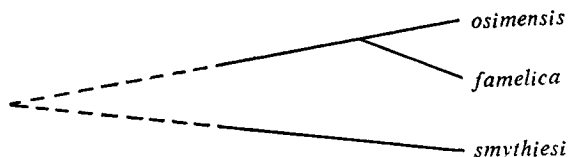


*famelica* and *smythiesi*, still their distribution patterns and karyotypes obviously show a distinct phylogenetic discontinuity between *smythiesi* and *osimensis-famelica* group. Considering from these results, the phylogenetic relation among these three *Aphaenogaster* species can be hypothesized in the following way:



In this connection, Hauschteck (1962) has observed the  $2n$  chromosome number of *A. subterranea* to be 22. This number is the same as that of *smythiesi*, which suggests a phylogenetic relation between *subterranea* and *smythiesi*.

The reason for the close resemblance in morphology between *famelica* and *smythiesi* might be due to a convergent adaptation to colder conditions, because many species occurring in high latitudes tend to be covered with a dense pile or rugosae. This morphological marker, increased rugosity, may be useful for identification or comparison among "Neo" species, which are considered as having expanded from the tropical to temperate zone and secondarily adapted to the climate. But if the species to be compared are composed of "Neo" and "Relict" species as in our case, this morphological marker might easily lead to a wrong conclusion, as I have shown above.

The useful morphological character is the leg length and body size of female. It seems interesting that in many ants there is some correlation between body size and chromosome number. Generally speaking, the high chromosome numbered species have large body and rather black color in comparison with related species, for example, *Tetramorium guineense* ( $n=11$ ) < *T. caespitum* ( $n=14$ ), *Camponotus* sp. (tropical species) ( $n=9$ ) < *C. japonica* ( $n=14$ ), *Pheidole fervida* ( $n=10$ ) < *P. nodus* ( $n=19$ ), and *Crematogaster laboriosa* ( $n=13$ ) < *C.* sp. (tropical type) ( $n=20$ ). These tendencies are in some agreement with plant evolution in which polyploid plants tend to large size than diploid species (Stebbins, 1950).

Phylogenetic agreement between the results of external morphology and of karyotype analysis have also been established in higher ant such as subfamilies (Brown, 1954; Imai, 1966). However, it has been proved in this study that external morphology by itself is not sufficient in cladistic analysis at the species level.

An effective phylogenetic analysis should include, wherever possible, a combination of morphological, distributional, and karyotypic analysis.

### Summary

The chromosome evolution and species differentiation in the three Japanese *Aphaenogaster* ants is studied by means of analysis of external morphology (mainly degree of rugosity), geographic and altitudinal distribution, and karyotype.

The close relation between *osimensis* and *famelica* was established by con-