Mycofloristic Ties of Japan to the Continents*

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ABSTRACT

The Japanese Agaricales can be divided into at least nine groups of species as related to their distribution elsewhere:

1) Cosmopolitan
2) Northern Hemisphere
3) Eurasian
4) North America and Eastern Asia
a) Western North America and Eastern Asia
b) Eastern North America and Eastern Asia
5) Far Eastern
6) Southeast Asiatic
7) Tropical or Subtropical
8) Arctic or Alpine
9) Endemic

The Japanese archipelago stretches north and south in the northwestern Pacific for about 3,000 km. This latitudinal extent and also the oceanic humid climate of all Japan are reflected in the complicated composition of its fungus flora. But we cannot at present fully explain the features of the fungus flora, because taxonomic and geographic studies in Japan are not advanced enough to permit it. We will, however, dare to report the Agaricales of Japan in their relations to those of surrounding countries as well as of Europe and North America, centering around the distribution of species.

Roughly speaking, fimicolous and humicolous fungi produce comparatively long-lived spores, so they may be able to extend their distributions far through the transportation of spores by air currents, birds, insects, etc. In the case of mycorrhizal fungi, however, migration by spores into new areas beyond the oceans or grand mountain ranges seems difficult, because the life of their spores is generally said to be very short. Accordingly, it is natural to assume that the mycorrhizal fungi have, in most cases, gradually extended their ranges toghther with their partner trees, through land bridges or along mountain chains, over geological ages.

The Japanese Agaricales can be divided into at least following nine groups of species from their modes of distribution:

1) Cosmopolitan – *Schizophyllum commune, Hygrophorus conicus, Collybia dryophila, Mycena pura, Psathyrella candolliana, Coprinus atramentarius, C. disseminatus,*

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Conocybe lactea, Stropharia semiglobata, Naematoloma fasciculare, etc. Namely, most of the cosmopolitans are saprophytes.

2) **Northern Hemisphere** – *Asterophora lycoperdoides, Panellus serotinus, Pleurocybella porrigens, Amanita muscaria, Phaeolepiota aurea, Rozites caperatus, Chroogomphus rutilus, Suillus luteus, S. granulatus*, etc. Most of the species of this group are distributed north of the equator, but some of the mycorrhizal ones have been introduced artificially into Australia, New Zealand, South America, etc., with their partner trees (HORAK, 1971; MCNABB, 1968, 1970, 1971; SINGER, 1964, 1969; STEVENSON, 1961, 1962).

3) **Eurasian** – *Lyophyllum transforme, Cortinarius praestans, Gomphidius roseus, Gyrodon lividus, Suillus bovinus*, etc. These are common to Europe, but not to North America.

4) **North America and Eastern Asia** – We can distinguish this group into two:

a) **Western North America and Eastern Asia**, that is, along the northern Pacific – *Chroogomphus tomentosus, Boletellus mirabilis*, etc. Most of the species of this group are associated with conifers such as *Abies, Tsuga, Pseudotsuga*, etc., but at present we have insufficient data. In both the Kii and Shikoku mountains *Pseudotsuga japonica* forests exist on small scales; here we expect some secotiaceous fungi (such as *Thaxterogaster*) to occur.

b) **Eastern North America and Eastern Asia** – *Catathelasma ventricosa, Rhodophyllus murraii, R. salmoneus, R. abortivus, Suillus pictus, S. subluteus, Tylopilus chromapes, T. alboater, T. eximius, T. ballouii, Boletus griseus, B. ornatipes, Porphyrellus gracilis, Boletellus russellii, Lactarius indigo* (Fig. 1), *L. gerardii*, and many others have been known up to the present. Among these, *Tylopilus alboater, T. ballouii*, etc. are penetrating further south into Southeast Asia (CORNER, 1972). We now recall ASA GRAY's theory on the close affinity of vascular floras of Japan and Eastern North America. If we follow his concept, there is every probability that, during the Ice Age, circumpolar fungi migrated south into the two separate regions from the polar region in company with vascular plants. After that, most of the latter have differentiated independently in specific, or at times even in generic levels, in each region, while in most of the fungi specific differentiation has not advanced so much.

5) **Far Eastern** – *Lampteromyces japonicus, Tricholoma matsutake, Oudemansiella brunneomarginata* (Fig. 1), *Amanita flavipes, A. spissacea, A. subjunquillea, Descolea flavoannulata* (Fig. 2), *Lactarius flavidulus, L. laeticolorus*, etc. Among these, *Tricholoma matsutake* is at present known from Japan, Sakhalin, Korea, and Formosa, and *Descolea flavoannulata* from the far eastern U.S.S.R., Japan, and Korea (Jeju island).

6) **Southeast Asiatic** – *Amanita rubrovolvata, A. perpasta, A. gymnopus* (Fig. 2), *Cortinarius nigrosquamosus, Boletus violaceofuscus, Tylopilus virens, T. nigropurpureus, T. nigerrimus, T. valens, T. neofelleus*, etc. Most of the species of this group range from central or western parts of Japan to highlands of Southeast Asia (including the mountain sides of the Himalayas), and at times to those of New Guinea. They usually occur in evergreen broadleaved, namely warm temperate forests, so they are presumably associated with that kind of vegetation type, forming mycorrhizae with evergreen oaks, *Quercus* (*Cyclobalanopsis*), *Castanopsis, Lithocarpus*, etc., or living saprophytically on remains of these trees. We now

call them "Southeast Asiatic elements". Probably after the Ice Age they extended their ranges from south to north together with evergreen oaks. They are also sometimes associated with deciduous Fagaceae near the northern limits of their ranges in Japan.

7) Tropical or Subtropical – *Panus badius, Anthracophyllum nigrita, Oudemansiella canarii, Xerulina chrysopepla, Mycena chlorophos, Filoboletus manipularis, Xeromphalina tenuipes* (Fig. 2), *Ripartitella brasiliensis,* etc. Most of these usually occur in lowlands of the tropical zone, for instance, tropical rain forests, but often penetrate further north into warm temperate zones (HONGO, 1955, 1956, 1974; KOBAYASI, 1949, 1951, 1963). Of course, the Ryukyu, the Amami, and the Bonin Islands, etc. are rich in these species (HONGO, 1977; ITO & IMAI, 1939, 1940; MIYAGI, 1964, 1971), and some of them are also found west of the Kanto provinces.

8) Arctic or Alpine – At present, the fungus flora of alpine zone of Japan is very little known, and further investigation is needed.

9) Endemic – Many may exist, but for the present there are none which we can positively term "endemic", because the fungus floras of the surrounding countries are very poorly known, except for that of the far eastern U.S.S.R. (VASSILIEVA, 1973). Judging from our present knowledge, however, *Clitocybe acromelalga* (Fig. 2), *Tricholoma muscarium,* etc. may belong here.

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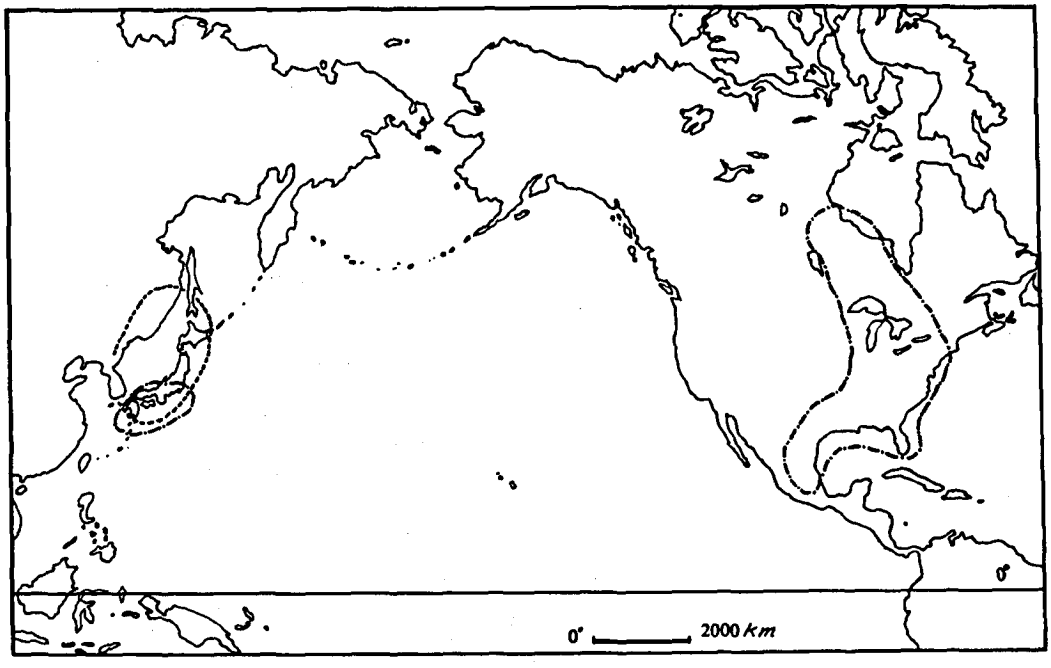

Fig. 1. Map showing two distribution types.
——— *Lactarius indigo*: Eastern North America and Eastern Asia.
--------- *Oudemansiella brunneomarginata*: Far Eastern.

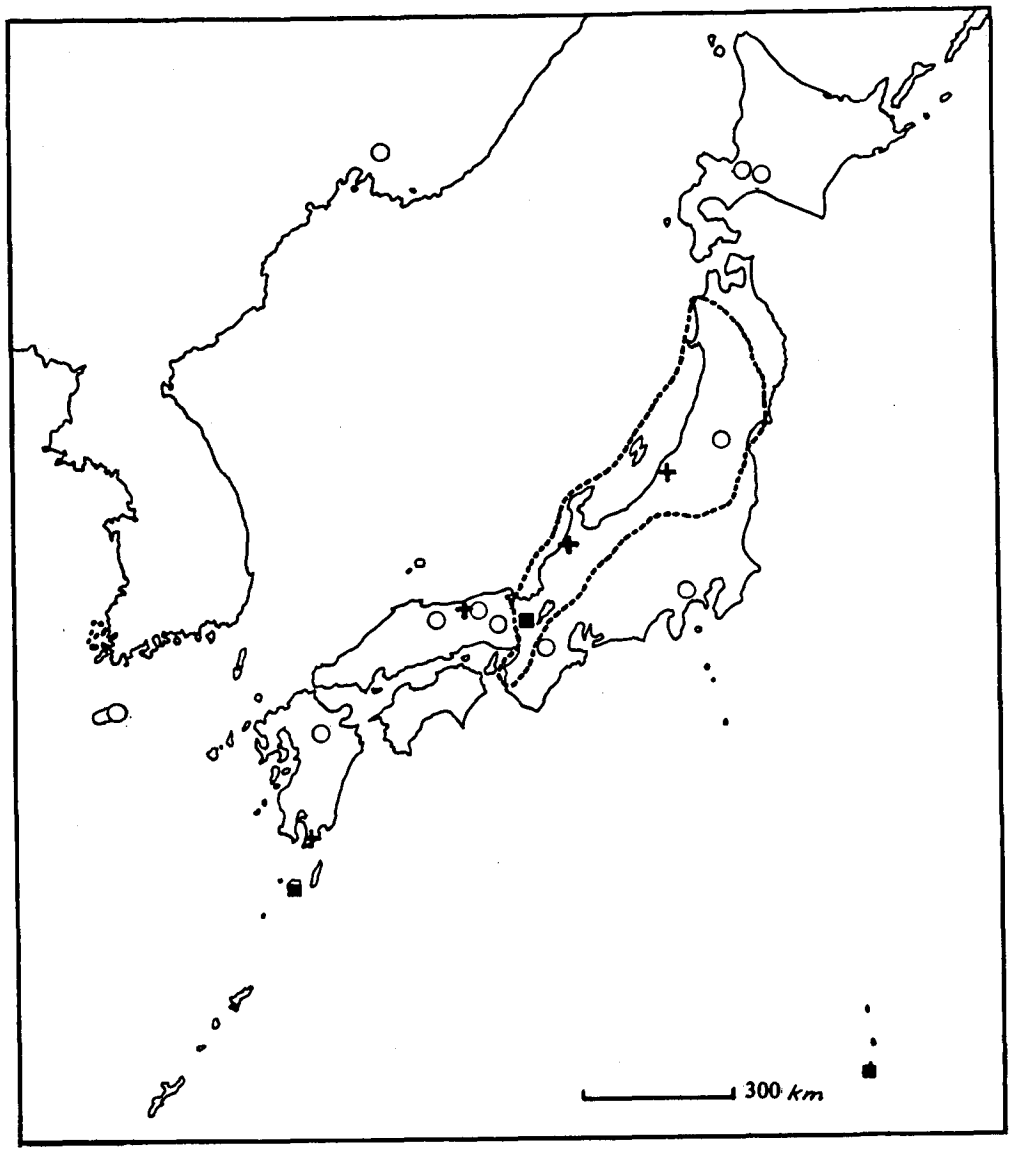

Fig. 2. Distribution of four interesting agarics in Japan and its adjacent countries.
----- *Clitocybe acromelalga*
■ *Xeromphalina tenuipes*
\+ *Amanita gymnopus*
○ *Descolea flavoannulata*