VARIABILITY IN THE MANDIBLES OF SOLDIERS IN THE TERMITE *ODONTOTERMES OBESUS* (RAMBUR) (ISOPTERA, FAMILY TERMITIDAE)

By

M. L. ROONWAL

Director, Zoological Survey of India, Calcutta

and

S. K. SANGAL

Lecturer in Zoology, D.A.V College, Dehra Dun

(With 7 Text-figures and 10 Tables)

CONTENTS

	PAGE
I—Introduction	1
II—Material and Methods	2
III—Analysis of Variability	5
(*a*) Measurements	
(*b*) Indices	
IV—Conclusions	11
V—Summary	12
VI—References	13

I—INTRODUCTION

The soldier mandibles in the common mound-building termite of north India, *Odontotermes obesus* (Rambur), are, as in other termites, used in taxonomic differentiation between allied species. The paired mandibles in this species (Text-fig. 1), are long, slender and sabre-shaped, with a pointed, incurved tip. On the inner margin there is a tooth which is minute and rudimentary on the right mandible and relatively large and prominent on the left. The more important mandibular taxonomic characters generally used in the genus *Odontotermes* are the following :—

The length of the mandibles in proportion to that of the head ; the shape, curvature and slenderness of the mandibles ; and the size, angle and position of the mandibular tooth, particularly on the left mandible.

Unfortunately, however, the extent of variability of the various characters in regard to the mandibles within any one of the oriental species of the genus *Odontotermes* is not adequately known at all, the published data being based at the most on a few (half a dozen or so) specimens in each species (*vide* Holmgren, 1913 ; Holmgren and Holmgren, 1917 ; Snyder, 1934). To fill up this gap in our knowledge, it was decided to collect and study the data on mandibular variability in at least one species

to start with, and the common species, *Odontotermes obesus* (Rambur), was selected for this purpose. The results of the measurements and the analysis of several characters in three-different populations, totalling 200 individuals, are presented here.

The three Tables 1, 2 and 3 (not those included in this paper), containing the *original* detailed data on measurements, etc., have been deposited in the library of the Forest Entomology Branch, Forest Research Institute, Dehra Dun.

Acknowledgements.—We are indebted to Dr. K. R. Nayar, the Statistician, Forest Research Institute, Dehra Dun, for his kind assistance in the statistical analysis of the data.

II—Material and Methods

Three population samples of 100, 50 and 50 individual soldiers respectively for each of the three separate populations studied, *viz.*, I, II and III, were obtained from three different mounds in the vicinity of Dehra Dun (in the western sub-Himalayan region of Uttar Pradesh, *ca.* 600 metres above sea-level) — two from the New Forest Estate and one from the Jhajra Forest, as follows :—

Population I (100 soldiers) : From Champion Block No. 52, in Demonstration Area, chir pine forest, New Forest Estate. 3. iv. 1955.

Population II (50 soldiers) : From Sample Plot No. 75 in Demonstration Area, chir pine forest, New Forest Estate. 24. vii. 1955.

Population III (50 soldiers) : Jhajra Forest (Dehra Dun Forest Division). 2. viii. 1955.

For each individual soldier the following nine measurements and four indices were taken :—

(a) *Measurements*

1. Length of head-capsule.
2. Width of head-capsule.
3. Minimum length of mandible.
4. Inner length of mandible.
5. Maximum mandibular curvature.
6. Mandibular tooth distance.
7. Width of mandible in level of tooth.
8. Length of mandibular tooth.
9. Tooth-angle. (Measured only for the left mandible.)

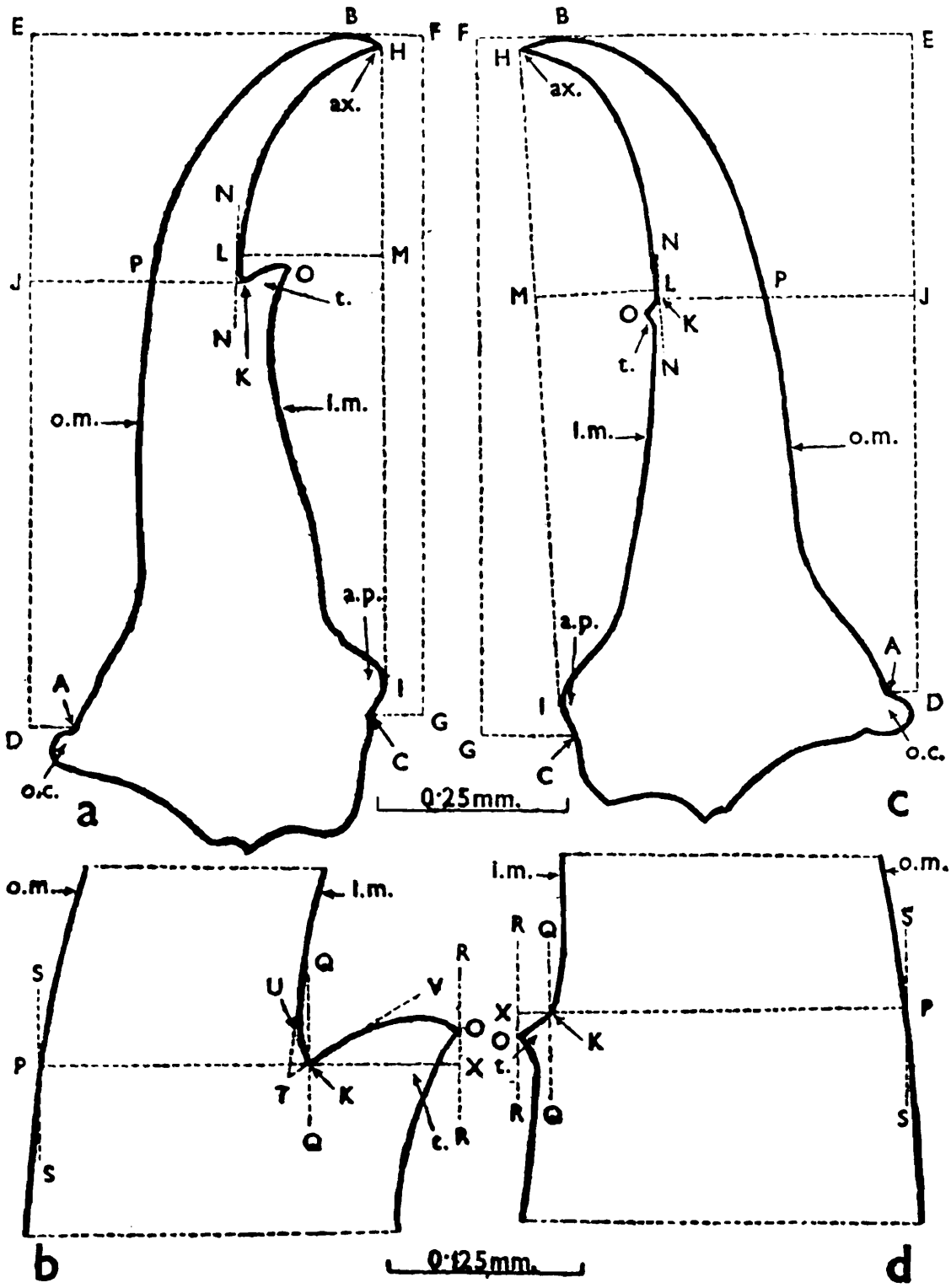
(b) *Indices*

1. Head-Mandible Index (A).
2. Head-Mandible Index (B).
3. Mandibular Tooth Index (A).
4. Mandibular Tooth Index (B).

The measurements were taken under the magnification of a stereobinocular microscope and with the aid of an eye-piece micrometer. For the tooth-angle, which presented considerable difficulty in measuring with accuracy direct from the specimen, an enlarged camera-lucida

sketch of the relevant portion of the mandible was first made for each individual, and the angle measured on the drawing.

The exact definitions of these measurements and indices are given below (also *vide* Text-fig. 1) :—



TEXT-FIG. 1.—Mandibles of *Odontotermes obesus* (Rambur), soldier caste, in dorsal view, to show the method of measuring the various characters in regard to size.

(*a*). Left mandible. (*b*). Middle portion of left mandible enlarged to show the tooth. (*c*). Right mandible. (*d*). Middle portion of right mandible enlarged to show the tooth.

a.p., anterior mandibular process ; *ax.*, apex of mandible ; *i.m.*, inner mandibular margin ; *o.m.*, outer mandibular margin ; *o.c.*, outer mandibular condyle ; *t.*, tooth. (For other lettering, see text.)

Definitions of measurements and indices of head-capsule of termites, especially Odontotermes obesus (*Rambur*) (Text-fig. 1).

(*a*) MEASUREMENTS

1. *Length of head-capsule to lateral base of mandible.*

   Definition : Distance between the two parallels marking the hindmost margin of the head-capsule and the external articulations of the mandibles.

2. *Maximum width of head-capsule.*

   Definition : Distance between the two parallels marking the outermost lateral margins of the head-capsule (including the compound eyes when present). (Separate measurements to be taken for the right and the left mandibles.)

3. *Maximum length of mandible* (Text-figs. 1*a*, *c* ; line D-E).

   Definition : Distance DE between the two parallels, AD and BE, marking the notch A at the upper base of the outer mandibular condyle and the most distal point B of mandible.

4. *Inner length of mandible* (Text-figs. 1*a*, *c* ; line G-F).

   Definition : Distance GF between the two parallels, CG and BF. marking the base (innermost proximal point) C of the anterior molar process and the most distal tip B of the mandible.

5. *Maximum mandibular curvature* (Text-figs. 1*a*, *c* ; line L-M).

   Definition : Greatest perpendicular distance between the two parallels NN and HI, marking the point L of maximum curvature of the inner edge of the mandible and the most projecting point I of the anterior molar process of mandible to the apex H of the mandible.

6. *Mandibular tooth distance from the distal tip* (Text-figs. 1*a*, *c* ; line E-J).

   Definition : Distance between the two parallels JK and BE marking the distal point K of the origin of tooth from the inner edge of the mandible and the most distal point B of the mandibular blade.

7. *Width of mandible in level of mandibular tooth* (Text-figs. 1*a—d* ; line K-P).

   Definition : Distance between the two parallels QQ and SS marking the distal point K of the origin of mandibular tooth from the mandibular blade and the farthest edge P of the outer surface of the mandible in that level.

8. *Length of the mandibular tooth* (Text-figs. 1*b*, *d* ; line K-X).

   Definition : Distance between the two parallels QQ and RR marking the distal point K of the origin of the mandibular tooth from the mandibular blade and the farthest tip O of the tooth.

9. *Tooth-angle* (Text-figs. 1*b* ; angle UTV).

   Definition : Angle in the *left* mandible between the two lines, *viz.* UT (marking the backward projection from the innermost margin of the mandible just distal to the mandibular tooth) and TV (marking the backward projection from the proximal margin of the tooth). (In the right mandible the tooth is too small for the accurate measurement of the tooth angle).

(*b*) INDICES

1 *Head-Mandible Index* (*A*).

Definition : Minimum length of mandible / Length of head-capsule to the lateral base of mandible.

2. *Head-Mandible Index* (*B*).

Definition : Minimum length of mandible / Maximum width of head-capsule.

3. *Mandibular Tooth Index* (*A*).

Definition : Mandibular tooth distance from distal tip of mandible / Inner length of mandible.

4. *Mandibular Tooth Index* (*B*).

Definition : Length of mandibular tooth / Width of mandible in level of mandibular tooth.

III—ANALYSIS OF VARIABILITY

(Text-figs. 2-7 ; and Tables 1-10)

The data for each of the three population samples, Nos. I--III, were analysed, the various statistical constants obtained and their significance tested. The results are given below. It is interesting to note that in almost all the characters studied, the means were significantly different for each population sample.

(*a*) MEASUREMENTS (Tables 1-3 ; and 6-8)

The measurements were analysed separately for the following three categories :—

(A). Head-capsule. (B). Left mandible. (C). Right mandible.

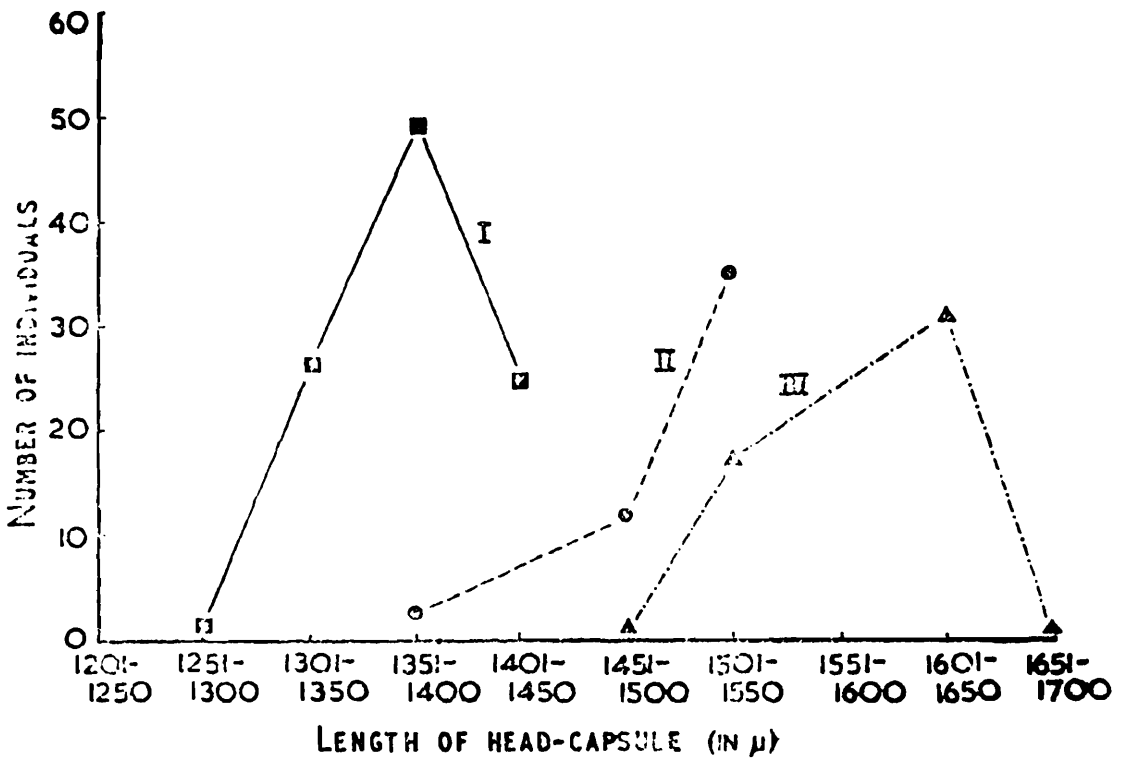
(A). *Head-capsule* (Tables 1 and 6)

1. *Length of head-capsule* (Text-fig. 2).—It varied from 1261-1692 μ. The mean values for each population, *viz.*, 1388·2, 1510·6 and 1587·3μ, were significantly different from one another at 0·1 per cent level of probability, the order being III>II>I. The standard deviations of the means were not significantly different at 5 per cent level of probability.

2. *Width of head-capsule* (Text-fig. 3).—It varied from 1087-1385 μ. The mean values, 1176·0, 1309·5 and 1328·0 μ, were significantly different at 0·1 per cent level of probability, the order being III>II>I. The standard deviations of the means were not significantly different at 5 per cent level of probability.

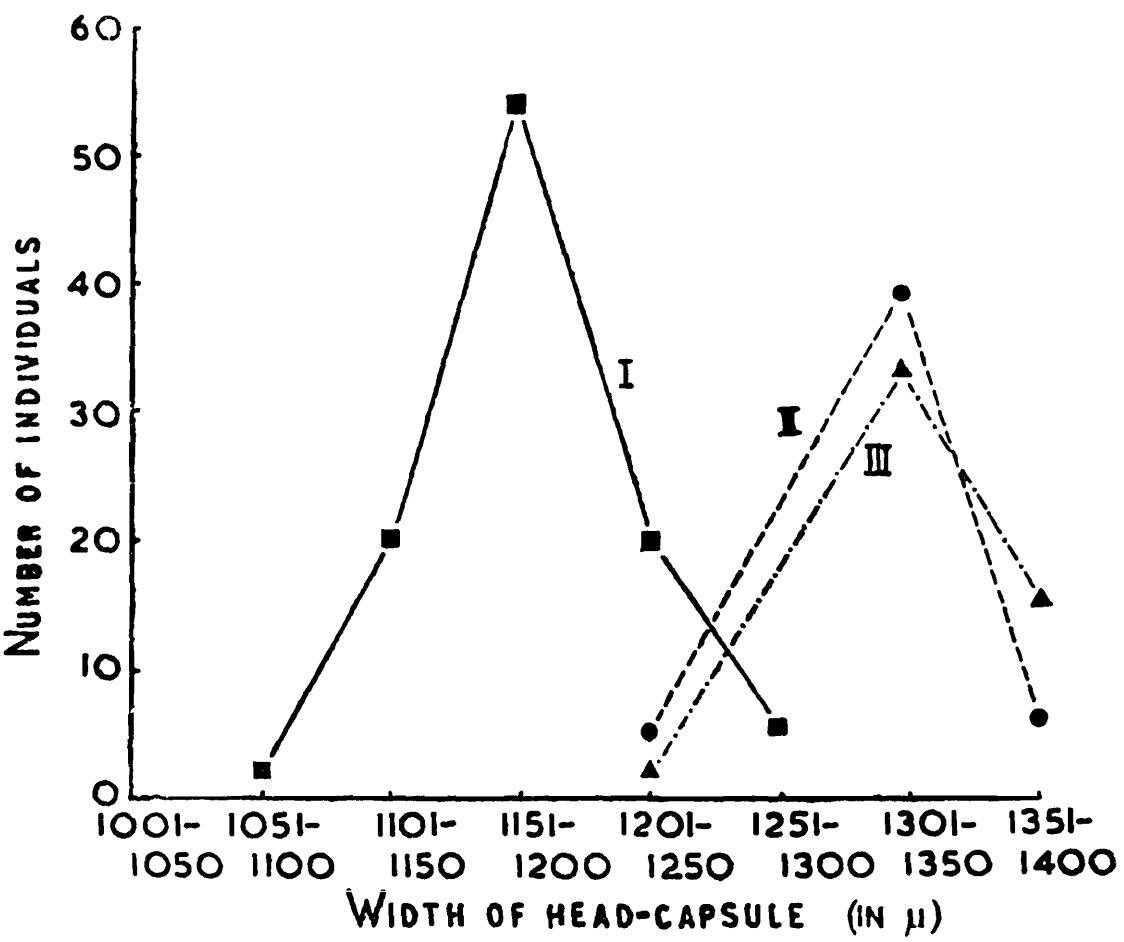
(B). *Left-mandible* (Tables 2 and 7)

1. *Minimum length.*—It varied from 865-1020 μ. The mean values, 912·2, 958·3 and 988·7 μ, were significantly different at 0·1 per cent level of probability, the order being III>II>I. The standard deviations of the means were significantly different at 5 per cent level of probability.

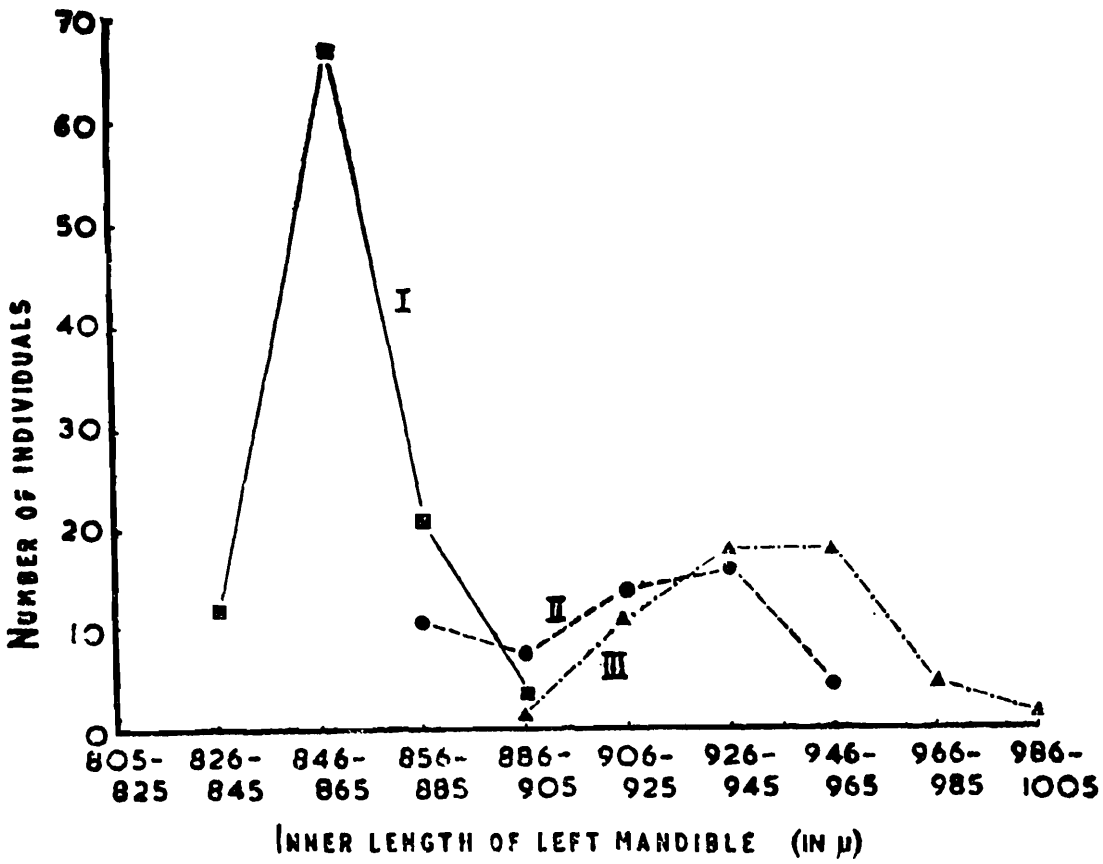


TEXT-FIG. 2.—Graph to show variation in the "length of head-capsule" of soldiers of *Odontotermes obesus* in three population samples, I, II and III, from Dehra Dun.

2. *Inner length* (Text-fig. 4).—It varied from 827-1000 μ. The mean values, 861·1, 915·8 and 944·9 μ, were significantly different at 0·1 per cent level of probability, the order being III>II>I. The standard deviations of the means were significantly different at 5 per cent level of probability.

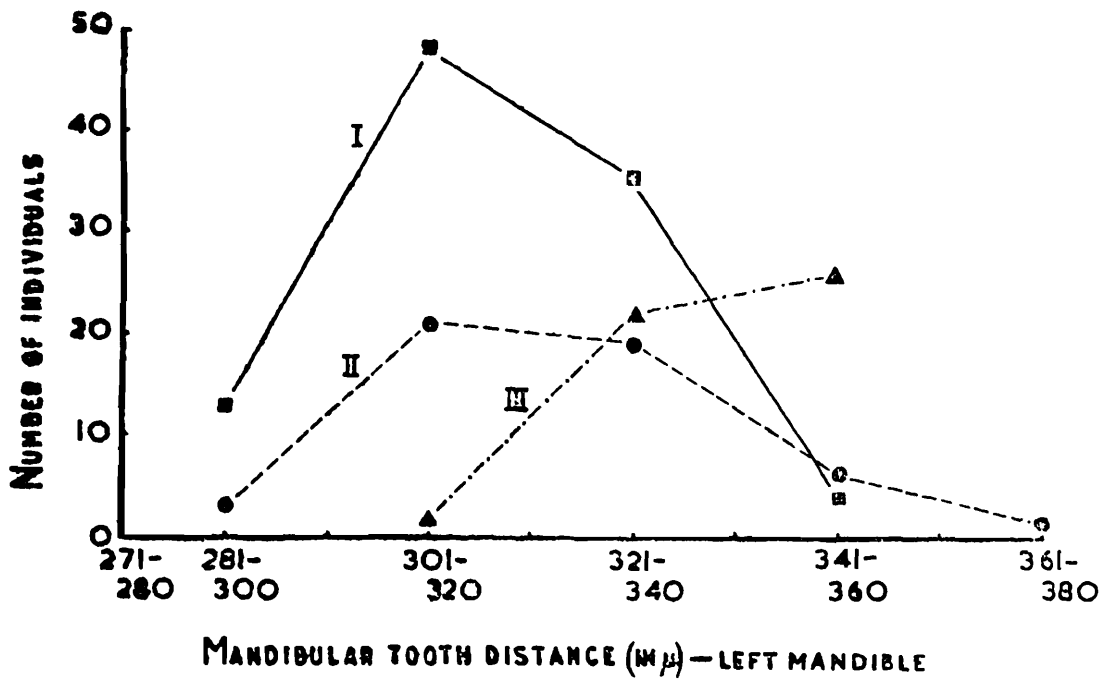


TEXT-FIG. 3.—Graph to show variation in the "width of head-capsule" of soldiers of *Odontotermes obesus* in three population samples, I, II and III, from Dehra Dun.



TEXT-FIG. 4.—Graph to show variation in the "inner length of left mandible" of soldiers of *Odontotermes obesus* in three population samples, I, II and III, from Dehra Dun.

3. *Maximum mandibular curvature.*—It varied from 96-163 μ. The mean for population No. I (129·3 μ) was significantly different from those for population Nos. II and III (139·9 and 142·0 μ respectively) at 0·1 per cent level of probability, but the latter two were not significantly different from each other. The order was III II>I. The standard deviations of the three means were not significantly different at 5 per cent level of probability.



TEXT-FIG. 5.—Graph to show variation in the "mandibular tooth distance" (distal tip of mandible to base of tooth) in the left mandible of soldiers of *Odontotermes obesus* in three population samples, I, II and III, from Dehra Dun.

4. *Mandibular tooth distance* (Text-fig. 5). -It varied from 286-367 μ. The mean for population No. III (336·1 μ) was significantly different from the means of population Nos. I and II (314·1 and 318·5 μ respectively) at 0·1 per cent level of probability but the latter two were not significantly different from each other. The order was III>II I. The standard deviations were significantly different from one another at 5 per cent level of probability.

5. *Width in level of tooth.*— It varied from 96-163 μ. The mean of population No. I (117·6 μ) was significantly different from the means of population Nos. II and III (137·5 and 133·3 μ respectively) at 0·1 per cent level of probability, but the latter two were not significantly different from each other. The order was II III>I. The standard deviations of the means were significantly different from one another at 5 per cent level of probability.

6. *Length of tooth.*—It varied from 28-61 μ. The mean values, 42·7, 46·2 and 55·6 μ, were significantly different from each other at 0·1 per cent level of probability, the order being III>II>I. The standard deviations of the means were not significantly different at 5 per cent level of probability.

7. *Tooth angle.*—It varied from 50°-86° The mean for population No. I (68·5°) was significantly different from the means of population Nos. II and III (65·2° and 65·3° respectively) at 1·0 per cent level of probability, but the latter two were not significantly different from each other. The order was I>III II. The standard deviations of the means were not significantly different from one another at 5 per cent level of probability.

(C). *Right mandible* (Tables 3 and 8)

1. *Minimum length.*—It varied from 827-1000 μ. The mean values, 888·3, 937·5 and 963·6 μ, were significantly different at 0·1 per cent level of probability, the order being III>II>I. The standard deviations of the means were not significantly different at 5 per cent level of probability.

2. *Inner length.*—It varied from 885-1020 μ. The mean values, 930·7, 979·3 and 1003·0 μ, were significantly different at 0·1 per cent level of probability, the order being III>II>I. The standard deviations of the means were significantly different at 5 per cent level of probability.

3. *Maximum mandibular curvature.*—It varied from 96-163 μ. The mean for population No. I (122·5 μ) was significantly different from the means of population Nos. II and III (144·9 and 144·5 respectively) at 0·1 per cent level of probability, but the latter two were not significantly different from each other. The order was II III>I. The standard deviations of the means were not significantly different at 5 per cent level of probability.

4. *Mandibular tooth distance.*—It varied from 346-428 μ. The mean values, 367·0, 389·0 and 407·6 μ, were significantly different at 0·1 per cent level of probability, the order being III>II>I. The standard deviations of the means were significantly different at 1 per cent level of probability.

5. *Width in level of tooth.*—It varied from 115-163 μ. The mean for population No. I (134·3 μ) was significantly different from the means for population Nos. II and III (150·4 and 147·4 μ respectively) at 0·1 per cent level of probability, but the latter two were not significantly different from

each other. The order was II III>I. The standard deviations of the means were not significantly different at 5 per cent level of probability.

6. *Length of tooth.*—It varied from 10-20 μ. The mean values, 18·1, 18·6 and 17·2 μ, were not significantly different at 5 per cent level of probability. The standard deviations of the means were significantly different at 0·1 per cent level of probability.

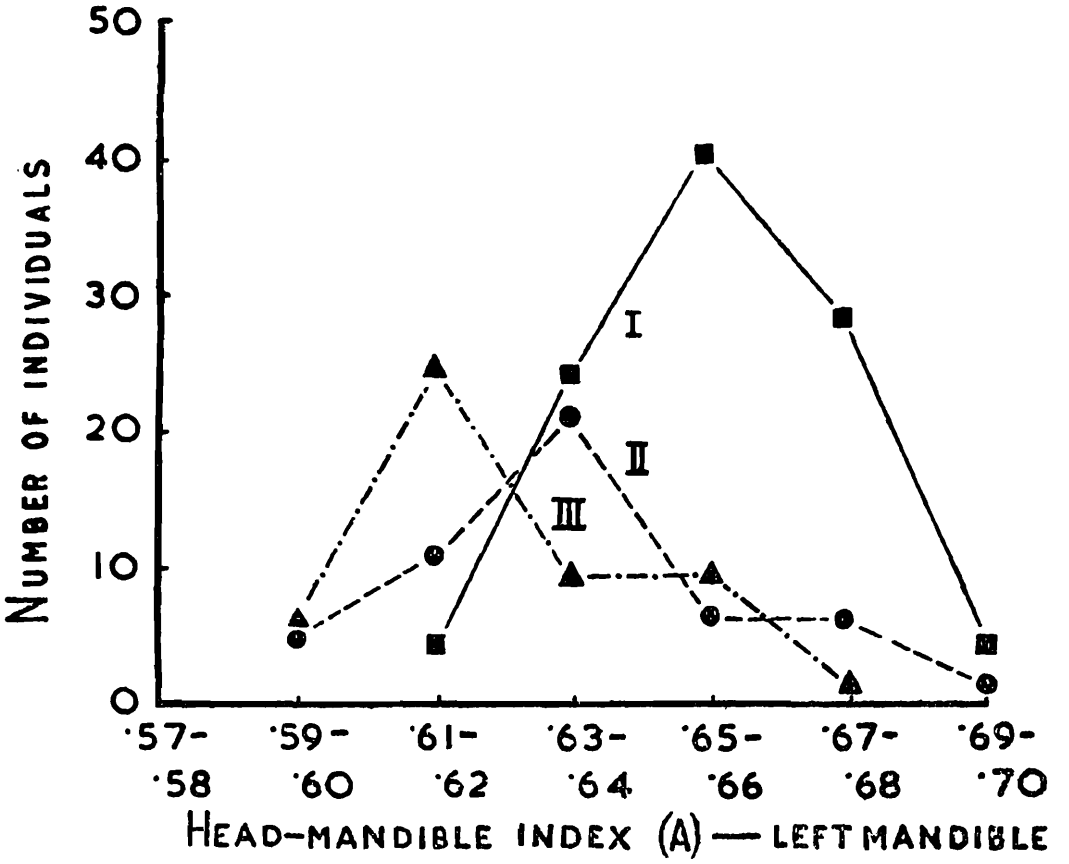
(*b*) INDICES (Tables 4, 5, 9 and 10)

The indices were calculated and analysed separately for the following two categories :—

(A) Left mandible. (B) Right mandible.

(A). *Left mandible* (Tables 4 and 9)

1. *Head-Mandible Index* (*A*) (Text-fig. 6).—It varied from 0·59-0·70. The means, 0·657, 0·636 and 0·624, respectively for the three population Nos. I-III, were significantly different from one another at 0·1 per cent level of probability, the order being I>II>III. The standard deviations of the means were not significantly different at 5 per cent level of probability.

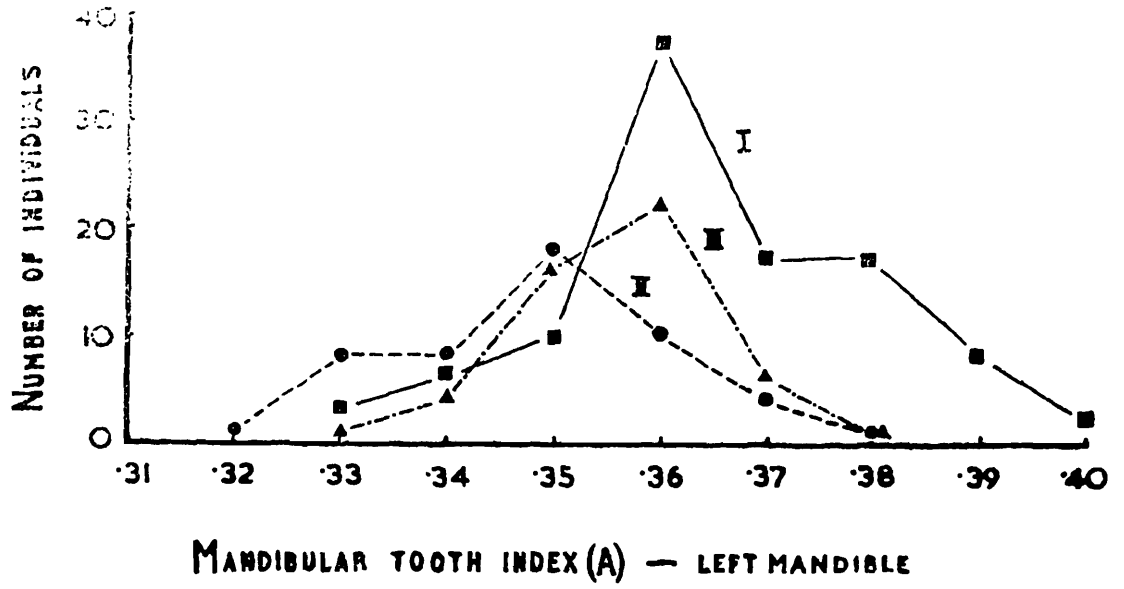


TEXT-FIG. 6.—Graph to show variation in the "Head-Mandible Index (A)" (Minimum length of mandible/Length of head-capsule to lateral base of mandible) in the left mandible of soldiers of *Odontotermes obesus* in three population samples, I, II and III, from Dehra Dun.

2. *Head-Mandible Index* (*B*).—It varied from 0·68-0·83. The means, 0·777, 0·733 and 0·744, respectively for the three population Nos. I-III, were significantly different from one another at 0·1 per cent level of

probability, the order being I>III>II. The standard deviations of the means were not significantly different at 5 per cent level of probability.

3. *Mandibular Tooth Index* (*A*) (Text-fig.7).—It varied from 0·32-0·40. The means, 0·365, 0·349 and 0·356, respectively for the three population Nos. I-III, were significantly different from one another at 0·1 per cent level of probability, the order being I>III>II. The standard deviations of the means were also significantly different from one another at 1 per cent level of probability.



TEXT-FIG. 7.—Graph to show variation in the "Mandibular Tooth Index (A)" (Mandibular tooth distance from distal tip/Inner length of mandible) in the left mandible of soldiers of *Odontotermes obesus* in three population samples, I, II and III, from Dehra Dun.

4. *Mandibular Tooth Index* (*B*).—It varied from 0·25-0·50. The mean values, 0·365, 0·340 and 0·421, for the three population Nos. I—III respectively, were significantly different from one another at 0·1 per cent level of probability, the order being III>I>II. The standard deviations of the means were not significantly different at 5 per cent level of probability.

(B). *Right mandible* (Tables 5 and 10)

1. *Head-Mandible Index* (*A*).—It varied from 0·58-0·72. The mean values, 0·640, 0·621 and 0·607, for the three population Nos. I—III respectively, were significantly different from one another at 0·1 per cent level of probability, the order being I>II>III. The standard deviations of the means were not significantly different at 5 per cent level of probability.

2. *Head-Mandible Index* (*B*).—It varied from 0·65-0·83. The mean of population No. I (0·756) was significantly different from the means of population Nos. II and III (0·716 and 0·726 respectively) at 0·1 per cent level of probability, the order being I>II III. The standard deviations of the means were not significantly different at 5 per cent level of probability.

3. *Mandibular Tooth Index* (*A*).—It varied from 0·36-0·43. The mean of population No. III (0·408) was significantly different from the means of the population Nos. I and II (0·395 and 0·397 respectively) at 0·1 per cent level of probability, but the latter two were not significantly different from each other ; the order was III>II I. The standard deviations of the means were significantly different at 0·1 per cent level of probability.

4. *Mandibular Tooth Index* (*B*) —It varied from 0·06 0·17. The mean value for the population No. I (0·135) was significantly different from the means of population Nos. II and III (0·123 and 0·117 respectively) at 0·1 per cent level of probability but the latter two were not significantly different from each other ; the order was I>II III. The standard deviations of the means were significantly different from each other at 0·1 per cent level of probability.

IV—CONCLUSIONS

It will be seen from the data discussed above that the mean values of the various measurements and indices in the three populations, Nos. I, II and III, were in almost all cases significantly different from one another at 0·1 per cent level of probability. The frequency distribution tables and the graphs (Text-figs. 2-7) further show that the peak values in most of the characters differed in the three samples. Considering that each population sample was from a different mound and presumably represented the progeny of a different queen-mother in each case, the above conclusions are not surprising. The pooled results of the three samples may well be taken as representing the variability occurring in *Odontotermes obesus* (Rambur), at any rate in the form occurring in and around Dehra Dun.

The data given here will, we hope, serve as a standard of comparison for the samples of *Odontotermes obesus* from other areas as well as for other species of the genus where the mandibular character, specially the position, size, etc., of the tooth, has been used to differentiate the various species. For *Odontotermes obesus* the range of some of the significant characters in the Dehra Dun samples are as follows :—

The maximum mandibular curvature of the left mandible is 96-163 μ (means of the three samples 129·3-142·0 μ) ; and for the right mandible 96-163 μ (means of three samples 122·5-144·9 μ).

The mandibular tooth index (A) (which represents the position of the tooth on the mandible) of the left mandible varies from 0·32-0·40 (means of the three samples 0·349-0·365). In other words, the tooth in the left mandible lies at about $\frac{1}{3\cdot1}$ - $\frac{1}{2\cdot5}$ the length of the mandible from the distal end of the latter. In the right mandible the tooth occupies nearly the same position as in the left but tends to shift a little backward (proximally), *i.e.*, towards the middle. Thus, the index varies from 0·36-0·43 (means of the three samples 0·395-0·408). In other words, the tooth in the right mandible lies about $\frac{1}{2.8}$ - $\frac{1}{2\cdot3}$ the length of the mandible from the distal end of the latter.

Regarding the size of the tooth in relation to the mandibular width, the ratio of mandible-width to tooth-width varies in the left mandible from 1 : 0·340 to 1 : 0·421, and in the right mandible (where the tooth is minute) from 1 : 0·0234 to 1 : 0·0326.

In the left mandible the tooth sustains an obtuse angle on the mandible, the angle varying from about 50°-86° (means of the three populations 65·2°-68·5°). In the right mandible the tooth is too minute for the angle to be measured with any degree of accuracy.

V—Summary

1. Variability in respect of the size, etc., of the mandibles of the soldier caste in *Odontotermes obesus* from Dehra Dun and vicinity, in three population samples, Nos. I, II and III, each from a different colony (mound), was studied. The number of individuals in a sample varied from 50-100. Nine measurements and four indices were studied as follows :—

(*a*) *Measurements* : (i) Length of head-capsule. (ii) Width of head-capsule. (iii) Minimum length of mandible. (iv) Inner length of mandible. (v) Maximum mandibular curvature. (vi) Mandibular tooth distance. (vii) Width of mandible in level of tooth. (viii) Length of mandibular tooth. (ix) Tooth angle (in left mandible).

(*b*) *Indices* : (i) Head-Mandible Index (A). (ii) Head-Mandible Index (B). (iii) Mandibular Tooth Index (A). (iv) Mandibular Tooth Index (B).

2. The precise definitions of these measurements and indices are provided.

3. The data were analysed statistically.

4. The mean values of the various measurements and indices in the three populations were in almost all cases significantly different from one another at the 1 per cent level of probability.

5. The inner length of mandible ranged from 827-1000 μ for the left mandible and 885-1020 μ for the right one.

6. The maximum mandibular curvature ranged from 96-163 μ in the left mandible and the same range applied to the right one.

7. The mandibular tooth distance (the distance between the base of the tooth and the distal tip of the mandible) ranged from 286-367 μ in the left mandible (where the tooth is large) and from 346-428 μ in the right mandible.

8. The "Head-Mandible Index (A)" (Minimum length of mandible/ Length of head-capsule to lateral base of mandible) ranged from 0·59-0·70 for the left mandible and 0·58-0·72 for the right one.

9. The "Mandibular Tooth Index (A)" (Mandibular Tooth distance from distal tip of mandible / Inner length of mandible) ranged from 0·32-0·40 in the left mandible and 0·36-0·43 in the right one. In other words,

from the distal tip of the mandible, the tooth lies at $\frac{1}{3\cdot1}-\frac{1}{2\cdot5}$ the length of the mandible in the left one ; and $\frac{1}{2\cdot8}-\frac{1}{2\cdot3}$ in the right one.

10. The ranges of variability provided in the paper may be taken as representing the variability occurring in the species, at least for the form occurring in and around Dehra Dun.

VI—REFERENCES

HOLMGREN, N. 1913. Termitenstudien. IV. Versuch einer Systematischen Monographie der Termiten der Orientalischen Region.—*Kungl. Sven. Vet. Akad. Handl.*, Uppsala and Stockholm, **50**(2), pp. 1-276, 8 pls.

HOLMGREN, K. AND HOLMGREN, N. 1917. Report on a collection of termites from India.—*Mem. Dept. Agric. India* (*Ent. Ser.*), Calcutta, **5**(3), pp. 137-171.

SNYDER, T E. 1934. New termites from India.—*Indian For. Rec.* (*Ent.*), New Delhi, **20**(11), pp. 1—28.

TABLE 1.—*Summary of measurements* (*in microns*) *and their statistical constants of the head-capsule of soldier caste in* Odontotermes obesus (*Rambur*) *in three different populations, each from a different mound-colony, collected from Dehra Dun and vicinity.*

Note.—S.E.—Standard Error of Mean. C.V.—Coefficient of Variation.

Population No.	Total number of individuals	Measurements of head-capsule (μ,)							
		Length				Width			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %
I	100	1261—1435	1388·2	3·51	2·5	1087-1261	1176·0	3·64	3·1
II	50	1385—1538	1510·6	6·45	3·0	1231-1385	1309·5	5·16	2·8
III	50	1462—1692	1587·3	6·12	2·7	1231-1385	1328·0	5·74	3·1

TABLE 2.—*Summary of measurements (in microns) and their statistical constants of the* left mandibles *of soldier caste in* Odontotermes obesus (*Rambur*) *in three different populations, each from a different mound-colony, in Dehra Dun and vicinity.*

Note.—S.E.—Standard Error of Mean. C.V.—Coefficient of Variation.

Population No.	Total number of individuals in sample	Measurements, etc., of left mandible											
		Minimum length				Inner length				Maximum mandibular curvature			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %
I	100	865—962	912·2	2·31	2·5	827—904	84·1	1·91	2·2	96—154	129	1·33	10·3
II	50	918—1000	958·3	3·90	2·9	877—959	915·8	3·65	2·8	102—163	139·9	1·95	9·8
III	50	959—1020	988·7	2·69	1·9	898—1000	944·9	2·95	2·2	122—163	142·0	1·85	9·2

Population No.	Total number of individuals in sample	Measurements, etc., of left mandible															
		Mandibular tooth distance				Width in level of tooth				Length of tooth				Tooth angle			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %
I	100	289—346	314·1	1·43	4·5	96—135	117·6	·82	7·0	28—58	42·7	·59	14·0	54—86°	68·5°	0·69	10·0
II	50	286—367	318·5	2·45	5·4	122—163	137·5	1·58	8·1	41—61	46·2	1·00	15·3	53—81°	65·2°	0·92	10·0
III	50	306—347	336·1	1·71	3·6	122—143	133·3	1·49	7·9	41—61	55·6	1·00	12·7	50—79°	65·3°	1·04	11·3

TABLE 3.—*Summary of measurements (in microns) and their statistical constants of the* right mandible *of soldier caste in* Odontotermes obesus (*Rambur*) *in three different populations, each from a different mound-colony, collected from Dehra Dun and vicinity.* (Tooth angle not measured for right mandible, *vide* Text.)

Note.—S.E.—Standard Error of Mean. C.V.—Coefficient of Variation.

Population No.	Total No. of individuals in sample	Measurements, etc., of right mandible											
		Minimum length				Inner length				Maximum mandibular curvature			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %
I	100	827—942	888·3	2·28	2·6	885—962	930·7	2·03	2·2	96—154	122·5	1·11	9·1
II	50	898—979	937·5	3·29	2·5	938—1020	979·3	3·20	2·3	122—163	144·9	1·67	8·2
III	50	938—1000	963·6	2·66	2·0	979—1020	100·3	2·13	1·5	122—163	144·5	1·74	8·5

Population No.	Total No. of individuals in sample	Measurements, etc., of right mandible											
		Mandibular tooth distance				Width in level of tooth				Length of tooth			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %	Range	Mean	S·E.	C.V. %
I	100	346—385	367·0	1·22	3·3	115—154	134·3	0·97	7·2	10—19	18·1	0·27	15·0
II	50	347—408	389·0	2·43	4·4	143—163	150·4	1·36	6·4	10—20	18·6	0·50	18·9
III	50	388—428	407·6	1·56	2·7	122—163	147·4	1·45	6·9	10—20	17·2	0·64	26·4

TABLE 4.—*Summary of indices and their statistical constants, etc., of various measurements of the* left mandible *of soldier caste in* Odontotermes obesus (*Rambur*) *in three different populations, each from a different mound-colony, collected in Dehra Dun and vicinity.*

Note.—S.E.—Standard Error of Mean. C.V.—Coefficient of Variation.

Population No.	Total number of individuals in sample	Indices, etc., of left mandible							
		Head-Manbidle Index (A)				Head-Mandible Index (B)			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %
I	100	0·62—0·70	0·657	0·0018	2·8	0·73—0·83	0·777	0·0022	2·9
II	50	0·60—0·69	0·636	0·003	3·7	0·68—0·78	0·733	0·003	3·2
III	50	0·59—0·67	0·624	0·0028	3·2	0·69—0·80	0·744	0·0029	2·8

Population No.	Total number of individuals in sample	Indices, etc., of left mandible							
		Mandibular Tooth Index (A)				Mandibular Tooth Index (B)			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %
I	100	0·33—0·40	0·365	0·0015	4·1	0·26—0·50	0·365	0·0050	13·7
II	50	0·32—0·38	0·349	0·002	3·7	0·25—0·50	0·340	0·008	15·8
III	50	0·33—0·38	0·356	0·0013	2·7	0·29—0·50	0·421	0·0082	13·7

TABLE 5.—*Summary of indices and their statistical constants, etc., of various measurements of the* right mandible *of soldier caste in* Odontotermes obesus (*Rambur*) *in three differnet populations, each from a different mound-colony, collected in Dehra Dun and vicinity.*

Note.—S.E.—Standard Error of Mean. C.V.—Coefficient of Variation.

Population No.	Total number of individuals in sample	Indices etc., of right mandible							
		Head-Mandible Index (A)				Head-Mandible Index (B)			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %
I	100	0·60—0·72	0·640	0·0020	3·1	0·71—0·83	0·756	0·0023	3·1
II	50	0·58—0·68	0·621	0·0030	3·9	0·65—0·78	0·716	0·0040	3.6
II	50	0·58—0·66	0·607	0·0030	3·5	0·68—0·78	0·726	0·0032	3·1

Population No.	Total number of individuals in sample	Indices etc., of right mandible							
		Mandibular tooth Index (A)				Mandibular tooth Index (B)			
		Range	Mean	S.E.	C.V. %	Range	Mean	S.E.	C.V. %
I	100	0·37—0·42	0·395	0·0012	3·0	0·07—0·17	0·135	0·0025	18·3
II	50	0·36—0·43	0·397	0·0020	4·2	0·07—0·14	0·123	0·0030	19·5
III	50	0·38—0·42	0·408	0·0014	2·4	0·06—0·16	0·117	0·0046	27·9

TABLE 6.—*Means, Standard Deviation and statistical significance of body-measurements of the soldier caste in* Odontotermes obesus *(Rambur) in three population samples, collected from three different mounds, in Dehra Dun and vicinity.*

Character.—Head-capsule.

Note.—1. S.D.—Standard Deviation.
2. N.S.— Not significant at 5% level of probability.
3. *—Significant at 5% level of probability.
4. **—Significant at 1% level of probability.
5. ***—Significant at 0·1% level of probability.

Population No.	Total number of individuals in sample	Head-capsule (in μ)			
		Length		Width	
		Mean	S.D.	Mean	S.D.
I	100	1388·2	35·12	1176·0	36·44
II	50	1510·6	45·61	1309·5	36·45
III	50	1587·3	43·28	1328·0	40·60
Significance	—	***	N.S.	***	N.S.
Bar diagram at 5% level of probability.	—	III>II>I	—	III>II>I	—

TABLE 7.—*Means, Standard Deviations and statistical significance of body-measurements of the soldier caste in* Odontotermes obesus (*Rambur*) *in three population samples, collected from three different mounds, in Dehra Dun and vicinity.*

Character.—Left mandible.

Note.—1. S.D.—Standard Deviation.
2. N.S.—Not Significant at 5 % level of probability.
3. *—Significant at 5 % level of probability.
4. **—Significant at 1 % level of probability.
5. ***—Significant at 0·1 % level of probability.

Population No.	Total number of individuals in sample	Left mandible													
		Minimum length (μ)		Inner length (μ)		Maximum mandibular curvature(μ)		Mandibular tooth distance (μ)		Width in level of tooth (μ)		Length of tooth (μ)		Tooth angle	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
I	100	912·2	23·08	861·1	19·14	129·3	13·32	314·1	14·28	117·6	8·22	42·7	5·95	68·5°	6·86
II	50	958·3	27·55	915·8	25·79	139·9	13·78	318·5	17·35	137·5	11·16	46·2	7·07	65·2°	6·53
III	50	988·7	19·05	944·9	20·86	142·0	13·09	336·1	12·08	133·3	10·57	55·6	7·06	65·3°	7·36
Significance	—	***	*	***	*	***	N.S.	***	*	***	*	***	N.S.	**	N.S.
Bar diagram at 5 per cent level of probability.	—	III> II> I	—	III> II> I	—	III> II> I	—	III> II> I	—	II> III> I	—	III> II> I	—	I> III II	—

TABLE 8.—*Means, Standard Deviations and statistical significance of body-measurements of the soldier cast in* Odontotermes obesus (*Rambur*) *in three population samples, collected from three different mounds, in Dehra Dun and vicinity.* (Tooth angle not measured, *vide* Text.)

Character.—Right mandible.

Note.—1. S.D.—Standard Deviation.
2. N.S.—Not Significant at 5 % level of probability.
3. *—Significant at 5 % level of probability.
4. **—Significant at 1 % level of probability.
5. ***—Significant at 0·1 % level of probability.

Population No.	Total number of individuals in sample	Right mandible											
		Minimum length (μ)		Inner length (μ)		Maximum mandibular curvature (μ)		Mandibular tooth distance (μ)		Width in level of tooth (μ)		Length of tooth (μ)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
I	100	888·3	22·75	930·7	20·28	122·5	11·12	367·0	12·23	134·3	9·68	18·1	2·71
II	50	937·5	23·23	979·3	22·65	144·9	11·84	389·0	17·19	150·4	9·65	18·6	3·51
III	50	963·6	18·81	1003·0	15·09	144·5	12·27	407·6	11·06	147·4	10·23	17·2	4·54
Significance	—	***	N.S.	***	*	***	N.S.	***	**	***	N.S.	N.S.	***
Bar diagram at 5 per cent level of probability.	—	III> II> I	—	III> II> I	—	II> III> I	—	III> II> I	—	II> III> I	—	—	—

TABLE 9.—*Summary of the results of indices of the left mandible of the soldier caste in* Odontotermes obesus (*Rambur*) *in three population samples, collected from three different mounds, in Dehra Dun and vicinity.*

Note.—1. S.D.—Standard Deviation.

2. N.S.—Not Significant at 5 % level of probability.

3. *—Significant at 5 % level of probability.

4. **—Significant at 1 % level of probability.

5. ***—Significant at 0·1 % level of probability.

Population No.	Total number of individuals in sample	Indices of Left Mandible							
		Head-Mandible Index (A)		Head-Mandible Index (B)		Mandibular Tooth Index (A)		Mandibular Tooth Index (B)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
I	100	·657	·0181	·777	·0223	·365	·0150	·365	·0500
II	50	·636	·0234	·733	·0237	·349	·0130	·340	·0537
III	50	·624	·0201	·744	·0205	·356	·0095	·421	·0578
Significance	—	***	N.S.	***	N.S.	***	**	***	N.S.
Bar diagram at 5 per cent level of probability	—	I> II> III	—	I> III> II	—	I> III> II	—	III> I> II	—

TABLE 10.– *Summary of the results of indices of the right mandible of the soldier caste in* Odontotermes obesus (*Rambur*) *in three population samples, collected from three different mounds, in Dehra Dun and vicinity.*

Note.—1. S. D.—Standard Deviation.

2. N.S.—Not Significant at 5 % level of probability.

3. * —Significant at 5 % level of probability.

4. ** —Significant at 1 % level of probability.

5. *** —Significant at 0·1 % level of probability.

Population No.	Total number of individuals in sample	Indices of right mandible							
		Head-mandible Index (A)		Head-mandible Index (B)		Mandibular Tooth Index (A)		Mandibular Tooth Index (B)	
		Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
I	100	·640	·0201	·756	·0233	·395	·0117	·135	·0246
II	50	·621	·0242	·716	·0260	·397	·0167	·123	·0234
III	50	·607	·0215	·726	·0226	·408	·0097	·117	·0326
Significance	—	***	N.S.	***	N.S.	***	***	***	***
Bar diagram at 5 per cent level of probability.	—	I> II> III	—	I III II	—	III II I	—	I II III	—