# On the Himalayan Uplift and Himalayan Corridors

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It is necessary to review studies carried out in the Himalayas from the interdisciplinary viewpoints for a comprehensive understanding of some features of Himalayan vegetation and the patterns of distribution of some plants, especially in connection with the Himalayan orogeny.

## Himalayan corridors

Kitamura (1955) postulated that the temperate zone of the southern side of the Great Himalayas represented a corridor through which Sino-Japanese plants migrated westwards, and named it the Himalayan corridor. However, he did not pay much attention to the eastward distribution of Mediterranean elements through the corridor and extended the Sino-Japanese region up to Afghanistan by drawing the Himalayan corridor (Kitamura, 1957).

The southern slopes in the Himalayas are generally drier than the northern slopes. In the case of the Great Himalayas, however, the south-facing slope is moister than the north facing one. Therefore, there are two corridors along the Outer and Lesser Himalayas respectively, on the south facing slopes and on the north facing slopes, and the Great Himalayas provide a corridor on its southern slope. The northern side of the Great Himalayas can not act as a corridor due to its dryness.

The eastern elements extended their distribution range westwards through the moister corridor and the western elements migrated eastwards through the drier corridor. However, for example, wet sal (*Shorea robusta*) forest occurring on the south-facing slopes of the Siwalik range in Central Nepal can not survive on the south facing slopes in the western Siwaliks. It moves to the north-facing slope and it is replaced by the dry hill sal forest in the west Siwalik range. The dry hill sal forest gives place to the subtropical decidous hill forest dominated by *Anogeissus latifolia* in the west Siwalik. The deciduous hill forest dominated by *Anogeissus latifolia* is replaced by the subtropical scrub composed of *Olea cuspidata*, *Dodonea viscosa* etc. in the further west. On the north-facing slope, the wet Sal forest replaces *Castanopsis indica- Schima wallichiana* forest in the west Siwalik where the dryness caused by the increase of mediterraneity of climate is prevailing. The Siwalik range provides corridors on the south and north sides of the range for the eastward migration of western elements and westward distribution of eastern elements. In the Lesser Himalayas, *Quercus lanuginosa-Q. incana* forest is replaced by *Q. incana* forest in West Nepal, and *Q. incana* forest occurs on the all exposures in West Nepal and Kumaon region in India and then it is confined to the northern side of the Lesser Himalayas westwards. *Cedrus deodara* forest replaces *Q. incana* forest on the southern slopes of the western Lesser Himalayas where *Q. incana* forest move to the northern side. The Himalayan corridors are twisted in this way.

## Historical sketch of Himalayan corridors

Prakash (1978) and Awasthi (1982) reported that the tropical forests covered the Siwalik area before its uplift in the lower Miocene. The first record of the Mediterranean elements in the Himalayan area was found above the sterile deposits indicating the uplifting of the main Himalayan ridge in the middle Miocene. This suggests that a simple Himalayan corridor was formed on the southern side of the main range in the upper Miocene. The prototype of Himalayan corridors was formed by the uplift of Outer and Lesser Himalayas.

Guo *et al* (1976) reported that the macrofossils and pollen of many temperate tree species (*Betula*, *Alnus*, *Carpinus*, *Magnolia*, *Cedrus*, *Abies*, *Picea*, *Sabina*, *Lespedeza* etc.) were found from the deposits of the last Interglacial period (Kangbula Interglacial). They concluded that the Great Himalayas experienced abrupt and a large-scale uplift during the last Glacial period.

Stainton (1972, 1977) recognized that there are two kinds of distributional gaps of Himalayan plants: one is the East Nepal-Sikkim Gap and the other is the Sino-West Himalaya Gap. *Actaea spicata*, *Lonicera quinquelocularis*, *L. webbiana*, *Plectranthus rugosus*, *Ribes alpestre*, *R. emodense*, *Sorbaria tomentosa*, *Viburnum cotinifolium* etc. show the former type of distribution gap. Although Stainton reasonably discussed about discontinuity in the distribution of the former by the specialty of wet climate and the lack of the medium-dry habitats in East Nepal and Sikkim, and the reoccurrence of drier conditions in Bhutan, he could not elucidate the latter discontinuity. *Acer caesium*, *Cotinus coggygria*, *Olea ferruginea*, *Quercus dilatata*, *Incarvillea arguta*, *Clematis grata* etc. have the latter discontinuity pattern.

I have discussed this big distribution gap in connection with the Himalayan uplift (Tabata, 1988, 1998). Chinese scientists showed that many temperate trees including *Cedrus*, one of western elements, occurred on the northern side of the Great Himalayas in the last Interglacial. It means the presence of the Himalayan corridor through which the western elements, preferring drier conditions, migrated eastwards up to the southwestern part of China during the last Interglacial period. The corridor on the northern side disappeared after the abrupt and drastic uplift during the last Glacial period and the big discontinuity of distribution range of plants, which were separated in West Himalayas and Southwest China, was formed by this kind of event in the Great Himalayan area during the last Glacial period.

There is another evidence to show the existence of the Himalayan corridor on the northern side of the Great Himalayas. The palynological study (Yoshida *et al*., 1984) showed that *Abies*, *Picea*, *Larix*, *Tsuga* and *Pinus* were found together with *Quercus*, *Keteleeria*, *Myrica*, *Podocarpus*, *Sapium* etc. from the Tetang Formation in Thakkhola (the upper stream area of the present Kaligandaki river). It is especially important that the occurrence of *Keteleeria* was confirmed from the Tetang Formation. *Keteleeria* is a warm temperate, sometimes subtropical, conifer which is now confined to the southern China though it was distributed from Asia to Europe in the Miocene. This suggests that the Himalayan corridor on the northern side of the Great Himalayas existed in the lower Neogene. The Annapurna-Dhaulagiri mountains were high enough for the growth of *Picea* and *Abies*, and the altitude of the mountains is estimated to be between 3500 m and a little bit higher than 4000 m asl. It is estimated from the presence of temperate and cold temperate trees that the Annapurna-Dhaulagiri mountains were not so high as to block the monsoon and the moist air reached up to Thakkhola area where the dry climate is prevailing and no forests are available now.

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