A TAXONOMIC REVISION OF THE GENUS *DOCIOSTAURUS* (*ACRIDIDAE: ACRIDOIDEA, GOMPHOCERINAE*)

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Preface

The genus *Dociostaurus* Thunberg is revised, nineteen species and nineteen subspecies now being included.

This genus consists of three subgenera: *Dociostaurus, Kazakia* and *Notostaurus*. The genus *Kazakia* Bie-Bienko is synonymised with *Dociostaurus* and the genus *Notostaurus* reduced to a subgenus of *Dociostaurus*.

Three species and three subspecies are newly described, also specific and subspecific synonymy are quoted.

Characters previously used for systematics and diagnosis in the genus were based only on external characters (epiphalli were presented for a few species). The following diagnosis and analyses were made in the present work:

1. A complete diagnostic description for every species using external characters.

2. A full study and description of the male genitalia with complete illustrations and drawings.

3. Statistical analysis of stridulatory peg intervals and file peg numbers. This was augmented in a few species by a study of oscillograms of the stridulation.

4. Study of the chromosomes of eight species and two subspecies.

The genus *Dociostaurus* Thunberg which was regarded as a purely palaearctic genus, is now known to occur in the Ethiopian region. *D. maroccanus* and *D. brevicollis* occur in the Somali Republic.

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1. *Dociostaurus* (*Stauronotulus*) *maroccanus* (Thunberg, 1815)

Type: ? *Gryllus maroccanus* Thunberg, 1815. **Mem. Acad. Imp. Sci. St. Petersb., 5:244.** Morocco, Barbary Coast.

Type lost. Neotype ♂ here designated. Morocco, Middle Atlas Mts. Aguelman Sidi Ali Ou Mohammed, 6500 ft, IX.1935 (K.H. Chapman).
British Museum (Natural History) London.

Synonymy

Gryllus cruciatus Charpentier, 1825. **Hore. Ent.** 137. Type? 'Lusitania'. Berlin Mus.

Oedipoda vastator Fischer de Waldheim, 1846. **Orth. Imp. Ross.,** Type ♀, 312, no. 30, tab. 14, fig. 1. Moscow or Acad. Sci. (Leningrad).

Epacromia oceanica Walker, 1870: 779, 780. Type ♀ Sandwich Islands, —— (presented by Cap. Beechey). Brit. Mus. Nat. Hist., London.

Dociostaurus maroccanus degeneratus Baranov, 1925. **Pol'opr. ogl. i. Kontr. st. Topehider, Fit. ent. Odsek.,** 3: 14, 21, fig. 8.

Dociostaurus maroccanus f. *xanthocnema* Tarbinsky, 1932.

Dociostaurus maroccanus ph. *solitaria* and ph. *gregaria* Tarbinsky, 1932.

Diagnosis. Male:

1. Phallic complex in side view (Fig. 3) with very long apical valves (Ap), quite unlike any other species in genus. Apical valves weakly sclerotised, slightly longer than basal valves (Bp) as measured from base of flexure (Fx). Apical third of apical valves free but rest closely attached to cingular valves (Cv). Apical valves widened just beyond posterior edge of cingular rami (Rm) as seen in side view, then gradually narrowed towards flexure (Fx). Cingular valves narrower (Cv) than apical penis valves and of same basic pattern as those in *D. hauensteini* and *crassiusculus,* i.e. typical for subg. *Stauronotulus.* Cingular valves widened at base and curving towards each other distally, basally joined by a thin transparent membrane. Cingular rami (Rm) rather small with regular rounded margin and forming a ring covering basal part of penis valves like a collar. Arch of cingulum (Ac) very small, bilobate in profile with posterior part (connected to zygoma) sclerotised with a concave upper margin. Distance between flexure (Fx) and arch of cingulum wide. Apodemes (Apd) short and thick with blunt, rounded apices. Flexure relatively long, well sclerotised and roughly at 90° to base of apical penis valves. Gonopore process (Gpr) short, sclerotised and widened in middle, with a sharp angular projection on its ventro-anterior margin (Figs. 1 and 3). Ejaculatory sac (Ejs) large (Figs. 1,4).

Epiphallus (Fig. 2) typical of subgenus *Stauronotulus.* Bridge (B) short, thick. Ancorae (A) long, elevated and sclerotised standing vertically on bridge. Lateral plates (Lp) relatively narrow, not elongated downwards. Posterior projection of lophus (Ppr) very small and curling upwards. Lophi (L) small and well sclerotised.

2. General colouration light brown or greyish red-brown with indistinct dark patterns (gregarious form) or greyish brown or dark brown with sharply defined patterns and markings (in solitarious form). Series of small brown spots above spiracle rows of abdomen.

3. Fastigium verticis pentagonal concave, nearly equilateral. Parallel sided posteriorly with distinct marginal carinulae and rounded angles (Fig. 6). Temporal foveolae rectangular, short, pitted, their length to maximum width ratio about 1.25 and slightly narrowed anteriorly Space betweeen antennal socket and temporal foveolae usually black.

4. Frontal ridge punctate, depressed at ocellus and below it, its marginal carinulae parallel up to upper level of antennal sockets or slightly widened at that level. Greatly narrowed between anterior margins of temporal foveolae.

5. Head subconical, relatively small in proportion to size of body, 0.5 – 0.6 times as long as pronotum as seen from above. Top of head produced abve level of pronotum.

6. Compound eyes vertically oriented, not bulging, longest axis being about 1.6 times length of subocular goove.

7. Antennae slightly longer than length of head and pronotum.

8. Pronotum elongate with distinct transverse sulci. Median carina somewhat elevated. Lateral carinae of metazona distinct. Prozonal disc narrow, constricted in area of transverse sulci 2 and 3. Prozona much shorter than metazona, ratio of lengths about 0.7. Lateral carinae weakly developed anterior to transverse sulcus 2 and bordered internally by light pigment. Metazonal disc bordered (Fig. 6) by two distinct lateral light bands which extend onto area between transverse sulci 3 and 4 and are distincltly convergent forwards. Posterior margins of metazona strongly oblique, posterior angle being rounded obtusangular. Lateral pronotal lobes rather deep, constricted and bearing a prominent whitish patch of pigment about 2/3 of way down lobe from its upper edge.

9. Tegmina and wings long, tips of folded tegmina extending far beyond tips of folded posterior femora to just level with them. Dark patterns always present on tegmina, especially in median field (between its close parallel cross-veins).

10. Posterior femora not particularly thick and powerful. Fore femora inflated in male. Dorsal spots of dorsal side of hind femora (3 in number) distinct and covering upper inner and upper outer areas in solitarious forms but indistinct in gregarious forms. If present these spots usually extend a short way onto inner and outer areas of femora. Upper genicular lobes of hind femora always dark brown or black but lower lobes vary in colouration (black or light on inner or outer aspect).

11. Hind tibiae red, pink or pale yellow (f. *xanthocnema* Tarbinsky) or even whitish.

12. Supra-anal plate (Fig. 5) (Sa) large, usually as long as wide, with triangular apex. Subgenital plate (Sg) broad, bluntly truncate and highly characteristic of this species. Cerci conspicuously elongate, their tips surpassing tip of supra-anal plate. Median lobes of last abdominal tergite decumbent, not produced at all.

13. Number and spacing of stridulatory pegs significantly different in solitarious (number about 85) and gregarious forms (number about 120). In gregarious forms (Fig. 7) spacing much more uniform than in solitarious forms (Fig. 8).

14. Chromosome characteristics are tabulated below (see plates 4,5).
Note that:

1) chromosomes are on the whole small in size and size range from large to small less abrupt than in other species;

2) a great many chromosomes in the set form 'ring' bivalents;

3) bivalents are symmetrical.

There is some suggestion that the total length of chromosomes from high altitude localities is less than that from low altitude ones (e.g. compare Aghonge village, 1500–2000 m, near Mashad with other material).

Locality		Autosome pair number										
	Chromosome characteristic	1	2	3	4	5	6	7	8	9	10	11
Darehgaz 500-750 m	Chiasmata: Terminal (t) or Interstitial (i)	ti	ti	ti	ti	ti	ti	t	ti	t	t	t
	Chiasmata: Number	2-3	2-3	1-2	1-2	1-2	1	1-2	1	1	1	1
	Terminal heterochromatic segments (size)	med	sm	sm	sm	sm	sm	sm	sm	sm	sm	sm
	Autosome pair symmetry symmetrical (s) asymmetrical (a)	s	s	s	s	s	s	s	s	s	s	s
	Chromosome length (%)	19.2	16	11.2	9.8	8.7	8	7.2	6.8	5.6	4.5	3
Aghonge (Mashad) 1500-2000 m	Chiasmata: Terminal (t) or Interstitial (i)	ti	ti	ti	ti	t	t	t	ti	t	t	t
	Chiasmata: Number	2-3	2-3	1-2	1-2	1	1	1-2	1-2	1	1	1
	Terminal heterochromatic segments (size)	med	sm	sm	sm	sm	sm	sm	sm	sm	sm	sm
	Autosome pair symmetry symmetrical (s) asymmetrical (a)	s	s	s	s	s	s	s	s	s	s	s
	Chromosome length (%)	18.5	16.5	12.5	11.1	9.7	7.4	6.7	6	4.7	3.9	3
Moghan 250-400 m	Chiasmata: Terminal (t) or Interstitial (i)	ti	ti	ti	ti	ti	ti	t	ti	t	t	t
	Chiasmata: Number	2-3	2-3	1-2	2	1-2	1-2	1-2	1-2	1	1	1
	Terminal heterochromatic segments (size)	med	med	sm	sm	sm	sm	sm	sm	sm	sm	sm
	Autosome pair symmetry symmetrical (s) asymmetrical (a)	s	s	s	s	s	s	s	s	s	s	s
	Chromosome length (%)	19.2	16.8	12.2	11	8.6	7.2	6.5	6.1	5.1	3.9	3.4
Kazerun (Fars) 400-600 m	Chiasmata: Terminal (t) or Interstitial (i)	ti	ti	usually t	usually t	ti	t	t	ti	t	t	t
	Chiasmata: Number	1-3	1-3	1-2	1-2	1-2	1-2	1-2	1-2	1	1	1
	Terminal heterochromatic segments (size)	med	med	med	sm	sm	sm	sm	sm	sm	sm	sm
	Autosome pair symmetry symmetrical (s) asymmetrical (a)	s	s	s	s	s	s	s	s	s	s	s
	Chromosome length (%)	18.3	16.4	12.3	10.7	10	8	7.3	6.3	4.2	3.5	3

Measurements.

	Male	Female
E/F ratio (France) solitarious form	1.25	1.30
E/F ratio gregarious form	1.75 (Cyprus)	1.85 (Syria)
Length of posterior femora (mm)	12.3–17.0	12.7–19.2
Length of tegmina (mm)	13.5–27.0	20.4–35.0
Length of body (mm)	17.5–36.0	26.0–45.0

Distribution.

USSR, Afghanistan, Iran, Iraq, Turkey, Syria, Lebanon, Israel, Jordan, Arabia (?).

Cyprus, Greece, Bulgaria, Yugoslavia, Hungary, France, Italy, Spain, Corsica, Sardinia, Sicily, Portugal.

Libya, Morocco, Tunisia, Algeria, Madeira, Canary Islands.

N.E. Africa; Somali republic. This last is a new record for the species of great zoogeographical interest.

Material examined.

USSR: 7 ♂, 5 ♀ E. Transcaucasia, 2.V.24 (Siazov).

Afghanistaan: 4 ♂, 4 ♀ Wazir Abad, 4 mls. N. of Kabul (20–25).VI.38 (S.A. Akhtar).

Iran: 2 ♂, 1 ♀ Bushehr to Kazerun, 21.V.27 (Siazov); 3 ♂, 3 ♀ Khusestan-Masjed Suleiman, – 32 (F. Marsh); 4 ♂, 2 ♀ Masjed Solaiman, — 33 (V. Pill); 5 ♂, 5 ♀ Mehran, 350 m, — V.46 (Gh. Farahbakhsh); 5 ♂, 6 ♀ Mehran, 2.VI.55 (A.A. Soltani); 7 ♂, 5 ♀ Sarakhs, 250–300 m, 7.VI.56 (A.A. Soltani); 4 ♂, 3 ♀ Moghan, 300–400 m, 2.VI.59 (H. Mirzayan); 5 ♂, 5 ♀ Moghan, 9.VI.58 (L.F.H. Merton); 3 ♂, 3 ♀ Gorgan, 250–400 m, 15.VII.60 (A.A. Soltani); 2 ♂, 2 ♀ Behshahr, nr. Caspian Sea, 30 m, 2.VIII.60 (A.A. Soltani); 3 ♂, 2 ♀ Fars-Kazerun, 600 m, 8.VIII.61 (H. Mirzayan); 4 ♂, 5 ♀ Shahrud-Abr, 2200–2500 m, 15.VIII.62 (A.A. Soltani); 3 ♂, 2 ♀ Khorramabad, Lorestan, 2.VII.63 (H. Mirzayan); 5 ♂, 3 ♀ Fars, Gereh, 700 m, 4.V.73 (A.A. Soltani); 6 ♂, 3 ♀ Mehran, 15.V.73 (A.A. Soltani); 5 ♂, 3 ♀ Gorgan, Maraveh tapph, 750 m, 23.V.73 (A.A. Soltani); 5 ♂, 2 ♀ Sarakhs, 1.VI.73 (A.A. Soltani); 4 ♂, 3 ♀ Dareh gaz, 600–700 m, 18. VI.73 (A.A. Soltani); 6 ♂, 3 ♀ Moghan, 2.VII.73 (A.A. Soltani).

Turkey: 6 ♂ , 4 ♀ Smyrna prov., Menemen, — 30 (Sureya Bay); 4 ♂, 2 ♀ Habiblar, S. Tireh, 21. VII.31 (B.P. Uvarov); 2 ♂, 2 ♀ Urfa, VII.31 (Eshnef Bey).

Iraq: 3 ♂, 3 ♀ Khanaghin, 26.V.32 (B.P. Uvarov); 3 ♂ , 2 ♀ Kurdistan, btwn. Kirkuk and Sulaymaniah, 28.V.32 (B.P. Uvarov).

Syria: 4 ♂ , 3 ♀ Hama, N. Syria, 1.VII.45 (Middle East Biological Studies Scheme); 5 ♂, 4 ♀ Hassetche, 17.V.46 (E.S. Brown).

Jordan: 4 ♂ , 2 ♀ Jordan valley, Khor Fasayil, 10.IV.51 (A.R. Waterston).

Israel: 5 ♂ , 3 ♀ Jericho, 17.V.31 (F. Bodenheimer); 3 ♂, 3 ♀ E. of Azaniya, 28.IV.72 (S. Blondheim).

Greece: 2 ♂ , 2 ♀ Kerkeni, Struma valley, 25.VI.35 (P. Buxton); 5 ♂ , 4 ♀ Mt. Hortiat nr. Salonika, 600 m, 8.VIII.38 (O. Grebenchikoff); 3 ♂, 2 ♀ Drosia, 17.VII.57 (G.A. Mavromoustakis).

Cyprus: 4 ♂, 4 ♀ Mesayitonia, 25.IV.35 (G.A. Mavromoustakis); 2 ♂ , 3 ♀ Larnaca airport, 19. V.50 (A.R. Waterston).

Yugoslavia: 1 ♂, 1 ♀ Macedonia, Lambet, — VI.16 (M. Burr); 2 ♂, 2 ♀ Herzegovina, Domanovic, 24. VII.30 (0. Holic); 4 ♂, 4 ♀ Montenegro, Titograd, 15.VI.47 (M. Gradojevic); 3 ♂, 3 ♀ S. Serbia, Kozuh Mts., Dvonsija Mt., nr. Gevgeli, 1500–1900 m, (13–17).VII.37 (O. Grebenchikoff).

Bulgaria: 3 ♂ , 4 ♀ Kostenetz, nr. Sofia, 700–1500 m, — VIII. 26 (E.M. Edwards).

Italy: 1 ♂ , 2 ♀ Rome, — VI.25 (D. Vitozanon).

Corsica: 3 ♂, 3 ♀ Calvi, 12.VII.31 (M.E. Mosely); 4 ♂, 3 ♀ N.S. Corsica, Belgodere, 500 m, 26. VII.63 (D.H. & D.J. Harvey).

Sardinia: 2 ♂ , 3 ♂ Macomer, 9.VI.31 (O. Grey).

France: 3 ♂ , 3 ♀ Bouches-du-Rhone, 22 kms. S.E. of Arles, nr. Mas Thiberte, (1–17). VII.60 (D.J. Philpot); 2 ♂, 3 ♀ Languedoc-Ronsillon prov. Nimes dep., Les Baux de Provence, VIII. 73 (N.D. Jago) in citadel plateau, bare rocks.

Spain: 3 ♀, 3 ♂ Sierra de Guadarrama, — VIII.26 (B.P. Uvarov).

Portugal: 2 ♀ , 1 ♂ Guarda arca, — VIII.66 (R.M. Dobson).

Canary I.: 4 ♂ , 3 ♀ Teneriffe, Tocoronte, 10.IV.27 (E. Appenhagen); 2 ♂ , 3♀. Teneriffe Montana zaco, 17.IV.52 (M. Morales); 2 ♂, 2 ♀ Teneriffe, Puertos de la Cruz, 8.IV.59 (O.W. Richards); 4 ♂ , 3 ♀ Teneriffe, Buenavista, S.L., 3.VI.64 (K.M. Guichard).

Morocco: 3 ♂, 4 ♀ Middle Atlas Mts., Aguelman Sidi Ali ou Mohammed, 6500 ft., — IX.35 (K.H. Chapman).

Algeria: 3 ♂, 3 ♀ Saida, — 23 (A. Cros); 1 ♂, 1 ♀ Oran, Frenda,— VI.27 (Balachovsky); 4 ♂, 3 ♀ El Gehra station, S. of Constantine, 2.VII.39 (M.N. Korsakoff).

Libya: 1 ♂ , 1 ♀ Cyrenaica, El Abiar, 2.IV.58 (K.M. Guichard).

Somali Rep.: 6♂, 4 ♀ Cajdn, 2.VII.49 (E. Burtt).

Discussion.

Dociostaurus maroccanus is the most serious pest of agriculture in the genus, e.g. in such countries as Iran.

According to UVAROV the species is exclusively palaearctic, but during my study I discovered several small highly melanic forms of the species in the Somali Republic section of the accessions col lections at the British Museum (misidentified as an *Oedaleus* species). This record has subsequently become the basis for a revised Commonwealth Institute map of the distribution of this pest. The speci mens are of small individuals, but the genitalia and stridulatory files are typical for *D. maroccanus*. Similar

small dark forms are also found on the northern fringe of distribution e.g. in Greece, Bulgaria, Yugoslavia, France and Canary Is.

The enormously elongated apical penis valves of this species though highly characteristic to the species are of a basic plan common to *D. hauensteini* and *D. crassiusculus* also. In particular the form of the cingular valves is the same in all three species indicating quite clearly that *D. maroccanus* should be put in the same species group. Despite great variation in size, colour and 'phase' the shape and structure of the genitalia are remarkably constant in this species (on basis of 150 examined male specimens).

Study of the male stridulatory file showed, however, that regularity of peg distribution offered a good phase character. Twenty-five of each extreme phase polymorph were examined and their peg intervals plotted (see graphs Figs. 7,8). Most of the specimens were collected during plague and recession periods in Iran by myself.

BARANOV (1925) described a dwarf race of the Moroccan Locust from Montenegro in Yugoslavia. Its diagnostic features were its smaller size, acute vertex, sharp frontal ridge and differences in form of the male genitalia (only epiphallus). He gave this small form the name *'degeneratus'* and of racial rank. UVAROV (1928a) made no final decision on the status of this insect. I have compared these insects with larger members of adjacent populations and with other small insects from other areas of southern Europe. I find no useful difference sufficient to separate them as a geographical race. It is general that the species becomes dwarfed in fringe areas less suitable to it biologically.

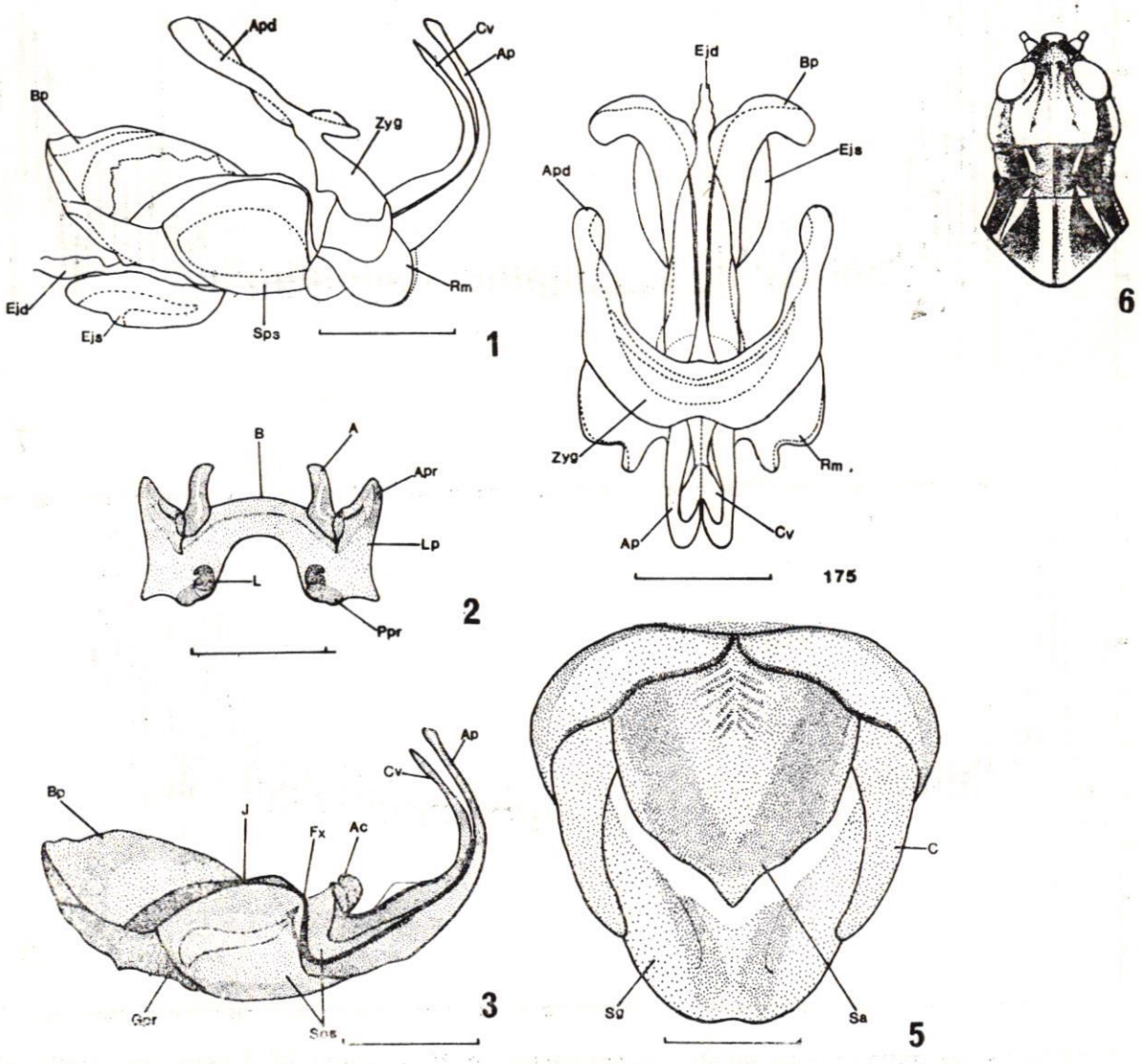
Other grasshoppers sympatric in Iran with *D. maroccanus* are *D. hauenstcini, D. crassiusculus nigrogeniculatus* (Moghan, Gorgan), *D. jagoi* (Mehran, Somar,) *D. albicornis turcmenus* (Mashad, Darehgaz) *D. tartarus* (Gorrgan), *Chorthippus apricarius asiaticus* (at high altitudes), *Calliptamus italicus, C. barbarus* (Mazandaran, Azerbaijan), *Oedaleus decorus, O. senegalensis, Sphingonotus rubescens, S. satrapes* (Mehran) some several tettigoniid species. Habitats for the species occur in two main belts (divided into 8 zones) (see Pasquier, 1958, L.F.H. Merton, 1961, H. Mirzayan and A. Soltani, unpubl.) which lie in the foothills of the Elburz and Zagros mountain ranges.

A study of phase variation in permanent breeding areas, involving observation of behaviour, general external characters, colouration, statistical measurements, etc., has been of great use in the recent past in assessing the recession status or upsurge status of populations. Much is now known of the food preferences of this insect, living as it does in grass association which offer permanent breeding areas at altitudes between 200 to 500 m. Its extreme altitudinal range lies from sea level up to 2200 m (in the north-eastern Elburz).

Presentation

Note that in all the drawings which follow the scale represents lmm. unless otherwise indicated. Graphs showing peg interval distribution, peg interval variation and peg number all show the nu ber of the peg (anterior to posterior) on the x axis and peg interval in arbitrary units on the y axis (each unit. 0.00034 mm.). Mean and S.D. for each peg interval are given (e.g. as in plate 2 figs. 7 and 8)

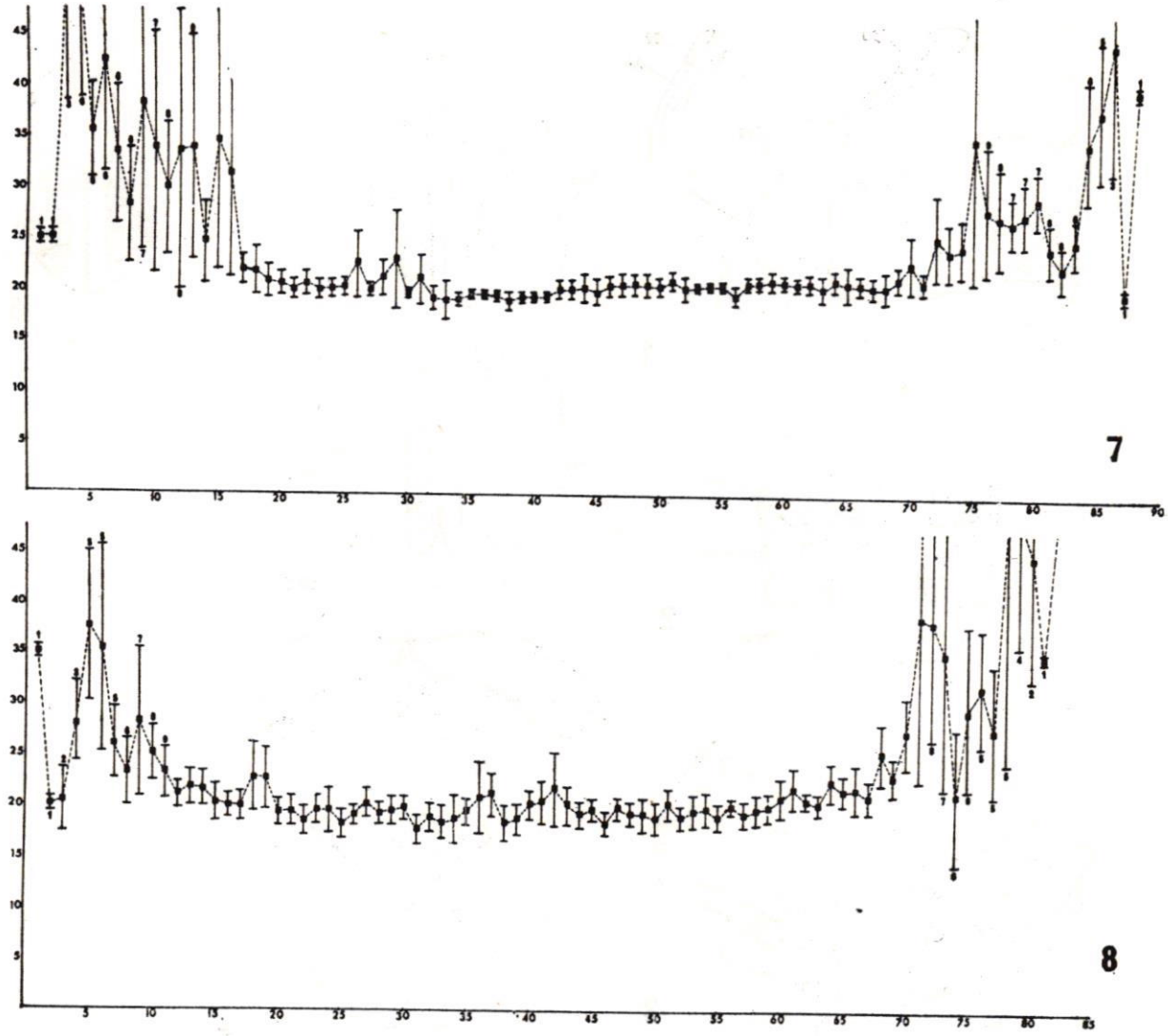
PLATE 1



D. maroccanus (Thunberg)

FIG. 1 Phallic complex from side view
FIG. 2 Epiphallus, dorsal aspect
FIG. 3 Phallic complex (zygoma and apodemes removed), lateral view
FIG. 4 Phallic complex, dorsal aspect
FIG. 5 Supra-anal plate, subgenital plate and cerci from above
FIG. 6 Head and pronotum from above

PLATE 2

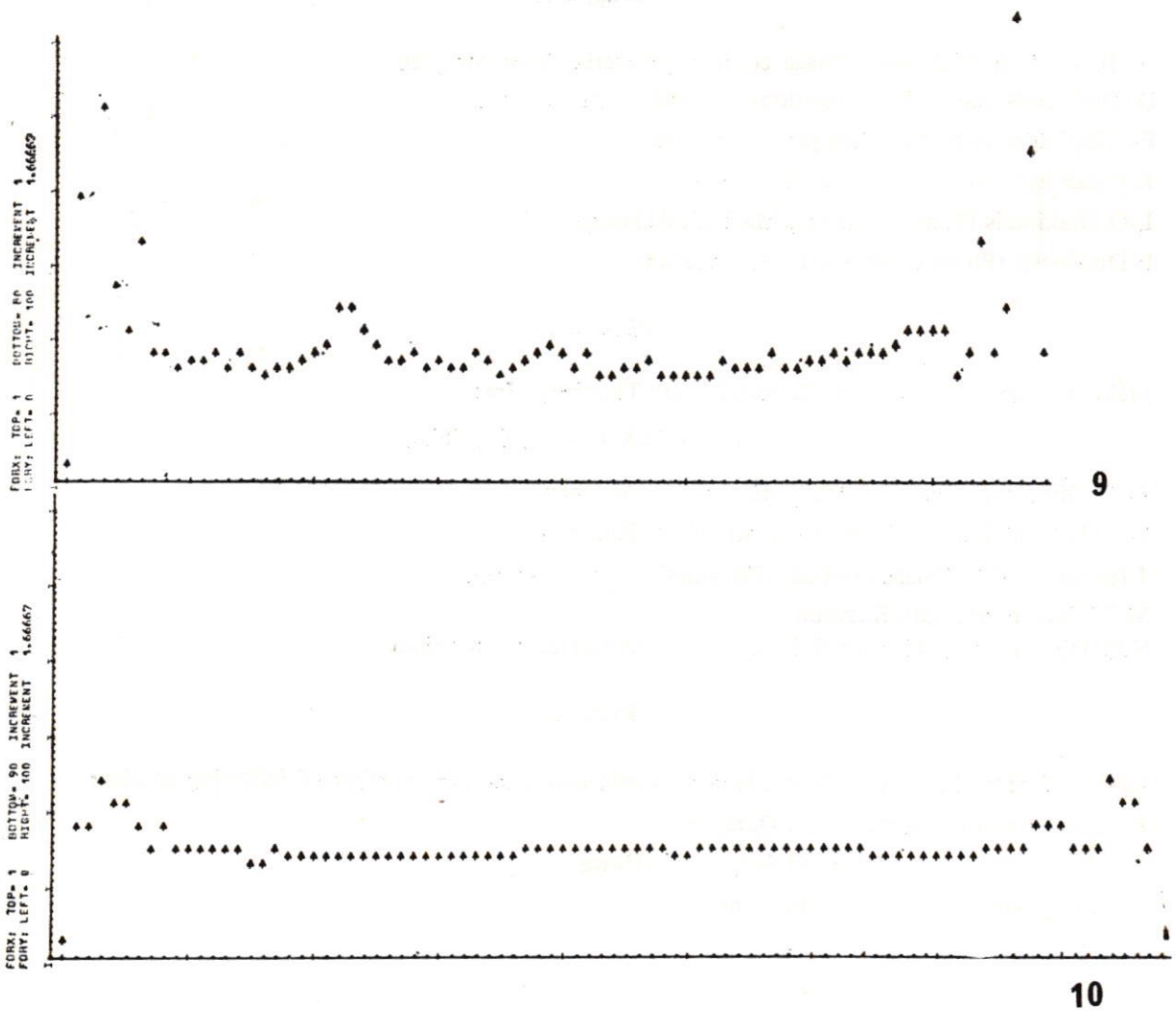


Stridulatory peg graph showing variation in peg intervals of 10 specimens of *D. maroccanus* (collected from Iran)

FIG. 7 Phase gregaria

FIG. 8 Phase solitaria

PLATE 3



Stridulatory file pattern from one specimen of *D. maroccanus* (collected from Iran)
FIG. 9 Solitarious phase
FIG. 10 Gregarious phase

PLATE 4

Meiosis in spermatocytes of *D. maroccanus* Thunberg (collected from Iran)

Mag. x 1500

A, B, C & E Diakinesis (Phase contrast), material from Moghan
D Diakinesis (normal illumination), material from Moghan
F-J Diplotene (normal), Fars prov., Kazerun
K Diakinesis (normal), Khorasan, Daregaz
L-O Diakinesis (Phase contrast), Mashad, Aghonge
P Diakinesis (Phase contrast), Fars, Kazerun

PLATE 5

Meiosis in spermatocytes of *D. maroccanus* Thunberg, Iran

Mag. x 1500 (A–M), 600 (N,0)

A–D Diplotene (Phase contrast), E. Azarba, Moghan
E–H Late diplotene (Phase -contrast), Fars, Kazerun
J (normal), K,L (Phase contrast) Diakinesis, Fars, Kazerun
M Diplotene (normal), Kazerun
N,O Diakinesis (x 40 normal illumination, several cells), Moghan

PLATE 6

Graph of percentage chromosome length against autosome pair number of following species:
D. maroccanus (Thunberg), Iran, Daregaz
D. anatolicus (Krauss), Israel, Golan, Bab-el-Hawa
D. hauensteini (I . Bolivar), Iran, Moghan

PLATE 4

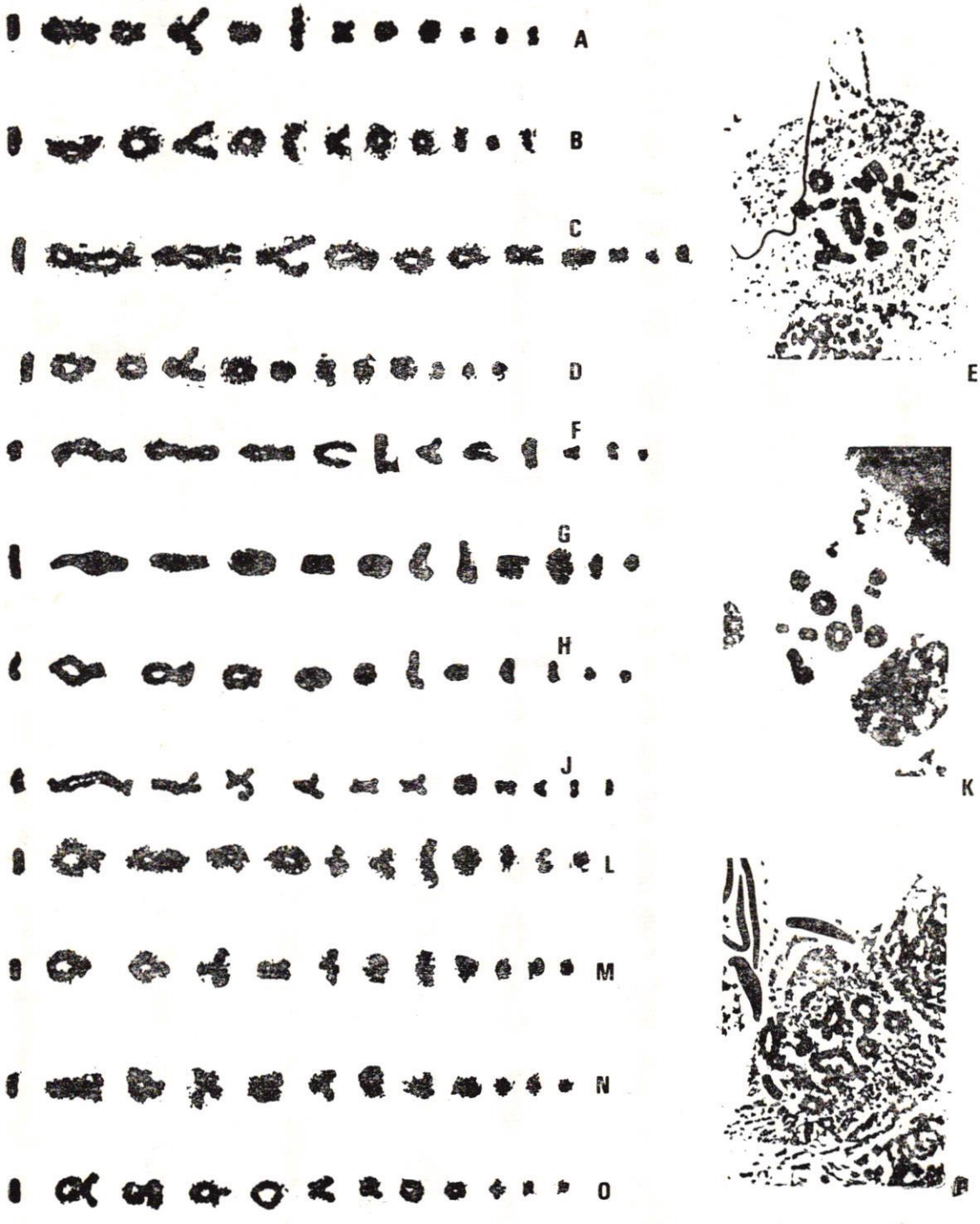


PLATE 5

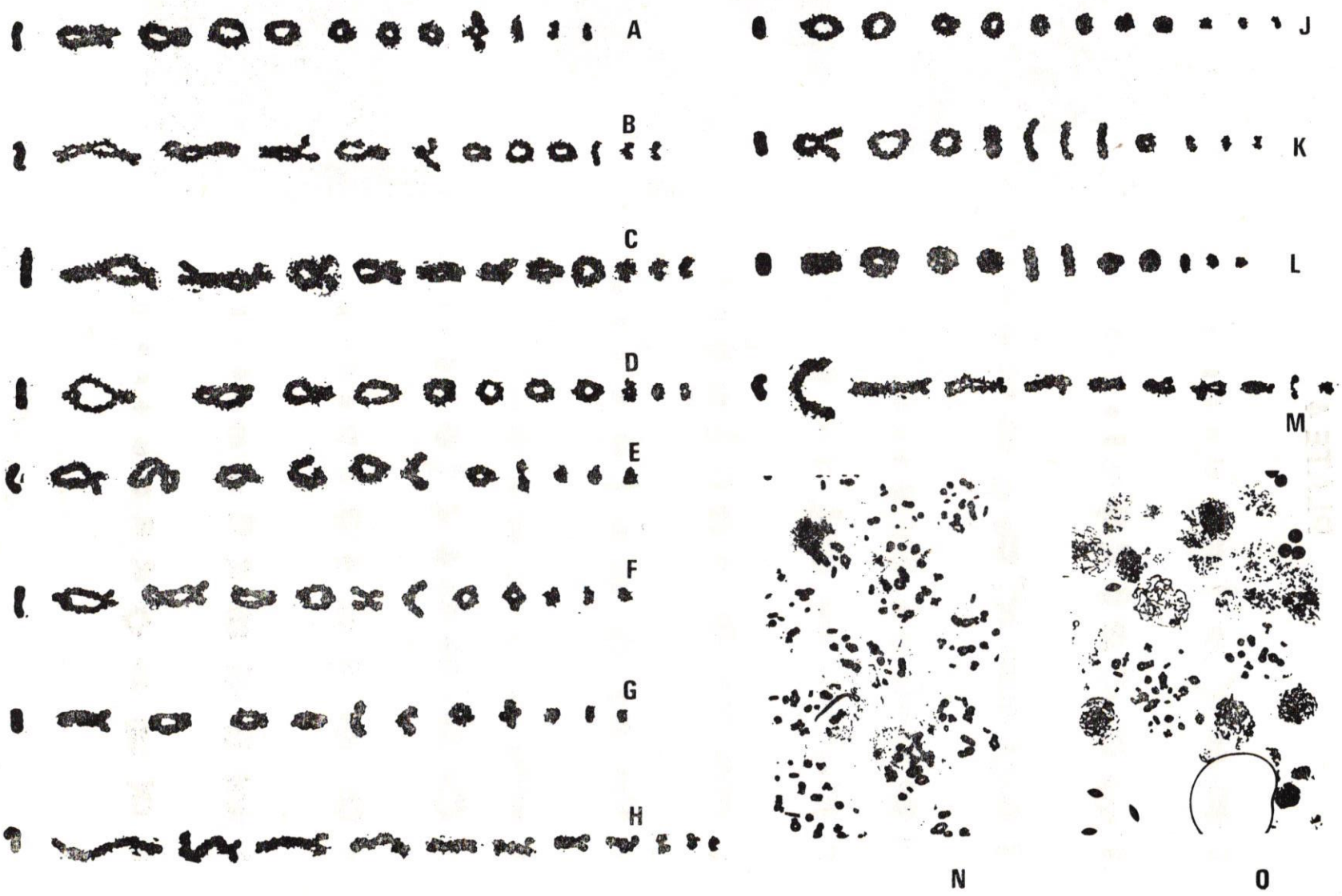
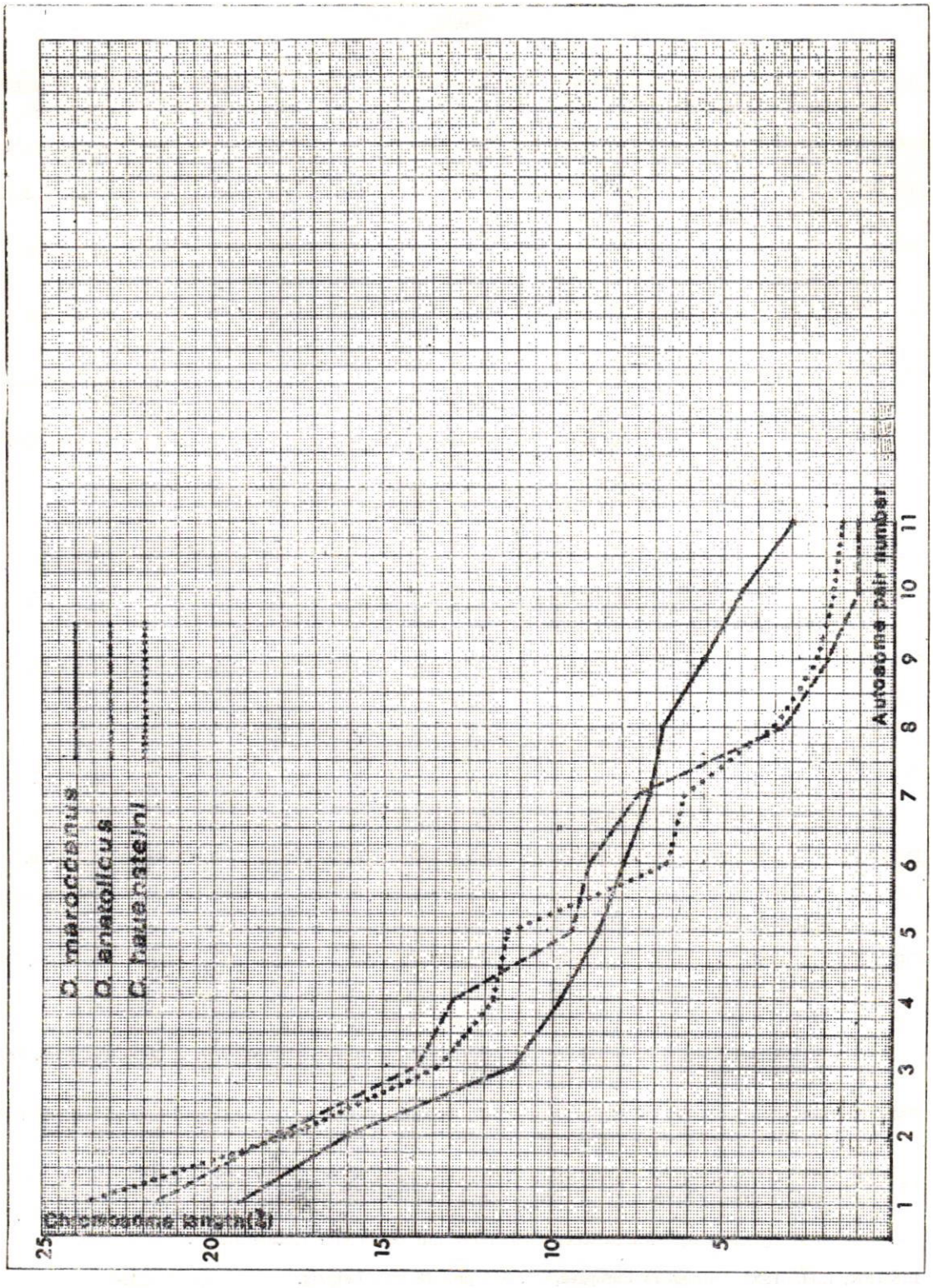


PLATE 6


C. marocanus
C. anatolicus
C. tataricatehi
Chromosome length (μ)
25
20
15
10
5
1
2
3
4
5
6
7
8
9
10
11
Autosome pair number

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