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PALAEOBOTANICAL DATA TO THE HISTORY OF THE FAMILY HAMAMELIDACEAE

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ABSTRACT. In the development of the family Hamamelidaceae in Eurasia three stages can be distinguished. In different regions of the continent particular phases of these stages were not synchronous and occupied different stretches of geological time. In Europe and Asia the history of the Hamamelidaceae was closely connected with that of the Turgaian flora, whose disappearance ran paralell to the process of extinction of the Hamamelidaceae.

In Georgia the history of the Hamamelidaceae proceeded against a background of the evolution of subtropical vegetation. As the evergreen forests dissapeared a great number of genera of the Hamamelidaceae became extinct. Only a few representatives continued to survive in the warm-temperate deciduous forest, which covered the plains and lower mountane belts of Colchis during the Late Pliocene.

KEY WORDS: Hamamelidaceae, geological history, stages of development, Asia, Europe, Western Georgia (Colchis)

INTRODUCTION

Among the angiosperms the Hamamelidaceae is one of most ancient families, considered to be a binding link between the Trochodendrales and the amentiferous orders Casuarinales, Urticales and Fagales. The family consists of 31 genera of which 15 are monotypic. The greatest number of Hamamelidaceae genera occur in the Northern hemisphere and only 4 genera are found in the Southern hemisphere.The largest regions of distribution are Eastern and South-Eastern Asia, the Atlantic coast of North America, Central America, East and South-East Africa and tropical Australia. The Hamamelidaceae are evergreen or deciduous trees and shrubs, growing on plains or in mountainous subtropical and warm-temperate forest about 1000–1300 m over the sea level.

STAGES OF DEVELOPMENT

In non-tropical Asia (Middle Asia, Siberian Plain and Amuro-Zeya Depression) the earliest remains of the Hamamelidaceae were found in Late Cretaceous (*Disanthus*, *Parrotia*, *Hamamelis*, *Fothergilla*, *Corylopsis* and *Liquidambar*) (Ziva 1973).

During the Palaeocene *Liquidambar* increased its area of distribution and the number of species grew larger (Kuprianova 1960). The taxonomic composition of the remaining Hamamelidaceae genera changed little throughout the Early Palaeogene.

In the Eocene and Oligocene, representatives of the Hamamelidaceae were widely distributed from Primorje to the Urals, penetrating to the far North. From the deposits of the Northern part of Western Siberia were described pollen of *Hamamelis* and some species of *Corylopsis* end *Fothergilla* (Lubomirova 1965). The genus *Liquidambar* was represented by several species (Kuprianova 1960).

By the beginning of the Neogene most of the Hamamelidaceae had become extinct throughout much of non-tropical Asia, although the genera *Hamamelis, Fortunearia, Parrotia* and *Liquidambar* survived until the end of the Miocene. Except for Liquidambar, they occupied a very limited area, being restricted to Korea and Japan (Tanai 1972). Only *Liquidambar* continued to play a fairly significant role in the floras of non-tropical Asia. In Miocene it was one of most widspread plants in Central Asia and Siberia (Gorbunov 1955). However, the area of its distribution had become distinctly limited by the end of the Miocene, while in the Pliocene and Pleistocene *Liquidambar* survived only in Japan, where it was represented by the single species *L. formosana* (Miki 1953).

In Europe, as in Asia, the earliest records of the Ha-

mamelidaceae date from the Cretaceous. Fossil seeds of about 20 species were described from deposits in Central Europe (Knobloch & Mai 1983, 1984, 1986). Two of them belong to *Disanthus,* one – to *Rhodoleia,* while the rest have been referred to the artificial genus *Klikovispermum,* which by some researchers consider to be close to *Rhodoleia* although Friis and Crane (1989) think, that it is rather heterogeneous group, probably belonging to different orders.

By the beginning of the Tertiary for the first time in Europe modern taxa appeared in great numbers and representatives of the Hamamelidaceae played a significant role among them (Mai 1987). From the Palaeocene London Clay, Chandler (1961) described remains of some species of genus *Corylopsis* and of *Liquidambar palaeocenicus* Chandl. More recently fruiting heads of this species have been investigated by Crane (Ferguson 1989), who concluded that they belonged to a platanoidaceous plant.

In the Eocene the taxonomic composition of the Hamamelidaceae was more diverse. Remains of *Protoaltingia, Fothergilla, Corylopsis, Liquidambar, Steinhauera* were described from the Eocene deposits of England, France and Germany (Chandler 1961, Mai & Walther 1978, 1985, Vaudois-Mieja 1980).

The Upper Oligocene and the Early and Middle Miocene can be considered as periods when the Hamamelidaceae fluorished in Europe (13–14 genera). But already in Upper Miocene (Sarmatian, Pannonian) the number of taxa became somewhat reduced. This process was continued in Pliocene and Pleistocene, only *Corylopsis, Parrotia* and *Liquidambar* survived in Europe.

The earliest discoveries of the Hamamelidaceae in Georgia date from the Palaeogene. Pollen grains of *Hamamelis, Corylopsis* and *Liquidambar* were found in the Eocene and Oligocene deposits of the Akhaltsikian depression. From the Oligocene untill the Upper Miocene, only these three genera and *Sycopsis* are known, but in the Upper Miocene the number of genera suddenly increased and from the Sarmatian and Meotian deposits of Western Georgia 14 taxa have been determined. They can be compared with following recent genera: *Hamamelis, Corylopsis, Eustigma, Fortunearia, Fothergilla, Parrotia, Parrotiopsis, Sycopsis, Distyliopsis, Distylium, Disanthus, Chunia, Liquidambar, Altingi* with the exception of *Parrotiopsis* all of them were described from pollen grains.

In Eurasia three main stages can be distinguished in the history of development of the Hamamelidaceae. The initial one embraced the period from the first appearance of the taxon in geological chronology (in the Cretaceous) until the time when its taxonomical diversity began to incrise. In Asia and Europe the first stage ended at the beginning of the Paleocene, but in Georgia continued untill the end of the Oligocene.

The second stage can be divided into two parts: 1) the period of increasing of number of of taxa and 2) the time of its flourishing. In Asia and Europe the first parts of second stage began simultaneously (in the Palaeocene), but the periods of flourishing were different; the Oligocene in Asia and Upper Oligocene, Lower and Middle Miocene in Europe.

During the Eocene the Palaeocene flora became extinct in Asia, being replaced by the Turgaian. The plants forming the nucleus of this flora were concentrated in the southern mountainous regions on the border of the Tethyan district. They revealed great tolerance, spreading north and south along the mountain ranges and proving capable of surviving the drop in temperature on the boundary of the Eocene and Oligocene (Meyen 1987). Probably to the number of such plants belonged Hamamelidaceae, great majority of which was represented by shrubs, that provided their survival.

By the end of the Palaeogene and during the Miocene, the Turgaian flora spread to the south and southwest (in Europe) replacing the retreating subtropical vegetation (Meyen 1987). This marked the beginning of the flourishing period of Hamamelidaceae in Europe, where typical turgaian polydominant forests were growing. Hamamelidaceae were mainly components of the marshy associations widely distributed in Central and South-Eastern Europe. Here existed a more diverse vegetation than in the western part of the continent, where the influence of a dry mediterranean climate was greater (Sinitsyn 1980).

In Georgia second stage in the development of the Hamamelidaceae began in the Early Neogene and continued up to the end of Miocene. The Upper Miocene may be considered as the time of peak flourishing of family in Western Georgia, whereas in Asia and Europe the process of their extinction was already under way.

The third stage in the development of the Hamamelidaceae was its decline and extinction which started in Asia during the Early Miocene and proceeded rather rapidly, whereas in Europe it began in the Late Miocene and progressed gradually.

In Georgia the extinction stage of Hamamelidaceae development extended throughout the whole of the Pliocene and most of the Pleistocene, and had a stepped character. During the Pontian and Kimmerian (Lower and Middle Pliocene) the taxonomically impoverished Hamamelidaceae were components of comparatively reduced evergreen forest and swamp associations. After the Kimmerian, along with the extinction of subtropical forest and the transformation of marshy associations, the Hamamelidaceae completely lost their coenotic importance. Only a few genera continued to exist in the warm-temperate deciduous forests which survived on the plains and in the lower mountane belt during the Late Pliocene and Lower and Middle Pleistocene.

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