

POPULATION DYNAMICS AND MORPHOMETRY OF THE 1954 — DESERT LOCUST POPULATION IN INDIA IN RELATION TO EYE-STRIPES AND SEX-RATIOS

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(With 15 Tables and 15 Text-figures)

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I — CHARACTERISTICS OF THE 1954-POPULATION

1. *General*

The year 1954 was the last but one year (the sixth year) of the ninth (documented) Desert Locust Cycle (1949-55) in India. The initial concentration (*the Kakko population* of 1949), which initiated this cycle in 1949 was studied earlier by Misra (1952), from the material obtained from Kakko village in the Bikaner District of Rajasthan.

The results of the study of the morphometric characters, related ratios, eye-stripe composition and sex-ratios for the 1954-population are presented here.

To ascertain the correct status and facies of the 1954-population, it is compared with the earlier known populations representing various degrees of phase-transformation, *viz.*, with the typical *solitarias* and *gregarias* of Roonwal *et al.* (1945, 1945 *a*, 1951, 1952); with the *Kakko concentration* of 1949 (Misra, 1952, 1953); with the *Ajmer Swarm* of 1950 (Roonwal and Misra, 1952) and with the group I of the 1955-population (Roonwal and Bhanotar, 1966).

2. *Locust situation in India during 1954*

The year 1954 was the peak year (heavy swarming activity) of the 1949-55 cycle. The influx of the seasonal exotic swarms in India from the western region started from 11th April and continued upto the first fortnight of December. A total of 174 mature and immature swarms invaded India.

No swarm over-wintered in India during the period December, 1953 to March, 1954. The population of scattered locusts remained low (January-March 1954).

3. *History of the 1954-population*(a) *General*

The 1954 was a critical year of the 1949-55 cycle. Roonwal (1954), from the studies based on the composition of eye-stripes and sex-ratios of a Dehra Dun swarm in 1954, hinted at the possible decline of the cycle which was then in its sixth year (which, as judged by the locust situation, was the peak year). The evidence of this decline is seen in the appearance of 7-striped individuals in the swarming populations (which are always 6-striped in swarms), in the early and later part of the year, even though the equilibrium in the sex-ratios and morphometric characters remained comparatively stable.

The effective role of eye-stripes as an indicator of phase-transformation is, thus, apparent.

(b) *Population densities*(i) *First period (January-April 1954):*

The population remained fluctuating, the density ranging from 40 to "countless"* per square mile. The individuals were either collected

* The expression used in the reports of the Plant Protection Adviser to the Government of India who supplied the material.

singly or from thin concentrations. But owing to a sudden influx from the west, the density in many areas became very great during the second fortnight of April. The specimens were of the "mixed type" (grey, pink and yellow). The temperature remained very low during the period.

(ii) *Second period (May-August, 1954):*

The density remained very high. The majority of individuals were collected from dense (mature) swarms, or singly from dense concentrations where the population was very high. Furthermore due to the exceptionally heavy and wide-spread rainfall, causing favourable conditions for egg-laying (suitable soil moisture), the concentration of swarms and individuals was heavy during the period. The density ranged from 80 to "countless" per square mile. The temperature and humidity remained above normal.

(iii) *Third period (September-December, 1954):*

The density ranged from 80 to "countless" per square mile. A few swarms over-wintered. The third generation of the *gregaria* breeding was reported from many parts of Rajasthan. The individuals (mixed type) were collected singly or from dense concentrations. The temperature remained below normal (extremely cold).

Except for the first period, the individuals of the remaining two periods had swarming antecedents.

4. Abbreviations used

Except where otherwise stated, the following abbreviations have been used throughout:—

- O, Width of head at ocular level.
- C, Width of head at genal level.
- P, Length of pronotum.
- H, Height of pronotum.
- M, Width of pronotum at the constriction.
- E, Length of elytron.
- W₁, Restricted width of elytron.
- F, Length of hind-femur.
- S.E., Standard error.
- S.D., Standard deviation.
- S.D.P., Sexual dimorphism percentage.

6-*gregaria* or 6-*greg.* or *greg.*, or *greg.* (6), typical 6-striped phase *gregaria* individuals.

6-7-*solitaria*, 6-*sol.*, 7-*sol.*, or *sol.* (6) or *sol.* (7), Typical 6- or 7-striped phase *solitaria* individuals.

6-7- striped, 6- or 7- eye-striped.

5-8- striped, 5- or 8- eye-striped.

Group I or Gr. I, 1954 Group I populations.

Group II or Gr. II, 1954 Group II populations.

Group III or Gr. III, 1954 Group III populations.

1955-Gr. I, 1955 Group I populations.

Gr. I(6) or Gr. I(7), 6- or 7-striped individuals of Group I.

Gr. II(6) or Gr. II(7), 6- or 7-striped individuals of Group II.

Gr. III(6) or Gr. III(7), 6- or 7-striped individuals of Group III. *Kakko pop.*, *Kakko Conc.* or *K* or *Inl. Conc.*, Initial concentration of locusts, Kakko village (Rajasthan) in 1949 (Misra, 1952).

Ajmer Sw., or *Ajm. sw.* or *Ajm. (6)*, Ajmer Swarm population of 1950 (Roonwal & Misra, 1952).

K (6) or *K (7)*, 6- or 7-striped individuals of initial or *Kakko Concentration* (1949).

NS, not significant.

n, number of examples.

*, Significant at 5% level.

** , Significant at 1% level.

***, Significant at 0.1% level.

5. Acknowledgments

The locust specimens studied here were received from the Plant Protection Adviser to the Government of India, New Delhi, and his assistance is gratefully acknowledged. Thanks are due to Director, Zoological Survey of India for giving us necessary laboratory facilities. We are deeply indebted to Dr. M. L. Roonwal, Vice-Chancellor, Jodhpur University, Jodhpur, for his valuable suggestions and guidance.

II — MATERIAL AND METHODS

1. General

(Tables 1 and 2)

For the 1954-population, 1819 individuals were studied from the following contiguous localities and districts of Rajasthan and West Punjab (India), the figures in bracket showing the number of individuals.

- | | |
|--------------------|-----------------------|
| 1. Bikaner (766) | 7. Jhunjhunu (36) |
| 2. Jaisalmer (348) | 8. Sikar (29) |
| 3. Jodhpur (183) | 9. Nagaur (100) |
| 4. Ganganagar (30) | 10. Mohindergarh (55) |
| 5. Jalore (34) | 11. Barmer (20) |
| 6. Narnaul (51) | 12. Churu (167) |

The month-wise distribution of the number of samples are as follows :—

- | | |
|----------------|-------------------|
| 1. January, 7 | 7. July, 490 |
| 2. February, 7 | 8. August, 152 |
| 3. March, 6 | 9. September, 173 |
| 4. April, 54 | 10. October, 127 |
| 5. May, 83 | 11. November, 1 |
| 6. June, 556 | 12. December, 163 |

Measurements: The morphometric measurements were taken according to method laid down in the Third International Locust Conference, London (1934); and as taken earlier by Roonwal *et al.* (1945, 1947, 1949, 1952, 1966); Misra *et al.* (1952), Rao (1942, 1960, fig. 17 *a, b*, facing page 295).

2. *Grouping of the random samples*

The population was *grouped* into three natural groups, based on consideration of the chronological position of the generations, and also on the well known seasonal periodicity and waves of swarming and immigrations that has so far been observed to have taken place in Rajasthan (western India).

For purpose of analysis, the 1819 individuals are grouped, as follows:—

(i) *Group I (74)*: First generation individuals. Specimens collected in January-April, from scattered populations as well as from thin concentrations. No swarm over-wintered in India during the period.

(ii) *Group II (1281)*: Second generation individuals. Specimens collected in May-August singly or from dense concentrations or from swarms.

(iii) *Group III (464)*: Third generation individuals. Specimens collected in September-December from the over-wintered swarms and from high concentrations.

III — STATISTICAL CHARACTERISTICS OF THE 1954-POPULATION

Randomness of the sample-data

In collecting the data of the 1954-population, no random sampling plan was designed before hand. But it seems hardly necessary to have such pre-determined scheme for the morphometrical studies as the samples in huge numbers were drawn regularly from all over the region, thus maintaining the randomness of the sample and validity of the results derived here. Only for estimating the population in the field, statistical technique of drawing random samples could have been adopted. For studying the seasonal fluctuation within a year in morphometrics, specimens were collected all over the year and from the geographical region having broadly the same latitude and longitude, similar temperature and humidity, uniform velocity of air, and more or less equal amount of rainfall, thus making the sample representative and homogenous.

Statistical technique

For the study of population characteristics, it is necessary to estimate some statistical parameters of the parent population from the information given by the sample. For this purpose, the 'point' method of estimation was employed. The common measures of location (mean) and dispersion (standard deviation) for describing and comparing populations were adopted. For the assessment of the status of the population under study with respect to typical phases and other known populations, parameters of each morphometric character or ratio were compared separately between two populations. Instead of applying the multivariate test of significance, the univariate method was used, firstly for judging the efficacy of each morphometric character independently without interacting with others and secondly for avoidance of complex statistical procedures. The difference of mean dimensions for two populations was expressed as a ratio to the standard error of their

difference and referred to normal-curve table for significance, if the sample-size were large. In the case of sample size being small and variances equal, the students' *t* test was applied for testing the hypotheses that the two groups of measurements were samples drawn from the same normally distributed populations. But when a decided difference in the variances for the two samples was noted by applying variance-ratio test, a more exact test procedure was used. Firstly, following the usual procedure, *t* was evaluated and then instead of referring it to the value given in "Students" *t* distribution table, a weighted *t* value was computed, the weights being the square of the standard errors of the two samples. For judging the significance of difference, the calculated *t* was compared with the weighted one. The minimum level of significance chosen was the 5 per cent point of probability.

IV—EYE-STRIPE COMPOSITION AND SEX-RATIOS

(a) *Eye-stripes* (Tables 2, 4 and 5)

Unlike the 1955-population (Roonwal and Bhanotar, 1966), no 5- or 8- eye-striped individuals were obtained in the 1954-population, only the 6- and 7-striped ones occurring as follows:—

Eye-stripe distribution (and % ± S.E.) in 1954-population

Group	6-striped	7-striped
I (74 exs.)	63(85.14 ± 4.13)	11(14.86 ± 4.14)
II (1281 exs.)	1278(99.77 ± 0.13)	3(0.23 ± 0.14)
III (464 exs.)	454(97.84 ± 0.62)	10(2.16 ± 0.69)

Distribution by sex- and eye-stripes (and % ± S.E.), in 1954-population

Group	Males		Females	
	6-striped	7-striped	6-striped	7-striped
I	32 (91.43 ± 4.75)	3 (8.57 ± 4.75)	31 (79.49 ± 6.75)	8 (20.51 ± 6.45)
II	697 (100)	0 (0)	581 (99.49 ± 0.29)	3 (0.51 ± 0.29)
III	3 (97.05 ± 1.09)	7 (2.95 ± 1.09)	224 (98.68 ± 0.76)	3 (1.32 ± 0.76)

(b) *Sex-ratios* (Tables 3 and 4)

Irrespective of eye-stripes, the lumped percentage of sex-ratio in the three population-groups is as follows:—

Gr. I	— ♂ ♂ ,	49.32 ± 5.81 ;	♀ ♀ ,	52.70 ± 5.81
Gr. II	— ♂ ♂ ,	54.41 ± 1.43 ;	♀ ♀ ,	45.59 ± 1.42
Gr. III	— ♂ ♂ ,	51.08 ± 2.37 ;	♀ ♀ ,	48.92 ± 2.37

The distribution (% ± S.E.) of the sex-ratio in the various eye-stripe categories is as follows:—

Group		6-striped		7-striped
I	♂ ♂ :	50.79 ± 6.30	♂ ♂ :	27.27 ± 13.45
	♀ ♀ :	49.21 ± 6.30	♂ ♂ :	72.73 ± 13.43
	♂ ♂ :	54.54 ± 1.39	♀ ♀ :	0.0
II	♀ ♀ :	45.46 ± 1.39	♀ ♀ :	0.0
	♂ ♂ :	50.66 ± 2.35	♂ ♂ :	70.00 ± 14.49
III	♀ ♀ :	49.34 ± 2.35	♀ ♀ :	30.00 ± 14.49

(c) Discussion

The phase position and facies of the three population-groups, in relation to eye-stripe category and sex-ratios, may now be discussed in the light of Roonwal's Hypotheses (1945):

Group I — The high percentage (85.14 ± 4.13) of 6-striped individuals (value above Roonwal's figure of 80%) and the near equality of sex-ratio (♂ : 50.79 ± 6.30 ; ♀ : 49.21 ± 6.30), indicate a *gregaria* facies of the population.

Group II — Here too, the high percentage (99.77 ± 0.13) of 6-striped individuals, with a fairly equalised sex-ratio (♂ : 54.54 ± 1.39 ; ♀ : 45.46 ± 1.39) indicate a phase *gregaria* facies of the population.

Group III — Finally, here again the high percentage (97.84 ± 0.69) of 6-striped individuals, with an almost equal sex-ratio (♂ : 50.66 ± 2.35 ; ♀ : 49.34 ± 2.35) indicate a phase *gregaria* facies of the population.

Thus throughout 1954, the population remained towards phase *gregaria*. But the emergence of a few 7-striped individuals in Group I ($14.86 \pm 4.14\%$), Group II ($0.23 \pm 0.14\%$) and Group III ($2.16 \pm 0.69\%$), indicates the general "mildness" of *gregaria*-ness and a possible trend towards *solitaria*-ness for the future population (of 1955). In actual facts, the 1955-population moved still closer to *solitaria*, and this was indeed the last year of the 1949-55 Cycle.

V — MORPHOMETRIC CHARACTERS

(SIZE OF BODY-PARTS)

(Tables 6, 7, 10-12, 14 and 15)

1. General

The following important and sensitive phase-characters were studied for the three population- Groups :—

1. Width of head at ocular level (O).
2. Maximum width of head at the genal level (C).
3. Length of pronotum at the keel (P).
4. Maximum height of pronotum (H).
5. Width of pronotum at the constriction (M).
6. Length of elytron (E).
7. Restricted width of elytron (W_1).
8. Length of hind-femur (F).

The data of the three Groups (I-III) were first compared among themselves (inter-group comparison). Each group was then compared with the following known populations (inter-population comparison), the data of which are now available in the literature :—

(i) 6- and 7-striped individuals of “typical phase *solitaria*”, 1936-47 (Roonwal, 1949 ; and Roonwal & Nag, 1951).

(ii) 6-striped individuals of “typical phase *gregaria*” 1936-47 (Roonwal, 1949 ; and Roonwal & Nag, 1951).

(iii) 6-striped (♂ and ♀) and 7-striped (♀) of the *Kakko concentration* of 1949 (first year of the 1949-55 cycle) (Misra, 1952).

(iv) 6-striped (♂ and ♀) of the *Ajmer Swarm* population of 1950 (second year of the 1949-55 cycle) (Roonwal & Misra, 1952).

(v) 6-striped (♂ and ♀) and 7-striped (♂) of Group I (1955-population in India, the last year of the 1949-55 Cycle) (Roonwal & Bhanotar, 1966).

2. Width of head at ocular level (O).

(Tables 6, 7 and 12 and Text-fig. 1)

(a) Mean width

The mean width (mm.) ± S.E. varies as follows:—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	6.40 ± 0.07	6.81 ± 0.13	0.41 ± 0.15
Gr. II(6)	6.44 ± 0.01	6.76 ± 0.01	0.32 ± 0.01
Gr. III(6)	6.41 ± 0.02	6.68 ± 0.02	0.27 ± 0.03
Gr. I(7)	6.60 ± 0.50	7.00 ± 0.06	0.40 ± 0.50
Gr. II(7)	—	7.00 ± 0.12	—
Gr. III(7)	6.33 ± 0.12	7.05 ± 0.07	0.72 ± 0.23

(b) Inter-group comparison (Table 7)

(i) *6-striped : Males* : The values in Grs. I-III are not significantly different from each other at all levels. *Females* : The value in Gr. I is not significantly different from Grs. II and III ; it is significantly higher in Gr. II than in Gr. III at all levels.

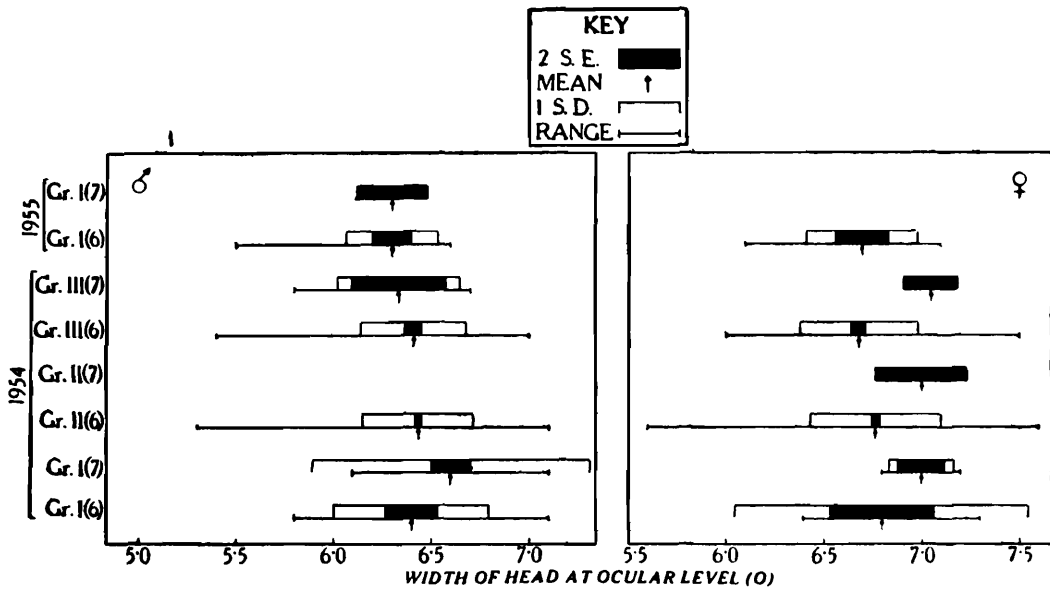
(ii) *7-striped : Males* : The value in Gr. I is not significantly different from Gr. III ; no males occurred in Gr. II. *Females* : The values in Grs. I-III are not significantly different from each other.

(c) Inter-sex comparison (Table 6)

In both 6- and 7- eye-striped categories, the value in corresponding females is significantly higher than in males at all levels, except for Gr. I(7), where no sexual difference is noticed.

(d) Inter-eye-stripe comparison (Table 8)

Males : Within the same eye-stripe group and sex, the values in 6-striped forms in Grs. I and III are not significantly different from that in 7-striped ones at all levels. No males occurred in Gr. II(7). *Females* : Within the same eye-stripe group and sex, the value in 6-striped individuals is not significantly different from that in 7-striped ones at all levels.



TEXT-FIG. 1. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding width of head at ocular level (O), 1954-Gr. I(6), I(7), II(6), II(7), III(6) and III(7), 6- and 7- striped individuals of 1954-Groups; 1955-Gr. I(6) and I(7), 6- and 7- striped individuals of 1955-Groups Also see text.

(e) Inter-population comparison (Table 12)

The three 1954-Groups compare with 1955-Group I population as follows (no comparison could be made with other population due to lack of data). The head-width (O) in the 1955-Gr. I varies thus:

1955-population	Mean (mm.) ± S.E.	
	Males	Females
Gr. I(6)	6.30 ± 0.050	6.71 ± 0.067
Gr. I(7)	6.27 ± 0.088	—

(i) 6-striped males: The value in 1954-Gr. I is not significantly different than that in 1955-Gr. I. But those in Grs. II and III are significantly higher than in 1955-Gr. I at 1% and 5% levels respectively.

(ii) 6-striped females: The values in 1954-Grs. I-III are not significantly different from the 1955-Gr. I at all levels.

(iii) 7-striped males: The values in 1954-Grs. I and III are not significantly different from the 1955-Gr. I at all levels. No males occurred in Gr. II.

(iv) 7-striped females: No females occurred in 1955-Gr. I, hence no comparison could be made.

(f) Sexual Dimorphism Percentage (S.D.P.)

The S.D.P. ± S.E. varies as follows:—

1954-population (and eye-stripes)	S.D.P.	Other populations (and eye-stripes)	S.D.P.
Gr. I(6)	6.41 ± 2.41	1955-Gr. I(6)	6.51 ± 1.36
Gr. I(7)	6.06	1955-Gr. II(6)	6.09 ± 0.31
Gr. II(6)	4.97 ± 0.27	1955-Gr. III(6)	8.17 ± 2.19
Gr. III(6)	4.21 ± 0.43		
Gr. III(7)	11.37		

In the 6-striped category, the values in the 1954-Grs. I-III are not significantly different from that in 1955-Grs. I and III. But the values in 1954-Grs. II and III are significantly lower than in 1955-Gr. II at 1% and 0.1% levels respectively. No comparison could be made in 7-striped category due to lack of data.

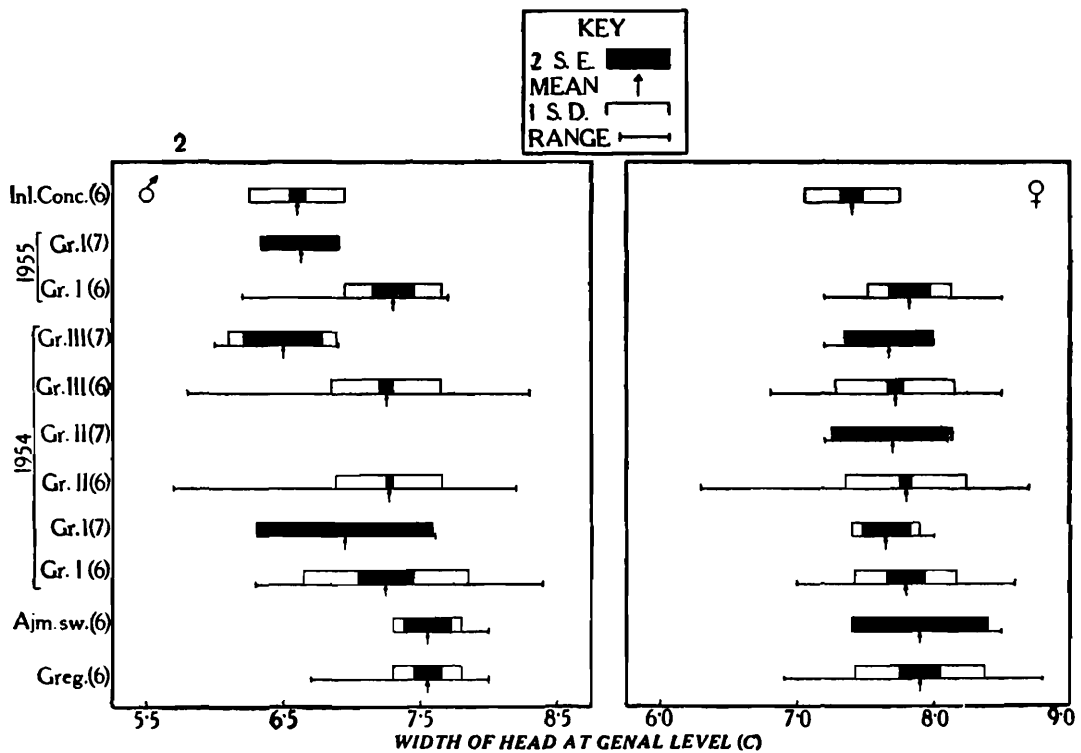
3. Width of head at genal level (C)

(Tables 6-7, 10-12, 14 and 15 and Text-Fig. 2)

(a) Mean width

The mean width (mm.) ± S.E. varies as follows:—

Group (and eye-stripes)	Males	Females	Differences
Gr. I(6)	7.26 ± 0.10	7.98 ± 0.07	0.72 ± 0.12
Gr. II(6)	7.27 ± 0.01	7.79 ± 0.02	0.52 ± 0.02
Gr. III(6)	7.26 ± 0.02	7.73 ± 0.03	0.47 ± 0.04
Gr. I(7)	6.97 ± 0.32	7.65 ± 0.09	0.68 ± 0.33
Gr. II(7)	—	7.70 ± 0.22	—
Gr. III(7)	6.50 ± 0.14	7.67 ± 0.16	1.17 ± 0.24



TEXT-FIG. 2. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding width of head at genal level (C). *Inl. Conc.* (6), 6-striped individuals of initial (or *Kakko*) concentration of 1949 (Misra, 1952), *Ajm. Sw.* (6), 6-striped individuals of Ajmer Swarm of 1950 (Roonwal and Misra, 1952); *Greg.* (6), 6-striped "typical" phase *gregaria*. Also see text-figure 1 and the text.

(b) Inter-group comparison (Table 7)

(i) 6-striped : Males : The values in Grs. I-III are not significantly different from each other at all levels. Females : The value in Gr. I

is significantly higher than in Gr. II (at 1% level) and Gr. III (at all levels). The value in Gr. II is significantly higher than in Gr. III (at all levels).

(ii) *7-stripped*: In both sexes, the value in each sex-group is not significantly different from those in other groups. No males occurred in Gr. II.

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

In both the 6- and 7-eye-stripped categories, the value in corresponding females in each group is significantly higher than in males at all levels.

(d) *Inter-eye-stripe comparison* (Table 6)

(i) *Males*: Within the same eye-stripe group and sex, the value in Gr. I(6) is not significantly different from that in Gr. I(7), but the value in Gr. III(6) is significantly higher (at all levels) than in Gr. III(7). No males occurred in Gr. II(7). (ii) *Females*: Within the same eye-stripe group and sex, the values in Gr. I(6) and Gr. III(6) are significantly higher than in Gr. I(7) at 5% level and Gr. III(7) at all levels respectively. No significant difference is seen in Grs. II(6) and II(7).

(e) *Inter-population comparison* (Tables 10-12, 14, 15)

The three 1954-Groups compare with other populations (data given below) as follows:—

<i>Other populations (and eye-stripes)</i>	<i>Mean (mm.) ± S.E.</i>	
	<i>Males</i>	<i>Females</i>
<i>6-greg.</i>	7.55 ± 0.045	7.89 ± 0.074
<i>Ajmer Sw. (6)</i>	7.53 ± 0.082	7.90 ± 0.248
<i>Kakko Conc. (6)</i>	6.60 ± 0.033	7.41 ± 0.041
1955-Gr. I(6)	7.31 ± 0.071	7.83 ± 0.074
1955-Gr. I(7)	6.63 ± 0.144	—

(i) *6-stripped males*: The values in 1954-Grs. I-III are significantly lower (at 1%, 0.1% and 0.1% levels respectively) than in *6-greg.*, but are higher than in *Kakko Conc.* (at all levels). The values in 1954-Grs. II and III are significantly lower than in *Ajmer Sw.* (at 1% level), but Gr. I shows no significant difference. The 1954-Grs. I-III do not show significant difference from the 1955-Gr. I.

(ii) *6-stripped females*: The value in 1954-Gr. III is significantly lower (at 5% level) than in *6-greg.*, but Grs. I and II show no significant difference. The values in 1954-Grs. I-III are significantly higher than in the *Kakko Conc.* (at all levels), but are not significantly different from the *Ajmer Sw.*

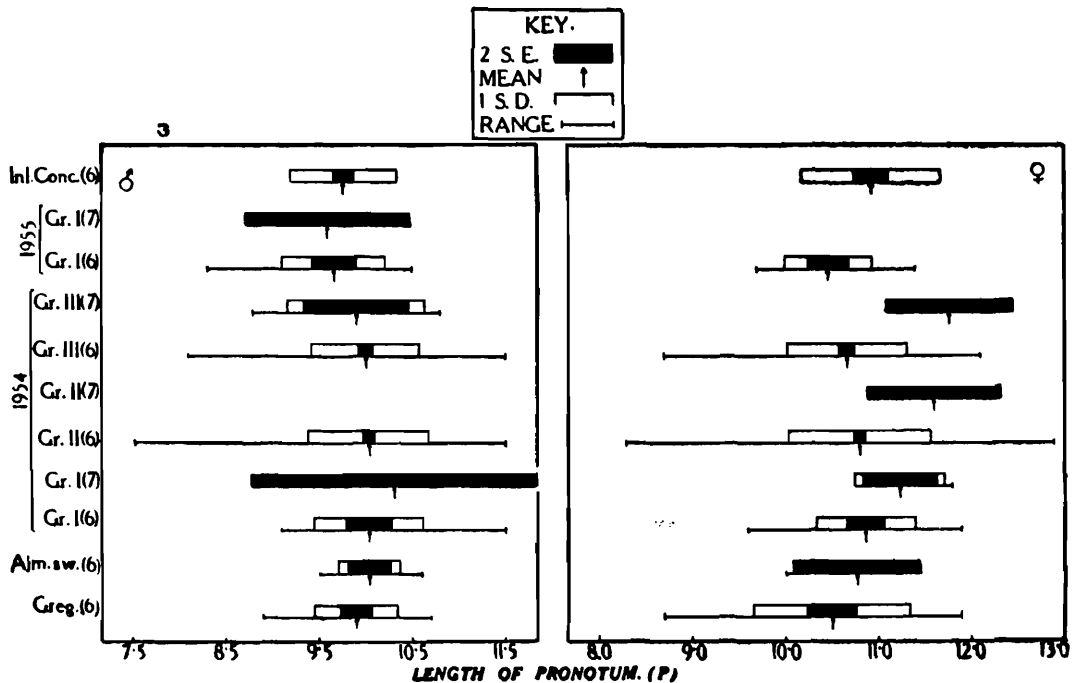
(iii) *7-stripped males*: The values in 1954-Grs. I and III are not significantly different from the 1955-Gr. I at all levels. No males occurred in Gr. II.

(iv) *7-stripped females*: No comparison could be made due to lack of data. No females occurred in 1955-Gr. I.

(f) Sexual Dimorphism Percentage (S.D.P.)

The S.D.P. \pm S.E. varies as follows:—

1954-population (and eye-stripes)		S.D.P.	Other populations (and eye-stripes)		S.D.P.
Gr. I(6)		9.92 \pm 1.83	1955-Gr. I(6)		7.11 \pm 1.46
Gr. I(7)		9.76	Kakko Conc. (6)		12.27 \pm 0.8
Gr. II(6)		7.15 \pm 0.34	6-greg.		4.50 \pm 1.50
Gr. III(6)		6.47 \pm 0.50			
Gr. III(7)		18.00			



TEXT-FIG. 3. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (\pm S.E.) and standard deviation (S.D.) in various populations regarding length of pronotum (P). For explanations see text and text-figures 1 and 2.

In the 6-stripped category, the values in 1954-Grs. I-III are not significantly different from that in 1955-Gr. I. But the values in 1954-Grs. I and II are significantly higher than in 6-greg., but the 1954-Gr. III does not differ significantly. The values in the 1954-Grs. II and III are significantly lower (at all levels) than in the *Kakko Conc.*, but those of Gr. I do not differ in this respect. No comparison could be made in the 7-stripped category, due to lack of data.

4. Length of pronotum at the keel (P)
(Tables 6-7, 10-12, 14 and 15 and Text-fig. 3)

(a) Mean length

The mean length (mm.) \pm S.E. varies as follows:—

Group (and eye-stripes)	Males	Females	Differences
Gr. I(6)	10.06 \pm 0.12	10.86 \pm 0.10	0.80 \pm 0.16
Gr. II(6)	10.04 \pm 0.03	10.81 \pm 0.03	0.77 \pm 0.04
Gr. III(6)	10.00 \pm 0.04	10.66 \pm 0.04	0.66 \pm 0.06
Gr. I(7)	10.30 \pm 0.78	11.22 \pm 0.20	0.92 \pm 0.59
Gr. II(7)	—	11.60 \pm 0.36	—
Gr. III(7)	9.90 \pm 0.28	11.77 \pm 0.34	1.87 \pm 0.49

(b) *Inter-group comparison* (Table 7)

(i) *6-stripped : Males* : Groups I-III are not significantly different from each other at all levels. *Females* : Gr. I shows no significant difference from Grs. II and III, but that in Gr. II is significantly higher (at 1% level) than in Gr. III.

(ii) *7-stripped : Males* : Group I is not significantly different from Gr. III ; no males occurred in Gr. II. *Females* : Groups I-III are not significantly different from each other.

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

Except for Gr. I(7), in both 6- and 7-stripped categories, the value in the corresponding females is significantly higher than in males at all levels.

(d) *Inter-eye-stripe comparison* (Table 6)

Males : Within the same group, the values in 6-stripped forms in Grs. I and III is not significantly different from that in 7-stripped ones. No males occurred in Gr. II(7) *Females* : Within the same group, the values in 6-stripped forms in Grs. I and II are not significantly different from those in 7-stripped ones, but the value in Gr. III(6) is significantly lower (at 1% level) than in Gr. III(7).

(e) *Inter-population comparison*

(Tables 10-12, 14 and 15)

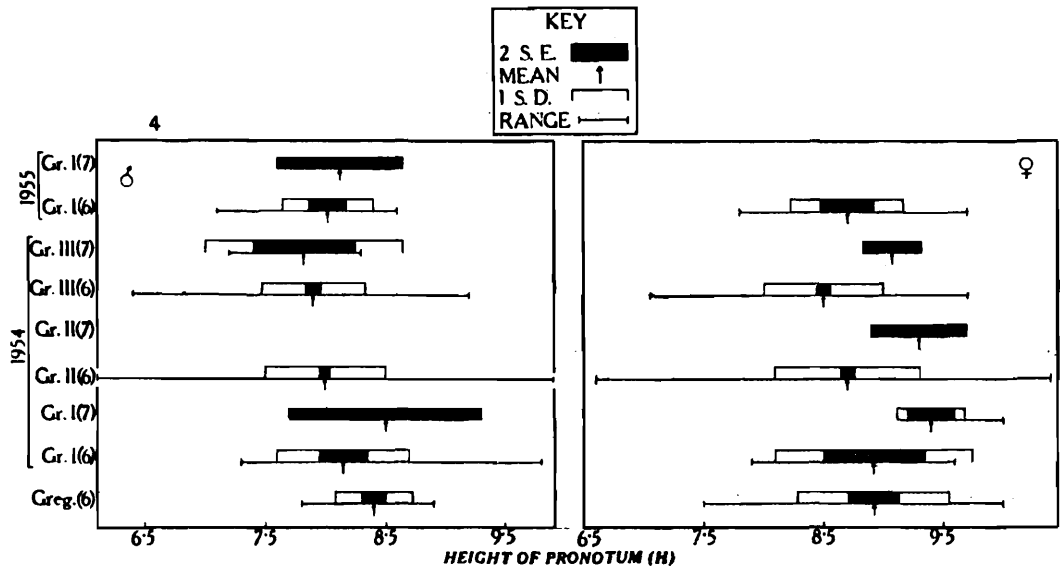
The three 1954-groups compare with other populations (data given below) as follows:—

<i>Other populations (and eye-stripes)</i>	<i>Mean (mm.) ± S.E.</i>	
	<i>Males</i>	<i>Females</i>
<i>6-greg.</i>	9.87 ± 0.079	10.49 ± 0.133
<i>Ajmer Sw. (6)</i>	10.01 ± 0.108	10.78 ± 0.343
<i>Kakko Conc. (6)</i>	9.76 ± 0.054	10.94 ± 0.088
1955-Gr. 1 (6)	9.66 ± 0.114	10.47 ± 0.113
1955-Gr. I(7)	9.67 ± 0.44	—

(i) *6-stripped males* : The values in 1954-Grs. I and III are not significantly different from *6-greg.* at all levels, but that in Gr. II is significantly higher at the 5% level. The 1954-Grs. I-III are not significantly different from the *Ajmer Sw.* (at all levels), but have significantly higher values (at all levels) than those in the *Kakko Conc.* and the 1955-Gr. I.

(ii) *6-stripped females* : The values in 1954-Grs. I and II are significantly higher than in *6-greg.* (at 5% level), but Gr. III shows no significant difference. The 1954-Grs. I-III show no difference from the *Ajmer Sw.* at all levels. Except for Gr. III, where the value is significantly lower (at 1% level) than in the *Kakko Conc.*, Grs. I-III show no significant difference. The values in 1954-Grs. I-III are significantly higher (at 1% level) than in 1955-Gr. I.

(iii) *7-stripped males* : The values in 1954-Grs. I and III are not significantly different from that in 1955-Gr. I at all levels. No males occurred in Gr. II.



TEXT-FIG. 4. *Schistocerca gregaria*. Dicogram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding height of pronotum (H). For explanations see text and text-figures 1 and 2.

(iv) *7-striped females*: No comparison could be made due to lack of data. No females occurred in 1955-Gr. I.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

The S. D. P. \pm S.E. varies as follows:—

1954-populations (and eye-stripes)	S.D.P.	Other populations (and eye-stripes)	S.D.P.
Gr. I(6)	7.95 \pm 1.55	1955-Gr. I(6)	8.38 \pm 1.74
Gr. I(7)	8.93	Kakko Conc.(6)	12.09 \pm 1.09
Gr. II(6)	7.67 \pm 0.42	6-greg.	6.28 \pm 1.60
Gr. III(6)	6.60 \pm 0.60	—	—
Gr. III(7)	18.89	—	—

In the 6-striped category, the values in the 1954-Grs. I-III are not significantly different from those in 1955-Gr. 1 and 6 *greg.*, but are significantly lower than in the *Kakko Conc.* at all levels. No comparison could be made in 7-striped category due to lack of data.

5. *Height of pronotum (H)*

(Tables 6-7 and 12 and Text-fig. 4)

(a) *Mean height*

The mean height (mm.) \pm S.E. varies as follows:—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	8.16 \pm 0.10	8.93 \pm 0.07	0.77 \pm 0.12
Gr. II(6)	7.99 \pm 0.02	8.69 \pm 0.03	0.70 \pm 0.04
Gr. III(6)	7.90 \pm 0.03	8.49 \pm 0.03	0.59 \pm 0.04
Gr. I(7)	8.50 \pm 0.40	9.39 \pm 0.10	0.89 \pm 0.40
Gr. II(7)	—	9.30 \pm 0.20	—
Gr. III(7)	7.83 \pm 0.16	9.07 \pm 0.12	1.24 \pm 0.25

(b) Inter-group comparison (Table 7)

(i) *6-stripped : Males* : The value in Gr. I is not significantly different from that in Gr. II, but is higher (at 1% level) than in Gr. III. The value in Gr. II is significantly higher than in Gr. III at the 5% level. *Females* : The value in Gr. I is significantly higher than in Gr. II (at 1% level) and Gr. III (at all levels). The value in Gr. II is significantly higher (at all levels) than in Gr. III.

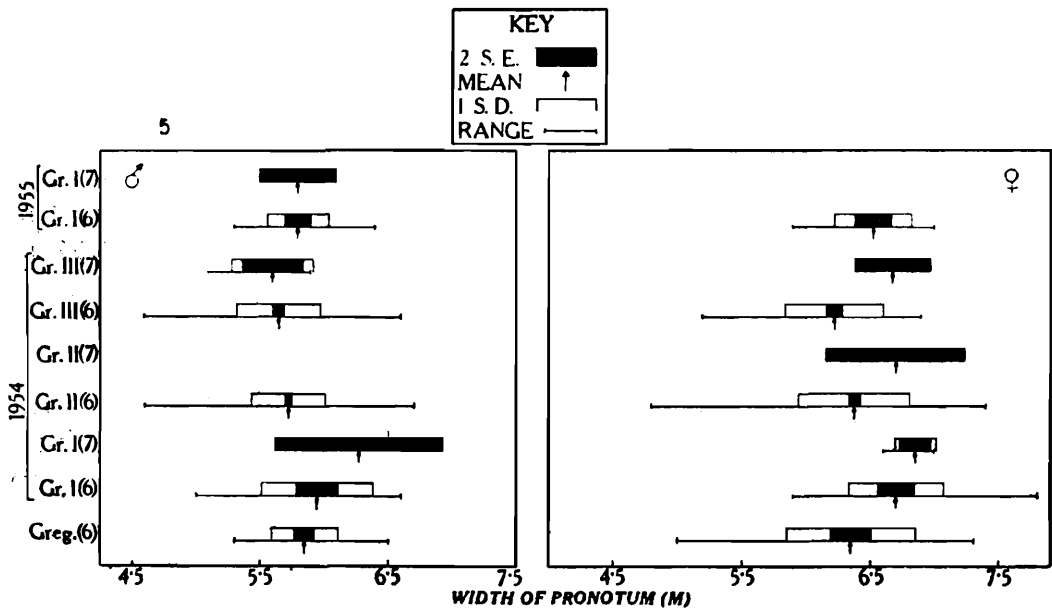
(ii) *7-stripped : Males* : The value in Gr. I is not significantly different (at all levels) than in Gr. III ; no males occurred in Gr. II. *Females* : The value in Grs. I-III are not significantly different from one other.

(c) Inter-sex comparison (Table 6)

In both 6- and 7-eye-striped categories, the value in corresponding females is significantly higher than in males at all levels.

(d) Inter-eye-stripe comparison (Table 6)

(i) *Males* : Within the same group, the values in 6-stripped forms in Grs. I and III are not significantly different from that in 7-stripped ones at all levels ; no males occurred in Gr. II(7). (ii) *Females* : Within the same group, the value in 6-stripped forms in Gr. II is not significantly different than that in Gr. II(7) ; but those in Grs. I(6) and III(6) are significantly lower than in Gr. I(7) at the 1% level and Gr. III(7) at the 5% level respectively.



TEXT-FIG. 5. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding width of pronotum (M). For explanations see text and text-figures 1 and 2.

(e) Inter-population comparison (Table 12)

The three 1954-Groups compare with other populations (data given below) as follows:—

1955-population (and eye-stripes)	Mean (mm.) ± S.E.	
	Males	Females
Gr. I(6)	8.03 ± 0.079	8.70 ± 0.111
Gr. I(7)	8.13 ± 0.262	—

In both sexes in the 6-striped category, the values in 1954-Grs. I-III are not significantly different (at all levels) from that in 1955-Gr. I(6). In the 7-striped category, the male values in 1954-Grs. I and III are not significantly different (at all levels) from that in 1955-Gr. I; no males occurred in Gr. II. The females could not be compared due to lack of data.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

The S.D.P. \pm S.E. varies as follows :—

<i>1954-population (and eye-stripes)</i>	<i>S.D.P.</i>	<i>Other populations (and eye-stripes)</i>	<i>S.D.P.</i>
Gr. I(6)	9.44 \pm 1.58	1955-Gr. I(6)	8.34 \pm 1.74
Gr. I(7)	10.47	1955-Gr. II(6)	10.32 \pm 0.43
Gr. II(6)	8.76 \pm 0.41	1955-Gr. III(6)	10.98 \pm 3.37
Gr. III(6)	7.47 \pm 0.57		
Gr. III(7)	15.84		

In the 6-striped category, the values in 1954-Grs. I-III show no significant difference from those in 1955-Grs. I and III; but Grs. II and III have significantly lower values (at all levels) than the 1955-Gr. II, while Gr. I shows no significant difference, in this respect. No comparison could be made in 7-striped category due to lack of data.

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

(Tables 6, 7 and 12 and Text-fig. 5)

(a) *Mean width*

The mean width (mm.) \pm S.E. varies as follows :—

<i>Group (and eye-stripes)</i>	<i>Males</i>	<i>Females</i>	<i>Difference</i>
Gr. I(6)	5.95 \pm 0.08	6.71 \pm 0.07	0.76 \pm 0.11
Gr. II(6)	5.73 \pm 0.01	6.38 \pm 0.02	0.65 \pm 0.02
Gr. III(6)	5.64 \pm 0.02	6.23 \pm 0.03	0.59 \pm 0.04
Gr. I(7)	6.27 \pm 0.33	6.85 \pm 0.06	0.58 \pm 0.34
Gr. II(7)	—	6.70 \pm 0.27	—
Gr. III(7)	5.59 \pm 0.12	6.67 \pm 0.15	1.08 \pm 0.21

(b) *Inter-group comparison (Table 7)*

(i) *6-striped : Males* : The value in Gr. I is significantly higher than in Gr. II (at 1% level) and Gr. III (at all levels). The value in Gr. II is significantly higher than in Gr. III at all levels. *Females* : The value in Gr. I is significantly higher than in Grs. II and III (at all levels) and that in Gr. II is higher than in Gr. III at all levels.

(ii) *7-striped : Males* : The value in Gr. I is significantly higher than in Gr. III at the 5% level; no males occurred in Gr. II. *Females* : The values in Grs. I-III are not significantly different from one other.

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

In both 6- and 7-eye-striped categories, the values in corresponding females are significantly higher than in males at all levels, except for Gr. I(7), where no sexual difference is noticed.

(d) *Inter-eye-stripe comparison* (Table 6)

(i) *Males*: Within the same group, the values in Grs. I(6) and III(6) are not significantly different from those in Grs. I(7) and III(7) respectively at all levels; no males occurred in Gr. II(7). (ii) *Females*: Within the same group, the values in Grs. I(6) and II(6) are not significantly different from those in Grs. I(7) and II(7) respectively, but the value in Gr. III(7) is higher than in Gr. III(6) at the 5% level.

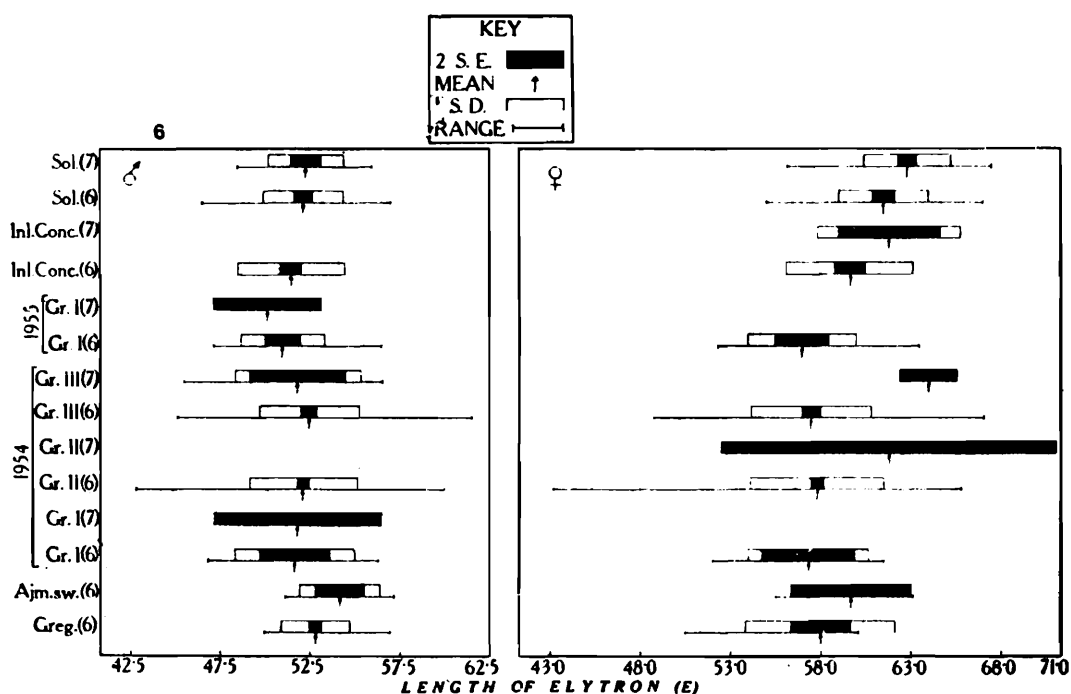
(e) *Inter-population comparison* (Table 12)

The three 1954-groups compare with other populations (data given below) as follows:—

1955-population (and eye-stripes)	Mean (mm.) ± S.E.	
	Males	Females
Gr. I(6)	5.80 ± 0.049	6.52 ± 0.071
Gr. I(7)	5.80 ± 0.15	—

(i) *6-striped males and females*: The values in 1954-Grs. I and II are not significantly different from that in 1955-Gr. I, but 1954-Gr. III has significantly lower values (at the 1% level in males and at all levels in females).

(ii) *7-striped*: *Males*: The values in 1954-Gr. I and Gr. III are not significantly different from that in 1955-Gr. I at all levels. No males occurred in Gr. II. *Females*: No comparison could be made due to lack of data.



TEXT-FIG. 6. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.E.) in various populations regarding length of elytron (E). *sol.* (6) & (7), 6- and 7-striped typical phase *solitaria*; *Inl. Conc.* (7) 7-striped individuals of the initial Kakko Concentration of 1949 (Misra, 1952). Also see text and text-figures 1 and 2.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

The S.D.P. \pm S.E. varies as follows :—

<i>1954-population (and eye-stripes)</i>	<i>S.D.P.</i>	<i>Other populations (and eye-stripes)</i>	<i>S.D.P.</i>
Gr. I(6)	12.77 \pm 1.86	1955-Gr. I(6)	12.41 \pm 1.56
Gr. I(7)	9.25	1955-Gr. II(6)	12.18 \pm 0.40
Gr. II(6)	11.34 \pm 0.74	1955-Gr. III(6)	14.21 \pm 2.58
Gr. III(6)	10.46 \pm 0.62		
Gr. III(7)	19.32		

In the 6-striped category, the values in 1954-Grs. I-III are not significantly different from those in 1955-Grs. I-III at all levels ; no comparison could be made in the 7-striped category due to lack of data.

7. *Length of elytron (E)*

(Tables 6, 7, 10-12, 14 and 15 ; and Text-fig. 6)

(a) *Mean length*

The mean length (mm.) \pm S.E. varies as follows :—

<i>Group (and eye-stripes)</i>	<i>Males</i>	<i>Females</i>	<i>Difference</i>
Gr. I(6)	51.71 \pm 0.97	57.24 \pm 1.27	6.53 \pm 1.60
Gr. II(6)	52.25 \pm 0.13	57.90 \pm 0.18	5.65 \pm 2.22
Gr. III(6)	52.41 \pm 0.21	57.51 \pm 0.25	5.10 \pm 0.33
Gr. I(7)	51.83 \pm 2.32	—	—
Gr. II(7)	—	61.90 \pm 4.65	—
Gr. III(7)	51.77 \pm 1.32	64.10 \pm 0.80	12.33 \pm 2.62

(b) *Inter-group comparison (Table 7)*

(i) *6-striped* : Within each sex category, in both sexes, the values in Grs. I-III are not significantly different from one other.

(ii) *7-striped* : *Males* : The value in Gr. I is not significantly different (at all levels) from that in Gr. III ; no males occurred in Gr. II. *Females* : The values in Gr. II and III are not significantly different from each other ; only one female occurred in Gr. I.

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

In both 6- and 7-eye-striped categories, the value in corresponding females is significantly higher than in males at all levels.

(d) *Inter-eye-stripe comparison (Table 6)*

Males : Within the same group, the values in Grs. I(6) and III(6) are not significantly different from those in Grs. I(7) and III(7) ; no males occurred in Gr. II(7).

Females : Within the same group, the value in Gr. II(6) is not significantly different from Gr. II(7) ; but that in Gr. III(6) is significantly lower than in Gr. III(7) at the 1% level.

(e) Inter-population comparison

(Tables 10-12, 14 and 15).

The three 1954-Groups compare with other populations (data given below) as follows :—

Other-populations (and eye-stripes)	Mean (mm.) \pm S.E.	
	Males	Females
6-greg.	52.85 \pm 0.52	58.01 \pm 0.81
Ajmer Sw. (6)	54.16 \pm 0.70	59.70 \pm 1.68
Kakko Conc. (6)	51.46 \pm 0.29	59.73 \pm 0.42
Kakko Conc. (7)	—	61.83 \pm 1.41
6-sol.	52.15 \pm 0.24	61.56 \pm 0.31
7-sol.	52.38 \pm 0.42	62.90 \pm 0.26
1955-Gr. I(6)	51.01 \pm 0.49	57.09 \pm 0.72
1955-Gr. I(7)	50.23 \pm 1.51	—

(i) *6-striped males* : The values in 1954-Grs. I-III are not significantly different (at all levels) from those in 6-greg. and 6-sol. The values in 1954-Grs. II and III are significantly lower than in *Ajmer Sw.* (at 1% and 5% levels respectively), but are higher than the *Kakko Conc.* (at 5% level) and 1955-Gr. I (at 1% level). The 1954-Gr. I shows no significant difference in this respect.

(ii) *6-striped females* : The values in 1954-Grs. I-III are not significantly different (at all levels) from those in 6-greg., the *Ajmer Sw.* and 1955-Gr. I, but are lower than in 6-sol. (at all levels). But the values in 1954-Grs. II and III are significantly lower than in the *Kakko Conc.* (at all levels); Gr. I shows no significant difference.

(iii) *7-striped males* : The values in 1954-Grs. I and III are not significantly different from those in 7-sol. and 1955-Gr. I; no males occurred in 1954-Gr. II, *Ajmer Sw.* and *Kakko Conc.*

(iv) *7-striped females* : The values in 1954-Grs. II and III are not significantly different from those in 7-sol. and the *Kakko Conc.*, only one male occurred in 1954-Gr. I and no females in 1955-Gr. I.

(f) Sexual Dimorphism Percentage (S.D.P.)

The S.D.P. \pm S.E. varies as follows :—

1954-population (and eye-stripes)	S.D.P.	Other populations (and eye-stripes)	S.D.P.
Gr. I(6)	10.69 \pm 3.22	1955-Gr. I(6)	11.92 \pm 1.78
Gr. II(6)	10.81 \pm 0.45	6-greg.	9.76 \pm 1.88
Gr. III(6)	9.73 \pm 0.65	6-sol.	18.04 \pm 0.80
Gr. III(7)	23.82		

In the 6-striped category, the values in 1954-Gr. I-III are not significantly different from those in 1955-Gr. I and 6-greg. at all levels, but are lower than in 6-sol. at all levels.

8. Restricted width of elytron (W_1)

(Tables 6, 7 and 12 and Fig. 7)

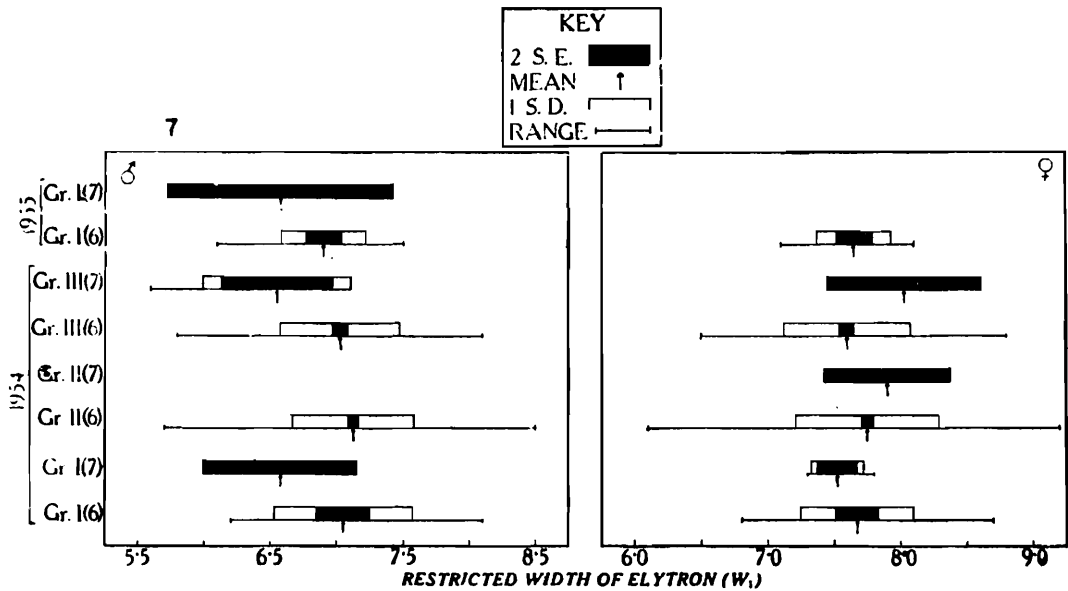
(a) Mean width

The mean width (mm.) \pm S.E. varies as follows :—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	7.05 \pm 0.10	7.67 \pm 0.08	0.62 \pm 0.13
Gr. II(6)	7.13 \pm 0.02	7.76 \pm 0.02	0.63 \pm 0.03
Gr. III(6)	7.02 \pm 0.03	7.60 \pm 0.03	0.58 \pm 0.04
Gr. I(7)	6.57 \pm 0.29	7.52 \pm 0.07	0.95 \pm 0.30
Gr. II(7)	—	7.90 \pm 0.24	—
Gr. III(7)	6.54 \pm 0.21	8.03 \pm 0.29	1.49 \pm 0.38

(b) Inter-group comparison (Table 7)

(i) 6-striped : Males : The values in Grs. I-III do not differ significantly from one another at all levels. Females : The value in Gr. I is not significantly different from Grs. II and III ; but the value in Gr. II is higher than in Gr. III at all levels.



TEXT-FIG. 7. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding restricted width of elytron (W_1). For explanations see text and text-figure 1.

(ii) 7-striped : Males : The value in Gr. I is not significantly different from Gr. III ; no males occurred in Gr. II. Females : The values in Grs. I-III are not significantly different from one another.

(c) Inter-sex comparison (Table 6)

In both 6- and 7-striped categories, the value in corresponding females is significantly higher than in males at all levels.

(d) *Inter-eye-stripe comparison* (Table 6)

Males: Within the same group, the value in Gr. I(6) is not significantly different from that in Gr. I(7); but that in Gr. III(6) is higher than in Gr. III(7) at the 1% level. No males occurred in Gr. II.

Females: Within the same group, the values in Grs. I(6), II(6) and III(6) are not significantly different from those in Grs. I(7), II(7) and III(7) respectively.

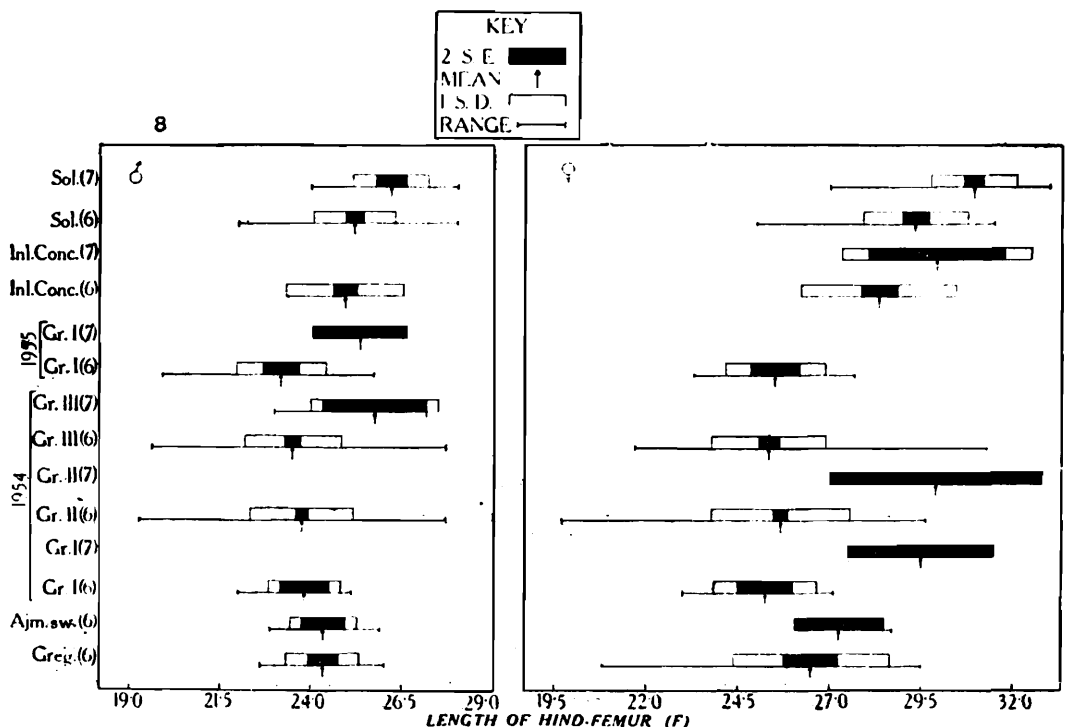
(e) *Inter-population comparison* (Table 12)

The three 1954-Groups compare with other populations (data given below) as follows:—

Other-populations (and eye-stripes)	Mean (mm.) \pm S.E.	
	Males	Females
1955-Gr. I(6)	6.89 \pm 0.067	7.66 \pm 0.066
1955-Gr. I(7)	6.57 \pm 0.43	—

(i) *6-striped: Males:* The values in 1954-Gr. I and III are not significantly different from that in 1955-Gr. I at all levels, but that in Gr. II is higher at all levels. *Females:* The values in 1954-Gr. I-III are not significantly different from that in 1955-Gr. I at all levels.

(ii) *7-striped: Males:* The values in 1954-Gr. I and II are not significantly different from that in 1955-Gr. I at all levels; no males occurred in Gr. II. *Females:* No comparison could be made due to lack of data.



TEXT-FIG. 8. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding length of hind-femur (F). For explanations see text and text-figures 1, 2 and 6.

(f) Sexual Dimorphism Percentage (S.D.P.)

The S.D.P. \pm S.E. varies as follows :—

1954-population (and eye-stripes)	S.D.P.	Other populations (and eye-stripes)	S.D.P.
Gr. I(6)	8.79 \pm 1.85	1955-Gr. I(6)	11.18 \pm 1.44
Gr. I(7)	14.46	1955-Gr. II(6)	10.14 \pm 0.47
Gr. II(6)	8.84 \pm 0.42	1955-Gr. III(6)	10.51 \pm 2.60
Gr. III(6)	8.26 \pm 0.67		
Gr. III(7)	22.78		

In the 6-striped category, the values in 1954-Grs. I-III are not significantly different (at all levels) from those in 1955-Grs. I-III; no comparison could be made in 7-striped category due to lack of data.

9. Length of hind-femur (F)

(Tables 6, 7, 10-12, 14 and 15 and Fig. 8)

(a) Mean length

The mean length (mm.) \pm S.E. varies as follows :—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	23.88 \pm 0.33	25.25 \pm 0.39	1.37 \pm 0.54
Gr. II(6)	23.76 \pm 0.07	25.71 \pm 0.10	1.95 \pm 0.12
Gr. III(6)	23.54 \pm 0.11	25.36 \pm 0.14	1.82 \pm 0.18
Gr. I(7)	—	29.50 \pm 1.00	—
Gr. II(7)	—	29.90 \pm 1.45	—
Gr. III(7)	25.73 \pm 0.71	—	—

(b) Inter-group comparison (Table 7)

(i) 6-striped: *Males*: The values in Grs. I, II and III are not significantly different from one another at all levels. *Females*: The value in Gr. I is not significantly different (at all levels) from those in Grs. II and III; but the value in Gr. II is significantly higher than in Gr. III at the 5% level.

(ii) 7-striped: *Males*: The value in Gr. III could not be compared with Grs. I and II, as only one male occurred in the Gr. I; and none in Gr. II. *Females*: The value in Gr. I is not significantly different from that in Gr. II at all levels; no females occurred in Gr. III.

(c) Inter-sex comparison (Table 6)

In both the 6- and 7-eye-striped categories, the value in the females is significantly higher than in corresponding males at all levels.

(d) Inter-eye-stripe comparison (Table 6)

Males: Within the same group, the value in Gr. III(6) is significantly lower than in Gr. III(7) at all levels. Only one male occurred in Gr. I(7) and none in Gr. II(7). *Females*: Within the same group, the values in Grs. I(6) and II(6) are significantly higher than in Gr. I(7) (at 5% level) and Gr. II(7) (at all levels); no females occurred in Gr. III(7).

(e) *Inter-population comparison*

(Tables 10-12, 14 and 15)

The three 1954-Groups compare with other populations (data given below) as follows :—

<i>Other-populations (and eye-stripes)</i>	<i>Mean (mm.) ± S.E.</i>	
	<i>Males</i>	<i>Females</i>
<i>6-greg.</i>	24.32 ± 0.20	26.44 ± 0.37
<i>Ajmer Sw. (6)</i>	24.37 ± 0.29	27.28 ± 0.61
<i>Kakko Conc. (6)</i>	24.92 ± 0.16	28.35 ± 0.25
<i>Kakko Conc. (7)</i>	—	29.94 ± 0.92
<i>6-sol.</i>	25.40 ± 0.12	29.37 ± 0.18
<i>7-sol.</i>	26.13 ± 0.21	30.92 ± 0.13
1955-Gr. I(6)	23.11 ± 0.26	25.52 ± 0.34
1955-Gr. I(7)	25.30 ± 0.64	—

(i) *6-striped males* : The values in 1954-Grs. II and III are significantly lower than in *6-greg.* (at all levels), the *Ajmer Sw.* (at 1% level) and the *Kakko Conc.* (at all levels) ; but Gr. I does not show significant difference in this respect. The values in 1954-Grs. I-III are significantly lower (at all levels) than in *6-sol.* Except for 1954-Gr. II, which shows significantly higher values from the 1955-Gr. I, Grs. I and III show no significant difference in the two years.

(ii) *6-striped females* : The values in 1954-Grs. I-III are significantly lower than in *6-sol.* (at all levels) and in *6-greg.* at 1% level (except for Gr. II which show no difference). The values in Grs. II and III are significantly lower than in *Ajmer Sw.* (at 1% level) and *Kakko Conc.* (at all levels) ; but Gr. I shows no significant difference. Except for 1954-Gr. II which shows significantly higher values from the 1955-Gr. I, Grs. I and III of these two years show no difference.

(iii) *7-striped : Males* : The value in 1954-Gr. III is not significantly different from that in *7-sol.* and 1955-Gr. I (at all levels) ; no males occurred in *Ajmer Sw.*, the *Kakko Conc.* and 1954-Gr. II, and only one in 1954-Gr. I. *Females* : The values in Grs. I and II are not significantly different from those in *7-sol.* and the *Kakko Conc.* at all levels. No females occurred in 1954-Gr. III and 1955-Gr. I.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

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

<i>1954-population (and eye-stripes)</i>	<i>S.D.P.</i>	<i>Other populations (and eye-stripes)</i>	<i>S.D.P.</i>
Gr. I(6)	5.74 ± 2.43	1955-Gr. I(6)	10.43 ± 1.94
Gr. II(6)	8.21 ± 0.54	<i>6-greg.</i>	8.72 ± 1.76
Gr. III(6)	7.73 ± 0.80	<i>6-sol.</i>	15.63 ± 0.89

In the 6-striped category, the values in 1954-Grs. I-III are significantly lower than in *6-sol.* (at all levels) ; but do not differ from *6-greg.* The values in 1954-Grs. I and III are not significantly different from that in 1955-Gr. I(6), but Gr. II is significantly lower at 1%

level. No comparison could be made in the 7-striped category due to lack of data.

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

(a) *Inter-group variation in the 1954-population*

(i) No appreciable difference is found in males for characters O, C, P, E and F. Group divergence is best seen in characters H, M and W_1 for males.

In 6-striped males, values of H differentiate Grs. I and II from Gr. III; the former two not differing from each other. Character W_1 shows difference between Grs. II and III only, the value in the former being significantly higher. Considerable group differences are seen in M (width of pronotum), the values in Grs. I and II are significantly higher than in Gr. III at all levels; the former also differ from each other (at all levels). In both sexes, E shows no group difference.

In 6-striped females, group-difference is more pronounced, the most sensitive characters in this respect being C, H, M, W_1 , and to some extent, O, F and P. For C, M and H, the value in Gr. I is significantly higher than in Gr. II, and both are higher than in Gr. III. For O, P, W_1 and F, the value in Gr. II is significantly higher than in Gr. III.

(ii) From inter-sex comparison, it is seen that sexual difference is seen in all the groups for all the characters, females having higher values than males.

(iii) Within the same group and sex, the value of O in 6- and 7-eye-striped forms, in both sexes, do not differ. In males, 7-striped forms are smaller than 6-striped ones for characters C and W_1 and larger for F (in Gr. III only). In females, significant differences are seen in C, P, H, M, E and F.

(b) *Inter-relation between the 1954-population and the 1955-(Gr. I) population*

The three groups of the 1954-population were compared with the 1955-Gr. I population (the immediately succeeding population), which was *gregaria* in nature (Roonwal and Bhanotar, 1966) in respect of eight characters *viz.*, O, C, P, H, M, E, W_1 and F, with the following results:—

(i) *1954-Gr. I versus 1955-Gr. I.*—There is no difference in most of the characters, but in the 6-striped category, in both sexes, the length of the pronotum (P) has a significantly higher value in the 1954-population.

(ii) *1954-Gr. II versus 1955-Gr. I.*—In 6-striped males the values of W_1 (at all levels) of O and P (at 1% level) and E and F (at 5% level) are higher in the 1954-Gr. II. In 6-striped females, only P is significantly different, the values being higher in the 1954-Gr. II.

(iii) *1954-Gr. III versus 1955-Gr. I.*—In 6-striped males, the values of P and E (at 1% level) and O (at 5% level) are significantly higher in the 1954-Gr. III. In females, only M differs, the value being lower in the 1954-Gr. III.

(c) *The 1954-Groups versus the Ajmer Swarm (1950) and the Kakko Concentration (1949)*

For further comparison of the 1954-population, comparison with two earlier populations, namely, the *Ajmer Swarm* of 1950 and the *Kakko Concentration* of 1949 (the former *gregaria* and the latter near *solitaria*) were made for four characters (C, P, E and F) with the following results:—

(i) *C*: In 6-striped males, the 1954-Gr. I does not differ from the *Ajmer Sw.*, but the value in Gr. II is significantly lower and in Gr. III still lower. The values in Grs. I and II are significantly higher and in Gr. III still higher than in the *Kakko Conc.* In 6-striped females, the values in Grs. I and II do not differ from the *Ajmer Sw.*, but are significantly higher than in the *Kakko Conc.*, and in Gr. III higher still when compared to the *Kakko Conc.*

(ii) *P*: In 6-striped males, the values in Grs. I-III are significantly higher than in the *Kakko Conc.*, but are not different from the *Ajmer Sw.* In 6-striped females, Grs. I and II show no difference from the *Kakko Conc.*, but the males in Gr. III is significantly lower.

(iii) *E*: In 6-striped males, Gr. I shows no significant difference from the *Ajmer Sw.* and the *Kakko Conc.*, but values in Grs. II and III are significantly lower than in *Ajmer Sw.* and all these are higher than the *Kakko Concentration*. In 6-striped females, the value in Grs. II and III are significantly lower than in the *Kakko Conc.*

(iv) *F*: In 6-striped males, the values in Gr. I do not show significant difference from the *Ajmer Sw.* and the *Kakko Conc.*, but those in Grs. II and III are significantly lower. In 6-striped females, the values in Grs. I-III are significantly lower than in the *Ajmer Sw.* and the *Kakko Conc.*

(d) *Phase status of the 1954-Groups*

For assessing the phase status of the 1954-Groups, four sensitive body-parts viz., C, P, E and F, were utilized. But for "*solitaria*" phase, data for only two characters, E and F, are available so that a detailed comparison could not be made. The results of the test of differences in values are given for each group separately, as follows:—

(i) *C*: The values in 6-striped males, for Grs. I-III are significantly smaller than in typical *gregaria*. In 6-striped females, the value in Gr. III is significantly lower than in *gregaria*, but Grs. I and II show no difference from *gregaria*.

(ii) *P*: In 6-striped males, the value in Gr. II is significantly higher than in typical *gregaria*, but Grs. I and III do not differ. In 6-striped females, the value in Grs. I and II is significantly higher than in typical *gregaria*, but Gr. III shows no difference.

In the 7-striped category, the value for males in Grs. I and III is not significantly different from that in typical *gregaria*. No males occurred in Gr. II. In females, however, the values in Grs. I, II and III are significantly higher than in typical *gregaria*.

(iii) *E*: In 6-striped males, the value in Grs. I, II and III is not significantly different from those in 6-*solitaria* and typical *gregaria*.

In 6-striped females, the values in Grs. I, II, III are not significantly different than in typical *gregaria*, but are significantly lower than that in 6-*solitaria*.

In the 7-striped category, the value for males in Grs. I and III and for males in Grs. II and III, is not significantly different than in 7-*solitaria*. No males occurred in Gr. II.

(iv) *F* : In 6-striped males, the value in Gr. I does not differ from 6-striped *gregaria*, but is significantly lower than in 6- and 7-striped *solitaria*. The value in Gr. II is significantly lower than in 6-*gregaria* and 6-and 7-*solitaria*. In 6-striped females, the value in Gr. I is significantly lower than in *gregaria* and 6-and 7-*solitaria* ; Gr. II shows no difference from *gregaria*, but the values are lower than in 6- and 7-*solitaria*. It is interesting to note that for both sexes and in 6-striped forms, the value in Gr. III is significantly higher (at all levels) from both phases *gregaria* and *solitaria*.

(e) *General conclusion*

From the above, discussion, it will be seen that the phase-status of the three groups of the 1954-population is as follows :—

Group I : Its morphometry indicates closer affinity to the typical phase *gregaria* and the *Ajmer Swarm* (1950) populations. The degree of gregariazation appears to be complete. The group differs from Grs. II and III in the case of females.

Group II and III : Morphometry indicates a close affinity between these two groups. The population of both is of a weak *gregaria* type. Gregariazation appears to be lesser in degree than in Gr. I, and the groups lie somewhere between the *Ajmer Swarm* (1950) and the *Kakko Concentration* (1949).

VI — MORPHOMETRIC RATIOS

1. *General*

The following seven ratios relating to the morphometric characters were studied :—

1. Length of pronotum (P)
Width of head at genal level (C)
2. Width of pronotum (M)
Width of head at genal level (C)
3. Height of pronotum (H)
Width of head at genal level (C)
4. Length of elytron (E)
Restricted width of elytron (W_1)
5. Length of elytron (E)
Length of hind-femur (F)
6. Length of elytron (E)
Width of head at genal level (C)
7. Length of hind-femur (F)
Width of head at genal level (C)

Note : The values of ratios were obtained for each specimen separately and then the means \pm S.E., etc., calculated.

2. Ratio P/C

(Tables 8-11, 13-15 and Text-fig. 9)

(a) Mean values

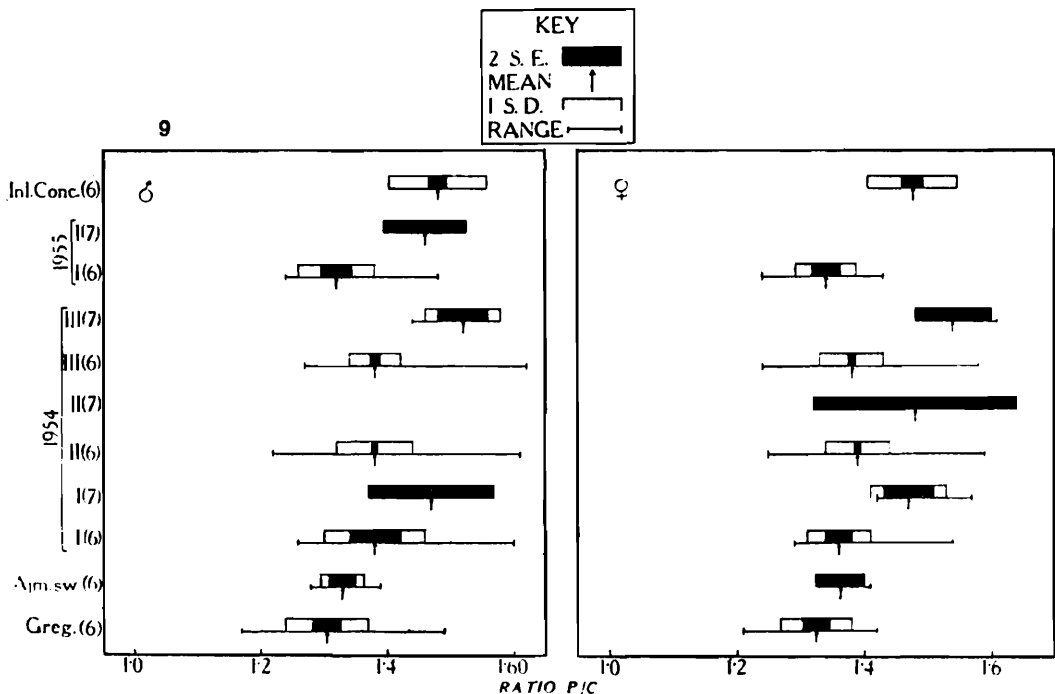
The mean values of P/C are as follows :—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	1.38 ± 0.02	1.36 ± 0.01	0.02 ± 0.02
Gr. II(6)	1.38 ± 0.002	1.39 ± 0.002	0.01 ± 0.003
Gr. III(6)	1.38 ± 0.004	1.38 ± 0.003	0.0 ± 0.0
Gr. I(7)	1.47 ± 0.05	1.47 ± 0.02	0.0 ± 0.0
Gr. II(7)	—	1.48 ± 0.08	—
Gr. III(7)	1.52 ± 0.02	1.54 ± 0.03	0.02 ± 0.04

(b) Inter-group comparison (Table 9)

6-striped : Males : The values in Grs. I-III are not significantly different from each other. **Females :** The value in Gr. I is significantly lower than in Gr. II and Gr. III at the 1% and 5% level respectively. The value in Gr. II is significantly higher than in Gr. III at the 5% level.

7-striped : Males : The value in Gr. I is not significantly different from that in Gr. III at all levels ; no males occurred in Gr. II. **Females :** The values in Grs. I-III are not significantly different from each other at all levels.



TEXT-FIG. 9. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding the ratio P/C (Length of pronotum/width of head at genal level).

For explanations see text and text-figures 1 and 2.

(c) *Inter-sex comparison* (Table 8)

In both 6- and 7-eye-striped categories, the value in corresponding males is not significantly different from that in females except for in Gr. II(6), where they are smaller at all levels.

(d) *Inter-eye-stripe comparison* (Table 8)

Males: Within the same group, the value in Gr. I(6), is not significantly different from that in Gr. I(7) at all levels, but that in Gr. III(6) is significantly lower than in Gr. III(7). No males occurred in Gr. II. *Females*: Within the same group, in 6-striped category, the value in Grs. I-III are significantly lower than in 7-striped ones at all levels.

(e) *Inter-population comparison* (Tables 10, 11, 13-15)

The three 1954-Groups compare with other populations (data given below) as follows:—

<i>Other populations (and eye-stripes)</i>	<i>Mean ± S.E.</i>	
	<i>Males</i>	<i>Females</i>
<i>6-greg.</i>	1.305 ± 0.011	1.324 ± 0.009
<i>Ajmer Sw. (6)</i>	1.330 ± 0.011	1.363 ± 0.018
<i>Kakko Conc. (6)</i>	1.483 ± 0.007	1.477 ± 0.008
1955-Gr. I(6)	1.32 ± 0.012	1.34 ± 0.011
1955-Gr. I(7)	1.46 ± 0.033	—

(i) *6-striped males*: The values in 1954-Grs. I-III are significantly higher than in typical *6-greg.* (at 5% level) and the *Ajmer Sw.* (at all levels), but are significantly lower (at all levels) than in the *Kakko Conc.* The values in 1954-Grs. I and III are significantly higher than in 1955-Gr. I (at all levels), but Gr. II shows no significant difference.

(ii) *6-striped females*: The values in 1954-Grs. I-III are significantly higher than in typical *6-greg.* (at 1% and at all levels); but are significantly lower (at all levels) than in the *Kakko Conc.*, but are not significantly different from the *Ajmer Sw.* The values in Grs. II and III are significantly higher (at all levels) than the 1955-Gr. I, but Gr. I show no significant difference.

(iii) *7-striped: Males*: The value in 1954-Grs. I and III are not significantly different from that in 1955-Gr. I at all levels. No males occurred in Gr. II. *Females*: No comparison could be made due to lack of data; and no females occurred in 1955-Gr. I.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

<i>1954-population (and eye-stripes)</i>	<i>S.D.P.</i>	<i>Other populations (and eye-stripes)</i>	<i>S.D.P.</i>
Gr. I(6)	-1.45 ± 1.27	1955-Gr. I(6)	1.52 ± 1.27
Gr. I(7)	0.0	<i>Kakko Conc. (6)</i>	-0.40 ± 0.72
Gr. II(6)	0.72 ± 0.23	<i>6-greg.</i>	1.46 ± 1.10
Gr. III(6)	0.0 ± 0.37		
Gr. III(7)	1.32		

In the 6-striped category, the values in 1954-Grs. I-III are not significantly different from those in 1955-Gr. I, typical 6-greg. and the Kakko Conc. at all levels ; no comparison could be made in 7-striped category due to lack of data.

3. Ratio M/C

(Tables 8, 9 and 13 and Text-fig. 10)

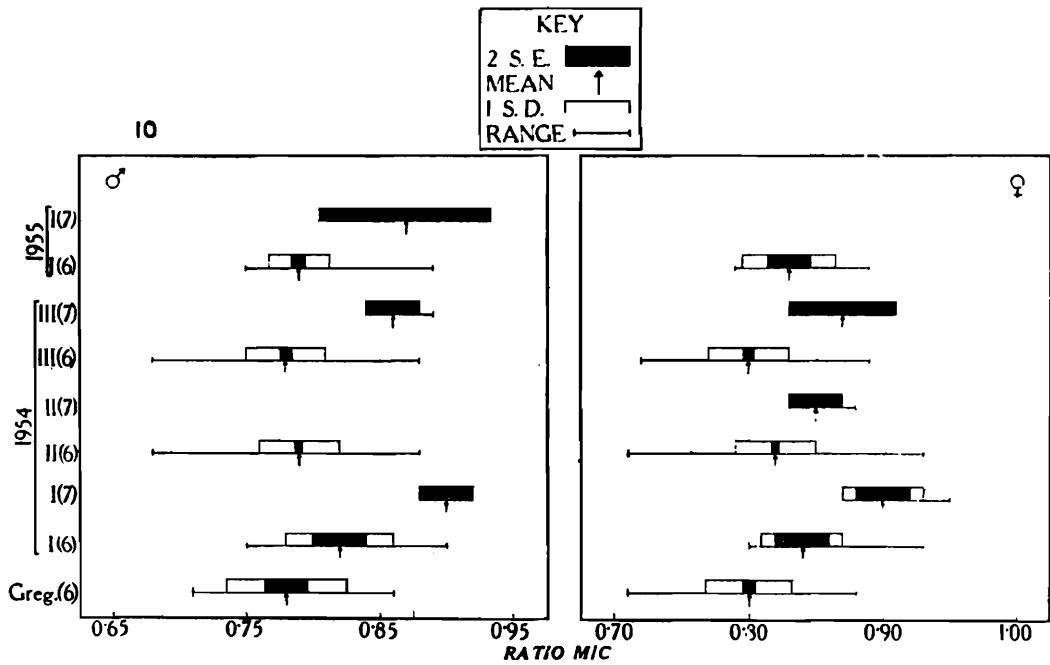
(a) Mean values

The values of M/C are as follows:—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	0.82 ± 0.01	0.84 ± 0.01	0.02 ± 0.014
Gr. II(6)	0.79 ± 0.001	0.82 ± 0.001	0.06 ± 0.01
Gr. III(6)	0.78 ± 0.002	0.80 ± 0.002	0.02 ± 0.003
Gr. I(7)	0.90 ± 0.01	0.90 ± 0.01	0.0 ± 0.0
Gr. II(7)	—	0.85 ± 0.01	—
Gr. III(7)	0.86 ± 0.01	0.87 ± 0.02	0.01 ± 0.02

(b) Inter-group comparison (Table 9)

(i) 6-striped : Males : The value in Gr. I is significantly higher than in Gr. II (at 1% level) and Gr. III. (at all levels). The value in Gr. II is significantly higher than in Gr. III at 5% level. Females : The value in Gr. I is significantly higher than in Gr. II (at 1% level) and Gr. III (at 5% level) and that in Gr. II is significantly higher (at 5% level) than in Gr. III.



TEXT-FIG. 10. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (± S.E.) and standard deviation (S.D.) in various populations regarding the ratio M/C (Width of pronotum /width of head at genal level). For explanations see text and text-figures 1 and 2.

(ii) *7-striped : Males* : The value in Gr. I is significantly higher (at 1% level) than in Gr. III ; no males occurred in Gr. II. *Females* : The values in Grs. I-III are not significantly different from each other at all levels.

(c) *Inter-sex comparison* (Table 8)

Within each group, the value in males is not significantly different from that in females, except in Grs. II(6) and III(6) where females are significantly larger (at all levels).

(d) *Inter-eye-stripe comparison* (Table 8)

Males : Within the same group, the values in Grs. I(6) and III(6) are significantly lower (at all levels) than in Grs. I(7) and III(7) respectively ; no males occurred in Gr. II. *Females* : Within the same group, in 6-striped category, the values in Grs. I-III are significantly lower (at all levels) than in 7-striped ones.

(e) *Inter-population comparison* (Table 13)

The three 1954-Groups compare with other populations (data given below) as follows :—

<i>Other populations (and eye-stripes)</i>	<i>Mean ± S.E.</i>	
	<i>Males</i>	<i>Females</i>
1955-Gr. I(6)	0.79 ± 0.005	0.83 ± 0.008
1955-Gr. I(7)	0.87 ± 0.032	—

(i) *6-striped : Males* : The value in 1955-Gr. I is significantly lower (at 1% level) from that in 1954-Gr. I and significantly higher (at 5% level) than in Gr. III, but is not significantly different from that in Gr. II. *Females* : The value in 1955-Gr. I is not significantly different from that in 1954-Grs. I and II (at all levels), but is significantly higher than in Gr. III (at all levels).

(ii) *7-striped : Males* : The value in 1955-Gr. I is not significantly different from that in 1954-Grs. I and III at all levels ; no male occurred in Gr. II. *Females* : No comparison could be made due to lack of data ; no females occurred in 1955-Gr. I.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

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

<i>1954-population (and eye-stripes)</i>	<i>S.D.P.</i>	<i>Other populations (and eye-stripes)</i>	<i>S.D.P.</i>
Gr. I(6)	2.44 ± 1.04	1955-Gr. I(6)	5.06 ± 1.22
Gr. I(7)	0.0	1955-Gr. II(6)	2.68 ± 0.23
Gr. II(6)	3.80 ± 0.22	1955-Gr. III(6)	0.90 ± 1.36
Gr. III(6)	2.56 ± 0.36		
Gr. III(7)	1.16		

In the 6-striped category, the values in 1954-Grs. I and II are not significantly different from that in 1955-Gr. I, but is significantly higher than in 1954-Gr. III. The value in 1954-Grs. I and III show no significant difference from that in 1955-Grs. II and III, but that in 1954-Gr. II is significantly higher than in 1955-Grs. II and III.

No comparison was possible in 7-striped category due to lack of data.

4. Ratio H/C

(Tables 8, 9 and 13 ; and Text-fig. 11)

(a) Mean values

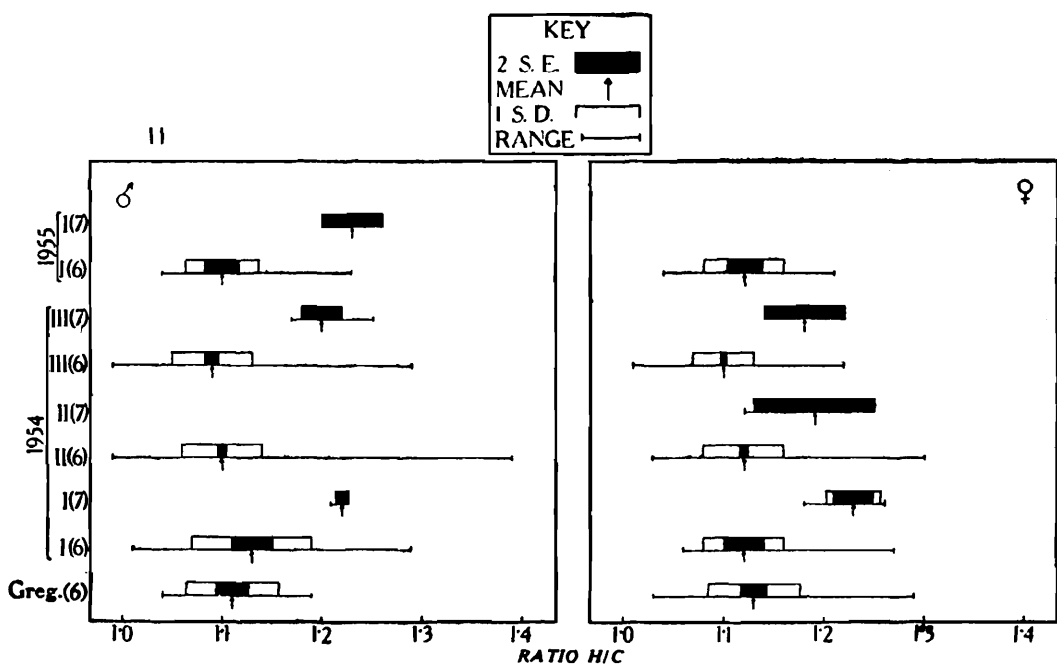
The values of H/C are as follows :—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	1.13 ± 0.01	1.12 ± 0.01	0.01 ± 0.014
Gr. II(6)	1.10 ± 0.002	1.12 ± 0.002	0.02 ± 0.003
Gr. III(6)	1.09 ± 0.003	1.10 ± 0.002	0.01 ± 0.004
Gr. I(7)	1.22 ± 0.004	1.23 ± 0.009	0.01 ± 0.02
Gr. II(7)	—	1.19 ± 0.03	—
Gr. III(7)	1.20 ± 0.01	1.18 ± 0.02	0.02 ± 0.018

(b) Inter-group comparison (Table 9)

(i) *6-striped: Males*: The value in Gr. I is significantly higher than in Gr. II (at 1% level) and in Gr. III (at all levels). The value in Gr. II is significantly higher (at 5% level) than in Gr. III. *Females*: The value in Gr. I is not significantly different from that in Gr. II at all levels, but is significantly higher (at 5% level) than in Gr. III. The value in Gr. II is significantly higher (at all levels) than in Gr. III.

(ii) *7-striped: Males*: The value in Gr. I is not significantly different from that in Gr. III; no males occurred in Gr. II. *Females*: The value in Gr. II is not significantly different from those in Grs. I and III, but that in Gr. I is significantly higher (at 5% level) than in Gr. III.



TEXT-FIG. 11. *Schistocerca gregaria*. Dicogram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding the ratio H/C. (Height of pronotum/width of head at genal level).

For explanations see text and text-figures 1 and 2.

(c) *Inter-sex comparison* (Table 8)

Within each group, the value in males is not significantly different from that in females, except in Grs. II(6) and III(6), where the values in females are significantly higher (at 0.1% and 5% levels) respectively.

(d) *Inter-eye-stripe comparison* (Table 8)

Males: Within the same group, the values in Grs. I(6) and III(6) are significantly lower than in Gr. I(7) and Gr. III(7) at all levels; no males occurred in Gr. II. *Females*: Within the same group, in 6-striped category, the values in Grs. I-III are significantly lower than in 7-striped ones at all levels.

(e) *Inter-population comparison* (Table 13)

The three 1954-Groups compare with 1955-Gr. I population (data given below) as follows:—

1955-population (and eye-stripes)	Mean \pm S.E.	
	Males	Females
Gr. I(6)	1.10 \pm 0.008	1.12 \pm 0.009
Gr. I(7)	1.23 \pm 0.014	—

(i) *6-striped*: *Males*: The value in 1955-Gr. I is not significantly different from those in 1954-Grs. II and III (at all levels), but is significantly lower than in Gr. I at 5% levels. *Females*: The value in 1955-Gr. I is not significantly different from those in 1954-Grs. I and II, but is significantly higher than in Gr. III at the 5% level.

(ii) *7-striped*: *Males*: The value in 1955-Gr. I is not significantly different from those in 1954-Grs. I and III; no males occurred in Gr. II. *Females*: The value in 1954-Grs. I-III could not be compared due to lack of data in other populations; no females occurred in 1955-Gr. I.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

The S.D.P. \pm S.E. varies as follows:—

1954-population (and eye-stripes)	S.D.P.	Other populations (and eye-stripes)	S.D.P.
Gr. I(6)	-0.88 \pm 1.16	1955-Gr. I(6)	1.82 \pm 1.10
Gr. I(7)	0.82	1955-Gr. II(6)	0.88 \pm 0.22
Gr. II(6)	1.82 \pm 0.20	1955-Gr. III(6)	-0.80 \pm 1.35
Gr. III(6)	0.92 \pm 0.31		
Gr. III(7)	-1.67		

In the 6-striped category, the values in 1954-Grs. I-III are not significantly different from those in 1955-Grs. I-III; no comparisons were possible in 7-striped category due to lack of data.

5. *Ratio E/W₁*

(Tables 8, 9 and 13 and Text-fig. 12)

(a) *Mean values*

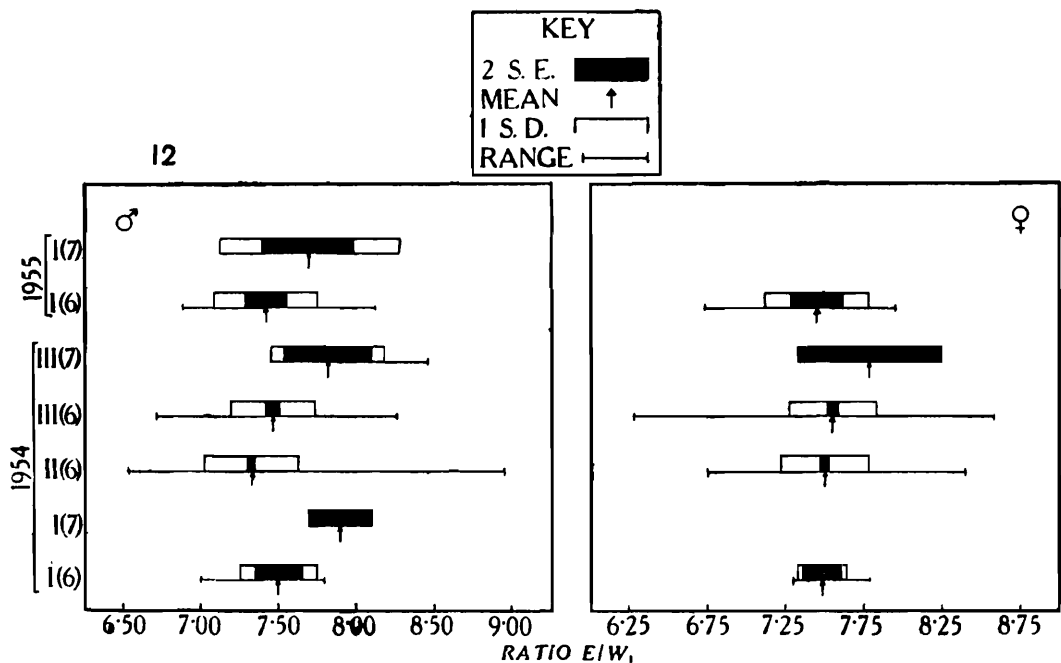
The values for E/W₁ are as follows:—

Groups (and eye-stripes)	Males	Females	Difference
Gr. I(6)	7.49 ± 0.08	7.58 ± 0.06	0.09 ± 0.11
Gr. II(6)	7.32 ± 0.01	7.49 ± 0.01	0.17 ± 0.014
Gr. III(6)	7.47 ± 0.02	7.55 ± 0.02	0.08 ± 0.03
Gr. I(7)	7.90 ± 0.10	—	—
Gr. II(7)	—	—	—
Gr. III(7)	7.82 ± 0.14	7.78 ± 0.23	0.04 ± 0.28

(b) Inter-group comparison (Table 9)

(i) 6-striped : *Males* : The value in Gr. I is not significantly different from those in Grs. II and III, but that in Gr. II is significantly lower than in Gr. III at all levels. *Females* : The value in Gr. I is not significantly different from those in Grs. II and III, but that in Gr. II is significantly lower than in Gr. III at 1% level.

(ii) 7-striped : *Males* : The value in Gr. I is not significantly different from that in Gr. III ; no males occurred in Gr. II. *Females* : No comparisons could be made due to lack of data, only one female occurred in Grs. I and II.



TEXT-FIG. 12. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding the ratio E/W_1 (Length of elytron/restricted width of elytron).

For explanations see text and text-figure 1.

(c) Inter-sex comparison (Table 8)

Within each group, the values in males is not significantly different from that in females except for Grs. II(6) and III(6) where the values in females are significantly higher at all levels and 1% level respectively.

(d) Inter-eye-stripe comparison (Table 8)

Males : Within the same group, in the 6-striped category, the values in Grs. I and III are significantly lower than in 7-striped ones at the

5% and at all levels respectively. *Females*: Within the same group, the value in Gr. III(6) is not significantly different from that in Gr. III(7); only one female occurred in Grs. I and II.

(e) *Inter-population comparison* (Table 13)

The three 1954-Groups compare with other populations (data given below) as follows:—

1955-population (and eye-stripes)	Mean \pm S.E.	
	Males	Females
Gr. I(6)	7.41 \pm 0.068	7.45 \pm 0.081
Gr. I(7)	7.69 \pm 0.285	—

(i) *6-striped*: In both males and females, the values in 1955-Gr. I are not significantly different from those in 1954-Grs. I-III at all levels.

(ii) *7-striped*: *Males*: The value in 1955-Gr. I is not significantly different from those in 1954-Grs. I and III; no males occurred in Gr. II. *Females*: No comparison could be made due to lack of data in other populations; no females occurred in 1955-Gr. I.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

The S.D.P. \pm S.E. varies as follows:—

1954-population (and eye-stripes)	S.D.P.	Other populations (and eye-stripes)	S.D.P.
Gr. I(6)	1.20 \pm 1.29	1955-Gr. I(6)	0.54 \pm 1.43
Gr. II(6)	2.32 \pm 0.26	1955-Gr. II(6)	2.02 \pm 0.30
Gr. III(6)	1.07 \pm 0.40	1955-Gr. III(6)	2.79 \pm 1.63
Gr. III(7)	—0.51		

In the 6-eye-striped category, the values in 1954-Grs. I-III are not significantly different from those in 1955-Grs. I-III; no comparison could be made in 7-striped category due to lack of data.

6. *Ratio E/F*

(Tables 8-11, 13-15 and Text-fig. 13)

(a) *Mean values*

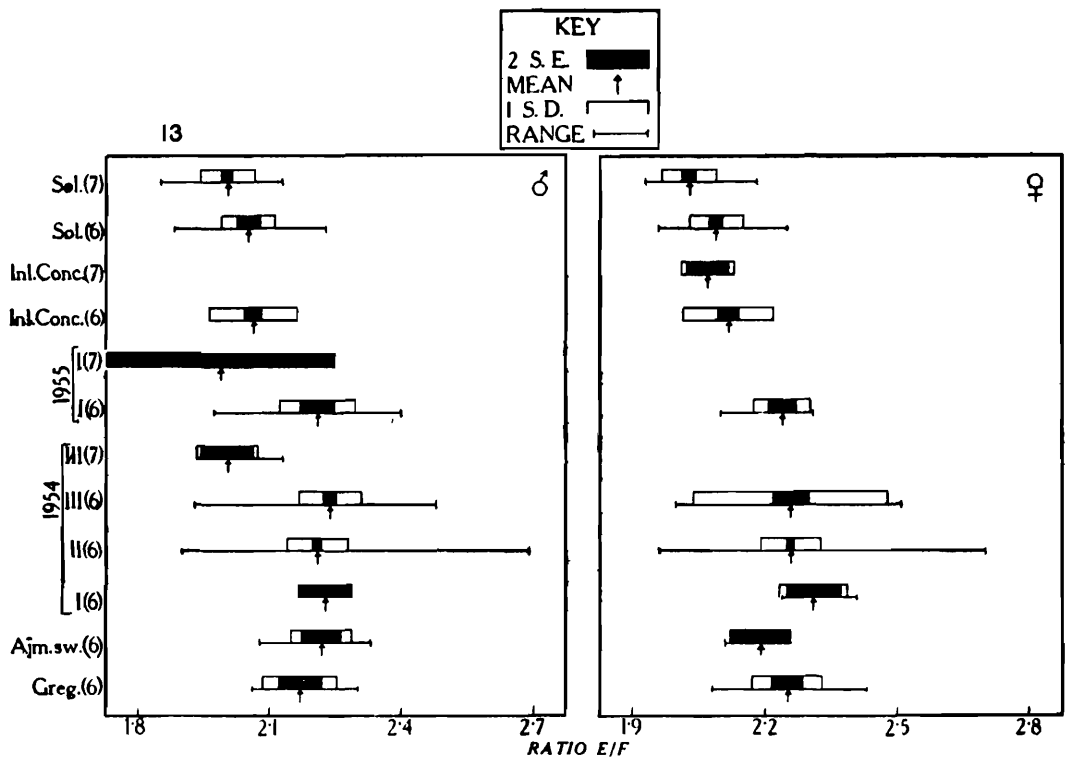
The values of E/F varies as follows:—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	2.23 \pm 0.03	2.31 \pm 0.03	0.081 \pm 0.06
Gr. II(6)	2.21 \pm 0.004	2.26 \pm 0.004	0.05 \pm 0.006
Gr. III(6)	2.22 \pm 0.007	2.26 \pm 0.02	0.04 \pm 0.021
Gr. I(7)	—	—	—
Gr. II(7)	—	—	—
Gr. III(7)	2.00 \pm 0.03	—	—

(b) *Inter-group comparison* (Table 9)

(i) *6-striped*: In both sexes, the values in Grs. I-III are not significantly different from each other.

(ii) *7-striped*: No males occurred in Gr. II, and only one in Gr. I. One female occurred in Grs. I and II and none in Gr. III.



TEXT-FIG. 13. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding the ratio E/F (Length of elytron/length of hind-femur).
For explanations see text and text-figures 1, 2 and 6.

(c) *Inter-sex comparison* (Table 8)

Within each group, the value in males is not significantly different from that in females, except in Gr. II(6), where the value in females is significantly larger at all levels.

(d) *Inter-eye-stripe comparison* (Table 8)

Males: Within the same group, the value in Gr. III(6) is not significantly different from that in Gr. III(7). No 7-striped males occurred in Gr. II and only one in Gr. I. *Females*: Only one 7-striped female occurred in Grs. I and II, and none in Gr. III.

(e) *Inter-population comparison*

(Tables 10-11 and 13-15)

The three 1954-Groups compare with other populations (data given below) as follows :—

Other populations (and eye-stripes)	Mean \pm S.E.	
	Males	Females
6-greg.	2.17 \pm 0.024	2.25 \pm 0.017
Ajmer Sw. (6)	2.22 \pm 0.023	2.19 \pm 0.035
Kakko Conc. (6)	2.06 \pm 0.010	2.12 \pm 0.011
Kakko Conc. (7)	—	2.07 \pm 0.022
6-sol.	2.05 \pm 0.012	2.09 \pm 0.008
7-sol.	2.00 \pm 0.006	2.03 \pm 0.007
1955-Gr. I(6)	2.21 \pm 0.018	2.24 \pm 0.016
1955-Gr. I(7)	1.99 \pm 0.013	—

(i) *6-stripped males*: The values in 1954-Grs. I and II are not significantly different from that in typical *6-greg.*; but the value in Gr. III is significantly higher (at 5% level). The values in 1954-Grs. I-III are significantly higher than in typical *6-sol.* at all levels, but are not significantly different from the *Ajmer Sw.* and the 1955-Gr. I. The values in *Kakko Conc.* is significantly lower than that in 1954-Gr. I (at 5% level) and Grs. II and III at all levels.

(ii) *6-stripped females*: The values in 1954-Grs. I-III are not significantly different from that in *6-greg.*; but are significantly higher than in *6-sol.*, at all levels. The value in 1954-Grs. I and III are not significantly different from that in *Ajmer Sw.*, but that in Gr. II is significantly higher (at 5% level). The value in the *Kakko Conc.* is significantly lower (at all levels) from 1954-Grs. I-III. The 1954-Gr. I is not significantly different from that in 1955-Gr. I, but Grs. II and III are significantly higher at 1% and 5% levels.

(iii) *7-stripped males*: The value in 1954-Gr. III is not significantly different from that in *7-sol.* and 1955-Gr. I. No males occurred in *Kakko Conc.* and in 1954-Gr. II and only one in 1954-Gr. I.

(iv) *7-stripped females*: No data are available for comparison, only one female occurring in Grs. I and II and none in Gr. III.

(f) Sexual Dimorphism Percentage (S.D.P.)

The S.D.P. \pm S.E. varies as follows:—

1954-population (and eye-stripes)	S.D.P.	Other populations (and eye-stripes)	S.D.P.
Gr. I(6)	3.59 \pm 2.22	1955-Gr. I(6)	1.36 \pm 1.10
Gr. II(6)	2.26 \pm 0.28	<i>Kakko Conc.</i> (6)	2.91 \pm 0.73
Gr. III(6)	1.80 \pm 1.03	<i>6-greg.</i>	3.69 \pm 1.40

In the 6-stripped category, the values in 1954-Grs. I-III are not significantly different from those in 1955-Gr. I, *6-greg.* and the *Kakko Conc.* at all levels. No comparison was made in 7-stripped category due to lack of data.

7. Ratio E/C

(Tables 8, 9 and 13 and Text-fig. 14)

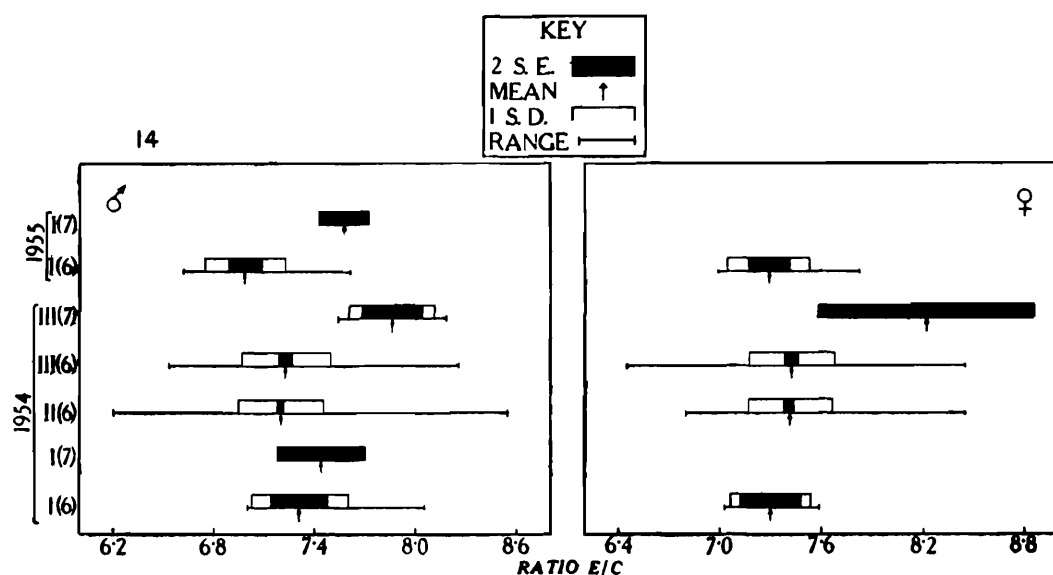
(a) Mean values

The values for E/C are as follows:—

Group (and eye-stripes)	Males	Females	Difference
Gr. I(6)	7.31 \pm 0.08	7.30 \pm 0.09	0.01 \pm 0.13
Gr. II(6)	7.20 \pm 0.01	7.45 \pm 0.01	0.25 \pm 0.014
Gr. III(6)	7.21 \pm 0.02	7.43 \pm 0.02	0.22 \pm 0.03
Gr. I(7)	7.44 \pm 0.13	—	—
Gr. II(7)	—	—	—
Gr. III(7)	7.86 \pm 0.09	8.22 \pm 0.32	0.36 \pm 0.23

(b) Inter-group comparison (Table 9)

6-stripped: In both sexes, the values in Grs. I-III are not significantly different from one another.



TEXT-FIG. 14. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S.E.) and standard deviation (S.D.) in various populations regarding the ratio E/C (Length of elytron/width of head at genal level). For explanations see text and text-figure 1.

7-striped: Males: The value in Gr. I is significantly lower than in Gr. III at the 5% level; no males occurred in Gr. II. *Females:* Only one female occurred in Grs. I and II; hence comparison could not be made.

(c) *Inter-sex comparison* (Table 8)

Within each group, the values in males are not significantly different from females, except in Grs. II(6) and III(6), where the values in females are significantly higher at all levels.

(d) *Inter-eye-stripe comparison* (Table 8)

Males: Within the same group, the value in Gr. I(6) is not significantly different from that in Gr. I(7), but that in Gr. III(6) is significantly lower than that in Gr. III(7) at all levels. *Females:* Within the same group, the value in Gr. III(6) is significantly lower than in Gr. III(7) at all levels. Only one female occurred in Grs. I(7) and II(7).

(e) *Inter-population comparison* (Table 13)

The three 1954-Groups compare with other populations (data given below) as follows:—

Other populations (and eye-stripes)	Mean \pm S.E.	
	Males	Females
1955-Gr. I(6)	6.98 \pm 0.05	7.79 \pm 0.058
1955-Gr. I(7)	7.57 \pm 0.075	—

(i) *6-striped: Males:* The value in the 1955-Gr. I is significantly lower than in 1954-Gr. I-III at all levels. *Females:* The value in 1955-Gr. I is not significantly different from that in 1954-Gr. I, but is significantly lower than in Gr. II (at 1% level) and Gr. III (at 5% level).

(ii) *7-striped : Males* : The value in 1955-Gr. I is not significantly different from that in 1954-Grs. I and III ; no males occurred in Gr. II. *Females* : No comparison could be made due to lack of data, no females occurred in 1955-Gr. I.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

The S.D.P. \pm S.E. varies as follows :—

1954-population (and eye-stripes)		S.D.P.	Other populations (and eye-stripes)		S.D.P.
Gr. I(6)		-0.14 ± 1.66	1955-Gr. I(6)		4.44 ± 1.12
Gr. II(6)		3.47 ± 0.23	1955-Gr. II(6)		2.74 ± 0.25
Gr. III(6)		3.05 ± 0.39	1955-Gr. III(6)		0.63 ± 1.79
Gr. III(7)		4.58			

In the 6-striped category, the values in 1954-Grs. I-III are not significantly different from those in 1955-Grs. I-III. No comparisons were possible in 7-striped category due to lack of data.

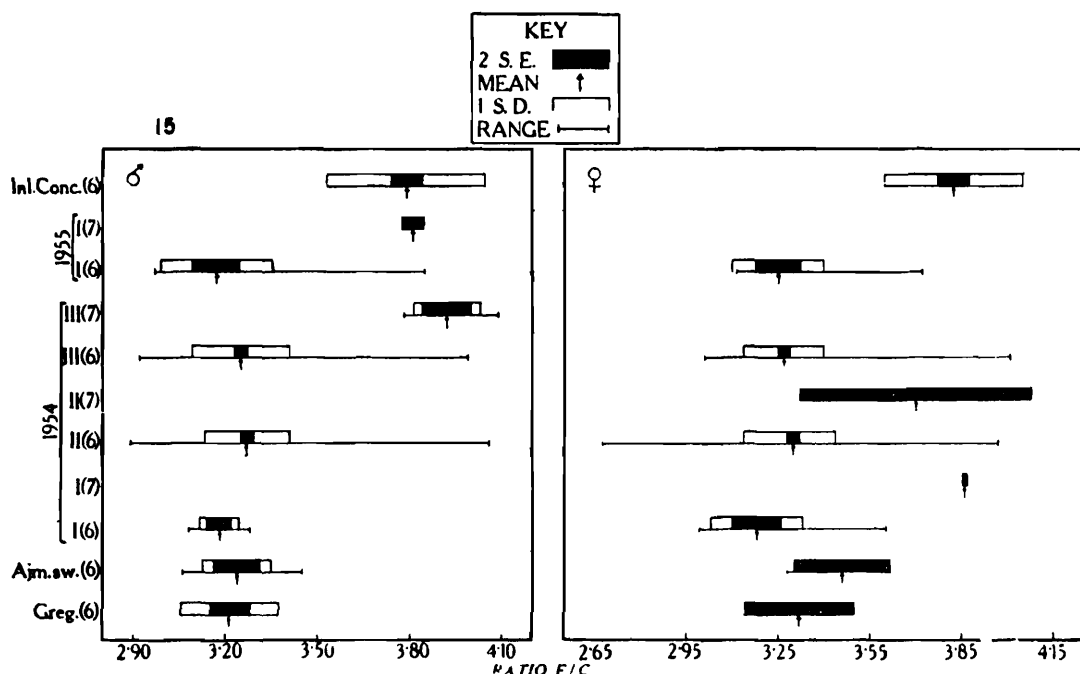
8. *Ratio F/C*

(Tables 8-11, 13-15 and Text-fig. 15)

(a) *Mean values*

The values for F/C are as follows :—

Groups (and eye-stripes)	Males	Females	Difference
Gr. I(6)	3.18 ± 0.02	3.18 ± 0.04	0.0 ± 0.0
Gr. II(6)	3.27 ± 0.01	3.30 ± 0.01	0.03 ± 0.01
Gr. III(6)	3.25 ± 0.01	3.27 ± 0.01	0.02 ± 0.01
Gr. I(7)	—	3.86 ± 0.007	—
Gr. II(7)	—	3.70 ± 0.19	—
Gr. III(7)	3.92 ± 0.04	—	—



TEXT-FIG. 15. *Schistocerca gregaria*. Dicegram to show variance in range, mean and its confidence limits (2 S. E.) and standard deviation (S.D.) in various populations regarding the ratio F/C (Length of hind-femur/width of head at genal level). For explanations see text and text-figures 1, 2 and 6.

(b) *Inter-group comparison* (Table 9)

6-stripped : Males : The value in Gr. I is significantly lower than in Grs. II and III at all levels, and that in Gr. II is significantly higher from that in Gr. III (at 5% level). *Females :* The value in Gr. I is significantly lower than in Gr. II (at 1% level) and Gr. III (at 5% level). The value in Gr. II is significantly higher than in Gr. III at 1% level.

7-stripped : Males : Only one male occurred in Gr. I and none in Gr. II ; hence no comparison could be made. *Females :* The value in Gr. I is not significantly different from that in Gr. II ; no females occurred in Gr. III.

(c) *Inter-sex comparison* (Table 8)

Within each group, the value in males is significantly lower than in females, except in Gr. I(6) where no significant difference is noticed between the sexes.

(d) *Inter-eye-stripe comparison* (Table 8)

Males : Within the same group, in the 6-stripped category, the value in Gr. III is significantly lower than that in 7-stripped ones at all levels. Only one male occurred in Gr. I(7) and none in Gr. II(7). *Females :* Within the same group, in the 6-stripped category, the values in Grs. I and II are significantly lower than in the 7-stripped one at all levels and 5% levels respectively. No females occurred in Gr. III(7).

(e) *Inter-population comparison*

(Tables 10, 11, 13-15)

The three 1954-Groups compare with other populations (data given below) as follows :—

<i>Other populations (and eye-stripes)</i>	<i>Mean ± S.E.</i>	
	<i>Males</i>	<i>Females</i>
<i>6-greg.</i>	3.223 ± 0.032	3.320 ± 0.032
<i>Ajmer Sw. (6)</i>	3.237 ± 0.036	3.458 ± 0.079
<i>Kakko Conc. (6)</i>	3.790 ± 0.024	3.824 ± 0.027
1954-Gr. I(6)	3.17 ± 0.038	3.25 ± 0.037
1954-Gr. I(7)	3.81 ± 0.016	—

(i) *6-stripped males :* The values in 1954-Grs. I-III are not significantly different from those in typical *6-greg.* and the *Ajmer Sw.*, but are significantly lower (at all levels) than in the *Kakko Conc.* The value in 1954-Gr. I is not significantly different from that in 1954-Gr. I, but the values in 1954-Grs. II and III are significantly higher (at 5% level) than in 1954-Gr. I.

(ii) *6-stripped females :* The value in 1954-Grs. II and III are not significantly different (at all levels) than in typical *6-greg.*, but that in Gr. I is significantly lower (at 5% level). The value in 1954-Grs. I-III is significantly lower than in the *Ajmer Sw.* at 1%, 5% and 5% levels respectively ; and from the *Kakko Conc.* at all levels. The value in 1954-Grs. I-III is not significantly different than in 1954-Gr. I.

(iii) *7-stripped males*: The value in 1954-Gr. III is not significantly different from that in 1955-Gr. I at all levels. No males occurred in Gr. II and only one in Gr. I.

(iv) *7-stripped females*: The value in 1954-Grs. I and II could not be compared with others due to lack of data; no females occurred in Gr. III.

(f) *Sexual Dimorphism Percentage (S.D.P.)*

The S.D.P. \pm S.E. varies as follows:—

<i>1954-population (and eye-stripes)</i>	<i>S.D.P.</i>	<i>Other populations (and eye-stripes)</i>	<i>S.D.P.</i>
Gr. I(6)	0.0 \pm 1.51	1955-Gr. I(6)	2.52 \pm 1.71
Gr. II(6)	0.92 \pm 0.32	<i>Kakko Conc.</i> (6)	0.90 \pm 0.96
Gr. III(6)	0.62 \pm 0.54	<i>6-greg.</i>	2.69 \pm 1.42

In the 6-striped category, the values in 1954-Grs. I-III are not significantly different from those in 1955-Gr. I, typical *6-greg.* and the *Kakko Conc.* No comparison was possible in the 7-striped category due to lack of data.

9. *General conclusions regarding morphometric ratios*

(a) *Inter-group variation in the 1954-population*

(i) In the 6-striped category males do not show much group differences in the ratios P/C, E/F and E/C. Females, however, show pronounced group divergence particularly in the ratios P/C, M/C, H/C, E/W₁, and F/C. The ratio E/F shows no group difference in either sex. The most significant and sensitive ratios are M/C, H/C and F/C for both the sexes. Compared to the morphometric measurements, the results obtained from the ratios are almost similar. In females, Gr. I differs from Grs. II and III in almost all the ratios; the latter two groups also differ from each other particularly in ratios P/C, M/C, H/C and F/C.

(ii) From inter-sex comparison, it is seen that in the 6-striped individuals, females outstrip the ratio for males and the values are significantly higher, more particularly in Group II (and for ratios E/W₁, F/C, E/C, H/C and M/C in Group III).

(iii) In inter-eye-stripe comparison, it is seen that 6-striped individuals have significantly smaller ratios than 7-striped ones in all Groups.

(b) *Inter-relation between 1954-population and 1955-Gr. I population*

The ratios P/C, M/C, H/C, E/W₁, E/F, E/C and F/C have been utilized for comparing the 1954-Grs. I-III and the 1955-Gr. I population, which was the succeeding population to 1954-population (particularly to the 1954-Gr. III) and which, according to Roonwal and Bhanotar (1966), was of a *gregaria* nature.

(i) *1954-Gr. I versus 1955-Gr. I: Males*: In the 6-striped category, the ratio P/C, M/C, E/C (at 1% level) and H/C (at 5% level) have significantly higher values in 1954-Gr. I than in 1955-Gr. I. *Females*: No significant difference is found in 6-striped specimens.

(ii) *1954-Gr. II versus 1955-Gr. I : Males* : In the 6-striped category, the ratios E/C (at all levels) and F/C (at 5% level) have significantly higher values in the 1954-Gr. II than in the 1955-Gr. I population. *Females* : In the 6-striped category, the ratios P/C and E/C have significantly higher values in 1954-Gr. II than in 1955-Gr. I (at 0.1% and 1% levels respectively).

(iii) *1954-Gr. III versus 1955-Gr. I : Males* : In the 6-striped category, significant differences are noted between 1954-Gr. III and 1955-Gr. I in the ratios P/C, E/C (at all levels) and M/C and F/C (at 5% level) the former (1954-Gr. III) having higher values for ratios P/C, E/C and F/C than the latter (1955-Gr. I), except in M/C, where the value in 1954-Gr. III is significantly lower than in 1955-Gr. I at 5% level. *Females* : In the 6-striped category, the ratios P/C and E/C are significantly higher (at all levels and at the 5% level respectively) and M/C and H/C lower (at all levels and at the 5% level respectively) in 1954-Gr. III than in 1955-Gr. I.

(c) *Comparison between the 1954-Groups, the Ajmer Sw. and the Kakko Conc.*

The most sensitive ratios viz., P/C, E/F and F/C, were used for finding the affinity between the 1954-population (Grs. I-III), the *Ajmer Swarm* of 1950 (*gregaria* in nature) and the *Kakko Conc.* of 1949 (intermediate between *gregaria* and *solitaria*) and the results are discussed below:—

P/C : In the 6-striped category, the value for males and females in Grs. I and II are significantly higher than in the *Ajmer Sw.*, but lower than in the *Kakko Conc.*, the value in Gr. III is significantly higher than in the *Ajmer Sw.* and lower than in the *Kakko Conc.*

E/F : In the 6-striped category, the values for males in Grs. I, II and III are significantly higher than in the *Kakko Conc.*; the value in Gr. III is significantly lower than in the *Ajmer Sw.* For females, the value in Grs. I and II are significantly higher than in the *Kakko Conc.*, and in Gr. III it is lower. The Gr. II value is significantly higher than in the *Ajmer Sw.*

F/C : In the 6-striped category, for males, the value in Grs. I and II are significantly lower, and in Gr. III higher, than in the *Kakko Conc.* For females, the values in Grs. I-III are significantly lower than in both the *Ajmer Sw.* and the *Kakko Conc.*

(d) *Phase status of the 1954-Groups (I-III) regarding ratios*

The ratios (P/C, E/F and F/C) for the 1954-Groups are compared below with those in the typical *gregaria* and one ratio (E/F) in typical *solitaria* populations (the data for the other ratios are not available).

P/C : In both sexes, the 6- and 7- eye-striped individuals (in Grs. I-III) have significantly higher ratios (at 1% and at all levels) than in the typical *6-gregaria*.

E/F : In the 6-striped category, in both sexes (in Grs. I-III) no difference is found from the *6-greg.* (except for Gr. III, where the value

is significantly higher than in *6-greg.*). But they are significantly larger than 6- and 7- striped *sol.* (at all levels).

F/C: Only in females, for Gr. I, in the 6-striped category, the ratio is significantly lower (at 5% level) than in *6-greg.*

VII—DISCUSSION AND CONCLUSIONS

The divergence between the three groups (I-III) of the 1954-population is more pronounced in females than in males, and in 6-striped individuals than in 7-striped ones. The divergences are best noticeable in the width of pronotum at the constriction (M). In males, characters O, C, P, E and F show no significant difference between the groups. It is not clear whether Gr. I is more in agreement with Gr. II than with Gr. III, but a decided difference is seen between the latter two groups, particularly in the case of females. A high degree of sexual dimorphism occurs in all the groups. Eye-stripes (6- and 7-) variation is markedly high in Gr. III.

The three groups are best differentiated by the ratios M/C, F/C and H/C, and least so by the ratios E/F, E/C and P/C (for males only). It appears that Gr. I is as much apart from Gr. II as from Gr. III, the latter two groups being highly discordant. Sexual difference is uniformly high for all ratios in Gr. II and moderately high for Gr. III, but in Gr. I no such difference is noted. Among the 7-striped individuals, inter-group and inter-sex differences are the lowest. Inter-eye-stripe differences are well marked in respect of the ratios, and the difference is more pronounced in Gr. III, than in any other group.

For examining the gradual change from *gregariaform* to *solitariaform* morphometry that might have occurred in the 1954-population, it is compared with the 1955-Gr. I with regard to eight body-parts and seven ratios. Regarding morphometric characters the 1954-Gr. I is nearer the 1955-Gr. I, than are 1954-Grs. II and III, particularly for males. Females and 7-striped forms show less difference between the groups. It is interesting to note that the length of pronotum (P) is found to be the best differentiating character for such comparison. In respect of morphometric ratios, the 1954-Gr. II appears to be less at variance with 1955-Gr. I as compared to the other groups.

Comparison of the 1954-Groups with the *Ajmer Swarm* (1950) and the *Kakko Concentration* (1949), has been made, utilizing four morphometric characters (C, P, E and F) and three ratios (P/C, E/F and F/C). Generally speaking, the 1954-Groups are intermediate between the *Ajmer Swarm* and the *Kakko Concentration*, but are closer to the former. As to the degree of this affinity of each of the groups, it can be stated that Gr. I is nearer to the *Ajmer Swarm* than are Grs. II and III.

The phase-status of the 1954-Groups has been assessed by utilizing four characters (C, P, E and F) and three ratios (P/C, E/F and F/C). Only E, F and E/F are, however, available for comparison in phase *solitaria*. The following are the noteworthy points as evidenced by each of the characters and ratios:—

For C in the 1954-Groups, females differ less from *gregaria* than do males. For P, the disparity between *gregaria* and the 1954-Groups, particularly Grs. I and III, is less pronounced. For E, females show a decided difference between the 1954-Groups and phase *solitaria*, but males show no such difference from either phase. For F, the 1954-Groups differ more from *solitaria* than from *gregaria*. The ratio P/C shows considerable difference between the 1954-groups and phase *gregaria*, E/F differentiates the 1954-Groups from the phase *solitaria* appreciably, but not from phase *gregaria*, F/C show very little or no difference between the 1954-groups and phase *gregaria*.

For judging the affinity of the groups to either of the phases, only E, F and E/F for which data are available for both *solitaria* and *gregaria* phases are taken into consideration. On the basis of these three variables, the 1954-groups may be considered closer to the *gregaria* than to the *solitaria* phase. Another notable point is that the length of hind-femur (F) is found to be a very sensitive character in detecting variation between the 1954-Groups and the typical phases.

The occurrence of over 80% 6-eye-striped individuals and of an equal proportion of the sexes (in 6-striped forms) in all the 1954-Groups (I-III), point towards the *gregaria* features of the population in accordance with Roonwal's Hypotheses (Roonwal, 1945). Furthermore, the occurrence of 7-eye-striped individuals in Grs. I (14.86%), II (0.23%) and III (2.16%) would suggest that the *gregaria* character is being "softened", as indicated by Roonwal (1955) for that same population.

Trends in the 1954-population

One of the characteristics of the phase *gregaria* population is that during swarming period, the "constancy" in various characters is maintained in eye-stripe composition, sex-ratios and morphometric characters and, as stated by Roonwal (1954), this phase is a variation-stable. This stability appears to be shaken in the 1954-population, particularly in the characters relating to the pronotum, head and hind-femur *viz.*, M, M/C, H/C and F/C and this further confirms the decline of the *gregaria* nature of the 1954-population.

Thus, one more lacuna (that for the 1954-population) has been filled in our knowledge of the dynamics of the morphometric characteristics and changes occurring in the various populations of the 1949-55 Swarming Cycle in India. Data for some crucial periods in the cycle have already been provided by Misra (1952) for the *Kakko Concentration* of 1949 (which started this cycle), Roonwal and Misra (1952) for a swarm of 1950, Roonwal (1955) for a small swarm of 1954 and Roonwal and Bhanotar (1966) for the 1955-population.

VIII—SUMMARY

1. For the 1954-Desert Locust population in India, random samples, consisting of 1819 individuals, were obtained for analysis, grouped under three homogenous groups, *viz.*, I (January—April), II (May—August) and III (September—December). The results are summarized below :

2. *Sex-ratios*: In the 6-striped category, the proportion of the two sexes are almost equal in all the three 1954-Groups, thereby indicating the *gregaria* nature of the population (Roonwal's Second Hypotheses, 1945).

3. *Eye-stripe composition*: The high proportion of 6- eye-striped individuals in the 1954-Gr. I (85.14%), II (99.77%) and III (97.84%), further points towards the *gregaria* nature of the population (Roonwal's first Hypotheses, 1945).

4. However, in such a *gregaria* population the appearance of 7-striped individuals, in all the three groups lead us to presume that a "softening" of the *gregaria* phase has occurred and this gives us a hint of the probable decline of the cycle in India, as also indicated by Roonwal (1955), for a small 1954-swarm, and as was confirmed by subsequent events (the 1949-55 Cycle having ended in 1955).

5. *Inter-group comparison*: The character C (for females) and H and M (for both sexes), show a high degree of divergence in the three groups; this is true to some extent for characters O, P, F and W_1 (females only). The character E is less sensitive in this respect. The characters O, C, P, E and F show no difference among the groups in males. On the whole, for majority of the characters, Group I differs from Grs. II and III in the case of females only, and the latter two groups show maximum difference among themselves (for both sexes).

6. *Inter-sex comparison*: In the majority of the morphometric characters, the values in females are significantly higher than in males.

7. *Ratios*: The three groups are best differentiated by the ratios H/C, M/C and F/C.

8. From the inter-population comparison of the 1954-Groups (I-III) with 1955-Gr. I (of *gregaria* nature), it is seen that the 1954-Gr. I is nearer the 1955-Gr. I, as is best demonstrated by the length of the pronotum (P). On comparison with the *Ajmer Swarm* (1950) and the *Kakko concentration* (1949) populations—the former for *gregaria* facies and latter intermediate between *gregaria* and *solitaria*—the 1954-groups are found to be closer to the *Ajmer Swarm* and this is especially so in respect of the 1954-Gr. I.

9. Comparison with "typical" phase data (*i.e.* typical *gregaria* and *solitaria*), the ratio P/C shows a marked difference between the 1954-groups and ph. *gregaria*; E shows a lesser difference. The character F is found to be the most sensitive in detecting variation between the 1954-groups and the phases.

10. It may be concluded that the stability of characters and eye-stripes, which is characteristic of a *gregaria* or swarming population, appears to be shaken in the 1954-population in India which, though broadly *gregaria* in nature, indicates a softening or weakening of the *gregaria* characteristics. The effect of this weakening is evident in the immediately succeeding populations of the year 1955, in which year the cycle came to an end. Thus, one more lacuna has been filled in our knowledge of the characteristics of a Desert Locust population in the Swarming Cycle of 1949-55, the characteristics of some of the other crucial years (1949 and 1955) having already been studied earlier.

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TABLE 1.—*Schistocerca gregaria*. Groupwise and monthly distribution of eye-stripe composition (6- and 7- striped) and sex-ratios in 1954-population in India.

Abbreviations : As in text.

Group	Month	6-striped		7-striped		Total	
		♂	♀	♂	♀	♂	♀
I	January	4 (100%)	0 (0%)	2 (66.7%)	1 (33.3%)	6 (85.7%)	1 (14.3%)
	February	4 (80%)	1 (20%)	1 (50%)	1 (50%)	5 (71.4%)	2 (28.6%)
	March	1 (50%)	1 (50%)	0 (0%)	4 (100%)	1 (16.7%)	5 (83.3%)
	April	23 (44.2%)	29 (55.8%)	0 (0%)	2 (100%)	23 (42.6%)	31 (57.4%)
Total for Group I		32 (50.8%)	31 (49.2%)	3 (27.3%)	8 (72.7%)	35 (49.3%)	39 (52.7%)

TABLE 1.—(Continued)

Group	Month	6-striped		7-striped		Total	
		♂	♀	♂	♀	♂	♀
II	May	48 (57.8%)	35 (42.2%)	0 (0%)	0 (0%)	48 (57.8%)	35 (42.2%)
	June	296 (53.4%)	258 (46.6%)	0 (0%)	2 (100%)	296 (53.2%)	260 (46.8%)
	July	259 (53%)	230 (47%)	0 (0%)	1 (100%)	259 (52.9%)	231 (47.1)
	August	94 (61.8%)	58 (38.2%)	0 (0%)	0 (0%)	94 (61.8%)	53 (38.2%)
Total for Group II		697 (54.5%)	581 (45.5%)	0 (0%)	3 (100%)	697 (54.4%)	584 (45.6%)
III	September	99 (59.3%)	68 (40.7%)	4 (66.7%)	2 (33.3%)	103 (59.5%)	70 (40.5%)
	October	46 (36.2%)	81 (63.8%)	0 (0%)	0 (0%)	46 (36.2%)	81 (63.8%)
	November	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)
	December	84 (52.8%)	75 (47.2%)	3 (75%)	1 (25%)	87 (53.4%)	76 (46.6%)
Total for Group III		230 (50.7%)	224 (49.3%)	7 (70%)	3 (30%)	237 (51.1%)	227 (48.9%)

TABLE 2. — *Schistocerca gregaria*. Number and distribution of samples Groups (I-III) according to sex and eye-strips in the 1954-population in India.

Abbreviations : As in text.

Group (and period)	Number of individuals						Number of individuals in both sexes		
	♂			♀			6-eye-strips	7-eye-strips	Total (6 & 7)
	6-eye-strips	7-eye-strips	Total (6 & 7)	6-eye-strips	7-eye-strips	Total (6 & 7)			
Gr. I (January-April)	32	3	35	31	8	39	63	11	74
Gr. II (May-August)	697	—	697	581	3	584	1278	3	1281
Gr. III (September-December)	230	7	237	224	3	227	454	10	464
All Groups (I-III)	959	10	969	836	14	850	1795	24	1819

TABLE 3. — *Schistocerca gregaria*. Sex ratio (irrespective of eye-stripes) in the 1954-population in India.*Abbreviations* : As in text.

Groups (and period)	Percentage of each sex + S.E.	
	♂	♀
Gr. I (January-April)	59.32±5.81	52.70±5.81
Gr. II (May-August)	54.41±1.43	45.59±1.42
Gr. III (September-December)	51.08±2.37	48.92±2.37
Total (all groups)	53.27±1.17	46.73±1.17

TABLE 4. — *Schistocerca gregaria*. Percentage of eye-stripes (6- and 7-) irrespective of sexes and their distribution in sexes in the 1954-population in India.

Abbreviations : As in text.

Group	Percentage of eye-stripes irrespective of sex \pm S.E.*		Sex-ratio (\pm S.E.*) in each eye-stripe group			
	6-eye-stripes	7-eye-stripes	6-eye-stripes		7-eye-stripes	
			♂	♀	♂	♀
I	85.14 \pm 4.13	14.86 \pm 4.14	50.79 \pm 6.30	49.21 \pm 6.30	27.27 \pm 13.45	72.73 \pm 13.43
II	99.77 \pm 0.13	0.23 \pm 0.14	54.54 \pm 1.39	45.46 \pm 1.39	0	0
III	97.84 \pm 0.69	2.16 \pm 0.69	50.66 \pm 2.35	49.34 \pm 2.35	70.00 \pm 14.49	30.00 \pm 14.49
All groups	98.68 \pm 0.27	1.32 \pm 0.27	53.43 \pm 1.18	46.57 \pm 1.18	41.67 \pm 10.06	58.33 \pm 10.06

*S.E., Standard Error.

TABLE 5. — *Schistocerca gregaria*. Sex-ratio and proportion of 6- and 7- eye-stripes individuals in the 1954-population in India.

Abbreviations : As in text.

Groups	Percentage of eye-stripes in each sex±S.E.*			
	♂		♀	
	6-eye-stripes	7-eye-stripes	6-eye-stripes	7-eye stripes
I	91.43±4.75	8.57±4.75	79.49±6.45	20.51±6.45
II	100.00	0	99.49±0.29	0.51±0.29
III	97.05±1.09	2.95±1.09	98.63±0.76	1.32±0.76
All groups	98.97±0.31	1.03±0.32	98.35±0.45	1.65±0.45

*S.E., Standard Error.

TABLE 6. — *Schistocerca gregaria*. Inter-sex and inter-eye-stripe comparison of morphometric characters between Groups I-III of the 1954-population in India.

Abbreviations : As in text.

Groups, sex and eye-stripes	Characters							
	O	C	P	H	M	E	W ₁	F
1. Inter-sex								
<i>6-eye-stripes</i>								
I ♂ : I ♀	**	***	***	***	***	**	***	*
II ♂ : II ♀	***	***	***	***	***	***	***	***
III ♂ : III ♀	***	***	***	***	***	***	***	***
<i>7-eye-stripes</i>								
I ♂ : I ♀	NS	*	NS	*	NS	—	**	—
II ♂ : II ♀	—	—	—	—	—	—	—	—
III ♂ : III ♀	*	**	**	**	***	**	**	—
2. Inter-eye-stripes								
<i>Males</i>								
I(6) : I(7)	NS	NS	NS	NS	NS	NS	NS	—
II(6) : II(7)	—	—	—	—	—	—	—	—
III(6) : III(7)	NS	***	NS	NS	NS	NS	**	***
<i>Females</i>								
I(6) : I(7)	NS	*	NS	**	NS	—	NS	**
II(6) : II(7)	NS	NS	NS	NS	NS	NS	NS	***
III(6) : III(7)	NS	***	**	*	*	**	NS	—

TABLE 8. — *Schistocerca gregaria*. Inter-sex and inter-eye-stripe comparison of various ratios between Groups I-III of 1954-population in India.

Abbreviations : As in text.

Groups, sex and eye-stripes	Ratios						
	P/C	M/C	H/C	E/W ₁	E/F	E/C	F/C
<i>1. Inter-sex comparison</i>							
<i>6-eye-stripes</i>							
I ♂ : I ♀	NS	NS	NS	NS	NS	NS	NS
II ♂ : II ♀	***	***	***	***	***	***	**
III ♂ : III ♀	NS	***	*	**	NS	***	*
<i>7-eye-stripes</i>							
I ♂ : I ♀	NS	NS	NS	—	—	—	—
II ♂ : II ♀	—	—	—	—	—	—	—
III ♂ : III ♀	NS	NS	NS	NS	—	NS	—
<i>2. Inter-eye-stripes comparison</i>							
<i>Males</i>							
I(6) : I(7)	NS	***	***	*	—	NS	—
II(6) : II(7)	—	—	—	—	—	—	—
III(6) : III(7)	***	***	***	***	NS	***	***
<i>Females</i>							
I(6) : I(7)	***	***	***	—	—	—	***
II(6) : II(7)	**	NS	**	—	—	—	*
III(6) : III(7)	***	***	***	NS	—	***	—

TABLE 9. — *Schistocerca gregaria*. Inter-group comparison of ratios (within same sex and eye-stripe category) between Groups I-III of 1954-population in India.

Abbreviations : As in text.

Groups, sex and eye-stripes	Ratios						
	P/C	M/C	H/C	E/W ₁	E/F	E/C	F/C
	<i>Inter-group comparison</i>						
<i>Males</i>							
I(6) : II(6)	NS	**	**	NS	NS	NS	***
I(6) : III(6)	NS	***	***	NS	NS	NS	***
I(7) : II(7)	—	—	—	—	—	—	—
I(7) : III(7)	NS	**	NS	NS	—	*	—
II(6) : III(6)	NS	***	*	***	NS	NS	*
II(7) : III(7)	—	—	—	—	—	—	—
<i>Females</i>							
I(6) : II(6)	**	***	NS	NS	NS	NS	**
I(6) : III(6)	*	***	*	NS	NS	NS	*
I(7) : II(7)	NS	**	NS	—	—	—	NS
I(7) : III(7)	NS	NS	*	—	—	—	—
II(6) : III(6)	*	***	***	**	NS	NS	**
II(7) : III(7)	NS	NS	NS	—	—	—	—

TABLE 10.— *Schistocerca gregaria*. Inter-population comparison of mean \pm S.E. values, for characters C, P, E, F and ratios P/C, E/F, F/C between Gr. I-1954-population and other known populations (Ajmer Swarm of 1950 and Kakko Concentration of 1949 in India.

Abbreviations : *Ajm.*, Ajmer Swarm of 1950; *K.*, Kakko Concentration of 1949; For further explanation and other abbreviations, see text.

1954-Gr. I Compared with known populations	Characters				Ratios		
	C	P	E	F	P/C	E/F	F/C
<i>Males</i>							
I(6) : Ajm(6)	NS	NS	NS	NS	*	NS	NS
I(6) : K(6)	***	*	NS	NS	***	*	***
I(7) : Ajm(6)	*	NS	NS	—	***	—	—
I(7) : K(6)	NS	NS	NS	—	NS	—	—
<i>Females</i>							
I(6) : Ajm(6)	NS	NS	NS	*	NS	NS	**
I(6) : K(6)	***	NS	NS	***	***	***	***
I(6) : K(7)	—	—	*	***	—	***	—
I(7) : Ajm(6)	NS	NS	—	NS	*	—	***
I(7) : K(6)	NS	NS	—	NS	NS	—	NS
I(7) : K(7)	—	—	—	NS	—	—	—

TABLE 11.—*Schistocerca gregaria*. Inter-population comparison of mean \pm S.E. values, for characters C, P, E, F and ratios P/C, E/F, F/C, between Grs. II and III of 1954-population and other known populations (Ajmer Swarm of 1950 and Kakko Concentration of 1949) in India.

Abbreviations : As in Table 10.

1954-Gr. II and III compared with known populations	Characters				Ratios		
	C	P	E	F	P/C	E/F	F/C
<i>Males</i>							
II(6) : Ajm(6)	**	NS	**	*	***	NS	NS
II(6) : K(6)	***	***	*	***	***	***	***
II(7) : Ajm(6)	—	—	—	—	—	—	—
II(7) : K(6)	—	—	—	—	—	—	—
<i>Females</i>							
II(6) : Ajm(6)	NS	NS	NS	*	NS	*	*
II(6) : K(6)	***	NS	***	***	***	***	***
II(6) : K(7)	—	—	**	***	—	***	—
II(7) : Ajm(6)	NS	NS	NS	NS	NS	—	NS
II(7) : K(6)	NS	NS	NS	NS	NS	—	NS
II(7) : K(7)	—	—	NS	NS	—	—	—
<i>Males</i>							
III(6) : Ajm(6)	**	NS	*	**	***	NS	NS
III(6) : K(6)	***	***	**	***	***	***	***
III(7) : Ajm(6)	***	NS	NS	NS	***	***	***
III(7) : K(6)	NS	NS	NS	NS	NS	NS	NS
<i>Females</i>							
III(6) : Ajm(6)	NS	NS	NS	**	NS	NS	*
III(6) : K(6)	***	**	***	***	***	***	***
III(6) : K(7)	—	—	**	***	—	***	—
III(7) : Ajm(6)	NS	*	NS	—	**	—	—
III(7) : K(6)	NS	NS	NS	—	NS	—	—
III(7) : K(7)	—	—	NS	—	—	—	—

TABLE 12. — *Schistocerca gregaria*. Inter-population comparison of mean \pm S.E. values for morphometric characters between 1954-Groups (I-III) and 1955-Gr. I population in India.

Abbreviations : As in text.

Groups		Characters							
1954	1955	O	C	P	H	M	E	W ₁	F
<i>Males</i>									
I(6) : I(6)		NS	NS	*	NS	NS	NS	NS	NS
I(6) : I(7)		NS	NS	NS	NS	NS	NS	NS	NS
I(7) : I(6)		NS	NS	NS	NS	NS	NS	NS	NS
I(7) : I(7)		NS	NS	NS	NS	NS	NS	NS	NS
<i>Females</i>									
I(6) : I(6)		NS	NS	**	NS	NS	NS	NS	NS
I(6) : I(7)		—	—	—	—	—	—	—	—
I(7) : I(6)		**	NS	**	***	***	—	NS	**
I(7) : I(7)		—	—	—	—	—	—	—	—
<i>Males</i>									
II(6) : I(6)		**	NS	**	NS	NS	*	***	*
II(6) : I(7)		NS	***	NS	NS	NS	NS	NS	*
II(7) : I(6)		—	—	—	—	—	—	—	—
II(7) : I(7)		—	—	—	—	—	—	—	—
<i>Females</i>									
II(6) : I(6)		NS	NS	**	NS	NS	NS	NS	NS
II(6) : I(7)		—	—	—	—	—	—	—	—
II(7) : I(6)		NS	NS	**	NS	NS	NS	NS	***
II(7) : I(7)		—	—	—	—	—	—	—	—
<i>Males</i>									
III(6) : I(6)		*	NS	**	NS	**	**	NS	NS
III(6) : I(7)		NS	***	NS	NS	NS	NS	NS	**
III(7) : I(6)		NS	***	NS	NS	NS	NS	NS	***
III(7) : I(7)		NS	NS	NS	NS	NS	NS	NS	NS
<i>Females</i>									
III(6) : I(6)		NS	NS	NS	NS	***	NS	NS	NS
III(6) : I(7)		—	—	—	—	—	—	—	—
III(7) : I(6)		NS	NS	***	NS	NS	**	NS	—
III(7) : I(7)		—	—	—	—	—	—	—	—

TABLE 13.—*Schistocerca gregaria*. Inter-population comparison of mean \pm S.E., for various ratios between 1954-Groups (I-III) and 1955-Gr. I-population.

Groups		Ratios						
1954	1955	P/C	M/C	H/C	E/W ₁	E/F	E/C	F/C
<i>Males</i>								
I(6)	I(6)	**	**	*	NS	NS	***	NS
I(6)	I(7)	NS	*	**	NS	**	NS	***
I(7)	I(6)	***	***	***	*	—	**	—
I(7)	I(7)	NS	NS	NS	NS	—	NS	—
<i>Females</i>								
I(6)	I(6)	NS	NS	NS	NS	NS	NS	NS
I(6)	I(7)	—	—	—	—	—	—	—
I(7)	I(6)	***	***	***	—	—	—	***
I(7)	I(7)	—	—	—	—	—	—	—
<i>Males</i>								
II(6)	I(6)	NS	NS	NS	NS	NS	***	*
II(6)	I(7)	*	*	***	NS	***	***	***
III(7)	I(6)	—	—	—	—	—	—	—
II(7)	I(7)	—	—	—	—	—	—	—
<i>Females</i>								
II(6)	I(6)	***	NS	NS	NS	NS	**	NS
II(6)	I(7)	—	—	—	—	—	—	—
II(7)	I(6)	NS	NS	*	—	—	—	*
II(7)	I(7)	—	—	—	—	—	—	—
<i>Males</i>								
III(6)	I(6)	***	*	NS	NS	NS	***	*
III(6)	I(7)	*	**	***	NS	***	***	***
III(7)	I(6)	***	***	***	**	***	***	***
III(7)	I(7)	NS	NS	NS	NS	NS	NS	NS
<i>Females</i>								
III(6)	I(6)	***	***	*	NS	NS	*	NS
III(6)	I(7)	—	—	—	—	—	—	—
III(7)	I(6)	***	NS	*	NS	—	***	—
III(7)	I(7)	—	—	—	—	—	—	—

TABLE 14.—*Schistocerca gregaria*. Inter-population comparison of mean \pm S. E. values for morphometric characters C, P, E, F and ratios P/C, E/F, F/C-between Gr. I-1954 population and typical phases (*gregaria* and *solitaria*) in India.

Abbreviations : As in text.

1954-Gr. I compared with typical phases	Characters				Ratios		
	C	P	E	F	P/C	E/F	F/C
<i>Males</i>							
I(6) : greg. (6)	**	NS	NS	NS	***	NS	NS
I(6) : sol. (6)	—	—	NS	***	—	***	—
I(6) : sol. (7)	—	—	NS	***	—	***	—
I(7) : greg. (6)	NS	NS	NS	—	***	—	—
I(7) : sol. (6)	—	—	NS	—	—	—	—
I(7) : sol. (7)	—	—	NS	—	—	—	—
<i>Females</i>							
I(6) : greg. (6)	NS	*	NS	*	**	NS	*
I(6) : sol. (6)	—	—	***	***	—	***	—
I(6) : sol. (7)	—	—	***	***	—	***	—
I(7) : greg. (6)	*	*	—	NS	***	—	—
I(7) : sol. (6)	—	—	—	NS	—	—	—
I(7) : sol. (7)	—	—	—	NS	—	—	—

TABLE 15.—*Schistocerca gregaria*. Inter-population comparison of mean \pm S.E. values for morphometric characters C, P, E, F and ratios P/C, E/F and F/C between Grs. II and III — 1954-population and typical phases (*gregaria* and *solitaria*) in India.

Abbreviations : As in text.

1954-Gr. II and III compared with typical phases.	Characters				Ratios		
	C	P	E	F	P/C	E/F	F/C
<i>Males</i>							
II(6) : greg. (6)	***	*	NS	**	***	NS	NS
II(6) : sol. (6)	—	—	NS	***	—	***	—
II(6) : sol. (7)	—	—	NS	***	—	***	—
II(7) : greg. (6)	—	—	—	—	—	—	—
II(7) : sol. (6)	—	—	—	—	—	—	—
II(7) : sol. (7)	—	—	—	—	—	—	—
<i>Females</i>							
II(6) : greg. (6)	NS	*	NS	NS	***	NS	NS
II(6) : sol. (6)	—	—	***	***	—	***	—
II(6) : sol. (7)	—	—	***	***	—	***	—
II(7) : greg. (6)	NS	*	NS	*	NS	—	*
II(7) : sol. (6)	—	—	NS	NS	—	—	—
II(7) : sol. (7)	—	—	NS	NS	—	—	—
<i>Males</i>							
III(6) : greg. (6)	***	NS	NS	***	***	*	NS
III(6) : sol. (6)	—	—	NS	***	—	***	—
III(6) : sol. (7)	—	—	NS	***	—	***	—
III(7) : greg. (6)	***	NS	NS	NS	***	***	***
III(7) : sol. (6)	—	—	NS	NS	—	NS	—
III(7) : sol. (7)	—	—	NS	NS	—	NS	—
<i>Females</i>							
III(6) : greg. (6)	*	NS	NS	**	***	NS	NS
III(6) : sol. (6)	—	—	***	***	—	***	—
III(6) : sol. (7)	—	—	***	***	—	***	—
III(7) : greg. (6)	NS	*	*	—	***	—	—
III(7) : sol. (6)	—	—	NS	—	—	—	—
III(7) : sol. (7)	—	—	NS	—	—	—	—