significantly different from one another. The values in Gr. I (6) and Gr. II (6) are significantly lower than in Gr. III (7), but Gr. III (6) is not different from Gr. III (7).

7. *Length of pronotum (P)*
(Plates 2 & 5 ; and Tables 3A-D & 4A-C)

(a) *Mean length (in mm.)*

The length of pronotum (**P**) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	9·66±0·11	10·47±0·11
2. Gr. I (7)	9·67±0·44	—
3. Gr. II (6)	9·94±0·02	10·86±0·03
4. Gr. II (7)	10·00	11·50±0·29
5. Gr. III (6)	9·86±0·06	10·76±0·29
6. Gr. III (7)	10·20±0·08	11·90±0·10

(b) *Inter-group comparison* (Table 3D)

(i) *6-striped males and females.—Males :* The mean values in Gr. I (9·66±0·11) and Gr. II (9·94±0·02) are not significantly different from that in Gr. III (9·86±0·06) at all levels. But the value in Gr. I is significantly lower than in Gr. II at the 5 per cent level only. *Females :* The values in Gr. I (10·47±0·11) and Gr. II (10·86±0·03) are not significantly different from those in Gr. III (10·76±0·29). But the value in Gr. I is significantly lower than that in Gr. II at all levels.

(ii) *7-striped males and females.—Males :* The value in Gr. I is not significantly different from that in Gr. III at all levels. Only one male occurred in Gr. II. *Females :* The value in Gr. II is not significantly different from that in Gr. III. No females occurred in Gr. I.

(c) *Inter-sex comparison*

In each Group the mean value (in mm.) in male is significantly lower than in females, as follow :

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	9·66±0·11	10·47±0·11	0·81±0·08
2. Gr. II (6)	9·94±0·02	10·86±0·03	0·92±0·04
3. Gr. III (6)	9·86±0·06	10·76±0·29	0·90±0·30
4. Gr. III (7)	10·20±0·08	11·90±0·10	1·75±0·13

(d) *Inter-population comparison* (Tables 4A-C)

The mean values in Groups I, II and III compare with those in other populations as follows :—

(i) *6-striped males.*—The value in Gr. I (9·66±0·11) is not significantly different from those in *6-gregaria* (9·87±0·08) and the *Kakko Concentration* (9·76±0·05), but it is significantly lower than in the

Ajmer Swarm (10·01±0·11) at the 5 per cent level only. The value in Gr. II (9·94±0·03) is not significantly different from those in *6-gregaria* and the *Ajmer Swarm*, but is significantly higher than in the *Kakko Concentration* at the 5 per cent and 1 per cent levels. The value in Gr. III (9·86±0·06) is not significantly different from all other populations.

(ii) *6-striped females.*—The values in Groups I (10·47±0·11), II (10·86±0·03) and III (10·76±0·29) are not significantly different from those in the *Ajmer Swarm* (10·78±0·34). The value in Gr. I is significantly lower than in the *Kakko Concentration* (10·94±0·09), but not significantly different from that in *6-gregaria* (10·49±0·13). The value in Gr. II is not significantly different from that in the *Kakko Concentration*, but is significantly higher than in *6-gregaria*. The value in Gr. III is not significantly different from either *6-gregaria* or the *Kakko Concentration* at all levels.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) in the 1955-Groups and other populations varies as follows :—

1955-population		Other populations	
Gr. I (6)	8·38±1·74	*6-greg.*	6·28±1·60
Gr. II (6)	9·26±0·44	*Ajmer Sw.* (1950)	7·69
Gr. II (7)	15·09	*Kakko Conc.* (1949)	12·09±1·09
Gr. III (6)	9·13±3·06		
Gr. III (7)	15·67±1·38		

In the 1955-population Groups I—III in the 6-striped category are not significantly different from one another, nor from the "other populations", except that Gr. II (6) is lower than the *Kakko Concentration* at the 5 per cent level. The values in Gr. I (6) and Gr. II (6) are lower than in Gr. III (7) at all levels, but Gr. III (6) does not differ from Gr. III (7).

8. *Height of pronotum (H)*

(Tables 3A-D)

(a) *Mean length (in mm.)*

The height of pronotum (H) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	8·03±0·08	8·70±0·11
2. Gr. I (7)	8·13±0·26	—
3. Gr. II (6)	8·14±0·02	8·98±0·03
4. Gr. II (7)	7·70	9·37±0·21
5. Gr. III (6)	8·20±0·04	9·10±0·27
6. Gr. III (7)	8·40±0·09	9·90±0·07

(b) *Inter-group comparison* (Table 3D)

(i) *6-striped males and females.—Males :* Within the groups, the values in Groups I—III are not significantly different from one another at all levels. *Females :* The value in Gr. I (8·70±0·11) is significantly lower than in Gr. II (8·98±0·03) at the 5 per cent level only ; and both these values are not significantly different from that in Gr. III (9·10±0·27).

(ii) *7-striped males and females.—Males :* The value in Gr. I is not significantly different from that in Gr. III at all levels. Only one male occurred in Gr. II. *Females :* The value in Gr. II (9·37±0·21) is significantly lower than in Gr. III (9·90±0·07) at the 5 per cent level only. No females occurred in Gr. I.

(c) *Inter-sex comparison*

In each Group the mean value (in mm.) in male is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6) . .	8·03±0·08	8·70±0·11	0·67±0·13
2. Gr. II (6) . .	8·14±0·02	8·98±0·03	0·84±0·03
3. Gr. III (6) .	8·20±0·04	9·10±0·27	0·93±0·28
4. Gr. III (7) .	8·40±0·09	9·90±0·07	1·58±0·11

(d) *Inter-population comparison*

The mean values in Groups I—III compare with those of *6-gregaria* as follows (no data are available for other populations) :—

(i) *6-striped males.*—The values in Gr. I (8·03±0·08), Gr. II (8·14 ±0·02) and Gr. III (8·20±0·04) are significantly lower than in *6-gregaria* (8·39±0·05) at all levels.

(ii) *6-striped females.*—The values in Gr. I (8·70±0·11), Gr. II (8·98±0·03) and Gr. III (9·10±0·27) are not significantly different from those in *6-gregaria* (8·92±0·10) at all levels.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) of the 1955-Groups is as follows :—

Gr. I (6)	8·34±1·74
Gr. II (6)	10·32±0·43
Gr. II (7)	21·69
Gr. III (6)	10·98±3·37
Gr. III (7)	17·86±1.53

The values in Gr. I (6) (8·34±1·74) ; Gr. II (6) (10·32±0·43) and Gr. III (6) (10·98±3·37) are not significantly different from one another. Inter-stripes, the values in Gr. I (6) and Gr. II(6) are significantly lower than in Gr. III (7) (17·86±1·53), but the value in Gr. III (6) is not significantly different from Gr. III (7).

9. *Broadest width of metasternal interspace (K)*

(Tables 3A-D)

(a) *Mean values (in mm.)*

The mean value of K varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	0·772±0·015	1·167±0·035
2. Gr. I (7)	0·750±0·144	—
3. Gr. II (6)	0·791±0·006	1·244±0·006
4. Gr. II (7)	0·750	1·225±0·058
5. Gr. III (6)	0·722±0·013	1·229±0·021
6. Gr. III (7)	0·750±0·017	1·267±0·021

(b) *Inter-group comparison* (Table 3D)

(i) *6-striped males and females.—Males :* The values for Gr. I (0·772 ±0·015 mm.) and Gr. II (0·791±0·006 mm.) are not significantly different from each other, but both these are significantly higher than those in Gr. III (0·722±0·013 mm.) at all levels. *Females :* The value for Gr. I (1·167±0·035 mm.) is significantly lower than those in Gr. II (1·244± 0·006 mm.) and Gr. III (1·229±0·021 mm.) at the 5 per cent level only. The values in Groups II and III are not significantly different from each other.

(ii) *7-striped males and females.—Males :* The value for Gr. I (0·750 ±0·144 mm.) is not significantly different from that in Gr. III (0·750± 0·017 mm.). Only one male occurred in Gr. II. *Females :* The values for Gr. II (1·225±0·058 mm.) and Gr. III (1·267±0·021 mm.) are not significantly different from each other. No females occurred in Gr. I.

(c) *Inter-sex comparison*

Within each Group, the mean value (in mm.) in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	0·772±0·015	1·167±0·035	0·395±0·037
2. Gr. II (6)	0·791±0·006	1·244±0·006	0·453±0·009
3. Gr. III (6)	0·772±0·013	1·229±0·021	0·507±0·025
4. Gr. III (7)	0·750±0·017	1·267±0·021	0·617+1·267

(d) *Sexual Dimorphism Percentage*

The values for S. D. P. (±S.E.) for the 1955-population vary as follows :—

Gr. I (6)	51·19±2·43
Gr. II (6)	57·34±0·53
Gr. II (7)	63·33
Gr. III (6)	70·28±3·42
Gr. III (7)	68·93±1·65

The value in Gr. I (6) (51·19±2·43) is significantly lower than in Gr. II (6) (57·34±0·53) at the 5 per cent level only, and both these values are significantly lower than in Gr. III (6) (70·28±3·42) at all levels. The value in Gr. III (7) (68·93±1·65) is not significantly different from that in Gr. III (6), but is significantly higher than those in Gr. I (6) and Gr. II (6) at all levels.

10. *Narrowest width of metasternal interspace* (*L*)

(Tables 3A-D)

(a) *Mean values* (*in mm.*)

The mean value for L varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	0·587±0·025	1·00±0·028
2. Gr. I (7)	0·500±0·144	—
3. Gr. II (6)	0·531±0·005	1·003±0·005
4. Gr. II (7)	0·500	0·950±0·053
5. Gr. III (6)	0·468±0·012	1·00±0·0
6. Gr. III (7)	0·510±0·021	1·00±0·012

(b) *Inter-group comparison* (Table 3D)

(i) *6-striped males and females.—Males :* The mean value for Gr. I (0·587±0·025 mm.) is significantly higher than in Groups II (0·531±0·005 mm.) and III (0·468±0·012 mm.) at all levels. The value for Gr. II is significantly higher than for Gr. III. *Females :* The values for Groups I, II and III are not significantly different from one another at all levels.

(ii) *7-striped males and females.—Males :* The mean values for Groups I (0·500±0·144 mm.) and III (0·510±0·021 mm.) are not significantly different from each other at all levels. Only one male occurred in Gr. II. *Females :* The values for Gr. II (0·950±0·053 mm.) is not

significantly different from that in Gr. III (1·00±0·012 mm.) at all levels. No female occurred in Gr. I.

(c) *Inter-sex comparison*

Within each Group, the mean value (in mm.) in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6) . .	0·587±0·025	1·00 ±0·028	0·413±0·038
2. Gr. II (6) . . .	0·531±0·005	1·003±0·005	0·471±0·007
3. Gr. III (6) . .	0·468±0·012	1·00 ±0·0	0·532±0·012
4. Gr. III (7) . . .	0·510±0·021	1·00 ±0·012	0·490±0·024

(d) *Sexual Dimorphism Percentage*

The value for S.D.P. (±S.E.) for the 1955-population varies as follows :—

Gr. I (6)	70·39±3·04
Gr. II (6) . . .	88·67±0·57
Gr. II (7) . . .	90·00
Gr. III (6) . . .	113·54±1·21
Gr. III (7)	96·08±2·13

The values for Gr. I (6) (70·39±3·04) and Gr. II (6) (88·67±0·57) are significantly lower than for Gr. III (6) (113·54±1·21) at all levels. Between Gr. I and Gr. II, the value in the latter is significantly higher than in the former. The value in Gr. III (7) (96·08±2·13) is significantly lower than in Gr. III (6) (113·54±1·21) but is significantly higher than in Gr. I (6) and Gr. II (6) at all levels.

11. *Length of elytron (E)*

(Plates 1, 5 & 6 ; and Tables 3A-D & 4A-C)

(a) *Mean length (in mm.)*

The mean length of elytron (E) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6) .	51·01±0.49	57·09±0·72
2. Gr. I (7)	50·23±1·51	--
3. Gr. II (6)	52·48±0·13	59·09±0·14
4. Gr. II (7)	50·20	60·22±0·90
5. Gr. III (6) .	52·07±0·31	59·74±0·91
6. Gr. III (7)	52·58±0·43	63·39±0.48

(b) *Inter-group comparison* (Table 3D)

(i) *6-eye-striped males and females.—Males :* The values in Gr. I (51·01±0·49) and Gr. II (52·48±0·13) are not significantly different from that in Gr. III (52·07±0·31) at all levels. Between Groups I and II, the value in the latter is significantly higher at the 5 per cent and 1 per cent levels but not at the 0·1 per cent level. *Females :* The value in Gr. I (57·09±0·72) is significantly lower than in Gr. II (59·09±0·14), at the 5 per cent and 1 per cent levels and in Gr. III (59·74±0·91) at the 5 per cent level. Between Groups II and III the values are not significantly different at all levels.

(ii) *7-eye-striped males and females.—Males :* The value in Gr. I (50·23±1·51) is not significantly different from that in Gr. III (52·58±0·43) at all levels. Only one male occurred in Gr. II. *Females :* The value in Gr. II (60·22±0·90) is significantly lower than in Gr. III (63·39±0·48) at the 5 per cent and 1 per cent levels. No female occurred in Gr. I.

(c) *Inter-sex comparison*

In each of the Groups the mean value (in mm.) in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6) . . .	51·01±0·49	57·09±0·72	6·08±0·84
2. Gr. II (6) . . .	52·48±0·13	59·09±0·14	6·61±0·19
3. Gr. III (6) . .	52·07±0·31	59·74±0·91	7·67±0·96
4. Gr. III (7) . .	52·58±0·43	63·39±0·48	10·81±0·64

(d) *Inter-population comparison* (Tables 4A-C)

The values in Groups I—III compare with those of other populations as follows :—

(i) *6-eye-striped males.*—The value in Gr. I (51·01±0·49) is significantly lower than those in *6-gregaria* (52·85±0·52), *6-solitaria* (52·15±0·24), the *Kakko Concentration* (51·46±0·29) and the *Ajmer Swarm* (54·16±0·70). The value in Gr. II (52·48±0·13) is not significantly different from those in *6-gregaria* and *6-solitaria*, whereas it is significantly higher than in the *Kakko Concentration* and lower than in the *Ajmer Swarm*. The value in Gr. III (52·07±0·31) is not significantly different from those in other populations, except from the *Ajmer Swarm* where it is higher.

(ii) *6-eye-striped females.*—The value in Gr. I (57·09±0·72) is not significantly different from those in *6-gregaria* (58·01±0·81) and the *Ajmer Swarm* (59·70±1·68), but is significantly lower than in *6-solitaria* (61·56±0·31) and the *Kakko Concentration* (59·73±0·42). The value in Gr. II (59·09±0·14) is not significantly different from the other population except from *6-solitaria* from which it is significantly lower at all levels. The value in Gr. III (59·74±0·91) is not significantly different from those in the other populations.

(iii) *7-eye-striped males.*—The values in Gr. I (50·23±1·51) and Gr. III (52·58±0·43) are not significantly different from that in *7-solitaria* (52·38±0·42) at all levels.

(iv) *7-eye-striped females.*—The value in Gr. II (60·22±0·90) is significantly lower than in *7-solitaria* (62·90±0·26), but is not significantly different from that in the *Kakko Concentration* (61·83±1·41). The value in Gr. III (63·39±0·48) is not significantly different either from the *7-solitaria* or the *Kakko Concentration* at all levels.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) varies as follows :—

1955-population		Other populations	
Gr. I (6)	11·92±1·78	*6-greg.*	9·76±1·88
Gr. II (6)	12·60±0·39	*6-sol.*	18.04±0.80
Gr. II (7)	19·96	*7-sol.*	20·08±1·08
Gr. III (6)	14·73±1·87	*Ajmer Sw.* (1950)	10·23
Gr. III (7)	20·56±1·33	*Kakko Conc.* (1949)	16·07±1·0

Within the 6-eye-stripe category of the 1955-Groups, the values of S.D.P. are not significantly different from one another at all levels of probability, but all these three are lower than in Gr. III (7). The values in Gr. I (6) and Gr. II (6) are not significantly different from that in *6-gregaria*, but are significantly lower than those in the *Kakko Concentration* and *6-solitaria* at the 5 per cent and 1 per cent levels of probability respectively. The value in Gr. III (6) is significantly higher than in *6-gregaria* at the 5 per cent level, but is not significantly different than those in the *Kakko Concentration* and *6-solitaria.* The value in Gr. III (7) is not significantly different from that in *7-solitaria.*

12. *Restricted width of elytron* (W_1)

(Tables 3A-D)

(a) *Mean length (in mm.)*

The width of the elytron (W_1) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	6·89±0·07	7·66±0·07
2. Gr. I (7)	6·57±0·43	—
3. Gr. II (6)	7·10±0·02	7·82±0·02
4. Gr. II (7)	6·20	7·67±0·14
5. Gr. III (6)	6·66±0·05	7·36±0·16
6. Gr. III (7)	6·71±0·07	7·84±0.06

(b) *Inter-group comparison* (Table 3D)

(i) *6-eye-striped males and females.—Males :* The value in Gr. I (6·89±0·07) is significantly lower than in Gr. II (7·10±0·02) but is significantly higher than in Gr. III (6·66±0·05) at the 5 per cent and 1 per cent levels. Between Groups II and III, the value in the former is significantly higher at all levels. *Females :* The values in Gr. I (7·66± 0·07) is significantly lower than in Gr. II (7·82±0·02) at the 5 per cent level only, and is not significantly different from that in Gr. III (7·36± 0·16). The value in Gr. II is significantly higher than in Gr. III at the 5 per cent and 1 per cent levels.

(ii) *7-eye-striped males and females.—Males :* The values of males in Gr. I (6·57±0·43) and females in Gr. II (7·67±0·14) are not significantly different from those in Gr. III males (6·71±0·07) and females (7·84±0·06) respectively at all levels. Only one male occurred in Gr. II and no female in Gr. I.

(c) *Inter-sex comparison*

Within each eye-stripe category in the various Groups, the mean value (in mm.) in male is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	6·89±0·07	7·66±0·07	0·77±0·10
2. Gr. II (6)	7·10±0·02	7·82±0·02	0·72±0·03
3. Gr. III (6)	6·66±0·05	7·36±0·16	0·70±0·17
4. Gr. III (7)	6·71±0·07	7·84±0·06	1·13±0·10

(d) *Inter-population comparison*

No comparison could be made due to lack of data in other populations.

Note : The width of elytron (W) in the *Kakko Concentration* (1949) and *Ajmer Swarm* (1950), referred to the entire width of elytron and not to the restricted width (W_1), as taken here in the 1955- population (*see* Roonwal & Bhanotar, *in Press*).

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) for the 1955-population varies as follows :—

Gr. I (6)	11·18±1·44
Gr. II (6)	10·14±0·47
Gr. II (7)	23·71
Gr. III (6)	10·51±2·60
Gr. III (7)	16·84±1·61

In the 1955-population, the values of Groups I—III in the 6-eye-striped category are not significantly different from one another at all levels, but all these are lower than in Gr. III (7).

13. *Length of hind-femur (F)*

(Plates 1, 5 & 6 ; and Tables 3A-D & 4A-C)

(a) *Mean length (in mm.)*

The mean length of the hind-femur (F) varies as follows :—

Group (and eye-stripes)	Males	Females
1. Gr. I (6)	23·11±0·26	25·52±0·34
2. Gr. I (7)	25·30±0·64	—
3. Gr. II (6)	24·06±0·07	26·50±0·07
4. Gr. II (7)	25·10	28·63±0·55
5. Gr. III (6)	25·24±0·16	27·97±0·90
6. Gr. III (7)	26·12±0·23	31·21±0·22

(b) *Inter-group comparison* (Table 3D)

(i) *6-eye-striped males and females.—Males :* The mean values in Gr. I (23.11±0·26) is significantly lower than in Gr. II (24·06±0·07), and both these values are significantly lower than in Gr. III (25·24±0·16) at all levels. *Females :* The value in Gr. I (25·52±0·34) is significantly lower than those in Gr. II (26·50±0·07) and Gr. III (27·97±0·90). But between Groups II and III, there is no significant difference.

(ii) *7-eye-striped males and females.—Males :* The value in Gr. I (25·30±0·64) is not significantly different from that in Gr. III (26·12±0·23). Only one male occurred in Gr. II. *Females :* The value in Gr. II (28·63±0·55) is significantly lower than in Gr. III (31·21±0·22) at all levels. No female occurred in Gr. I.

(c) *Inter-sex comparison*

Within each eye-stripe category, in each of the 1955-groups the mean value in males is significantly lower than in females, as follows :—

Group (and eye-stripes)	Males	Females	Difference
1. Gr. I (6)	23·11±0·26	25·52±0·34	2·41±0·428
2. Gr. II (6) . .	24·06±0·07	26·50±0·07	2·44±0·10
3. Gr. III (6) . .	25·24±0·16	27·97±0·90	2·73±0·10
4. Gr III (7)	26·12±0·23	31·21±0·22	5·09±0·32

(d) *Inter-population comparison* (Tables 4A-C)

The mean values in Groups I—III compare with those of other populations as follows :—

(i) *6-eye-striped males.*—The value in Gr. I (23·11±0·26) is significantly lower than in *6-gregaria* (24·32±0·20), *6-solitaria* (25·40±0·12), the *Kakko Concentration* (24·92±0·16) and the *Ajmer Swarm* (24·37±0·29). The value in Gr. II (24·06±0·07) is not significantly different from that in *6-gregaria* and the *Ajmer Swarm*, but is significantly lower than in *6-solitaria* and the *Kakko Concentration* at all levels. The value in Gr. III (25·24±0·16) is not significantly different from those in *6-solitaria* and the *Kakko Concentration* but is significantly higher than in *6-gregaria* and the *Ajmer Swarm.*

(ii) *6-eye-striped females.*—The value in Gr. I (25·52±0·34) is not significantly different from that in *6-gregaria* (26·44±0·37). However, it is significantly lower than in *6-solitaria* (29·37±0·18) and the *Kakko Concentration* (28·35±0·25) at all levels, and from the *Ajmer Swarm* (27·28±0·25) at the 5 per cent level only. The value in Gr. II (26·50±0·07) is not significantly different from that in *6-gregaria* and the *Ajmer Swarm*, but is significantly lower than in *6-solitaria* and the *Kakko Concentration* at all levels. The value in Gr. III (27·97±0·90) is not significantly different from that in the other populations.

(iii) *7-eye-striped males.*—The value in Groups I (25·30±0·64) and III (26·12±0·23) are not significantly different from that in *7-solitaria* (26·13±0·21) at all levels. Only one male occurred in Gr. II.

(iv) *7-eye-striped females.*—The value in Gr. II (28·63±0·55) is significantly lower than in *7-solitaria* (30·92±0·13) at all levels, but is not significantly different from that in the *Kakko Concentration* (29·94±0·92). The value in Gr. III (31·21±0·22) is not significantly different from Gr. II and the *Kakko Concentration.* No female occurred in Gr. I.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) varies as follows :—

1955-population		Other populations	
Gr. I (6)	10·43±1·94	*6-greg.* . .	8·72±1·76
Gr. II (6)	10·14±0·43	*6-sol.*	15·63±0·89
Gr. II (7)	14·06	*7-sol.*	18·33±1·07
Gr. III (6)	10·82±3·66	*Ajmer Sw.* (1950)	11·94
Gr. III (7)	19·49±1·35	*Kakko Conc.* (1949)	13·76±1·24

In the 1955-population, the values in Groups I—III within the 6-striped category are not significantly different from one another, but all these three are lower than in Gr. III (7). The value in Gr. I (6) is not significantly different from *6-gregaria* and the *Kakko Concentration* but is lower than *6-solitaria* at the 5 per cent level. The value in Gr. II (6) is not different from *6-gregaria*, but is lower than in the *Kakko Concentration* at the 5 per cent and 1 per cent levels, and from *6-solitaria* at all levels. The value in Gr. III (6) is not significantly different from "other populations". The value in Gr. III (7) is not different from *7-solitaria.*

14. *General conclusions regarding size of body-parts*

1. On the basis of the morphometrical analysis of the twelve body-parts discussed above, it is concluded that Group II occupies a position in between Groups I and III, but shows affinity, in most characters, to the former. Regarding the length of pronotum (P), the height of pronotum (H), width of pronotum at the constriction (M) and the length of the elytron (E), Group II is, however, closer to Group III than to Group I. The characters B (width of eye), C (width of head at the genal level), W_1 (restricted width of elytron) and F (length of hind-femur) have proved to be very sensitive for phase differentiation.

2. The study of the sex-differences in body-parts reveals that the mean lengths for females are definitely larger than those for males. These differences cannot be accounted for by sampling error and a real difference seems to exist. In the case of characters width of eye (B) for Groups I and III and the length of hind-femur (F) for Group I, however, the sexual difference is not as real as apparent from the Student's '*t*' test based on the classical theory of errors.

3. A detailed comparison of Groups I, II and III have been made with the other previously studied populations. A general conclusion drawn from these comparisons is that Groups I and II have been sampled from identical populations having means similar to typical *phase gregaria* and to the *Ajmer Swarm of* 1950 (the second year of the 1949-55 swarming cycle). Group III shows similar characteristics which are similar to those of *phase solitaria* and the *Kakko Concentration of* 1949 (the first year of the 1949-55 cycle). As usual, the length of elytron (E) for males behaves exceptionally. The *6-striped* females in Group III do not show any definite result when compared with the other populations, but its values are nearer to those of *phase solitaria*. The reason for this may be due to small size of the sample ($n=14$). Among the 1955-Groups, Gr. II shows more consistent results than the other two Groups, possibly due to its large sample size and uniform population density. Among the four characters, namely, E, F, C, P, the length of the hind-femur (F) and the width of the head at the genal level (C), are the two most phase-sensitive characters.

4. Within the 1955-Groups, the Sexual Dimorphism Percentage (S.D.P.) does not show much discriminating power for detecting possible divergences between the Groups, except in the characters broadest (K) and narrowest (L) width of the metasternal interspace, where the values show a high degree of difference. Nevertheless, the S.D.P. with respect to C, P, E and F also in inter-population comparisons, does help, in varying degrees, to place a Group in one of the phases to which it may possibly belong. In this regard the length of the elytron (E) is the most phase-sensitive character and shows the *phase gregaria* characters of Groups I and II and the *phase solitaria* characters of Group III.

V—MORPHOMETRY (B)—RATIOS

1. *General*

The ratios of values of the sizes of the various pairs of body-parts were first calculated for each individual specimen, and then the means and other statistical constants calculated in the usual way.

2. *Rotio E/F*

(Plates 3, 5 & 7 ; and Tables 5A-D, 6 & 7A-C)

(a) *Mean values*

The mean values for E/F in 6- and 7-eye-striped forms are as follows :—

Group	Males	Females
1. Gr. I (6)	2·21±0·018	2·24±0·016
2. Gr. II (6)	2·18±0·004	2·23±0·004
3. Gr. III (6)	2·07±0·010	2·11±0·031
4. Gr. I (7)	1·99±0·013	Nil
5. Gr. II (7)	2·00	2·10±0·021
6. Gr. III (7)	2·01±0·009	2·04±0·008

(b) *Inter-group comparison* (Table 5A-D)

(i) *6-striped males and females.—Males :* The value in Gr. I (2·21±0·018) is not significantly different from that in Gr. II (2·18±0·004), but both these values are significantly higher than in Gr. III (2·07±0·010) at all levels. *Females :* The value in Gr. I (2·24±0·016) is not significantly different from that in Gr. II (2·23±0·004). Both these values are significantly higher in Gr. III (2·11±0·031) ; the S.D. is also significantly different at the 5 per cent level of probability.

(ii) *7-striped males and females.—Males :* The value in Gr. I (1·99±0·013) is not significantly different from that in Gr. III (2·01±0·009) at all levels. Only one male occurred in Gr. II. *Females :* The value in Gr. II (2·10±0·021) is significantly higher than in Gr. III (2·04±0·008) at the 5 per cent level only. No females occurred in Gr. I.

(c) *Inter-sex comparison* (Table 6)

In Groups II (6) and III (7), marked with an asterisk(*), the values in males are significantly slightly lower than in females. In other groups, however, the sexes do not differ significantly.

Group	Males	Females	Difference
Gr. I (6) . . .	2·21±0·018	2·24±0·016	0·03±0·024
Gr. II (6)* . .	2·18±0·004	2·23±0·004	*0·05±0·006
Gr III (6	2·07±0·010	2·11±0·031	0·04±0·032
Gr. III (7)* . .	2·01±0·009	2·04±0·008	*0·03±0·01

(d) *Inter-population comparison* (Tables 7A-C)

The mean values in Group I—III compare with those of other populations as follows :—

(i) *6-striped males.*—The values in Gr. I (2·21±0·018) and Gr. II (2·18±0·004) are not significantly different from those in *6-gregaria* males (2·17±0·024) and the *Ajmer Swarm* (2·22±0·023), but are significantly higher than in *6-solitaria* males (2·05±0·012) and the *Kakko Concentration* (2·06±0·010) at all levels of probability. The value in Gr. III (2·07±0·10) is not significantly different from those in *6-solitaria* and the *Kakko Concentration*, but is significantly lower than in *6-gregaria* and the *Ajmer Swarm.*

(ii) *6-striped females.*—The values in Gr. I (2·24±0·016) and Gr. II (2·23±0·004) are not significantly different from those in *6-gregaria* (2·25±0·017) and the *Ajmer Swarm* (2·19±0·035) but are significantly higher than in *6-solitaria* (2·09±0·008) and the *Kakko Concentration* (2·12±0·011) at all levels of probability. The values in Gr. III (2·11±0·03) are significantly lower than in *6-gregaria*, but not significantly different from other populations.

(iii) *7-striped males.*—The values in Groups I (1·99±0·013) and Gr. III (2·01±0·009) are not significantly different from those in *7-solitaria* (2·00±0·006) at all levels of probability.

(iv) *7-striped females.*—The value in Gr. II (2·10±0·021) is significantly higher than in *7-solilaria* (2·03±0·007) at the 5 per cent and 1 per cent levels, (but not so at the 0·1 per cent), but is not significantly different from the *Kakko Concentration* (2·07±0·022) at all levels of probability. The value in Gr. III (2·04±0·008) is not significantly different from either *7-solitaria* or the *Kakko Concentration* at all levels of probability.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (± S.E.) varies as follows :—

1955-population		Other populations	
Gr. I (6)	1·36±1·10	*6-greg.*	3·69±1·40
Gr. II (6)	2·29±0·23	*Ajmer Sw.*	—1·35
Gr. II (7)	5·00	*kakko Conc.*	2·91±0·73
Gr. III (6)	1·93±1·57	*6-sol.*	1·95±0·45
Gr. III (7)	1·49±0·63	*7-sol.*	1·50±0·62

Between the *1955-Groups*, the S.D.P. is not significantly different from one another. It is also not significantly different from other populations. It is, therefore, concluded that the ratio E/F is, in this respect, is not a phase-sensitive character.

3. *Ratio* E/W_1
(Tables 5A—D & 6)

(a) *Mean values*

The mean values for E/W_1 in 6- and 7-eye-striped forms are as follows :—

Group	Males	Females
1. I (6) .	7·41±0·068	7·45±0·081
2. II (6) .	7·42±0·016	7·57±0·015
3. III (6) .	7·88±0·038	8·10±0·123
4. I (7) .	7·69±0·285	Nil
5. II (7) .	8·10	7·92±0·132
6. III (7)	7·84±0·068	8·12±0·045

(b) *Inter-group comparison* (Tables 5A—D)

(i) *6-striped males and females.—Males :* The mean values in Gr. I (7·41±0·068) and Gr. II (7·42±0·016) are significantly lower than in Gr. III (7·88±0·038) at all levels of probability. Groups I and II are not significantly different from each other at all levels. *Females :* The values in Gr. I (7·45±0·081) and Gr. II (7·57±0·015) are significantly lower than in Gr. III (8·10±0·123). Groups I and II are not significantly different from each other at all levels.

(ii) *7-striped males and females.—Males :* The values in Gr. I (7·69±0·285) and Gr. III (7·84±0·068) are not significantly different at all levels of probability. Only one male occurred in Gr. II. *Females :* The values in Gr. II (7·92±0·132) and Gr. III (8·12±0·045) are not significantly different from each other at all levels. No females occurred in Gr. I.

(c) *Inter-sex comparison* (Table 6)

In Groups II (6) and III (7), marked with an asterisk (*), the values in males are slightly lower than in females. In other groups the sexes do not differ significantly.

Group	Males	Females	Difference
I (6)	7·41±0·068	7·45±0·081	0·04±0·105
*II (6)	7·42±0·016	7·57±0·015	*0·15±0·022
III (6)	7·88±0·038	8·10±0·123	0·22±0·139
*III (7)	7·84±0·068	8·12±0·045	*0·28±0·082

(d) *Inter-population comparison*

No Comparison could be made due to lack of data in other populations (see *note*, P. 26).

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) for the 1955-population varies as follows :—

Gr. I (6)	0·54±1·43
Gr. II (6)	2·02±0·30
Gr. II (7)	—2·22
Gr. III (6)	2·79±1·63
Gr. III (7)	3·57±1·07

Between the *1955-Groups*, the S.D.P. is not significantly different at all levels.

4. *Ratio E/C*

(Tables 5A-D & 6)

(a) *Mean values*

The mean values in 6- and 7-eye-striped forms vary as follows :—

Group	Males	Females
1. I (6)	6·98±0·05	7·29±0·06
2. II (6)	7·30±0·01	7·50±0·01
3. III (6)	7·98±0·04	8·03±0·14
4. I (7)	7·57±0·07	Nil
5. II (7)	7·97	7·96±0·11
6. III (7)	7·92±0·05	8·23±0·03

(*b*) *Inter-group comparison* (Tables 5A-D)

(i) *6-striped males and females.—Males :* At all levels, the value in Gr. I (6·98±0·05) is significantly lower than in Gr. II (7·30±0·01), and both these values are significantly lower than in Gr. III (7·98±0·04). *Females :* At all levels the value in Gr. I (7·29±0·06) is significantly lower than in Gr. II (7·50±0·01), and both these values are significantly lower than in Gr. III (8·03±0·14).

(ii) *7-striped males and females.—Males :* The value in Gr. I (7·57± 0·07) is significantly lower than in Gr. III (7·92±0·05) at the 5% level. Only one male occured in Gr. II. *Females :* The value in Gr. II (7·96± 0·11) is not significantly different from that in Gr. III (8·23±0·03) at all levels.

(c) *Inter-sex comparison* (Table 6)

In Groups I (6), II (6) and III (7), marked with an asterisk (*), the values in males are significantly lower than in females. In Group III (6), however, the sexes do not differ significantly.

Group	Males	Females	Difference
*I (6)	6·98±0·05	7·29±0·06	*0·31±0·08
*II (6)	7·30±0·01	7·50±0·01	*0·20±0·02
III (6)	7·98±0·04	8·03±0·14	0·05±0·14
*III (7)	7·92±0·05	8·23±0·03	*0·31±0·06

(d) *Inter-population comparison*

Due to lack of data regarding E/C in other populations no comparison is possible.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) for the 1955-population varies as follows :—

Gr. I (6)	4·44±1·12
Gr. II (6)	2·74±0·25
Gr. II (7)	—0·13
Gr. III (6)	0·63±1·79
Gr. III (7)	3·91±0·75

Within the *1955-Groups*, the values for the S.D.P. are not significantly different from one another at all levels. No data for other populations are available.

5. *Ratio F/C*
(Plates 3 & 5 ; & Tables 5A-D, 6 & 7A-C)

(a) *Mean values*

The mean values for F/C for 6- and 7- striped forms vary as follows :—

Group	Males	Females
1. I (6)	3·17±0·04	3·25±0·04
2. II (6)	3·35±0·01	3·36±0·01
3. III (6)	3·86±0·03	3·82±0·09
4. I (7)	3·81±0·02	Nil
5. II (7)	3·98	3·79±0·08
6. III (7)	3·93±0·02	4·04±0·02

(b) *Inter-group comparison* (Tables 5A-D)

(i) *6-striped males and females.—Males :* The values in Gr. I (3·17±0·04) and Gr. II (3·35±0·01) are significantly lower than in Gr. III (3·86±0·03) at all levels. The value in Gr. II is significantly higher than in Gr. I. *Females :* The values in Gr. I (3·25±0·04) is significantly lower than in Gr. II (3·36±0·01) at the 5% and 1% levels, but not at the 0·1% level. Both these values are significantly lower than in Gr. III (3·82±0·09) at all levels.

(ii) *7-striped males and females.—Males :* The value in Gr. I (3·81±0·02) is significantly lower than in Gr. III (3·93±0·02) at the 5% level only. One male occured in Gr. II. *Females :* The value in Gr. II (3·79±0·08) is significantly lower than in Gr. III (4·04±0·02) at the 5% and 1% level only. No female occurred in Gr. I.

(c) *Inter-sex comparison* (Table 6)

In Group III (7), marked with an asterisk (*), the value in males is significantly lower than in females. In other groups the sexes do not differ significantly.

Group	Males	Females	Difference
Gr. I (6)	3·17±0·04	3·25±0·04	0·08±0·06
Gr. II (6)	3·35±0·01	3·36±0·01	0·01±0·01
Gr. III (6)	3·86±0·03	3·82±0·09	0·04±0·09
*Gr. III (7)	3·93±0·02	4·04±0·02	* 0·11±0·03

(d) *Inter-population comparison* (Tables 7A-C)

The mean value in Groups I—III compare with other populations as follows :—

(i) *6-striped males.*—The value in Gr. I (3·17±0·04) is not significantly different from *6-gregaria* (3·23±0·03) and the *Ajmer Swarm* (3·23±0·03), but the values in Gr. II (3·35±0·01) and Gr. III (3·86±0·03) are significantly higher at all levels. The values in Groups I and II are significantly lower than in the *Kakko Concentration* (3·79±0·02), but Gr. III is not significantly different from the latter.

(ii) *6-striped females.*—The value in Gr. I (3·25±0·04) is not significantly different from *6-gregaria* (3·32±0·03) and the *Kakko Concentration* (3·82±0·02), but is significantly lower than in the *Ajmer Swarm* (3·45±0·07) at the 5% level only. The value in Gr. II (3·36±0·01) is not significantly different from that in the *Ajmer Swarm* at all levels, but is significantly higher than in *6-gregaria* and significantly lower than in the *Kakko Concentration* at all levels. The value in Gr. III (3·82±0·09) is not significantly different from the *Kakko Concentration*, but is significantly higher than in *6-gregaria* and the *Ajmer Swarm*.

(e) *Sexual Dimorphism Percentage*

The S.D.P. (±S.E.) varies as follows :—

1955-population		Other populations	
Gr. I (6)	2·52±1·71	*6-greg.* . .	2·69±1·42
Gr. II (6)	0·30±0·33	*Ajmer Sw.* (1950)	6·83
Gr. II (7) .	—4·77	*Kakko Conc.* (1949)	0·90±0·96
Gr .III (6) .	—1·04±2·40		
Gr. III (7) .	2·80±0·72		

At all levels of probability the S. D. P. is not significantly different either between each of the *1955-groups*, or between these groups and the other populations, except in Gr. III (7), where the value is higher than in Gr. II (6) at the 5 per cent and 1 per cent levels.

6. *Ratio P/C*

(Plates 4 & 5, and Tables 5A-D, 6 & 7A-C)

(a) *Mean values*

Group	Males	Females
1. I (6) . . .	1·32±0·012	1·34±0·011
2. II (6) .	1·38±0·003	1·38±0·002
3. III (6) . . .	1·51±0·007	1·47±0·025
4. I (7) . . .	1·46±0·033	Nil
5. II (7)	1·59	1·50±0·027
6. III(7)	1·52±0·011	1·54±0·009

(b) *Inter-group comparison* (Tables 5A-D)

(i) *6-striped males and females.—Males :* At all levels the value in Gr. I (1·32±0·012) is significantly lower than in Gr. II (1·38±0·003), and both these values are significantly lower than in Gr. III (1·51±0·007). *Females :* At all levels the value in Gr. I (1·34±0·011) is significantly lower than in Gr. II (1·38±0·002), and both these values are significantly lower than in Gr. III (1·47±0·025).

(ii) *7-striped males and females.—Males :* At all levels the value in Gr. I (1·46±0·033) is not significantly different from that in Gr. III (1·52 ±0·11). Only one male occurred in Gr. II. *Females :* At all levels, the value in Gr. II (1·50±0·027) is not significantly different from that in Gr. III (1·54±0·009). No females occurred in Gr. I.

(c) *Inter-sex comparison* (Table 6)

The sexual differences are given below but in none of the groups are they statistically significant.

Group	Males	Females	Difference
I (6)	1·32±0·012	1·34±0·011	0·02±0·017
II (6)	1·38±0·003	1·38±0·002	0
III (6)	1·51±0·007	1·47±0·025	0·04±0·026
III (7)	1·52±0·011	1·54±0·009	0·02±0·014

(d) *Inter-population comparison* (Tables 7A-C)

The values in Groups I—III compare with other populations as follows :—

(i) *6-striped males.*—The value in Gr. I (1·32±0·012) is not significantly different from those in *6-gregaria* (1·305±0·01) and the *Ajmer Swarm* (1·330±0·011), but is significantly lower than in the *Kakko Concentration* (1·483±0·007) at all levels. The values in Groups II (1·38±0·003) and III (1·51±0·007) are significantly higher than in *6-gregaria* and the *Kakko Concentration* at all levels. The value in Gr. II is significantly higher than in the *Ajmer Swarm*, but Gr. III not significantly different from the latter.

(ii) *6-striped females.*—The value in Gr. I (1·34±0·011) is not significantly different from those in *6-gregaria* (1·324±0·009) and the *Ajmer Swarm* (1·363± 0·018), but is significantly lower than in the *Kakko Concentration* (1·477±0·008) at all levels. The value in Gr. II (1·38±0·002) is not significantly different from that in the *Ajmer Swarm*, but is significantly higher than in *6-gregaria* and lower than in the *Kakko Concentration* at all levels. The value in Gr. III (1·47±0·03) is not significantly different from that in the *Kakko Concentration*, but is significantly higher than in *6-gregaria* and the *Ajmer Swarm*.

(e) *Sexual Dimorphism Percentage*

The S. D. P. (±S.E.) varies as follows :—

1955-population		Other populations	
Gr. I (6)	1·52±1·27	*6-greg.*	1·46±1·10
Gr. II (6) .	Nil	*Ajmer Sw.* (1950)	2·48
Gr. II (7) .	—5·66	*Kakko Conc.* (1949)	—0·40±0·72
Gr. III (6) .	—2·65±1·73		
Gr. III (7)	1·32±0·96		

Within the *1955-Groups*, the S. D. P. is not significantly different at all levels. The value in Gr. III (6) is significantly higher than in *6-gregaria* at the 5 per cent level only.

7. *Ratio M/C*

(Tables 5A-D and 6)

(a) *Mean values*

The mean values for M/C in the 6- and 7-eye-striped forms are as follows :—

Group	Males	Females
1. I (6)	0·79±0·005	0·83±0·005
2. II (6)	0·82±0·002	0·84±0·001
3. III (6) . . .	0·89±0·003	0·90±0·012
4. I (7) . .	0·87±0·032	Nil
5. II (7) . .	0·91	0·88±0·012
6. III (7)	0·90±0·006	0·92±0·004

(b) *Inter-group comparison* (Table 5D)

(i) *6-striped males and females.—Males :* At all levels the value in Gr. I (0·79±0·005) is significantly lower than in Gr. II (0·82±0·002), and both these are significantly lower than in Gr. III (0·89±0·003). *Females :* At all levels the values in Gr. I (0·83±0·008) and Gr. II (0·84±0·001) are significantly lower than in Gr. III (0·90±0·012), but Groups I and II are not significantly different from each other.

(ii) *7-striped males and females.—Males :* The value in Gr. I (0·87±0·032) is not significantly different from that in Gr. III (0·90±0·006) at all levels. Only one male occurred in Gr. II. *Females :* The value in Gr. II (0·88±0·012) is significantly lower than in Gr. III (0·92±0·004) at the 5 per cent and 1 per cent levels only. No females occurred in Gr. I.

(c) *Inter-sex comparisons* (Table 6)

In Groups I (6), II (6) and III (7), marked with an asterisk (*), the values in males are significantly lower than in females. In Group III (6), however, the sexes do not differ significantly.

Group	Males	Females	Difference
*I (6)	0·79±0·005	0·83±0·008	*0·04±0·009
*II (6)	0·82±0·002	0·84±0·001	0·02±0·002
III (6)	0·89±0·003	0·90±0·012	*0·01±0·012
*III (7)	0·90±0·006	0·92±0·004	*0·02±0·007

(d) *Inter-population comparison.*

The values for Groups I—III compare with that for *6-gregaria*, as follows (the data for other populations are not available) :—

(i) *6-striped males.*—The mean value in Gr. I (0·79±0·005) is not significantly different from that in *6-gregaria* (0·779±0·008), but the values in Groups II (0·82±0·002) and III (0·89±0·003) are significantly higher than the latter at all levels.

(ii) *6-striped females.*—The values in Groups I (0·83±0·008), II (0·842±0·001) and III (0·90±0·012) are significantly higher than in *6-gregaria* (0·805±0·005) at all levels.

(e) *Sexual Dimorphism Percentage*

The S. D. P. (±S.E.) varies as follows :—

Gr. I (6)	5·06±1·22
Gr. II (6)	2·68±0·23
Gr. II (7)	—2·21
Gr. III (6)	0·90±1·36
Gr. III (7)	2·11±0·82

Within the *1955-Groups* values are not significantly different at all levels of probability except that the value in Gr. I (6) is significantly higher, at the 5 per cent level, than in Gr. III (6) and Gr. III (7).

8. *Ratio H/C*
(Tables 5A-D & 6)

(a) *Mean values*

The mean values for H/C in the 6- and 7-eye-striped forms are as follows :—

Group	Males	Females
1. I (6)	1·10±0·008	1·12±0·009
2. II (6)	1·13±0·002	1·14±0·002
3. III(6)	1·25±0·006	1·24±0·016
4. I (7)	1·23±0·014	Nil
5. II (7)	1·22	1·23±0·016
6. III (7)	1·25±0·008	1·29±0·002

(b) *Inter-group comparison* (Table 5A-D)

(i) *6-striped males and females.—Males :* At all levels the value in Gr. I (1·10±0·008) is significantly lower than in Gr. II (1·13±0·002), and both these values are significantly lower than in Gr. III (1·25±0·006). *Females :* The value in Gr. I (1·12±0·009) is significantly lower than in Gr. II (1·14±0·002) at the 5 per cent level only, and both these values are significantly lower than in Gr.III (1·24±0·016) at all levels.

(ii) *7-striped males and females.—Males :* The value in Gr. I (1·23±0·014) is not significantly different from that in Gr. III (1·25±0·008) at all levels of probability. Only one male occurred in Gr. II. *Females :* The value in Gr. II (1·23±0·016) is significantly lower than in Gr. III (1·29±0·002) at all levels. No females occurred in Gr. I.

(c) *Inter-sex comparison* (Table 6)

In Groups II (6) and III (7), marked with an asterisk (*), the values in males are slightly lower than in females. In the other groups, however, the sexes do not differ significantly.

Group	Males	Females	Difference
I (6)	1·10±0·008	1·12±0·009	0·02±0·012
*II (6) . .	1·13±0·002	1·14±0·002	*0 01±0·003
III (6) . .	1·25±0·006	1·24±0·016	0·01±0·017
*III(7)	1·25±0·008	1·29±0·002	*0·04±0·010

(d) *Inter-population comparison*

(i) *6-striped males.*—The value in Gr. I (1·10±0·008) is not significantly different from that in *6-gregaria* (1·112±0·008), but those in Groups II (1·13±0·002) and III (1·25±0·006) are significantly higher than the latter at the 5 per cent level and at all levels respectively.

(ii) *6-striped females.*—At all levels the values in Group, I (1·12± 0·009) and II (1·14±0·002) are not significantly different from that in *6-gregaria* (1·126±0·007), but that in Gr. III (1·24±0·016) is significantly lower than in *6-gregaria.*

(e) *Sexual Dimorphism Percentage*

The S. D. P. (±S.E.) for the 1955-population varies as follows :—

Gr. I (6)	1·82±1·10
Gr. II (6)	0·88±0·22
Gr. II (7)	0·82
Gr. III (6)	—0·80±1·35
Gr. III (7)	3·20±0·86

Within the 6-striped category, the values in Groups I—III are not significantly different from one another. The value in Gr. III (7) is higher than in Gr. II (6) and Gr. III (6) at the 5 per cent and 1 per cent levels in both cases, but is not significantly different from Gr. I (6).

9. *Ratio K/L*

(Tables 5A-D & 6)

The phase significance of this ratio :

$$\frac{\text{Broadest width of metasternal interspace}}{\text{Narrowest width of metasternal interspace}}$$

was first pointed out by Roonwal (1946). In the 1955-populations the ratio varies in the manner discussed below.

(a) *Mean values*

Group	Males	Females
1. I (6)	1·35±0·05	1·18±0·04
2. II (6)	1·52±0·01	1·25±0·01
3. III(6)	1·58±0·02	1·24±0·02
4. I (7)	1·61±0·20	Nil
5. II (7)	1·50	1·29±0·03
6. III (7)	1·49±0·04	1·27±0·02

(b) *Inter-group comparison* (Table 5)

(i) *6-striped males and females.—Males :* At all levels the value in Gr. I (1·35±0·05) is significantly lower than in Gr. II (1·52±0·01), and both these values are significantly lower than in Gr. III (1·58±0·02). *Females :* The values in Groups I, II and III are not significantly different from each other at all levels.

(ii) *7-striped males and females.—Males :* The value in Gr. I (1·61±0·20) is not significantly different from that in Gr. III (1·49±0·04) at all levels. Only one male occurred in Gr. II. *Females :* The value in Gr. II (1·29±0·03) is not significantly different from that in Gr. III (1·27±0·02) at all levels. No female occurred in Gr. I.

(c) *Inter-sex comparison* (Table 6)

In all the Groups, marked with an asterisk (*), the values in males are significantly higher than in females, as follows :—

Group	Males	Females	Difference
*I (6)	1·35±0·050	1·18±0·037	*0·17±0·061
*II (6)	1·52±0·012	1·25±0·006	*0·27±0·013
*III (6)	1·58±0·025	1·24±0·022	*0·34±0·033
*III (7)	1·49±0·035	1·27±0·019	*0·22±0·040

(d) *Inter-population comparison*

Due to lack of data the value of K/L cannot be compared with other populations.

(e) *Sexual Dimorphism Percentage*

The S. D. P. (±S.E.) for the 1955-population varies as follows :—

Gr. I (6)	—12·59±4·02
Gr. II (6)	—17·76±0·91
Gr. II (7)	—14·00
Gr. III (6)	—21·52±1·88
Gr. III (7)	—14·77±2·38

The value in Gr. I (6) is significantly lower than in Gr. III (6) at the 5 per cent level only. In all other Groups the values are not significantly different from one another.

10. *General conclusions regarding morphometric ratios*

1. Taking into consideration, the eight ratios, namely, E/F, E/W_1, E/C, F/C, P/C, M/C, H/C and K/L, it is evident that Group II is intermediate between Groups I and III, and is nearer to the former. Regarding the ratios E/F and E/W_1, the statistical tests of significance conveys results which are quite in conformity with the theoretical expectation that Group I and II both should differ from Group III. The ratios which include the width of head at the genal level (C) as a denominator are found to be sensitively correlated with different degrees of population densities as evidenced by the highly significant differences among the various Groups. However, in regard to the metasternal index (K/L), Group II is nearer to Group III than to Group I, and whereas the differences between the Groups are all significant in the case of males, this is not so in the case of females. Taken as a whole, the differences observed in most ratios between the Groups are quite marked and the probability of obtaining such large differences by chance causes is negligible. The Groups may thus be considered as having been drawn from populations having different mean values. This in itself justifies the *groupings* of a year's collection for biometrical studies.

2. Regarding inter-sex comparison (Table 6) in the various Groups, I(6), II(6), III(6) and III(7), for all the ratios, except the metasternal interspace ratio (K/L), the males generally have lower values than females, this sexual difference being more marked in the 7-eye-striped individuals (Group III) than in the 6-eye-striped ones (Groups I—III). In respect of K/L, however, the males have *higher* values than females in all the four groups. The ratio P/C is the least sex-sensitive, and no inter-sex differences is noticeable, while the ratio K/L is the most sex-sensitive since not only is the inter-sex difference present in all the four groups but also its magnitude is large.

3. The problem of assigning the 1955-Groups to proper phases has been dealt with on the basis of configuration of three morphometric ratios, *viz.*, E/F, F/C, and P/C. Regarding E/F ratio, Groups I and II show such differences in mean values with *phase solitaria* and the *Kakko Concentration* (of 1949) that it is unlikely that they have been drawn from the same type of populations by random sampling. Group III is significantly different from *phase gregaria* and the *Ajmer Swarm* (of 1950). Values of *phase solitaria* are not available for comparison with the *1955-Groups* in regard to the ratios F/C and P/C. These latter ratios also give almost the same result as E/F. Thus, in general terms, it can be remarked that Groups I and II both possess characteristics which are identical with or very close to those of *phase gregaria*, and Group III with those of *phase solitaria*.

4. The Sexual Dimorphism Percentage (S.D.P.) with respect to various morphometric ratios does not convey explicitly the closeness of the Groups to the appropriate phase, as is apparent from the tests of significance.

VI—DISCUSSION AND CONCLUSIONS

Some general conclusions drawn from the data presented above may now be discussed.

(a) *Trend of morphological characters during swarming period*

(Plates 6 & 7)

Roonwal (1954) has shown that with regard to number of eye-stripes and related characters in the Desert Locust the *gregaria* phase is variation-stable (little variation) and there is a flowering of variation in the *solitaria* phase. This situation holds good also for other morphometric characters, such as E, F, C and the ratios E/F, etc.

Furthermore, the characters E, F and C, in both sexes, show almost the same kind of fluctuations, thus suggesting a positive correlation between them. The character E is, however, exceptional in males where the trend is irregular.

(b) *Relative size of eye in the 1955-Groups* (Tables 3A-D)

That vision may play an important role in the maintenance of gregarization was emphasised by Roonwal (1958). In this connection, in addition to variation in the number of eye-stripes and the differential distribution of pigment in the eyes, significant variations also occur in the size (length and width) of eyes in different populations. In the 1955-Groups, the size of eye in Groups I and II (which are close to phase *gregaria* in other characters) is not significantly different from each other, but both these are significantly lower than in Group III which is close to phase *solitaria*.

(c) *Remarks on the Group III population of 1955*

The Group III (September to December) of the year 1955 is of particular interest as it is a " dissocians " population marking the end of the 1949-55 swarming cycle and immediately precedes the non-swarming period of 1956-59. This population reveals the following characters which are likely to be of interest in the study of field populations under similar circumstances :—

(i) The population density was low (about 40—1333 per square mile), except in two localities where it was moderate (3600 and 8400 per square mile).

(ii) Of the 150 specimens available in this Group, 113 (75 per cent) belong to phase *solitaria* (taking the E/F ratio as a phase criterion). In these 113 phase *solitaria* individuals, the proportion of 6- and 7-eye-striped individuals is not very different (6-striped, 52 per cent ; and 7-striped, 48 per cent). The decrease in the relative proportion of 6-striped (52 per cent) forms far below the normal 80 per cent and above level of " *gregaria* " populations (Roonwal, 1945), and the sudden increase of the 7-striped (48 per cent) ones from the normal 20 per cent or lower, along with the presence of 8-striped forms (the extreme *solitaria* form), shows the complete domination of this Group by the *solitaria* features, overshadowing the *gregaria* nature of the two earlier Groups (I and II). Somewhat similar results were reported by Roonwal (1954) in the peak *solitaria* year (1936) of the non-swarming period (1932-39) in an earlier locust cycle, when the percentage of 7-striped individuals was higher than the 6-striped ones, and a few 8- striped forms also appeared.

(iii) In the 6-eye-striped category, the proportion of males and females in Group III is ♂ 84 : ♀ 16, *i.e.*, the males predominate, as postulated for *solitaria* 6-striped populations in Roonwal's Second Hypothesis (1945).

(iv) The mean values of estimated parameters of the morphometric characters E, F, C, P and the ratios E/F, E/C, F/C and P/C of Group III

individuals show a close proximity to phase *solitaria* as defined by Roonwal (1949), and no significant differences between the two are noticeable. Similarly, the values of S.D.P. (Sexual Dimorphism Percentage) for characters E and F and for the ratio E/F do not show any significant differences between the two populations.

(v) Thus, on the basis of the morphometric characters, the unstability in the eye-stripe variability and the inequality in the sex-ratios (in the 6-striped category), it may be concluded that Group III was a true *solitaria* population, initiating the new solitary-cycle (1956 onward).

VII—SUMMARY

1. The random samples of Desert Locust population of the year 1955, consisting of 1,179 specimens, were, for convenience of study, grouped under three natural Groups, I (January-April), II (May-August) and III (September-December).

2. Regarding eye-stripe composition, the high proportion of 6-striped individuals in Groups I (93 per cent) and II (99 per cent), indicates phase *gregaria* features and the relative abundance of individuals with 7-striped (44 per cent) in Group III shows its *solitaria* nature. Two 8-striped females in Group III were obtained. The position of 5-striped forms (obtained in Group II) is discussed.

3. Sex-ratios in relation to eye-stripes are discussed. In the 6 striped category, the proportion of sexes is about equal in Groups I and II, whereas in Group III the males predominate (♂ 84 per cent : ♀16 per cent).

4. From inter-group comparisons it is seen that the values of various morphometric characters are not significantly, different from each other, and that these two groups must have originated from nearly similar parent populations. The values in Group III differ significantly from those in Groups I and II.

5. From inter-sex comparisons it is seen that within the same Group the values for males, in all characters, are significantly lower than in females.

6. From inter-phase comparisons it is seen that the mean values for various characters for Groups I and II are not significantly different from the corresponding values in phase *gregaria* and the " Ajmer swarm " (1950), whereas the values in Group III are almost similar to that in phase *solitaria*.

7. A remarkably high degree of sexual dimorphism, as expressed in the Sexual Dimorphism Percentage (S.D.P.), is noticed in characters K and L relating to the metasternal interspace.

8. The ratios E/F, E/W_1, E/C, F/C, P/C, M/C, H/C, and K/L generally show results which are similar to those derived from the study of the size of the body-parts.

9. The size of the compound eye (length and width) was studied. Groups I and II do not differ in this respect, but eyes in Group III are significantly larger than in the other two groups.

10. Group I and II are near phase *gregaria*, but Group III (September-December, 1955) is close to phase *solitaria*. The significance of this position is discussed.

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TABLE 1.—*Group-wise and monthly distribution of eye-stripe (6- and 7-striped) composition and sex-ratios in the 1955-population of the Desert Locust in India.*

Group	Month (1955)	Number of individuals in each sex and eye-stripe category					
		6-eye-striped		7-eye-striped		Total	
		♂	♀	♂	♀	♂	♀
I	January	22 (57·9%)	16 (42·1%)	—	—	22 (57·9%)	16 (42·1%)
	February	1 (—)	—	—	—	1 (—)	—
	March	—	2 (—)	3 (—)	—	3 (60%)	2 (40%)
	April	—	—	—	—	—	—
Total for Group I	—	23 (56·0%)	18 (44·0%)	3 (—)	—	26 (59·0%)	18 (41·0%)
II	May	130 (51·6%)	122 (48·4%)	—	—	130 (51·6%)	122 (48·4%)
	June	139 (42·0%)	192 (58·0%)	—	4 (—)	139 (41·5%)	196 (58·5%)
	July	114 (46·1%)	133 (53·9%)	—	3 (—)	114 (45·6%)	136 (54·4%)
	August	61 (58·1%)	44 (41·9%)	1 (25·0%)	3 (75·0%)	62 (56·9%)	47 (43·1%)
Total for Group II	—	444 (47·5%)	491 (52·5%)	1 (9·0%)	10 (91·0%)	445 (47·0%)	501 (53·0%)
III	September	27 (84·4%)	5 (15·6%)	6 (46·2%)	7 (53·8%)	33 (73·3%)	12 (26·7%)
	October	28 (87·5%)	4 (12·5%)	4 (14·8%)	23 (85·2%)	32 (54·0%)	27 (46·0%)
	November	16 (84·2%)	3 (15·8%)	11 (45·8%)	13 (54·2%)	27 (62·8%)	16 (37·2%)
	December	—	1 (—)	—	—	—	1 (—)
Total for Group III	—	71 (84·0%)	13 (16·0%)	21 (33·0%)	43 (67·0%)	92 (62·0%)	56 (38·0%)

TABLE 2.—*Sex-ratio and proportion of 6- and 7-eye-striped individuals in Groups I, II and III in the 1955-population of the Desert Locust in India.*

Group	Sex	Number of eye-stripes					Percentage by sex-ratio in each type±S.E.*		Percentage of individuals in each type±S.E.*	
		5	6	7	8	Total	6-striped	7-striped	6-striped	7-striped
I	♂	—	23	3	—	26 (59·0%)	56·0±7·0	—	—	—
	♀	—	18	—	—	18 (41·0%)	44·0±7·0	—	—	—
	Total	—	41	3	—	44 (100·0%)	..	..	93·0±4·0	7·0±4·0
II	♂	—	444	1	—	445 (47·0%)	47·5±2·0	9·0±9·0	—	—
	♀	2	491	10	—	503 (53·0%)	52·5±2·0	91·0±9·0	—	—
	Total	2	935	11	—	948 (100·0%)	..	..	98·9±0·3	1·1±0·3
III	♂	—	71	21	—	92 (62·0%)	84·0±4·0	33·0±5·0	—	—
	♀		13	43	2	58 (38·0%)	16·0±4·0	67·0±5·0	—	—
	Total	—	84	64	2	150 (100·0%)	..	..	56·0±4·0	44·0±4·0

* Standard Error.

TABLE 3A.—*Values for various morphometric characters in Desert Locust population in India for 1955 (Group I).*

Abbreviations :— *n*, Number of individuals.
S. E., Standard error.
S. D., Standard deviation.
C. V., Coefficient of variation.

Sex and number of eye stripes	Group I				
	n	Range	Mean ± S.E.	S.D. ± S.E.	C.V. ± S.E.
1	2	3	4	5	6
			1. Length of eye (A)		
1. ♂♂(6)	23	3·25—4·00	3·76±0·04	0·176±0·026	4·68±0·69
2. ♂♂(7)	3	3·75—4·00	3·83±0·082	0·142±0·058	3·71±1·51
3. ♀♀(6)	18	3·50—4·00	3·93±0·034	0·144±0·024	3·66±0·61
4. ♀♀(7)	..	..	..	..	..
			2. Width of eye (B)		
5. ♂♂(6)	23	2·00—2·50	2·40±0·030	0·146±0·022	6·70±0·99
6. ♂♂(7)	3	2·50—2·50	2·50±0·0	..	..
7. ♀♀(6)	18	2·25—2·50	2·47±0·019	0·080±0·013	3·24±0·54
8. ♀♀(7)	..	..	..	..	..
			3. Width of head at ocular region (O)		
9. ♂♂(6)	23	5·5 —6·6	6·30±0·050	0·242±0·036	3·84±0·57
10. ♂♂(7)	3	6·1 —6·4	6·27±0·088	0·153±0·062	2·44±1·00
11. ♀♀(6)	18	6·1 —7·1	6·71±0·067	0·284±0·047	4·23±0·70
12. ♀♀(7)	..	..	..	..	
			4. Width of head at genal level (C)		
13. ♂♂(6)	23	6·2—7·7	7·31±0·071	0·342±0·05	4·68±0·69
14. ♂♂(7)	3	6·4—6·9	6·63±0·144	0·250±0·102	3·77±1·54
5. ♀♀(6)	17	7·2—8·5	7·83±0·074	0·314±0·052	4·01±0·67
16. ♀♀(7)	..	..	..	..	..
			5. Length of pronotum (P)		
17. ♂♂(6)	23	8·3—10·5	9·66±0·114	0·548±0·081	5·67±0·84
8. ♂♂(7)	3	9·0—10·5	0·67±0·44	0·765±0·31	7·91±3·23
19. ♀♀(6)	18	9·7—11·4	10·47±0·113	0·479±0·080	4·57±0·76
20. ♀♀(7)	..	..	..	..	..
			6. Height of pronotum (H)		
21. ♂♂(6)	23	7·1—8·6	8·03±0·079	0·377±0·056	4·69±0·69
22. ♂♂(7)	3	7·7—8·6	8·13±0·262	0·453±0·184	5·57±2·27
23. ♂♂(6)	18	7·8—9·7	8·70±0·111	0·471±0·078	5·41±0·90
24. ♀♀(7)	..	..	..	..	..

TABLE 3A—*contd.*

Sex and number of eye-stripes	Group I				
	n	Range	Mean ± S. E.	S. D. ± S. E.	C. V. ± S. E.
1	2	3	4	5	6
7. Width of pronotum at Constriction (M)					
25.♂♂(6)	23	5·3—6·4	5·80±0·049	0·238±0·03	4·10±0·60
26.♂♂(7)	3	5·6—6·1	5·80±0·15	0·264±0·11	4·55±1·86
27.♀♀(6)	18	5·9—7·0	6·52±0·071	0·300±0·05	4·60±0·77
28.♀♀(7)	..	..	..	..	..
8. Length of elytra (E)					
29.♂♂(6)	23	47·2—56·4	51·01±0·49	2·33±0·34	0·046±0·007
30.♂♂(7)	3	47·5—52·7	50·23±1·51	2·61±1·07	5·20 ±2·12
31.♀♀(6)	17	52·4—63·5	57·09±0·72	2·98±0·51	5·22 ±0·90
32.♀♀(7)	..	..	..	..	..
9. Broadest width of metasternal interspace (K)					
33.♂♂(6)	23	0·75—1·00	0·7717±0·015	0·072±0·011	9·33± 1·375
34.♂♂(7)	3	0·50—1·00	0·75 ±0·144	0·25 ±0·102	33·33±13·606
35.♀♀(6)	18	1·00—1·50	1·1667±0·035	0·1485±0·025	12·72± 2·12
36.♀♀(7)	..	..	..	..	..
10. Narrowest width of metasternal interspace (L)					
37.♂♂(6)	23	0·50—0·75	0·5869±0·025	0·1216±0·017	20·72± 3·055
38.♂♂(7)	3	0·25—0·75	0·50 ±0·144	0·25±0·102	50·00±20·402
39.♀♀(6)	18	0·75—1·25	1·00 ±0·028	0·1212±0·020	12·12± 2·02
40.♀♀(7)	..	..	..	..	..
11. Restricted width of elytra (W_1)					
1.♂♂(6)	23	6·1 —7·5	6·89±0·067	0·320±0·047	4·64±0·68
42.♂♂(7)	3	6·0 —7·4	6·57±0·43	0·738±0·30	11·23± 4·59
4 ♀(6)	18	7·1 —8·1	7·66±0·066	0·281±0·047	3·67± 0.61
44 ♀(7)	..	..	..	..	..
12. Length of hind-femur (F)					
45.♂♂(6)	23	19·9—25·7	23·11±0·26	1·25±0·18	5·41± 0·80
46.♂♂(7)	3	24·2—26·4	25·30±0·64	1·10±0·45	4·35± 1·78
47.♀♀(6)	16	23·3—27·7	25·52±0·34	1·38±0·24	5·40± 0·95
48.♀♀(7)	..	..	..	..	..

TABLE 3B.—*Values for various morphometric characters in Desert Locust population in India for 1955 (Group II).*

Abbreviations :—As in Table 3A.

Sex and number of eye-stripes	Group II				
	n	Range	Mean ± S. E.	S. D. ± S. E.	C. V. ± S. E.
1	2	3	4	5	6
1. Length of eye (A)					
1.♂♂ (6)	443	3·00 —4·25	3·81±0·01	0·202±0·007	5·32±0·18
2.♂♂ (7)	1	..	3·75±0·0	..	..
3.♀♀ (6)	491	3·10 —4·50	3·99±0·009	0·192±0·006	4·81±0·15
4.♀♀ (7)	10	4 00 —4·50	4·25±0·065	0·204±0·046	4·80±1·07
2. Width of eye (B)					
5. ♂♂(6	443	2·00 —2·90	2·46±0·004	0·075±0·003	3·04±0·12
6. ♂♂(7)	1	..	2·50±0·0	..	..
7. ♀♀(6)	491	2·00 —2·75	2·54±0·008	1·174±0·006	6·35±0·219
8. ♀♀(7)	10	2·50 —3·00	2·70±0·050	0·369±0·082	13·18±2·9
3. Width of head at ocular region (O)					
9. ♂♂(6)	441	5·4 —7·2	6·40±0·013	0·265±0·009	4·14±0·14
10. ♂♂(7)	1	..	6·10±0·0	..	..
11. ♀♀(6)	490	5·8 —7·5	6·79±0·015	0·332±0.011	4·88±0·16
12. ♀♀(7)	10	6·4 —7·4	6·94±0·105	0·333±0·075	4·80±1·07
4. Width of head at genal level (C)					
13. ♂♂(6)	443	5·9 —8·2	7·20±0·02	0·418±0·014	5·80±0·19
14. ♂♂(7)	1	..	6·30±0·0	..	..
15. ♀♀(6)	491	6·5 —8·8	7·88±0·019	0·427±0·014	5·42±0·17
16. ♀♀(7)	10	7·0 —8·2	7·63±0·146	0·462±0·103	6·05±1·35
5. Length of pronotum (P)					
17. ♂♂(6)	441	8·2—11·4	9·94±0·023	0·600±0·020	6·04±0·203
18. ♂♂(7)	1	..	10·00±0·0	..	..
19. ♀♀(6)	487	8·7 —12·4	10·86±0·030	0·663±0·021	6·11±0·19
20. ♀♀(7)	9	10·2 —13·2	11·50±0·29	0·859±0·202	7·45±1·76
6. Height of pronotum (H)					
21. ♂♂(6)	443	6·8—9·3	8·14±0·022	0·458±0·015	·62±0·19
22. ♂♂(7)	1	..	7·70±0·0	..	..
23. ♀♀(6)	491	1—10·8	8·98±0·026	0·576±0·018	6·35±0·20
24. ♀♀(7)	10	8·5—10·5	9·37±0·207	0·555±0·146	6·99±1·56

TABLE 3B—*contd.*

Sex and number of eye-stripes	Group II				
	n	Range	Mean ± S.E.	S.D. ± S.E.	C. V. ± S.E.
1	2	3	4	5	6
7. Width of pronotum at constriction (M)					
25. ♂♂(6)	443	5·1—7·1	5·91±0·015	0·319±0·010	5·39±0·181
26. ♂♂(7)	1	..	5·70±0·0	..	..
27. ♀♀(6)	491	5·5—8·3	6·63±0·017	0·373±0·012	5·63±0·18
28. ♀♀(7)	10	6·1—7·2	6·78±0·121	0·386±0·09	5·69±1·27
8. Length of elytra (E)					
29. ♂♂(6)	421	44·5—58·8	52·48±0·13	2·66±0·09	5·07±0·17
30. ♂♂(7)	1	..	50·20±0·0	..	..
31. ♀♀(6)	459	8·6—66·5	59·09±0·14	3·02±0·10	5·12±0·17
32. ♀♀(7)	9	57·0—64·5	60·22±0·90	2·70±6·64	4·48±1·05
9 Broadest width of metasternal interspace(K)					
33. ♂♂(6)	438	0·50—1·25	0·7905±0·006	0·1145±0·0039	14·48±0·489
34. ♂♂(7)	1	..	0·75±0·0	..	..
35. ♀♀(6)	488	1·00—1·50	1·2438±0·006	0·1342±0·0043	10·79±0·3454
36. ♀♀(7)	10	1·00—1·50	1·225±0·058	0·1844±0·0412	15·05±3·366
10. Narrowest width of metasternal interspace (L)					
37. ♂♂(6)	438	0·25—1·25	0·5314±0·005	0.1082±0·0037	20±36±0·6879
38. ♂♂(7)	1	..	0·50±0·0	..	..
39. ♀♀(6)	488	0·50—1·25	1·0026±0·005	0·1039±0·0038	10·36±0·3317
40. ♀♀(7)	10	0·75—1·25	0·95±0·053	0·1581±0·0373	16·64±3·9226
11. Restricted width of elytra (W_1)					
41. ♂♂(6)	444	6·0—8·7	7·10±0·021	0·451±0·015	6·35±0·213
42. ♂♂(7)	1	..	6·20±0·0	..	..
43. ♀♀(6)	491	6·1—10·1	7·82±0·023	0·514±0·016	6·57±0·210
44. ♀♀(7)	10	7·0—8·4	7·67±0·14	0·0459±0·103	5·99±1·34
12. Length of hind femur (F)					
45. ♂♂(6)	417	19·9—26·9	24·06±0·07	1·32±0·05	5·49±0·19
46. ♂♂(7)	1	..	25·10±0·0	..	..
47. ♀♀(6)	454	21·7—30·5	26·50±0·07	1·58±0·05	5·96±0·20
48. ♀♀(7)	9	26·3—31·6	28·63±0·55	1·66±0·39	5·81±1·37

TABLE 3C.—*Values for various morphometric characters in Desert Locust population in India for 1955 (Group III).*

Abbreviations :—As in Table 3A.

Sex and number of eye-stripes	Group III				
	n	Range	Mean ± S.E.	S. D. ± S.E.	C. V. ± S.E.
1	2	3	4	5	6
			1. Length of eye (A)		
1. ♂♂(6)	71	3·50 —4·25	3·88±0·019	0·161±0·014	4·15±0·35
2. ♂♂(7)	21	3·75 —4·50	4·00±0·034	0·154±0·024	3·86±0·59
3. ♀♀(6)	13	3·25 —4·50	4·06±0·09	0·312±0·061	7·69±1·51
4. ♀♀(7)	43	4·00 —4·75	4·41±0·03	0·194±0·021	4·40±0·47
			2. Width of eye (B)		
5. ♂♂(6)	71	2·20 —2·75	2·54±0·015	0·127±0·011	5·01±0·42
6. ♂♂(7)	21	2·50 —2·75	2·65±0·026	0·120±0·019	4·54±0·70
7. ♀♀(6)	13	2·25 —3·00	2·65±0·064	0·231±0·045	8·73±1·71
8. ♀♀(7)	43	2·75 —3·00	2·88±0·019	0·126±0·014	4·36±0·47
			3. Width of head at ocular region (O).		
9. ♂♂(6)	71	5·7—6·7	6·24±0·025	0·212±0·018	3·40±0·285
10. ♂♂(7)	21	6·1—7·1	6·46±0·049	0·225±0·035	3·49±0·538
11. ♀♀(6)	13	5·6—7·3	6·75±0·013	0·482±0·095	7·15±1·40
12. ♀♀(7)	43	6·4—7·8	7·14±0·046	0·301±0·032	4·22±0·455
			4. Width of head at genal level (C)		
13. ♂♂(6)	71	5·9—7·7	6·55±0·043	0·359±0·03	5·48±0·46
14. ♂♂(7)	21	6·2—7·2	6·67±0·053	0·242±0·037	3·63±0·56
15. ♀♀(6)	13	6·1—8·3	7·42±0·165	0·595±0·117	8·01±1·57
16. ♀♀(7)	43	7·1—8·4	7·70±0·050	0·325±0·035	4·21±0·45
			5. Length of pronotum (P)		
17. ♂♂(6)	71	8·8—11·2	9·86±0·060	0·508±0·043	5·16±0·433
18. ♂♂(7)	21	9·4—11·0	10·20±0·084	0·383±0·059	3·77±0·582
19. ♀♀(6)	13	7·9—12·0	10·76±0·295	1·063±0·209	9·88±1·94
20. ♀♀(7)	43	10·5—13·2	11·90±0·102	0·667±0·072	5·60±0·064
			6. Height of pronotum (H)		
21. ♂♂(6)	71	7·2—9·2	8·20±0·045	0·375±0·031	4·59±0·385
22. ♂♂(7)	21	7·7—9·3	8·40±0·091	0·419±0·065	5·01±0·773
23. ♀♀ (6)	13	7·1—10·2	9·10±0·272	0·981±0·192	10·78±2·11
24. ♀♀ 7	43	9·1—10·8	9·90±0·069	0·456±0·049	4·58±0·490

TABLE 3C—*contd.*

Sex and number of eye-stripes	Group III				
	n	Range	Mean ± S.E.	S.D. ± S.E.	C.V. ± S.E.
1	2	3	4	5	6
7. Width of pronotum at constriction (M)					
25. ♂♂(6)	71	5·3—6·4	5·84±0·028	0·235±0·020	4·02±0·337
26. ♂♂(7)	21	5·5—6·5	5·98±0·048	0·220±0·034	3·69±0·57
27. ♀♀(6)	13	5·4—7·2	6·67±0·147	0·530±0·104	7·94±1·56
28. ♀♀(7)	43	6·6—7·6	7·09±0·045	0·293±0·032	4·13±0·445
8. Length of elytra (E)					
29. ♂♂(6)	61	46·3—57·9	52·07±0·310	2·50±0·22	4·80±0·421
30. ♂♂(7)	21	49·2—57·6	52·58±0·43	1·91±0·30	3·64±0·57
31. ♀♀(6)	11	54·3—65·1	59·74±0·91	3·01±0·64	5·04±1·07
32. ♀♀(7)	38	57·9—68·2	63·39±0·48	2·94±0·34	4·64±0·53
9. Broadest width of metasternal interspace (K)					
33. ♂♂(6)	71	0·50—1·00	0·7218±0·013	0·1072±0·0090	14·85±1·2463
34. ♂♂(7)	21	0·50—1·00	0·75±0·017	0·077±0·0119	10·27±1·5842
35. ♀♀(6)	12	1·00—1·25	1·2291±0·021	0·0721±0·0147	5·87±1·1973
36. ♀♀(7)	43	1·00—1·75	1·267±0·021	0·138±0·015	10·88±1·1741
10. Narrowest width of metasternal interspace (L)					
37. ♂♂(6)	71	0·25—0·75	0·4683±0·012	0·1020±0·0086	21·78±1·8278
38. ♂♂(7)	21	0·25—0·75	0·51±0·021	0·095±0·0147	18·56±2·8636
39. ♀♀(6)	12	0·75—1·25	1·00±0·0	0·0±0·0	0·0±0·0
40. ♀♀(7)	43	0·75—1·25	1·00±0·012	0·0768±0·0083	7·68±0·8281
11. Restricted width of elytra (W_1)					
41. ♂♂(6)	71	5·9—7·8	6·66±0·047	0·394±0·033	5·91±0·50
42. ♂♂(7)	21	6·1—7·4	6·71±0·075	0·345±0·053	5·15±0·795
43. ♀♀(6)	13	6·3—8·2	7·36±0·165	0·595±0·117	8·09±1·59
44. ♀♀(7)	43	7·1—8·6	7·84±0·063	0·413±0·044	5·26±0·57
12. Length of hind-femur (F)					
45. ♂♂(6)	61	21·8—27·7	25·24±0·156	1·22±0·110	4·82±0·44
46. ♂♂(7)	19	24·6—29·0	26·12±0·23	0·99±0·16	3·80±0·62
47. ♀♀(6)	12	21·5—31·9	27·97±0·90	3·14±0·64	11·22±2·29
48. ♀♀(7)	40	28·3—34·1	31·21±0·22	1·41±0·16	4·51±0·50

TABLE 3D.—*Inter-group comparisons of various morphometric characters (within the same sex and eye-stripe group) between Groups I—III of the 1955 Desert Locust population in India (From data in Tables 3A, 3B and 3C).*

Abbreviations :—NS., Not significant at 5% level of probability.
*, Significant at 5% level of probability.
**, Significant at 1% level of probability.
***, Significant at 0·1% level of probability.

Sex and number of eye-stripes	Significance of difference between the 1955-groups								
	Mean			S.D.			C.V.		
	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III
1	2	3	4	5	6	7	8	9	10
1. Length of ey (A)									
1. ♂♂(6)	NS	**	**	NS	NS	**	NS	NS	**
2. ♂♂(7)	..	NS	..	..	NS	..	..	NS	..
3. ♀♀(6)	NS	NS	NS	NS	**	**	NS	*	NS
4. ♀♀(7)	..	..	*	..	..	NS	..	..	NS
2. Width of eye (B)									
5. ♂♂(6)	*	***	***	***	NS	*	***	NS	***
6. ♂♂(7)	..	NS	..	..	NS	..	..	NS	..
7. ♀♀(6)	***	*	NS	***	*	*	***	**	NS
8. ♀♀(7)	..	..	**	..	..	*	..	..	**
3. Width of head at ocular region (O)									
9. ♂♂(6)	NS	NS	***	NS	NS	**	NS	NS	**
10. ♂♂(7)	..	NS	..	..	NS	..	..	NS	..
11. ♀♀(6)	NS	NS	*	NS	*	*	NS	NS	NS
12. ♀♀(7)	..	..	NS	..	..	NS	..	..	NS
4. Width of head at genal level (C)									
13. ♂♂(6)	***	***	***	NS	NS	*	NS	NS	NS
14. ♂♂(7)	..	NS	..	..	NS	..	..	NS	..
15. ♀♀(6)	NS	*	**	NS	**	*	*	*	NS
16. ♀♀(7)	..	..	NS	..	..	NS	..	..	NS
5. Length of pronotum (P)									
17. ♂♂(6)	*	NS	NS	NS	NS	*	NS	NS	NS
18. ♂♂(7)	..	NS	..	..	*	..	..	NS	..
19 ♀♀(6)	**	NS	NS	NS	**	**	NS	*	*
20 ♀♀(7)	..	..	NS	..		NS	..	..	NS

TABLE 3D—*continued.*

Sex and number of eye-stripes	Significance of difference between the 1955-groups								
	Mean			S.D.			C.V.		
	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III
1	2	3	4	5	6	7	8	9	10
6. Height of pronotum (H)									
21. ♂♂(6)	NS	NS	NS	NS	NS	*	NS	NS	**
22. ♂♂(7)	..	NS	..	..	NS	..	..	NS	..
23. ♀♀(6)	*	NS	NS	NS	**	***	NS	*	*
24. ♀♀(7)	..	..	*	..	..	NS	..	..	NS
7. Width of pronotum at constriction (M)									
25. ♂♂(6)	*	NS	*	*	NS	***	*	NS	***
26. ♂♂(7)	..	NS	..	..	NS	..	..	NS	..
27. ♀♀(6)	NS	NS	NS	NS	*	*	NS	NS	NS
28. ♀♀(7)	..	..	*	..	..	NS	..	..	NS
8. Length of elytra (E)									
29. ♂♂(6)	**	NS	NS	NS	NS	NS	NS	NS	NS
30. ♂♂(7)	..	NS	..	..	NS	..	..	NS	..
31. ♀♀(6)	**	*	NS	NS	NS	NS	NS	NS	NS
32. ♀♀(7)	..	..	**	..	..	..	NS	..	NS
9. Broadest width of metasternal interspace (K)									
23. ♂♂(6)	1 S	*	***	**	*	NS	***	**	NS
34. ♂♂(7)	..	NS	..	..	***	..	..	NS	..
35. ♀♀(6)	*	*	NS	NS	**	**	NS	**	***
36. ♀♀(7)	..	..	NS	..	..	NS	..	..	NS
10. Narrowest width of metasternal interspace (L)									
37. ♂♂(6)	*	***	***	NS	NS	NS	NS	NS	NS
38. ♂♂(7)	..	NS	..	..	**	..	..	NS	..
39. ♀♀(6)	NS	NS	NS	NS	..	..	NS	***	***
40. ♀♀(7)	..	..	NS	..	..	***	..	..	*
11. Restricted width of elytra (W_1)									
41. ♂♂(6)	**	**	***	*	NS	NS	**	NS	NS
♂♂(7)	..	NS	..	..	*	..	..	NS	..
43. ♀♀(6)	*	NS	**	**	*	NS	***	*	NS
44. ♀♀(6)	..	..	NS	..	..	NS	..	..	NS
12. Length of hind-femur (F)									
45. ♂♂(6)	***	***	***	NS	NS	NS	NS	NS	NS
46. ♂♂(7)	..	NS	..	..	NS	..	..	NS	..
47. ♀♀(6)	**	*	NS	NS	**	***	NS	*	*
48. ♀♀(7)	..	..	***	..	..	NS	..	..	NS

TABLE 4A.—*Values of Mean, S.D. and C.V of the morphometric characters E, F, C and P in the 1955-population (Groups I-III) of the Desert Locust in India.*

Abbreviations :—n, Number of individuals.
S. E. Standard error.
S. D., Standard deviation.
C. V., Coefficient of variation.

Statistical constants	Nature of population		
	Group I	Group II	Group III
—	1	2	3
1. Length of elytra (E)			
Male (6)			
1. Mean ± S.E.	51·01±0·49	52·48±0·13	52·07±0·31
(*n*)	(23)	(421)	(65)
2. S.D. ± S.E.	2·33±0·34	2·66±0·09	2·50±0·22
3. C.V. ± S.E.	4·57±0·68	5·07±0·17	4·80±0·42
Female (6)			
1. Mean ± S.E.	57·09±0·72	59·09±0·14	59·74±0·91
(*n*)	(17)	(459)	(11)
2. S.D. ± S.E.	2·98±0·51	3·02±0·10	3·01±0·64
3. C.V. ± S.E.	5·22±0·90	5·12±0·17	5·04±1·07
Male (7)			
1. Mean ± S.E.	50·23±1·51	50·2	52·58 ±0·43
(*n*)	(3)	(1)	(20)
2. S.D. ± S.E.	2·61±1·07	—	1·91±0·30
3. C.V. ± S.E.	5·20±2·12	—	3·64±0·58
Female (7)			
1. Mean ± S.E.	..	60·22 ± 0·90	63·39 ± 0·48
(*n*)		(9)	(38)
2. S. D. ± S.E.	..	2·60 ± 0·64	2·94 ± 0·34
3. C.V. ± S.E.	..	4·48 ± 1·05	4·64 ± 0·53

TABLE 4A—*contd.*

Statistical constants	Nature of population		
	Group I	Group II	Group III
—	1	2	3
2. Length of hind-femur (F)			
Male (6)			
1. Mean ± S.E.	23·11 ± 0·26	24·06 ± 0·07	25·24 ± 0·16
(*n*)	(23)	(417)	(61)
2. S.D. ± S.E.	1·26 ± 0·18	1·32 ± 0·05	1·22 ±0·11
3. C.V. ± S.E.	5·41 ± 0·80	5·49 ± 0·19	4·82 ± 0·44
Female (6)			
1. Mean ± S.E.	25·52 ± 0·34	26·50 ± 0·07	27·97 ± 0·91
(*n*)	(16)	(454)	(12)
2. S.D. ± S.E.	1·37 ± 0·24	1·58 ± 0·05	3·14 ± 0·64
3. C.V. ± S.E.	5·40 ± 0·95	5·96 ± 0·20	11·22 ± 2·29
Male (7)			
1. Mean ± S.E.	25·3 ± 0·64	25·1	26·12 ± 0·23
(*n*)	(3)	(1)	(19)
2. S.D. ± S.E.	1·1 ± 0·45	—	0·99 ±0·16
3. C.V. ± S.E.	4·35 ± 1·78	—	3·80 ±0·620
Female (7)			
1. Mean ± S.E.	—	28·63 ± 0·55	31·21 ± 0·22
(*n*)		(9)	(40)
2. S.D. ± S.E.	—	1·66 ± 0·39	1·41 ± 0·16
3. C.V. ± S.E.	—	5·81 ± 0·39	4·51 ± 0·50
3. Width of Head at Genal Level (C)			
Male (6)			
1. Mean ± S.E.	7·31 ± 0·071	7·21 ± 0·020	6·55 ± 0·04
(*n*)	(23)	(443)	(71)
2. S.D. ± S.E.	0·342± 0·050	0·42 ± 0·014	0·36 ± 0·03
3. C.V. ± S.E.	4·68 ± 0·69	5·80 ± 0·19	5·48 ± 0·46
Female (6)			
1. Mean ± S.E.	7·83 ± 0·074	7·88 ± 0·019	7·42 ± 0·16
(*n*)	(18)	(491)	(13)
2. S.D. ± S.E.	0·314± 0·052	0·43 ± 0·014	0·59 ± 0·12
3. C.V. ± S.E.	4·01 ± 0·67	5·42 ± 0·17	8·01 ± 1·57

TABLE 4A—*concld.*

Statistical constants	Nature of population		
	Group I	Group II	Group III
—	1	2	3
Male (7)			
1. Mean ± S.E.	6·63 ± 0·144	6·3	6·67 ± 0·05
(*n*)	(3)	(1)	(21)
2. S.D. ± S.E.	0·250± 0·102	—	0·24 ± 0·04
3. C.V. ± S.E.	3·77 ± 1·54	—	3·63 ± 0·56
Female (7)			
1. Mean ± S.E.	..	7·63 ± 0·146	7·70 ± 0·05
(*n*)		(10)	(43)
2. S.D. ± S.E.	..	0·462± 0·103	0·33 ± 0·04
3. C.V. ± S.E.	..	6·05 ± 1·35	4·21 ± 0·45
4. Length of pronotum (P)			
Male (6)			
1. Mean ± S.E.	9·66 ± 0·114	9·94 ± 0·029	9·86 ± 0·06
(*n*)	(23)	(441)	(71)
2. S.D. ± S.E.	0·548± 0·081	0·60 ± 0·020	0·51 ± 0·04
3. C.V. ± S.E.	5·67 ± 0·84	6·04 ± 0·20	5·16 ± 0·43
Female (6)			
1. Mean ± S.E.	10·47 ± 0·113	10·86 ± 0·030	10·76 ± 0·29
(*n*)	(18)	(487)	(13)
2. S.D. ± S.E.	0·479± 0·080	0·66 ± 0·021	1·06 ± 0·21
3. C.V. ± S.E.	4·57 ± 0·76	6·11 ± 0·20	9·88 ± 1·94
Male (7)			
1. Mean ± S.E.	·67 ± 0·44	10·0	10·2 ± 0·08
(*n*)	(3)	(1)	(21)
2. S.D. ± S.E.	0·765± 0·31	—	0·38 ± 0·06
3. C.V. ± S.E.	7·91 ± 3·23	—	3·77 ±1.58
Female (7)			
1. Mean ± S.E.	..	11·50 ± 0·29	11·90 ± 0·10
(*n*)		(9)	(43)
2. S D. ± S.E.	..	0·859± 0·202	0·667± 0·072
3. S E. ± S.E.	..	7·45 ± 1·76	5.60 ± 0·60

TABLE 4B.—*Values of the morphometric characters E, F, C and P, in the Desert Locust in India, for "typical" phase* gregaria *and phase* solitaria *(Roonwal, 1949 ; Roonwal & Nag 1951) ; the* Kakko Concentration(1949) *and the* Ajmer Swarm (1950).

Abbreviations :—As in Table 4A.

Statistical constants	Nature of population			
	Phase gregaria	*Phase solitaria*	Kakko population	Ajmer swarm
—	1	2	3	4
1. Length of elytra (E)				
Male (6)				
1. Mean ± S.E.	52·85 ± 0·52	52·15 ± 0·24	51·46 ± 0·29	54·16 ± 0·70
(*n*)	(14)	(89)	(112)	(10)
2. S.D. ± S.E.	1·93 ± 0·36	2·23 ± 0·17	3·03 ± 0·20	2·20 ± 0·49
3. C.V. ± S.E.	3·65 ± 0·69	4·28 ± 0·32	5·89 ± 0·39	4·0 ± 0·91
Female (6)				
1. Mean ± S.E.	58·01 ± 0·81	61·56 ± 0·31	59·73 ± 0·42	59·70 ± 1·63
(*n*)	(26)	(63)	(72)	(4)
2. S. D. ± S.E.	4·12 ± 0·57	2·49 ± 0·22	3·53 ± 0·29	3·37 ± 1·19
3. C. V. ± S.E.	7·10 ± 0·98	4·04 ± 0·36	5·91 ± 0·49	5·64 ± 1·99
Male (7)				
1. Mean ± S.E.	..	52·38 ± 0·42	..	55·2
(*n*)		(25)		(1)
2. S.D. ± S.E.	..	2·10 ± 0·30	..	—
3. C. V. ± S.E.	..	4·01 ± 0·57	..	—
Female (7)				
1 Mean ± S.E.	..	62·90 ± 0·26	61·83 ± 1·41	..
(*n*)		(84)	(8)	
2. S.D. ± S.E.	..	2·42 ± 0·19	3·99 ± 1·00	..
3. C.V. ± S.E.	..	3·85 ± 0·30	6·45 ± 1·64	..
2. Length of hind-femur (F)				
Male (6)				
1. Mean ± S.E.	24·32 ± 0·20	25·40 ± 0·12	24·92 ± 0·16	24·37 ± 0·29
(*n*)	(25)	(89)	(112)	(10)
2. S.D. ± S.E.	0·99 ± 0·14	1·12 ± 0·08	1·64 ± 0·11	0·91 ± 0·20
3. C.V. ± S.E.	4·07 ± 0·58	4·42 ± 0·33	6·58 ± 0·44	·73 ± 0·83

TABLE 4B—*contd.*

Statistical constants	Nature of population			
	Phase gregaria	*Phase solitaria*	Kakko population	Ajmer swarm
—	1	2	3	4
Female (6)				
1. Mean ± S.E. . .	26·44 ± 0·37	29·37 ± 0·18	28·35 ± 0·25	27·28 ± 0·25
(*n*)	(34)	(63)	(72)	4)
2. S.D. ± S.E.	2·13 ± 0·26	1·44 ± 0·13	2·14 ± 0·18	1·23 ± 0·43
3. C.V. ± S.E. . . .	8·06 ± 0·98	4·90 ± 0·44	7·55 ± 0·63	4·51 ± 1·59
Male (7)				
1. Mean ± S.E. . .	..	26·13 ± 0·21	..	26·9
(*n*)		(2)		(1)
2. S.D. ± S.E. . .	..	1·04 ± 0·15	..	—
3. C.V. ± S.E. . . .	..	3·98 ± 0·56	..	—
Female (7)				
1. Mean ± S.E. . .	..	30·92 ± 0·13	29·94 ± 0·92	..
(*n*)		(84)	(8)	
2. S.D. ± S.E. . .	..	1·21 ± 0·09	2·61 ± 0·65	..
3 .C.V ± S.E. . .	..	3·92 ± 0·30	8·72 ± 2·18	..
3. Width of Head at Genal Level (C)				
Male (6)				
1. Mean ± S.E. . .	7·55 ± 0·045	..	6·60 ± 0·033	7·53 ± 0·082
(*n*)	(34)		(112)	(10)
2. S.D. ± S.E. . .	0·26 ± 0·032	..	0·35 ± 0·023	0·26 ± 0·058
3 C.V. ± S.E. . . .	3·44 ± 0·42	..	5·30 ± 0·35	3·45 ± 0·77
Female (6)				
1. Mean ± S.E. . .	7·89 ± 0·074	..	7·41 ± 0·041	7·90 ± 0·248
(*n*)	(40)		(72)	(4)
2. S.D. ± S.E. . . .	0·47 ± 0·053	..	0·35 ± 0·029	0·50 ± 0·176
3. C.V. ± S.E. . . .	5·96 ± 0·67	..	4·72 ± 0·39	6·29 ± 2·32

TABLE 4B—*contd.*

Statistical constants	Nature of population			
	Phase gregaria	*Phase solitaria*	Kakko population	Ajmer swarm
—	1	2	3	4
	Male (7)			
1. Mean ± S.E.	..	..	..	6·9
(*n*)				(1)
2. S.D. ± S.E.	..	..		—
3. C.V. ± S.E.	..	..	..	—
	Female (7)			
1. Mean ± S.E.	..	..	..	..
(*n*)				
2. S.D. ± S.E.		..	..	..
3. C.V. ± S.E.	..	..	..	..
	4. Length of pronotum (P)			
	Male (6)			
1. Mean ± S.E.	9·87±0·079	..	9·76±0·054	10·01±0·108
(*n*)	(31)		(112)	(10)
2. S.D. ± S.E.	0·44±0·056	..	0·57±0·038	0·34±0·076
3. C.V. ± S.E.	4·46±0·57	..	5·84±0·39	3·40±0·76
	Female (6)			
1. Mean ± S.E.	10·49±0·133	..	10·94±0·088	10·78±0·343
(*n*)	(40)		(72)	(4)
2. S.D. ± S.E.	0·84±0·094	..	0·75±0·063	0·69±0·244
3. C.V. ± S.E.	8·01 ±0·90	..	6·86±0·57	6·40±2·26
	Male (7)			
1. Mean ± S.E.	..	..	..	10·2
(*n*)				(1)
2. S.D. ± S.E.	..	..	..	—
3. C.V. ± S.E.	..	..	..	—
	Female (7)			
1. Mean ± S.E.	..	..	..	—
(*n*)				
2. S.D. ± S.E.	..	..	..	—
3. C.V. ± S.E.	..	..		—

TABLE 4C.—*Inter-population comparison of statistical constants (Mean, S.D. and C.V.) of the morphometric characters E, F, C and P between Groups I-III of the 1955-population (Table 4A) and other populations (Table 4B) of the Desert Locust in India.*

Abbreviations :— NS., Not Significant.

*, Significant at 5 per cent level of probability.

**, Significant at 1 per cent level of probability.

***, Significant at 0·1 per cent level of probability.

Statistica lconstants	Significant test between various populations at 5%, 1% and 0·1% levels											
	Cols. 1 & 4	Cols. 2 & 4	Cols. 3 & 4	Cols. 1 & 5	Cols. 2 & 5	Cols. 3 & 5	Cols. 1 & 6	Cols. 2 & 6	Cols. 3 & 6	Cols. 1 & 7	Cols. 2 & 7	Col 3 & 7
—	1	2	3	4	5	6	7	8	9	10	11	12
1. Length of elytra (E)												
Male (6)												
1. Mean±S.E. .	*	NS	NS	*	NS	NS	**	**	NS	***	*	**
2. S.D.±S.E. .	NS	NS	NS	NS	*	NS	NS	***	*	NS	NS	NS
3. C.V.±S.E. .	NS	*	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
Female (6)												
1. Mean±S.E. .	NS	NS	NS	***	***	NS	**	NS	NS	NS	NS	NS
2. S.D.±S.E. .	NS	**	NS	NS	*	NS	NS	**S	NS	NS	NS	NS
3. C.V.±S.E. .	NS	*	NS	NS	**	NS	NS	NS	NS	NS	NS	NS
Male (7)												
. Mean±S.E. .	..	..	..	NS	..	NS	..	...	..	..	..	..
2. S.D.±S.E. .	..	..	..	NS	..	NS	..	..	..	..	..	..
3. C.V.±S.E. .	..	..	..	NS	..	NS	..	..	..	..	..	..
Female (7)												
1. Mean±S.E. .	..	..	..	..	**	NS	..	NS	NS	..	..	..
2. S.D.±S.E. .	..	..	..	..	NS	**	..	NS	NS	..	..	..
3. C.V.±S.E. .	..	..	..	..	NS	NS		NS	NS	..	..	..
2. Length of hind-femur (F)												
Male (6)												
1. Mean±S.E. .	***	NS	*	***	***	NS	***	***	NS	**	NS	**
2. S.D.±S.E. .	NS	NS	NS	NS	*	NS	NS	***	NS	NS	NS	NS
3. C.V.±S.E. .	NS	*	NS	NS	*	NS	NS	*	**	NS	*	N

TABLE 4C—*contd.*

Statistical constants	Significant test between various populations at 5%, 1% and 0·1% levels											
	Cols. 1 & 4	Cols. 2 & 4	Cols. 3 & 4	Cols. 1 & 5	Cols. 2 & 5	Cols. 3 & 5	Cols. 1 & 6	Cols. 2 & 6	Cols. 3 & 6	Cols. 1 & 7	Cols. 2 & 7	Cols. 3 & 7
—	1	2	3	4	5	6	7	8	9	10	11	12
Female (6)												
1, Mean±S.E. .	NS	NS	NS	***	***	NS	***	***	NS	*	NS	NS
2. S.D.±S.E. .	*	**	*	NS	NS	***	*	***	NS	NS	NS	NS
3. C.V.±S.E .	NS	*	NS	NS	*	**	NS	*	NS	NS	NS	*
Male(7)												
1. Mean±S.E. .	..	..	..	NS	..	NS	..	..	..	..	..	..
2, S.D.±S.E. .	..	..	..	NS	..	NS	..	..	..	..	..	..
3. C.V.±S E.	..	..	..	NS	..	NS	..	..	..	..	..	..
Female (7)												
1. Mean ±S.E. .	..	..	..	..	***	NS		NS	NS	..	..	..
2. S.D. ± S.E.	..	..	..	..	NS	*	..	NS	**	..	..	..
3. C.V. ± S.E. .	..	..	..	..	NS	NS	..	NS	NS	..	..	..
3. Width of Head at Genal Level (C)												
Male (6)												
1. Mean ± S.E.	**	***	***	..	..	..	***	***	NS	*	***	***
2. S.D. ± S.E. .	NS	***	**	..	..	..	NS	**	NS	NS	*	NS
3. C.V. ± S.E. .	NS	**	**	..	..	..	NS	NS	NS	NS	**	*
Female (6)												
1. Mean ± S.E.	NS	NS	**	..	..	..	***	***	NS	NS	NS	NS
2. S.D. ± S.E.	*	*	NS	..	..	..	NS	NS	**	NS	NS	NS
3. C.V. ± S.E. .	*	NS	NS	..	..	..	NS	NS	*	NS	NS	NS

TABLE 4C—*concld.*

Statistical constants	Significant test between various populations at 5 %, 1 % and 0.1 % levels.											
	Cols. 1 & 4	Cols. 2 & 4	Cols. 3 & 4	Cols. 1 & 5	Cols. 2 & 5	Cols. 3 & 5	Cols. 1 & 6	Cols. 2 & 6	Cols. 3 & 6	Cols. 1 & 7	Cols. 2 & 7	Cols. 3 & 7
—	1	2	3	4	5	6	7	8	9	10	11	12
					Male (7)							
1. Mean ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
2. S.D. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
					Female (7)							
1. Mean ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
2. S.D. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	
					4. Length of pronotum (P)							
					Male (6)							
1. Mean ± S.E.	NS	NS	NS	..	..	..	NS	**	NS	*	NS	NS
2. S.D. ± S.E.	NS	*	NS	..	..	..	NS	NS	NS	NS	*	NS
3. C.V. ± S.E.	NS	**	NS	..	..	..	NS	NS	NS	*	***	
					Female (6)							
1. Mean ± S.E.	NS	**	NS	..	..	..	**	NS	NS	NS	NS	
2. S.D. ± S.E.	**	**	NS	..	..	..	*	***	*	NS	NS	
3. C.V. ± S.E.	**	*	NS	..	..	..	*	NS	NS	NS	NS	
					Male (7)							
1 Mean ± S.E.	..	..	..	..	..	..	..	..	..	..	..	
2. S.D. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
					Female (7)							
1. Mean ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
2. S.D. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..

TABLE 5A.—*Values for various morphometric ratios in the Desert Locust population in India for 1955 (Group I).*

Abbreviations.— *n*, Number of individuals.
S.E., Standard error.
S.D., Standard deviation.
C.V., Coefficient of variation.

Sex and number of eye-stripes	Group 1				
	n	Range	Mean ± S.E.	S.D. ± S.E.	C.V. ± S.E.
1	2	3	4	5	6
			1. Ratio E/F		
1. ♂♂ (6)	23	1·97—2·40	2·21±0·018	0·085±0·013	3·85±0·57
2. ♂♂ (7)	3	1·96—2·00	1·99±0·013	0·023±0·009	1·16±0·47
3. ♀♀ (6) . .	15	2·10—2·31	2·24±0·016	0·063±0·012	2·81±0·51
4. ♀♀ (7) . .	..	..	..	..	..
			2. Ratio E/W_1		
5. ♂♂ (6) .	23	6·88—8·12	7·41±0·068	0·326±0·048	4·40±0·649
6. ♂♂ (7) .	3	7·12—8·02	7·69±0·285	0·493±0·20	6·41±2·62
7. ♀♀ (6)	17	6·74—8·01	7·45±0·081	0·333±0·057	4·47±0·77
8. ♀♀ (7) .	..	..	..	..	..
			3. Ratio E/C		
9. ♂♂ (6) .	23	6·61—7·61	6·98±0·05	0·238±0·035	3·41±0·50
10. ♂♂ (7) .	3	7·42—7·64	7·57±0·075	0·130±0·053	1·72±0·70
11. ♀♀ (6) . .	17	6·99—7·83	7·29±0·058	0·240±0·041	3·29±0·56
12. ♀♀ (7) .	..	..	..	..	..
			4. Ratio F/C		
13. ♂ (6) .	23	2·97—3·85	3·17±0·038	0·184±0·027	5·80±0·86
14. ♂♂ (7) . .	3	3·78—3·83	3·81±0·016	0·028±0·011	0·73±0·30
15. ♀♀ (6) . .	16	3·11—3·72	3·25±0·037	0·15±0·027	4·62±0·82
16. ♀♀ (7) . .	..	..	..	..	..

TABLE 5A—*contd.*

Sex and number of eye-stripes	Group I				
	n	Range	Mean ± S.E.	S.D. ± S.E.	C.V. ± S.E.
1	2	3	4	5	6
			5. Ratio P/C		
17. ♂♂ (6)	23	1·24—1·48	1·32±0·012	0·059±0·009	4·47±0·66
18. ♂♂ (7)	3	1·41—1·52	1·46±0·033	0·057±0·023	3·90±1·59
19. ♀♀ (6)	18	1·24—1·43	1·34±0·011	0·048±0·008	3·58±0·60
20. ♀♀ (7)	..	..	..	..	..
			6. Ratio M/C		
21. ♂♂ (6)	23	0·750—0·887	0·79±0·005	0·023±0·003	2·91±0·43
22. ♂♂ (7)	3	0·848—0·891	0·87±0·032	0·056±0·023	6·54±2·63
23. ♀♀ (6)	18	0·787—0·889	0·83±0·008	0·035±0·006	4·22±0·70
24. ♀♀(7)	..	..		..	..
			7. Ratio H/C		
25. ♂♂ (6)	23	1·04—1·23	1·10±0·008	0·037±0·005	3·36±0·50
26. ♂♂ (7)	3	1·20—1·25	1·23±0·014	0·025±0·010	2·03±0·83
27. ♀♀ (6)	18	1·04—1·21	1·12±0·009	0·039±0·006	3·48±0·58
28. ♀♀ (7)	..	..	..	..	..
			8. Metasternal index (K/L)		
29. ♂♂ (6)	23	1·00—1·50	1·35±0·05	0·220±0·03	16·30±2·40
30. ♂♂ (7)	3	1·33—2·00	1·61±0·20	0·348±0·14	21·61±8·82
31. ♀♀ (6)	18	1·00—1·50	1·18±0·04	0·156±0·03	13·22±2.20
32. ♀♀ (7)	..	..	..	..	..

TABLE 5B.—*Values for various morphometric ratios in the Desert Locust population in India for 1955 (Group II).*

Abbreviations :—As in Table 5A.

Sex and number of eye-stripes	Group II				
	n	Range	Mean ± S. E.	S. D. ± S. E.	C. V ± S. E
1	2	3	4	5	6
			1. Ratio E/F		
1. ♂ ♂ (6)	399	1·93—2·44	2·18±0·004	0·073±0·003	3·36±0·12
2. ♂ ♂ (7)	1	..	2·00±0·0	..	..
3. ♀ ♀ (6)	429	1·93—2·45	2·23±0·004	0·072±0·002	3·22±0·11
4. ♀ ♀ (7)	9	2·02—2·18	2·10±0·021	0·062±0·015	2·97±0·70
			2. Ratio E/W_1		
5. ♂ ♂ (6)	420	6·64—8·38	7·42±0·016	0·320±0·011	4·30±0·150
6. ♂ ♂ (7)	1	..	8·10±0·0	..	..
7. ♀ ♀ (6)	457	6·84—8·71	7·57±0·015	0·320±0·011	4·23±0·14
8. ♀ ♀ (7)	9	7·11—8·36	7·92±0·132	0·396±0·093	4·996±1·18
			3. Ratio E/C		
9. ♂ ♂ (6)	420	6·51—8·30	7·30±0·014	0·283±0·010	3·87±0·13
10. ♂ ♂ (7)	1	..	7·97±0·0	..	..
11. ♀ ♀ (6)	458	6·48—8·36	7·50±0·011	0·236±0·008	3·14±0·10
12. ♀ ♀ (7)	9	7·28—8·38	7·96±0·109	0·326±0·077	4·10±0·97
			4. Ratio F/C		
13. ♂ ♂ (6)	416	2·89—4·02	3·35±0·009	0·179±0·006	5·34±0·18
14. ♂ ♂ (7)	1	..	3·98±0·0	..	..
15. ♀ ♀ (6)	454	3·02—4·12	3·36±0·007	0·145±0·005	4.32±0·14
16. ♀ ♀ (7)	9	3.37—4·16	3·79±0·079	0·238±0·056	6·28±1·48
			5. Ratio P/C		
17. ♂ ♂ 6)	439	1.24—1·63	1.38±0·003	0·060±0·002	4·34±0·147
18. ♂ ♂ (7)	1	..	1·59±0·0	..	..
19. ♀ ♀ (6)	487	1·23—1·69	1·38±0.002	0·052±0·002	3·77±0·12
20. ♀ ♀ (7)	9	1·39—1·63	1·50±0·027	0·082±0·019	5·47±1·29
			6. Ratio M/C		
21 ♂ ♂ (6)	442	0·743—0·932	0·82±0·002	0·031±0·001	3·73±0·13
22. ♂ ♂ (7)	1	..	0·905±0 0	..	..
23. ♀ ♀ (6)	491	0.768—0·932	0·842±0·001	0·025±0·001	3.01±0·10
24. ♀ ♀ (7)	9	0·836—0·934	0·885±0·012	0·036±0·008	4·06±0·96
			7. Ratio H/C		
25. ♂ ♂ (6)	446	0·96—1·30	1·13±0·002	0·040±0·001	3·54±0·12
26. ♂ ♂ (7)	1	..	1·22±0·0	..	..
27. ♀ ♀ (6)	491	1·03 —1·30	1·14±0·002	0·036±0·001	3·16±0·10
28. ♀ ♀ (7)	10	1·13—1·30	1·23±0·016	0·052±0·012	4·23±0·95
			8. Metasternal index (K/L)		
29. ♂ ♂ (6)	440	1·00—3·00	1·52±0·01	0·241±0·01	15·91±0·54
30. ♂ ♂ (7)	1	..	1·50±0·0	..	..
31 ♀ ♀ (6)	488	1·00—2·50	1·25±0·01	0·126±0·004	10·09±0·32
32. ♀ ♀ (7)	10	1·20—1·50	1·29±0·03	0·085±0·019	6·56±1·47

TABLE 5C.—*Values for various morphometric ratios in the Desert Locust population in India for 1955 (Group III).*

Abbreviations :—As in Table 5A.

Sex and number of eye-stripes	Group III				
	n	Range	Mean ± S.E.	S.D. ± S.E.	C.V ± S.E.
1	2	3	4	5	6
			1. Ratio E/F		
1. ♂♂ (6) . .	55	1·97—2·30	2·07±0·010	0·071±0·007	3·43±0·33
2. ♂♂ (7) . .	19	1·95—2·08	2·01±0·009	0·041±0·007	2·04±0·33
3. ♀♀ (6) .	11	1·95—2·27	2·11±0·031	0·103±0·022	4·88±1·04
4. ♀♀ (7) .	36	1·96—2·17	2·04±0·008	0·051±0·006	2·50±0·29
			2. Ratio E/W		
5. ♂♂ (6) . .	66	6·95—8·46	7·88±0·038	0·311±0·027	3·95±0·344
6. ♂♂ (7)	20	7·38—8·61	7·84±0·068	0·305±0·048	3·89±0·62
7. ♀♀ (6)	10	7·46—8·97	8·10±0·123	0·388±0·087	4·79±1.07
8. ♀♀ (7) .	38	7·66—8·82	8·12±0·045	0·280±0·032	3·4 ±0·39
			3. Ratio E/C		
9. ♂♂ (6) .	65	6·99—8·51	7·98±0·036	0·294±0·027	3·68±0·32
10. ♂♂ (7)	20	7·55—8·39	7·92±0·047	0·21±0·033	2·65±0·42
11. ♀♀ (6) .	11	7·28—8·70	8·03±0·138	0·457±0·098	5·69±1·2
12. ♀♀ (7) .	38	7·90—8·73	8·23±0·033	0·205±0·24	2·50±0·29
			4. Ratio F/C		
13. ♂♂ (6) .	61	3·04—4·11	3·86±0·029	0·230±0·021	5·96±9·54
14. ♂♂ (7) .	19	3·74—4·08	3·93±0·021	0·093±0·015	·36±0·38
15. ♀♀ (6) . .	12	3·23—4·14	3·82±0·088	0·305±0·062	7·97±1·6
16. ♀♀ (7) :	40	3·78—4·27	4·04±0·018	0·115±0·013	2·86±0·32

TABLE 5C—*continued.*

Sex and number of eye-stripes	Group III				
	n	Range	Mean ± S.E.	S.D. ± S.E.	C.V. ± S.E.
1	2	3	4	5	6
			5. Ratio P/C,		
17. ♂♂(6)	71	1·26—1·62	1·51±0·007	0·062±0·005	4·14±0·348
18. ♂♀ (7)	21	1·46—1·60	1·52±0·011	0·051±0·008	3·35±0·52
19. ♀♀(6)	13	1·30—1·57	1·47±0·025	0·091±0·018	6·21±1·22
20. ♀♀(7)	43	1·43—1·68	1·54±0·009	0·06±0·006	3·89±0·42
			6. Ratio M/C		
21. ♂♂ (6)	71	0·814—0·950	0·89±0·003	0·027±0·002	3·03±0·25
22. ♂♂ (7)	21	0·838—0·938	0·90±0·006	0·029±0·004	·24±0·50
23. ♀♀(6)	13	0·824—0·957	0·90±0·012	0·042±0·008	4·72±0·93
24. ♀♀(7)	43	0·875—0·972	0·92±0·004	0·023±0·002	2·50±0·27
			7. Ratio H/C		
25. ♂♂ (6)	71	1·10—1·33	1·25±0·006	0·051±0·004	4·08±0·34
26, ♂♂ (7)	21	1·16—1·31	1·25±0·008	0·039±0·006	3·10±0·48
27. ♀♀(6)	13	1·12—1·31	1·24±0·016	0·057±0·011	4·61±0·90
28. ♀♀(7)	43	1·21—1·38	1·29±0·002	0·041±0.004	3·20±0·35
			8. Metasternal index (K/L)		
29. ♂♂ (6)	71	1·00—2·00	1·58±0·02	0·207±0·02	13·11±1·10
30. ♂♂ (7)	21	1·00—2·00	1·49±0·04	0·162±0·03	10·89±1·68
31. ♀♀(6)	12	1·00—1·33	1·24±0·02	0·078±0·016	6·27±1·28
32 ♀♀(7)	43	1·00 1·67	1·27±0·02	0·122±0·013	9·65±1·04

TABLE 5D.—*Inter-group comparisons of various morphometric ratios (within the same sex and eye-stripe group) between Groups I-III of the 1955-population of the Desert Locust in India (From data in Table 5A, 5B and 5C).*

Abbreviations :—N,S., Not Significant. at 5% level of probability.

*, Significant at 5% level of probability.

**, Significant at 1% level of probability.

***, Significant at 0·1% level of probability.

Sex and number of eye-stripes	Significance of difference between 1955—groups								
	Mean			S.D.			C.V.		
	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III	Gr. I & Gr. II	Gr. I & Gr. III	Gr.. II & Gr. III	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III
1. Ratio E/F									
1. ♂♂ (6)	NS	***	***	NS	NS	NS	NS	NS	NS
2. ♂♂ (7)	..	NS	..	..	NS	..	..	NS	..
3. ♀♀ (6)	NS	**	***	NS	*	*	NS	NS	NS
4. ♀♀ (7)	..	..	*	..	..	NS	..	..	NS
2. Ratio E/W1									
5. ♂♂ (6)	NS	***	***	NS	NS	NS	NS	NS	NS
6. ♂♂ (7)	..	NS	..	..	NS	..	..	NS	..
7. ♀♀ (6)	NS	***	***	NS	NS	NS	NS	NS	NS
8. ♀♀ (7)	..	..	NS	..	..	NS	..	..	NS
3. Ratio E/C									
9. ♂♂ (6)	***	***	***	NS	NS	NS	NS	NS	NS
10. ♂♂ (7)	..	*	..	..	NS	..	..	NS	
11. ♀♀ (6)	***	***	***	NS	**	***	NS	NS	..
12. ♀♀ (7)	..	..	NS	..	..	*	..	..	N
4. Ratio F/C									
13. ♂♂ (6)	***	***	***	NS	NS	***	NS	NS	NS
14. ♂♂ (7)	..	*	..	..	*	..	..	**	..
15. ♀♀ (6)	**	***	***	NS	**	***	NS	NS	*
16. ♀♀ (7)	..	**	..	..	..	***	..	..	*
5. Ratio P/C.									
17. ♂♂ (6)	***	***	***	NS	NS	***	NS	NS	NS
18. ♂♂ (7)	..	NS	..	..	NS	..	..	NS	..
19. ♀♀ (6)	***	***	***	NS	..	***	NS	NS	*
20. ♀♀ (7)	..	..	NS	..	..	NS	..	..	NS

TABLE 5D—*concluded.*

Sex and number of eye-stripes	Significance of difference between 1955—groups								
	Mean			S.D.			C.V.		
	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III	Gr. I & Gr. II	Gr. I & Gr. III	Gr. II & Gr. III
6. Ratio M/C									
21. ♂♂ (6)	***	***	***	*	NS	*	NS	NS	*
22. ♂♂ (7)	..	NS	..	..	*	..	..	NS	..
23. ♀♀ (6)	NS	***	***	**	NS	***	NS	NS	NS
24. ♀♀ (7)	..	..	**	..	..	*	..	..	NS
7. Ratio H/C									
25. ♂♂ (6)	***	***	***	NS	*	*	NS	NS	NS
26. ♂♂ (7)	..	NS	..	..	NS	..	..	NS	..
27. ♀♀ (6)	*	***	***	NS	NS	*	NS	NS	NS
28. ♀♀ (7)	..	..	***	..	..	NS	..	..	NS
8. Metasternal index (K/L)									
29. ♂♂ (6)	***	***	**	NS	NS	*	NS	NS	*
30. ♂♂ (7)	..	NS	..	*	**	..	..	NS	..
31. ♀♀ (6)	NS	NS	NS	*	**	**	NS	*	**
32. ♀♀ (7)	..	..	NS	..	..	NS	..	..	NS

TABLE 6.—*Inter-sex comparison of morphometric ratios in the various Groups of the 1955-population of the Desert Locust.*

Abbreviations : —*h*, Values in males significantly *lower* than in females.

H, Values in males significantly *higher* than in females.

x, No significant difference between males and females.

Group (and number of eye-stripes, 6 or 7)	Ratios, and inter-sex comparison							
	E/F	E/W_1	E/C	F/C	P/C	M/C	H/C	K/L
I (6)	*x*	*x*	*h*	*x*	*x*	*h*	*x*	*H*
II (6)	*h*	*h*	*h*	*x*	*x*	*x*	*h*	*H*
III (6)	*x*	*x*	*x*	*x*	*x*	*h*	*x*	*H*
III (7)	*h*	*h*	*h*	*h*	*x*	*h*	*h*	*H*

TABLE 7A.—*Values of Mean, S.D. and C.V of morphometric ratios E/F, F/C and P/C of the Desert Locust population in India for 1955 (Groups I-III).*

Abbreviations :—*n*, Number of individuals.
S.E., Standard error.
S.D., Standard deviation.
C.V., Coefficient of variation.

Statistical constants	Nature of population		
	Group I	Group II	Group III
—	(1)	(2)	(3)
	1. Ratio E/F		
	Male (6)		
1. Mean ± S.E. (*n*)	2·21±0·018 (23)	2·18±0·004 (399)	2·07±0·010 (55)
2. S.D. ± S.E.	0·085±0·013	0·07±0·003	0·07±0·007
3. C.V. ± S.E.	3·85±0·57	3·36±0·12	3·43±0·33
	Female (6)		
1. Mean ± S.E. (*n*)	2·24±0·016 (15)	2·23±0·004 (429)	2·11±0·03 (11)
2. S.D. ± S.E.	0·063±0·012	0·07±0·002	0·103±0·022
3. C.V. ± S.E.	2·81±0·51	3·22±0·11	4·88±1·04
	Male (7)		
1. Mean ± S.E. (*n*)	1·99±0·013 (3)	2·00 (1)	2·01±0·009 (19)
2. S.D. ± S.E.	0·023±0·009	—	0·041±0·007
3. C.V.± S.E.	1·156±0·47	—	2·04±0·33
	Female (7)		
1. Mean ± S.E. (*n*)	..	2·10 ±0·021 (9)	2·04 ±0·008 (36)
2. S.D. ± S.E.	..	0·062±0·015	0·05 ±0·006
3. C.V. ± S.E.	..	2·97 ±0·70	2·50 ±0·29
	2. Ratio F/C		
	Male (6)		
1. Mean ± S.E. (*n*)	3·17 ±0·038 (23)	3·35 ±0·009 (416)	3·86 ±0·03 (61)
2. S.D. ± S.E.	0·184±0·027	0·179±0·006	0·23 ±0·021
3. C.V. ± S.E.	5·80 ±0·86	5·34 ±0·185	5·96 ±0·540
	Female (6)		
1. Mean ± S.E. (*n*)	3·25 ±0·037 (16)	3·36 ±0·007 (454)	3·82 ±0·09 (12)
2. S.D. ± S.E.	0·15 ±0·027	0·145±0·005	0·30 ±0·06
3. C.V. ± S.E.	4·62 ±0·82	4·32 ±0·143	7·97 ±1·63

TABLE 7A—*continued.*

Statistical constants	Nature of population		
	Group I	Group II	Group III
—	(1)	(2)	(3)
2. Ratio F/C—*contd.*			
Male (7)			
1. Mean ±S. E. (*n*)	3·81 ±0·016 (3)	3·98 (1)	3·93 ±0·02 (19)
2. S. D. ±S. E.	0·028±0·011	..	0·093±0·015
3. C. V. ±S. E.	0·73 ±0·30	..	2·36 ±0·38
Female (7)			
1. Mean ±S. E. (*n*)	..	3·79 ±0·079 (9)	4·04 ±0·018 (40)
2. S. D. ±S. E.	..	0·238±0·056	0·12 ±0·01
3. C. V. ±S. E.	..	6·28 ±1·48	2·86 ±0·32
3. Ratio P/C			
Male (6)			
1. Mean ±S. E. (*n*)	1·32 ±0·012 (23)	1·38 ±0·003 (439)	1·51 ±0·007 (71)
2. S. D. ±S. E.	0·059±0·009	0·060±0·002	0·062±0·005
3. C. V. ±S. E.	4·47 ±0·66	4·34 ±0·147	4·14 ±0·35
Female (6)			
1. Mean ±S. E. (*n*)	1·34 ±0·011 (18)	1·38 ±0·002 (487)	1·47 ±0·03 (13)
2. S. D. ±S. E.	0·023±0·003	0·052±0·002	0·091±0·018
3. C. V. ±S. E.	2·91 ±0·43	3·77 ±0·121	6·207±1·217
Male (7)			
1. Mean ±S. E. (*n*)	1·46 ±0·033 (3)	1·59 (1)	1·52 ±0·011 (21)
2. S. D. ±S. E.	0·057±0·023	..	0·051±0·008
3. C. V. ±S. E.	3·90 ±1·59	..	3·35 ±0·52
Female (7)			
1. Mean ±S. E. (*n*)	..	1·50 ±0·027 (9)	1·54 ±0·009 (43)
2. S. D. ±S. E.	..	0·082±0·019	0·091±0·018
3. C. V. ±S. E.	..	5·47 ±1·29	6·21 ±1·22

TABLE 7B.—*Values of Mean, S.D. and C. V.of morphometric ratios E/F, F/C and P/C, in the Desert Locust in India, for the "typical" phase* gregaria *and phase* solitaria *populations, the* Kakko Concentration (1949) *and the* Ajmer-Swarm (1950).

Abbreviations :—As in Table 7A.

Statistical constants	Nature of population			
	Phase gregaria	*Phase solitaria*	Kakko population	Ajmer swarm
—	(4)	(5)	(6)	(7)
1. Ratio E/F				
Male (6)				
1 Mean ±S. E. (*n*)	2·17 ±0·024 (11)	2·05 ±0·012 (89)	2·06 ±0·010 (112)	2·22 ±0·023 (10)
2 S. D. ± S. E.	0·08 ±0·017	0·06 ±0·004	0·10 ±0·007	0·07 ±0·016
3 C. V. ±S. E.	3·69 ±0·79	2·93 ±0·22	5·04 ±0·34	3·29 ±0·73
Female (6)				
1 Mean ±S. E. (*n*)	2·25 ±0·017 (23)	2·09 ±0·008 (63)	2·12 ±0·011 (72)	2·19 ±0·035 (4)
2. S. D. ±S. E.	0·08 ±0·012	0·06 ±0·005	0·10 ±0·008	0·07 ±0·025
3. C. V. ±S. E.	3·51 ±0·52	2·87 ±0·26	4·72 ±0·39	3·17 ±1·12
Male (7)				
1. Mean ±S. E. (*n*)	..	2·00 ±0·006 (25)	..	2·05 (1)
2. S. D. ±S. E.	..	0·06 ±0·008	..	—
3. C. V. ±S. E.	..	3·00 ±0·42	..	—
Female (7)				
1. Mean ±S. E. (*n*)	..	2·03 ±0·007 (84)	2·07 ±0·022 (8)	..
2. S. D. ±S. E.	..	0·06 ±0·005	0·06 ±0·015	..
3. C. V. ±S. E.	..	2·96 ±0·23	2·90 ±0·73	..
2. Ratio F/C				
Male (6)				
1 Mean ±S. E. (*n*)	3·233±0·032 (25)	..	3·790±0·024 (112)	3·237±0·036 (10)
2. S. D. ±S. E.	0·161±0·023	..	0·254±0·017	0·113±0·025
3. C. V. ±S. E.	4·980±0·704	..	6·702±0·448	3·491±0·781
Female (6)				
1. Mean ±S. E. (*n*)	3·320±0·032 (31)	..	3·824±0·027 (72)	3·458±0·079 (4)
2. S. D. ±S. E.	0·176±0·022	..	0·226±0·019	0·157±0·056
3. C. V. ±S. E.	5·301±0·674	..	5·910±0·493	4·540±1·605

TABLE 7B—*continued.*

Statistical constants	Nature of Population			
	Phase gregaria	*Phase solitaria*	Kakko population	Ajmer swarm
—	(4)	(5)	(6)	(7)
2. Ratio F/C—*contd.*				
Male (7)				
1. Mean ±S. E. (*n*)	..	..	..	3·90 (1)
2. S. D. ± S. E.	..	..	..	—
3. C. V. ±S. E.	..	..	..	—
Female (7)				
1. Mean ±S. E. (*n*)	..	..	..	..
2. S. D. ±S. E.	..	..	..	..
3. C. V. ±S. E.	..	..	..	..
3. Ratio P/C				
Male (6)				
1. Mean ±S. E. (*n*)	1·305±0·011 (31)	..	1·483±0·007 (112)	1·330±0·011 (10)
2. S. D. ±S. E.	0·063±0·008	..	0·078±0·005	0·034±0·008
3. C. V. ±S. E.	4·828±0·618	..	5·260±0·351	2·556±0·572
Female (6)				
1. Mean ±S. E. (*n*)	1·324±0·009 (37)	..	1·477±0·008 (72)	1·363±0·018 (4)
2. S. D. ±S. E.	·055±0·006	..	0·069±0·006	0·036±0·013
3. C. V. ±S. E.	·154±0·486	..	4·672±0·389	2·641±0·934
Male (7)				
1. Mean ±S. E. (*n*)	..	..	..	1·48 (1)
2. S. D. ±S. E.	..	..	..	—
3. C. V. ±S. E.	..	..	..	—
Female (7)				
1. Mean ±S. E. (*n*)	..	..	..	..
2. S. D. ±S. E.	..	..	..	—
3. C. V. ±S. E.	..	..	..	—

TABLE 7C.—*Inter-population comparison of morphometric ratios (E/F, F/C and P/C) between populations of 1955 (Groups I- III) (Table 7A) and other populations (Table 7B), in the Desert Locust in India.*

Abbreviations :—NS., Not Significant.

*, Significant at 5% level of probability.

**, Significant at 1% level of probability.

***, Significant at 0·1 % level of probability.

Statistical constants	Significant test between various populations at 5%, 1% and 0·1% levels											
	Cols. 1 & 4	Cols. 2 & 4	Cols. 3 & 4	Cols. 1 & 5	Cols. 2 & 5	Cols. 3 & 5	Cols. 1 & 6	Cols. 2 & 6	Cols. 3 & 6	Cols. 1 & 7	Cols. 2 & 7	Cols. 3 & 7
1. Ratio E/F												
Male (6)												
1. Mean ±S. E.	NS	NS	***	***	***	NS	***	***	NS	NS	NS	***
2. S. D. ±S. E.	NS	NS	NS	*	**	NS	NS	***	***	NS	NS	NS
3. C. V. ±S. E.	NS	NS	NS	NS	NS	NS	NS	***	***	NS	NS	NS
Female (6)												
1. Mean ±S. E.	NS	NS	***	***	***	NS	***	***	NS	NS	NS	NS
2. S. D. ±S. E.	NS	NS	NS	NS	*	**	*	***	NS	NS	NS	NS
3. C. V. ±S. E.	NS	NS	NS	NS	NS	NS	**	***	NS	NS	NS	NS
Male (7)												
1. Mean ±S. E.	..	..	..	NS	..	NS	..	..	..	..	..	..
2. S. D. ±S. E.	..	..	..	NS	..	*	..	..	..	..	..	..
3. C. V. ±S. E.	..	..	..	**	..	NS	..	..	..	..	..	..
Female (7)												
1. Mean ± S.E.	..	..	..	..	**	NS	..	NS	NS	..	..	..
2. S.D. ± S.E.	..	..	..	..	NS	NS	..	NS	NS	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	NS	NS	..	NS	NS	..	..	..
2. Ratio F/C												
Male (6)												
1 Mean ± S.E.	NS	***	***	..	..	..	***	***	NS	NS	**	***
2. S.D. ± S.E.	NS	NS	*	..	..	..	*	***	NS	*	NS	**
3. C.V. ± S.E.	NS	NS	NS	..	..	..	NS	**	NS	*	*	**

TABLE 7C—*continued.*

Statistical constants	Significant test between various populations at 5%, 1% and 0·1% levels											
	Cols. 1 & 4	Cols. 2 & 4	Cols. 3 & 4	Cols. 1 & 5	Cols. 2 & 5	Cols. 3 & 5	Cols. 1 & 6	Cols. 2 & 6	Cols. 3 & 6	Cols. 1 & 7	Cols. 2 & 7	Cols. 3 & 7
2. Ratio F/C—*contd.*												
Female (6)												
1. Mean ± S.E.	NS	***	***	..	..	..	NS	***	NS	*	NS	**
2. S.D. ± S.E.	NS	NS	**	..	..	..	*	***	NS	NS	NS	NS
3. C.V. ± S.E.	NS	NS	NS	..	..	..	NS	**	NS	NS	NS	NS
Male (7)												
1. Mean ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
2. S.D. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
Female (7)												
1. Mean ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
2. S.D. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. Ratio P/C												
Male (6)												
1. Mean ± S.E.	NS	***	***	..	..	..	***	***	*	NS	***	NS
2. S.D. ±S.E.	NS	NS	NS	..	..	..	NS	***	**	*	*	*
3. C.V. ± S.E.	NS	NS	NS	..	..	..	NS	*	*	*	**	*
Female (6)												
1. Mean ± S.E.	NS	***	***	..	..	..	***	***	NS	NS	NS	***
2. S.D. ± S.E.	***	NS	**	..	..	..	***	***	NS	NS	NS	*
3. C.V. ± S.E.	NS	NS	NS	..	..	..	**	*	NS	NS	NS	*
Male (7)												
1. Mean ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
2. S.D. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	..		..	..	..	..	..
Female (7)												
1. Mean ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
2. S.D. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..
3. C.V. ± S.E.	..	..	..	..	..	..	..	..	..	..	..	..