CYTOTAXONOMIC STUDIES ON SOME AUSTRALIAN DOLICHODERINE ANTS (*HYMENOPTERA: FORMICIDAE*)

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INTRODUCTION

The cytotaxonomic study of ants has been firmly established only recently with the papers of HAUSCHTECK (1961, 1962, 1963, 1965), IMAI and YOSIDA (1964) and IMAI (1966), although other workers have touched on ant chromosomes (e.g. SMITH and PEACOCK 1957; WHELDEN and HASKINS 1953; KUMBKARNI 1965). HAUSCHTECK (1962) has reviewed the field.

Dolichoderine ant species have received relatively little attention in work to date, most data relating to the subfamilies Myrmicinae and Formicinae. HAUSCHTECK (1963) reports a diploid number of 22 for an unnamed species of the subfamily Dolichoderinae. CROZIER (1968*a*) reports small karyotype differences between samples from different populations of Australian *Iridomirmex* of the « *detectus* » group, which group is here considered in a broader context. A South American species of *Dorymyrmex* has a haploid number of 9 (CROZIER 1968*b*). The Japanese species *Iridomyrmex itoi,* found to have a haploid number of 14 (IMAI and YOSIDA 1964), is considered by BROWN (1958 and *in litt.*) conspecific with *I. glaber* dealt with here.

The species covered here are placed in the tribe Tapinomini. Species in other groups will be treated in future papers.

METHODS

The localities from which samples, comprised of workers and immature stages, were taken are given in Table I. The tissues found most useful were prepupal cerebral ganglia and early pupal testes, although cerebral ganglia and testes of both stages were useful on occasion. Maintenance of the samples at 20°C. often yielded prepupae from material collected as larvae.

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In the great majority of cases, the material was treated with colcemid (CIBA, 0.05% w/w solution in insect Ringer) for 10-20 hours. The organism was punctured using a sterile needle and placed in an excavated glass block containing colcemid-Ringer solution so that the puncture was below the surface of the solution. Material treated in this way, or fresh material, was dissected under 1% w/w Sodium Citrate solution; the structures to be studied were left under this hypotonic solution for 10-20 minutes and then transferred to stain. The stains used were saturated solutions of Orcein (Gurr's Synthetic) and Carmine + Orcein, in 50% Acetic Acid. Staining was for half an hour in the Aceto-Carmine-Orcein and then the structures were rinsed in the Aceto-Orcein, transferred to a fresh drop of Aceto-Orcein on a slide and macerated with fine needles before being made into squash preparations.

Chromosome measurements were carried out on prints at 3900× using a dissecting binocular (Zeiss « Citoplast ») with an eyepiece graticule where each scale division marked off 0.034 mm on the print. Pin pricks along the centre of each chromatid were used to delineate straight sections for measurement. The lengths of both chromatids on either side of the centromere have been summed in the computation of L (long arm length), S (short arm length), T (total length) and r (L/S). T, L and S have been converted to percentages of the Total Complement

TABLE 1
Localities for samples studied.

Determination	*2n*	*n*	*Locality*
Technomyrmex albipes	18	9	Sandringham, Victoria
Iridomyrmex sp. (ANIC-5)	14	7	Grampians Ra., Victoria
» (« *detectus* » group)	18	—	Beaumaris, Victoria
» »	—	9	11 mi. WSW of Euston, N.S.W.
» sp. (ANIC-11)	18	9	Parkville, Victoria
» sp. (ANIC-12)	18	—	5 mi. W of Hopetoun, Victoria
» sp. (ANIC-6)	18	9	5 mi. W of Melton, Victoria
» *gracilis* (A)	18	9	3 mi. N. by W. of Cranbourne, Victoria
» *gracilis* (B)	18	—	5 mi. W. of Melton, Victoria
» *gracilis* (C)	18	—	26 mi. SSW of Pooncarie, N.S.W.
» *mattiroloi*	18	9	5 mi. N. by W of Cranbourne, Victoria
» *itinerans*	16	8	Grampians Ra., Victoria
» *nitidus*	—	8	5 mi. W of Melton, Victoria
» *humilis*	16	8	Parkville, Victoria
» *glaber*	28	14	18 mi. NE of Camperdown, Victoria

Length (TCL) of a diploid metaphase in each case. Thus TCL's of haploid metaphases were doubled before calculating these percentages.

Chromosome classification

Precise descriptions of ant chromosomes have not been attempted in previously published work owing to the difficulties imposed by their small size, although the pioneering papers of HAUSCHTECK (1962) and SMITH and PEACOCK (1957) gave details of chromosome morphology and IMAI's (1966) plates could have enabled him to do so. Preparations of a number of species reported here allowed karyotype analysis of a higher order than had been previously possible.

LEVAN *et al.* (1964) have proposed a standard nomenclature for centromere position which is followed here, except that chromosomes termed subtelocentric under their system are termed subacrocentric and the term acrocentric is used to cover all chromosomes with an arm ratio greater than 7.0. It should be realised that r, the arm ratio, fluctuates more with measurement error as the centromere nears the end of the chromosome. PATAU (1960) and MOORE and GREGORY (1963) have pointed out the dangers in a too ready acceptance of apparent measurable differences between chromosomes.

Karyogram graphs, after PATAU (1960), were used wherever possible to assist the karyotypic description for each species. For these graphs, the chromosome arm lengths, S and L, expressed as percentages of the diploid TCL of each metaphase, were plotted against each other on ordinary graph paper. Following this, axes of T (total length) and r (the arm ratio, L/S) could be drawn in. The r axes shown divide chromosomes into metacentric, submetacentric, subacrocentric and acrocentric categories following the arbitrary criteria of LEVAN *et al.* (1964). It was found that the use of these karyogram graphs acted more as a brake upon excessive « characterization » of chromosomes than as a means of uncovering differences.

PATAU (1960) and ROTHFELS and SIMINOVITCH (1958) have noted that chromosomes in the same karyotype may contract at different rates. Accordingly, graphic karyograms are best used to compare metaphases of approximately the same average chromosome length. Figures 7 and 8 show three metaphases of *Iridomyrmex humilis,* two with relatively long (average chromosome length 3.7 μ and 4.8 μ) and one with relatively short chromosomes (average chromosome length 2.6 μ).

Due to their small size, it has been possible to characterize few single chromosomes in ant karyotypes. Classification is therefore into group (A, B, C etc.) based on size and centromere position. Rather than attempt to apply an overall nomenclature based on presumed homologies which, in the absence of hybrid data etc., are only speculative, chromosome groups in each karyotype have been labelled largely independently (for example, *I. gracilis,* karyotype (A), group C comprises chromosomes presumed homologous with C and D group chromosomes in the *I. detectus* (Beaumaris) and *I.* sp. (ANIC-11) karyotypes but not with the C group of the *I. glaber* karyotype). Groups implied by arrangement of chromosomes (Figures 1, 2 & 9) are therefore lettered serially, and are characterized in Table 2.

TABLE 2

Chromosome groups of species studied *.

Species	Groups					
	A	B	C	D	E	F
Technomyrmex albipes	(1) large sm	(2-7) med. m	(8) small smm	(9) small a		
Iridomyrmex spp. ANIC-5	(1-2) large m	(3-6) med. m	(7) small a			
Beaumaris « *detectus* »	(1) large m	(2-6) med. m	(7) small sm	(8-9) small a		
Euston « *detectus* »	(1) large m	(2-6) med. m	(7-9) small sm			
ANIC-11	(1) large m	(2-6) med. m	(7) small sm	(8-9) small saa		
ANIC-12	(1) large m	(2-6) med. m	(7) small sm	(8) small sa	(9) small a	
ANIC-6	(1) large m	(2-6) med. m	(7) small sa	(8-9) small sm		
gracilis (A)	(1) large m	(2-6) med. m	(7) small sa	(8-9) small a		
gracilis (BC)	(1) large m	(2-6) med. m/sa	(7) small a	(8) small sm	(9) small a	
mattiroloi	(1-6) large m	(7) med. sm	(8) small sa	(9) small m		
itinerans	(1) large m	(2-7) med. m	(8) small a			
nitidus	(1) large m	(2-7) large m	(8) small a			
humilis	(1) large sm	(2-6) med. m	(7) med. m	(8) small a		
glaber	(1) large m	(2-8) med. m	(9) large sa	(10-11) large sm	(12) med. sa	(13-14) small saa

* Numbers in parentheses refer to chromosome pairs in each group. Further explanation in text.

Cytological observations

Technomyrmex albipes (Smith)

$n = 9$; $2n = 18$
Material examined: Cerebral ganglia of prepupae and male pupae, pupal testes.

The karyotype of this species consists of seven metacentric chromosomes, one submetacentric to metacentric and one acrocentric (Figures 1 & 2).

Iridomyrmex sp. (ANIC-5)

$n = 7$; $2n = 14$
Material examined: Embyros, cerebral ganglia of prepupae, worker and male pupae, pupal and prepupal testes, prepupal gut and malpighian tubules.

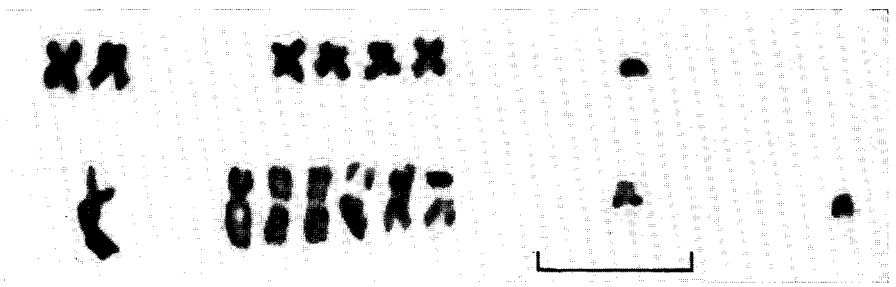

Fig. 1. — Haploid karyograms of *Iridomyrmex* sp. (ANIC-5), $n = 7$ (top) and *Technomyrmex albipes*, $n = 9$. The chromosomes are divided into groups as characterized in Table 2. Scale represents 5 microns.

Metaphase plates of this species contain one acrocentric and six metacentric chromosomes (Figure 1). The conclusions based upon colcemid-treated preparations are consistent with those based upon untreated ones.

Iridomyrmex - « *detectus* » group

Karyotype variation between samples from different localities, possibly interspecific, has been dealt with elsewhere (CROZIER 1968*a*). This report attempts to relate the karyotypes of this group to the cytogenetic evolution of the genus as a whole. *I.* « *detectus* » is of particular taxonomic importance, being the generitype, and the Beaumaris karyotype will be used as a basis for comparison for many species below.

Beaumaris sample

$2n = 18$
Material examined: Prepupal celebral ganglia.

This karyotype consists of six metacentric pairs of chromosomes, one small submetacentric pair and two acrocentric pairs (Figure 3).

Euston sample

$n = 9$

Material: Prepupal testes and cerebral ganglia.

This karyotype differs from that of the Beaumaris sample in that the three small chromosomes (Table 2 and Figure 3) are all submetacentric (CROZIER 1968*a*). The karyotype groups distinguished differ accordingly.

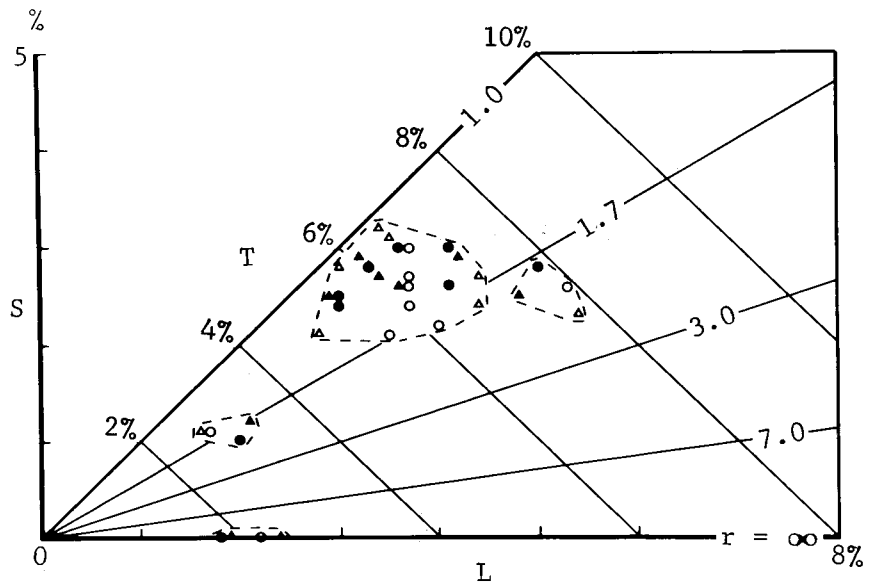

Fig. 2. — Karyogram graph for *Technomyrmex albipes,* showing four haploid metaphases. Symbols: S = short arm length in % Total Diploid Complement Length (TDCL); L = long arm length in % TDCL; T = S + L (total length of chromosome in % TDCL); r = L/S. Further explanation in text.
The average chromosome lengths per metaphase are: solid triangles, 3.3 μ; solid circles, 3.2 μ; open triangles, 4.6 μ; open circles, 4.5 μ.

Iridomyrmex sp. (ANIC-11)

$n = 9$; $2n = 18$

Material examined: Larval and prepupal cerebral ganglia, squashes of whole larvae.

The karyotype here (Fig. 3) appears consistent with the Beaumaris « *detectus* » karyotype. The morphology of the small chromosomes, however, could be ascertained only with the greatest difficulty in the preparations available, and some modification of this concept may be necessary in future.

Iridomyrmex sp. (ANIC-12)

$2n = 18$

Material examined: Prepupal cerebral ganglia.

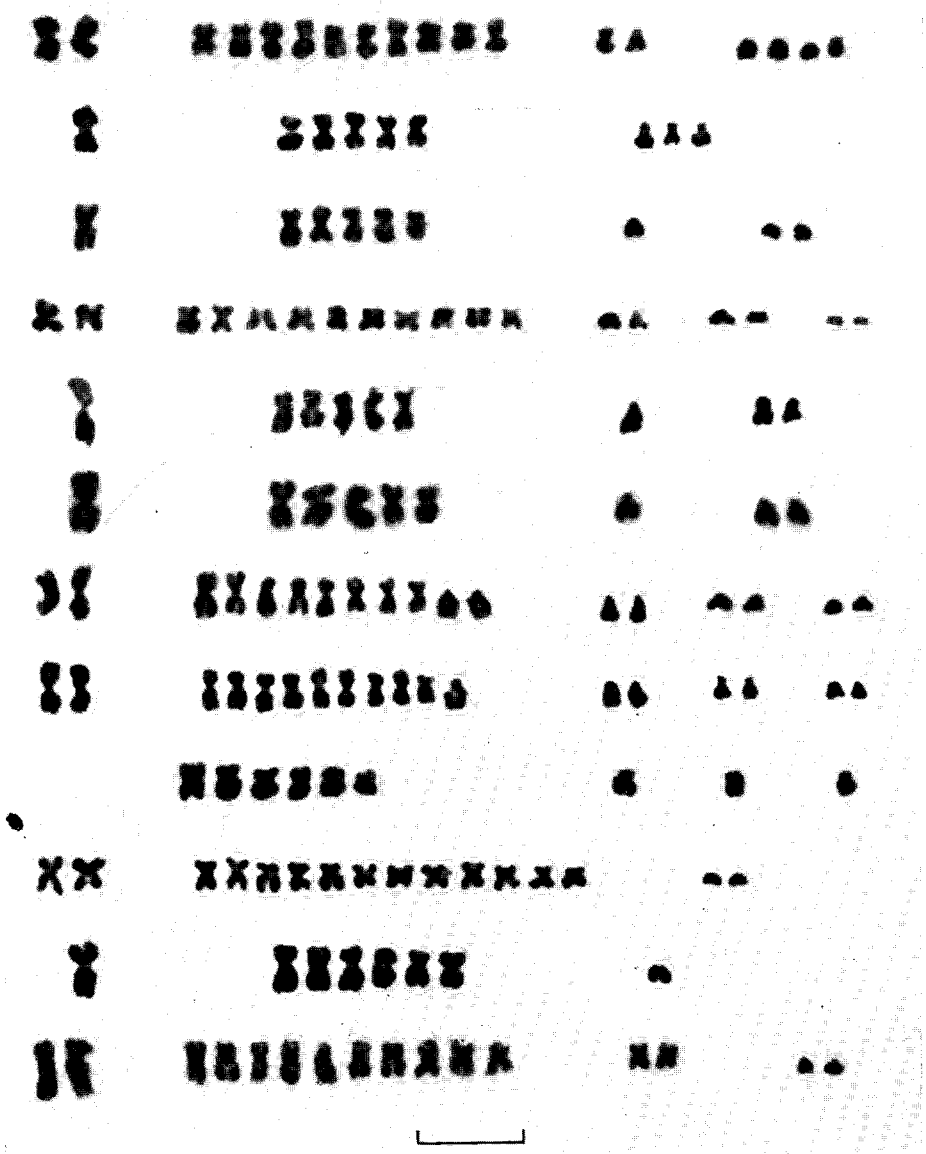

Fig. 3. — Karyograms of 8-and 9-chromosome species of *Iridomyrmex*, with the chromosomes arranged into groups as in Table 2. Scale represents 5 microns. From top to bottom, the species represented are:

« *detectus* » (Beaumaris)	$2n = 18$	*gracilis* (B)	$2n = 18$
« *detectus* » (Euston)	$n = 9$	*gracilis* (C)	$2n = 18$
sp. (ANIC-11)	$n = 9$	*mattiroloi*	$n = 9$
sp. (ANIC-12)	$2n = 18$	*itinerans*	$2n = 16$
sp. (ANIC-6)	$n = 9$	*nitidus*	$n = 8$
gracilis (A)	$n = 9$	*humilis*	$2n = 16$

The karyotype of this species, comprising six metacentric chromosomes, one submetacentric, one subacrocentric and one acrocentric, differs from that of the Beaumaris « *detectus* » in the size and morphology of the three smallest pairs (Figure 3).

Iridomyrmex sp. (ANIC-6)

$n = 9$; $2n = 18$
Material examined: Prepupal cerebral ganglia and testes, pupal testes.

Six metacentric chromosomes, two submetacentrics and one subacrocentric are found in haploid metaphases of this species (Figure 3). The karyotype is thus more similar to that of *I. sp.* ANIC-12 than that of the Beaumaris « *detectus* », but differs from it in that chromosomes 8 and 9 cannot be reliably separated.

Iridomyrmex gracilis (Lowne)

$n = 9$; $2n = 18$
Material examined: Prepupal cerebral ganglia and testes, pupal testes.

Three different karyotypes have been found in this species, and are considered separately below.

A) A sample taken near Cranbourne, Victoria, shows a karyotype similar to that of the Beaumaris « *detectus* ». The three small chromosomes, however, are quite similar, although in suitable cells a short arm can be distinguished on one, which is designated number 7 in Table 2. The karyotype therefore consists of six metacentric chromosomes, one subacrocentric and two acrocentrics. Since karyotype A differs, in the morphology of the small chromosomes, from both B and C karyotypes, it is best regarded as being of different « chromosomal race » (Figures 3 and 4).

B) A sample from near Melton, Victoria, exhibits a karyotype strikingly different from other 9-chromosome karyotypes in this genus in the possession of a pair of large subacrocentric chromosomes, apparently derived by a pericentric inversion from one of the smaller B group chromosomes (Figure 3 and Table 2).

C) Preparations from a colony fragment taken near Pooncarie, N.S.W., reveal a karyotype apparently heterozygous for the inversion giving rise to the subacrocentric noted in karyotype B. Only one large subacrocentric could be seen in preparations from this sample, and this, together with the observation of the subacrocentric pair in the Melton karyotype, is seen as strongly suggestive of heterozygosity for a pericentric inversion. Capture of the other homozygote would be necessary before it could be regarded as proven that an inversion polymorphism exists in this species. The karyotype in other respects is consistent with that from Melton, and the karyotype of the BC chromosomal race may said to contain five metacentric pairs, one pair which may be either subacrocentric or metacentric, one small submetacentric, and two acrocentrics separable by size.

Iridomyrmex mattiroloi Emery

n = 9; $2n = 18$
Material examined: Male pupal cerebral ganglia and testes, gyne pupal ovaries.

The karyotype of this species consists of seven metacentric chromosomes, one submetacentric and one subacrocentric (Figure 3). There is insufficient size diffe-

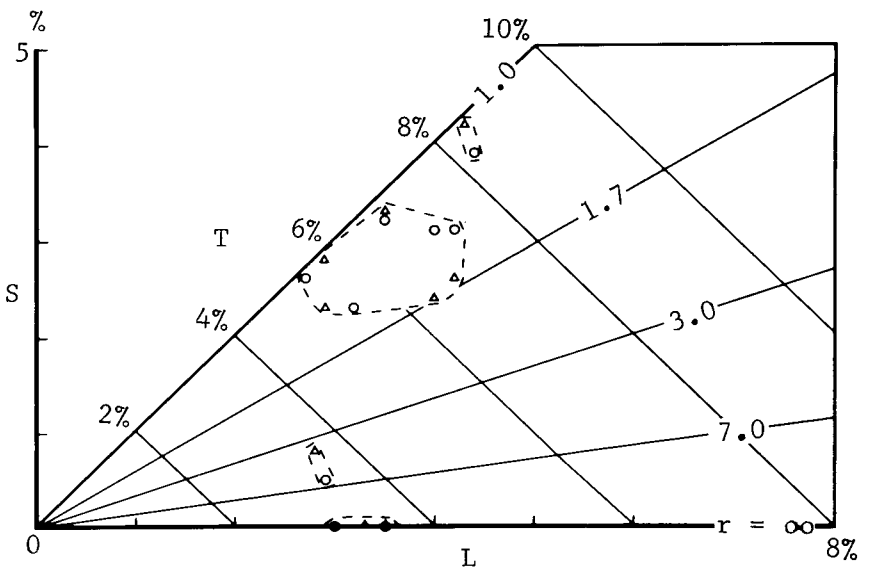

Fig. 4. — Karyogram graph for *Iridomyrmex gracilis* (A), showing two haploid metaphases, Symbols as for Figure (2). Average chromosome lengths per metaphase: circles, 3.5 μ; triangles, 3.3 μ.

rentiation among the six large metacentrics to enable subdivision. This species also differs from all the others studied karyotypically in the genus in that the smallest chromosome is metacentric, rather than acrocentric or subacrocentric.

An ovarian preparation of this species yielded many pachytene nuclei and also one commencing diplotene (Figure 5). Bivalent separation has not proceeded sufficiently to enable identification of chiasmata. SMITH (1942) presents figures of pachytene cells with incompleteness of pairing, in *Neodiprion* spp., superficially similar to that termed diplotene in Figure 5. That the cell here is one in diplotene rather than pachytene with incomplete pairing is indicated by the chromosomes being shorter and thicker than those of pachytene nuclei in the same preparation.

Iridomyrmex itinerans (Lowne)

$n = 8$; $2n = 16$
Material examined: Larval and prepupal cerebral ganglia, pupal testes.

This species is one of a group with *I. humilis* and *I. nitidus* where the karyotype contains eight rather than nine chromosomes and also contains only one small chromosome, rather than three as in the 9-chromosome species. It thus appears that the 8-chromosome karyotypes are either derived from the others by a centric fusion or gave rise to them through a dissociation.

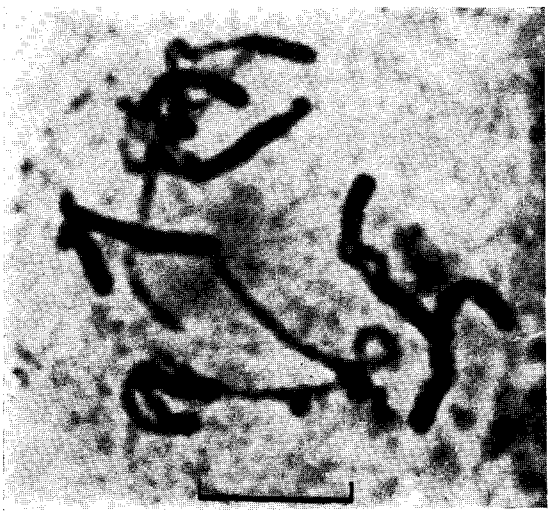

Fig. 5. — Early diplotene cell from queen pupal ovary, *Iridomyrmex mattiroloi*. Scale represents 5 microns.

The *I. itinerans* karyotype contains seven metacentric chromosomes and one acrocentric, falling into size groups as in Figure 3 and Table 2.

Iridomyrmex nitidus (Mayr)

$n = 8$
Material examined: Prepupal and pupal testes and cerebral ganglia.

The karyotype of this species contains seven metacentric chromosomes and one acrocentric. The longest chromosome is not as distinct from the others as in most other *Iridomyrmex* karyotypes (Figures 3 and 6).

Iridomyrmex humilis (Mayr)

$n = 8$; $2n = 16$
Material examined: Prepupal cerebral ganglia, pupal testes.

As well as large numbers of highly condensed metaphases (e.g. one measured for Figure 8), a number were obtained for this species in which the chromosomes

were unusually long, enabling karyotype characterization of a higher order than usual. The close correspondence in Figure 7 between the haploid metaphase, which was not pretreated with colcemid, and the diploid one which was, should be noted in view of SMITH's (1965) warning of possible karyotype distortion due to the use of colchicine.

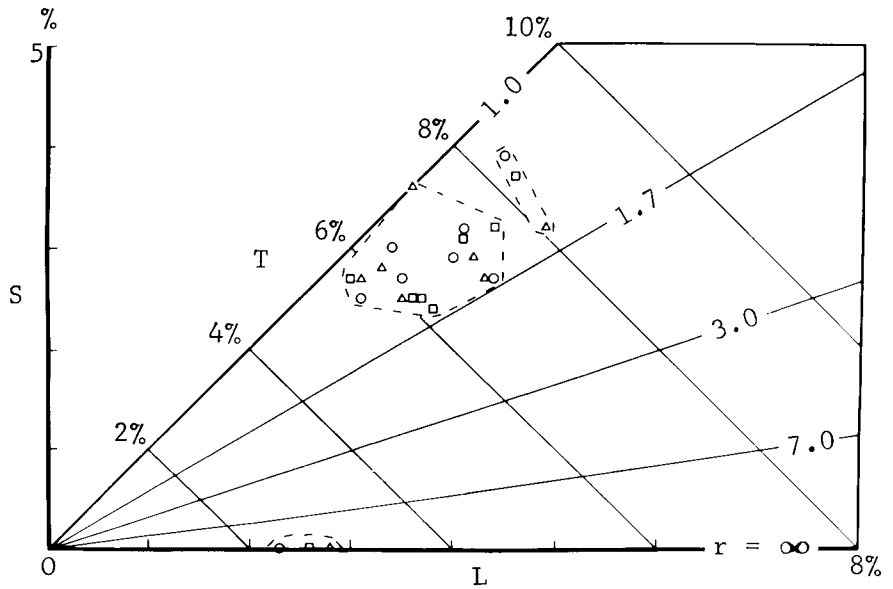

Fig. 6. — Karyogram graph for *Iridomyrmex nitidus*, showing three haploid metaphases. Symbols as in figure (2). Average chromosome lengths per metaphase: circles, 4.4 μ; squares, 4.1 μ; triangles, 3.8 μ.

The karyotype of this species contains one submetacentric chromosome, six metacentrics and one acrocentric, being divisible into four groups (Figure 3 and Table 2). In view of the relative lengths of chromosomes 1 and 7, I suggest that there is a relationship between the *I. humilis* karyotype and one of the other 8-chromosome karyotypes (the *I. nitidus* one seems most likely) wherein a translocation, of material from the long arm of chromosome 1 of *I. humilis* onto one of the others, possibly 7, converted the *I. humilis* karyotype to that of *I. nitidus*, the direction of change being unknown. It would be therefore particularly inadvisable here to consider chromosome 1 of either species as equivalent to that of the other.

Iridomyrmex glaber (Mayr)

$n = 14$; $2n = 28$
Material examined: Prepupal cerebral ganglia, pupal testes.

The karyotype of this species (Figure 9), with eight metacentric chromosomes, four subacrocentric to acrocentric, and two submetacentrics, cannot be derived simply from that of any of the other species reported here. It does appear consistent with that of the Japanese *I. itoi* Forel (IMAI and YOSIDA 1964, and *in litt.*), a form regarded by BROWN (1958 and *in litt.*) as conspecific with it.

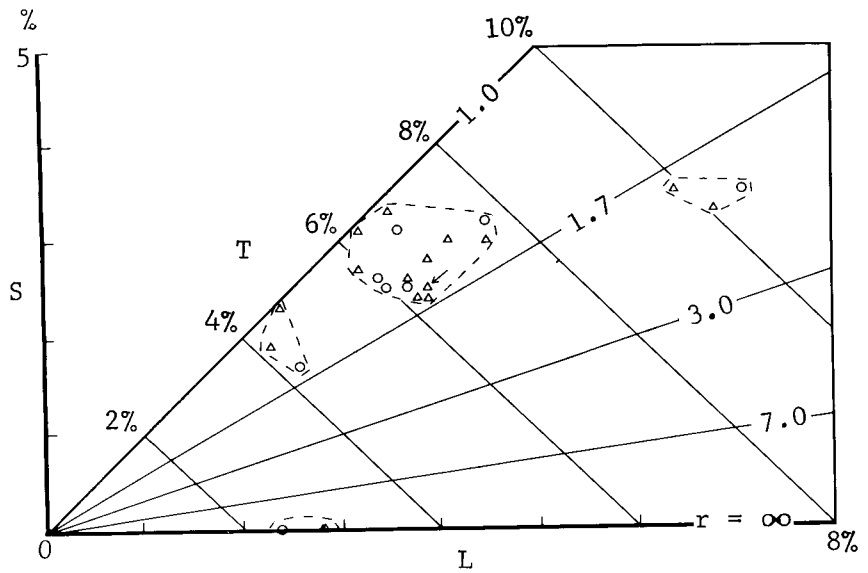

Fig. 7. — Karyogram graph for *Iridomyrmex humilis,* showing one haploid and one diploid metaphase, each with relatively long chromosomes. Symbols as in Figure (2). Average chromosome lengths per metaphase: circles, 4.8 μ; triangles, 3.7 μ. The haploid metaphase was from a preparation not pre-treated with colcemid. Arrow indicates a chromosome of poorer morphology than rest.

Morphological observations.

Iridomyrmex glaber differs from its congeners considered here in a number of respects, perhaps the most striking of which is the possession of five mid-dorsal tubercles in the larvae. *I. humilis* larvae have one, those of the other 8-and 9-chromosome species none. *I. glaber* is also distinguished by a deeply excised propodeal declivity and the larvae are yellow, not white as in the other species.

Iridomyrmex species with a haploid number of eight have the eyes placed more anteriorly in the worker than those where it is nine. Quantification of this has been attempted by using Head Length (HL) as defined by BROWN (1953) and Ocular Occipital Length (OOL), here defined as the distance between the mid-point of the eye and the posteriormost part of the head, measured with the head in a position suitable for measurement of the axes of the eye (using the midpoint

of the eye rather than one edge eliminates interference from variation in eye size, and the OOL is in practice the average between measurements from both edges). From Figure 10 it can be seen that the Ocular Occipital Index (OOI = OOL/HL $\times 100$) has significantly higher values for 8-chromosome species than for those with a haploid number of nine.

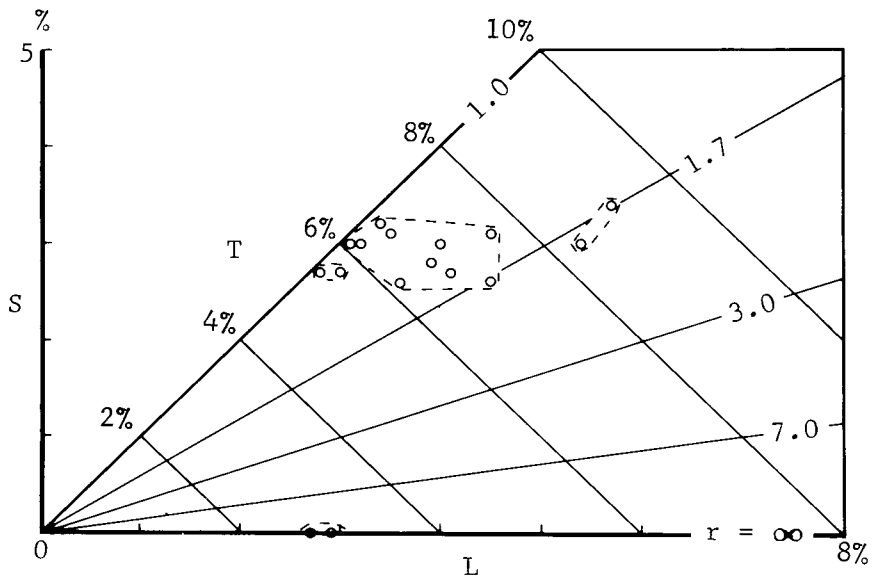

Fig. 8. — Karyogram graph for *Iridomyrmex humilis,* showing one diploid metaphase with relatively short chromosomes, average chromosome length: 2.6 μ. Symbols as in figure (2).

DISCUSSION

Iridomyrmex humilis (the Argentine Ant) is a cosmopolitan species of New World origin, and a number of deep-seated differences between it and the native Australian *Iridomyrmex* are known in the structure of the terminal sternites (PAVAN 1955; PAVAN and RONCHETTI 1955) and the proventriculus (EISNER 1957). Thus the apparent close cytological relationship between this species and the Australian *Iridomyrmex* is rather surprising; work on other New World Tapinomini is required.

Speculation as to which 9-chromosome species is most closely related to the 8-chromosome group would not be fruitful at this stage. A simple one step change between the two groups cannot be proposed on the basis of the known karyotypes, as even in *I. gracilis* (A) a short arm is present on one of the small chromosomes. In view of the absence of short arms from the small chromosomes in the three 8-chromosome species studied, all the

small chromosomes would have to be acrocentric. The possibility remains that such a karyotype, or an 8-chromosome one with a subacrocentric chromosome 8, will be eventually found.

Differences in chromosome number between species of the same genus have been previously reported in the genera *Lasius, Formica, Camponotus, Pheidole, Aphaenogaster* and *Myrmica* (see HAUSCHTECK 1962; HAUSCHTECK

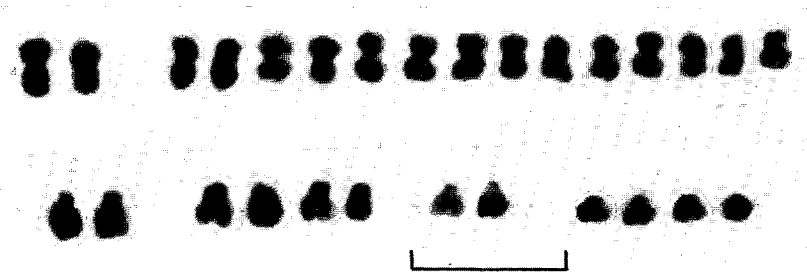

Fig. 9. — Diploid karyogram of *Iridomyrmex glaber*, $2n = 28$. The chromosomes are divided into groups as characterized in Table 2. Scale represents 5 microns.

1965; IMAI 1966; KUMBKARNI 1965). HAUSCHTECK's (1962) data on *Lasius* species suggest that a fusion between chromosomes exists in one section of that genus compared with another. The data presented in this paper suggest that at least three major chromosomal changes have occurred during the chromosomal evolution of *Iridomyrmex* (one pericentric inversion, one centric fusion or dissociation and either a pericentric inversion in chromosome 1 of *I. humilis* or the translocation postulated) plus a number of minor ones (note the variation of morphology in the small chromosomes in particular). *I glaber,* and probably *I. sp.* (ANIC-5), might well be removed from the genus as it is not possible to relate them chromosomally to the other species, but more data on morphologically similar species, within and outside *Iridomyrmex,* are needed.

It should be remembered that most of the species reported here were from single colony fragments. Thus, in view of the findings in *I. gracilis* and *I.* « *detectus* », there may be variability in the karyotype of many of these species too.

IMAI (1966) has suggested that polyploidy may have occurred in ant evolution, on the basis of counts then known to him for the subfamily Formicinae. As the proportion of species sampled is very small, there is no recognizable base number, and there are no species with exact multiples in the proposed series, the data is not yet at all convincing for this theory; further-

more, one further count (KUMBKARNI 1965) falls in one of the gaps in IMAI's series. Although the occasional production of diploid sperm (e.g. SMITH and PEACOCK 1957; HAUSCHTECK 1965), the occasional thelytokous production of diploid eggs (e.g. TUCKER 1958; LEDOUX 1956; LEUTERT 1963; and see CRAWLEY 1912) and the small effective population size in populations of social Hymenoptera (WILSON 1963) would seem factors favouring polyploidy

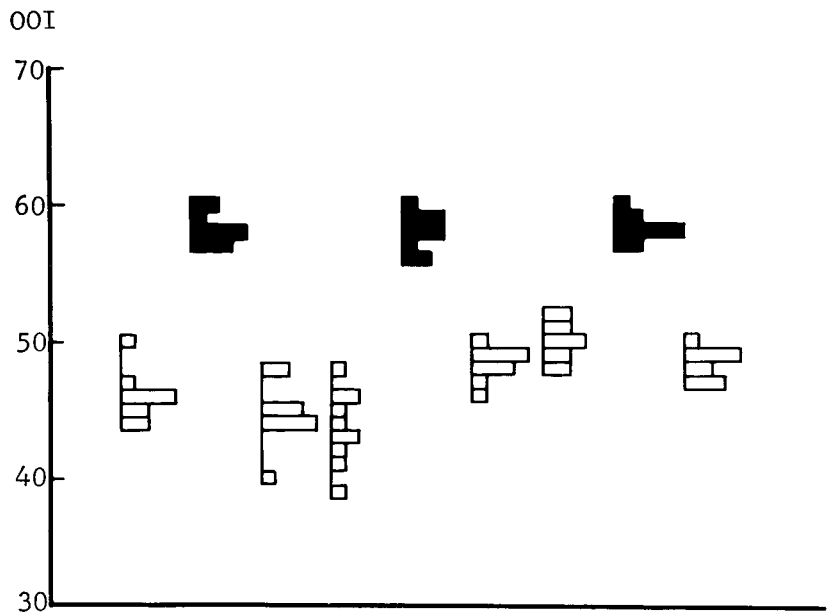

Fig. 10. — Ranges of Ocular Occipital Indices in 8-and 9-chromosome *Iridomyrmex* species, results of measurements on ten specimens in each sample. From left to right, results for:

« *detectus* » (Beaumaris sample)
itinerans
« *detectus* » (Euston sample)
gracilis (B+C)
nitidus
gracilis (A)
sp. (ANIC-11)
humilis
mattiroloi
sp. (ANIC-6)

8-chromosome species are represented by solid histograms, those with a haploid number of 9, by open ones. Further explanation in text.

in the order, only one case has been firmly demonstrated (KERR and ARAUJO 1957). Further work, however, might yield another case among the lower myrmicine ants (HAUSCHTECK 1965).

Various authors (e.g. SUOMALAINEN 1950, 1962; DOBZHANSKY 1951; WHITE 1954), have suggested that populations of Hymenoptera should be genetically less variable than those of non-arrhenotokous bisexual groups due

to a more rapid elimination of deleterious recessive genes through their exposure in the haploid males. SUOMALAINEN (1962) also suggests the converse, that a new favourable gene « will have a greater chance to spread through a population and to establish itself in a species with haploid males as compared with one of diploid males ». DOBZHANSKY (1951), WHITE (1954) and KERR (1951), however, recognize the importance of sex limited gene effects in hymenopteran evolution, although suggesting that the store of concealed variability in hymenopterous females is lower than in groups with diploid males.

Hymenopteran sexes are morphologically and behaviourally very distinct from each other, particularly in the ants and social bees, where the range of female activities vastly surpasses that of the male. Thus the same genomes yield quite different phenotypes, depending on the level of ploidy. The system can be treated as one of total sex linkage, and in this case it has been shown that the fitness of the same allele can be quite different, and not strictly comparable, in the two sexes, and yet be maintained in the population (LI 1967).

Although quantitative analyses of the genetic variability of hymenopterous populations await application of techniques such as that of HUBBY and LEWONTIN (1967), there are some data available. Various sex limited genes are known, e.g., the caste determination loci of *Melipona* species (KERR 1950), genes for abdomen colour in *Trigona mosquito* and *Melipona marginata* (KERR 1951) and the sex alleles of *Apis mellifera* and *Bracon hebetor* (see DRESCHER and ROTHENBUHLER 1964; WOYKE 1965; WHITING 1961). Colour pattern polymorphisms are also known for *Pseudaugochloropsis nigerrima* (MICHENER and KERFOOT 1967), *Tenthredo accerrima* and *T. perkinsi* (WATERHOUSE and SANDERSON 1958). The responses to selection of *Bracon hebetor* (SCOSSIROLI and VON BORSTEL 1963), *Dahlbominus fuscipennis* (WILKES 1964) and *A. mellifera* (see ROTHENBUHLER 1958) are evidence of significant stores of genetic variability in these species.

The discovery of an apparent inversion polymorphism in *Iridomyrmex gracilis* (BC) and of interpopulation karyotype variation in the *I.* « *detectus* » group are therefore not surprising in view of the known genetic variability in other Hymenoptera, as shown above, as well as the probable chromosome number polymorphism of *Tenthredo accerrima* (WATERHOUSE and SANDERSON 1958). The evolutionary chromosomal changes observed between *Iridomyrmex* species, and the wide divergence of karyotype observed between species in a number of genera of ants suggest further that the principles of karyotype evolution in other bisexual animals apply also to ants despite their haplo-diploid genetic system.

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DETERMINATIONS AND DEPOSITION OF SPECIMENS

The samples used here are referred to either by determinations made by Dr. W. L. Brown or code numbers (ANIC) supplied by Dr. R. W. Taylor referring to « provisional species » in the Australian National Insect Collection. Worker specimens of all samples will be deposited in the Australian National Insect Collection, Canberra.

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SUMMARY

1) Details of chromosome number and morphology for two genera of Tapinomini are reported and are summarized in Table 2.

2) Haploid numbers of nine for *Technomyrmex* and seven, eight, nine and fourteen for *Iridomyrmex* species are reported.

3) Chromosomal differences between the species of *Iridomyrmex* indicate the occurrence of certain rearrangements during the evolution of the group — including a centric fusion or dissociation relating the 8-and 9-chromosome species.

4) Evidence is presented suggestive of a pericentric inversion polymorphism in one species of *Iridomyrmex*.

5) A correlation of external morphology with cytology is demonstrated for *Iridomyrmex*.

6) In view of these findings and the genetic variability now known in hymenopteran populations, it is concluded that the principles of karyotype evolution in other bisexual animals apply also to ants despite their haplo-diploidy.