From: The Vegetation of the Armenian Soviet Socialist Republic, A. K. Magakian, Moscow, 1941.

Chapter 8 Forests

The Size and Location of Armenia's Forests

In comparison with the other republics of the Transcaucasus, Armenia is poor in forest. In all, 361,035 hectares, or 10%, of Armenia's land area is forested, of which only 302,112 hectares are actually covered with trees.

The distribution of forest over Armenia's territory is extremely uneven. Two principal tracts of forested land, widely separated from one another, may be seen on a map. The largest, which covers 248,000 hectares, is located in the northeastern part of the republic. The second, smaller tract occupies 80,000 hectares of the republic's southeast. The remaining 33,000 hectares of forest are not in a single, compact mass, but are dispersed in small stands and woods in various regions.

The regional distribution of Armenia's forests is indicated in Appendix 1. This data very clearly shows that most of the republic's forest is concentrated in its northeastern and southeastern areas, while the central part is almost completely unwooded, and the regions of Artik, Amasia, Novo-Bayazet, Vagrashapat, Oktemberyan, Leninakan, Martunin, Talin, and Yerevan have no forest whatever. The amount of forest cover in most of the other regions is negligible. Only the northern regions of Idzhevan, Delizhan, Shamshadinskii, and Alaverdi have more or less normal amounts of forested land.

The Composition of Armenia's Forests

The tables in appendices 2 and 3 will give some

idea of the richness and variety of the forests in Armenia. These appendices contain most of the trees and shrubs found in Armenian forests, including wild varieties of fruit trees.

The most wide-spread species and ones which form the bulk of Armenia's forests are types of oak, beech, hornbeam, linden (lime), maple, elm, ash, oreintal hornbeam, birch, pine, and juniper. The following table shows the area covered by each of these tree varieties, from which it can be seen that types of oak, beech, and hornbeam form the predominant bulk of the republic's forests.

Tree	Area (in hectares)
Oak	80,241
Beech	109,201
Hornbeam	60,365
Oriental hornbean	9,486
Ash	3,069
Maple	201
Linden	2,950
Elm	634
Birch	769
Pine	927
Juniper	7,862
Other trees	8,674
Shrub	17,733
Total	302,112

The Classification of Armenia's Forests

Armenia's forests may be broadly divided into two 'types', basing our distinction mainly their local physio-geographical (predominantly climatic) features, and from the composition of their flora. On the basis of these

criteria, we can easily see that the forests of northern Armenia are of a different type from those of the south.

A Brief Description of the Environmental Conditions that Determine the Disposition of Armenia's Forests

Armenia's forests are located chiefly in its mountains and valleys. There is no forest at all in Armenia's lowlands, tablelands, plateaux, and plains. The steepness of forested slopes ranges from 20-30 degrees and higher.

(omitted paragraphs on temperature ranges, soil types and altitudes of forested areas.)

In northern Armenia, the lower forest zone, up to an elevation of 1,500-1,600 meters, is occupied by the oak, Quercus iberica Stev. The lowest part of this belt (1,000 meters and lower) has been significantly destroyed by humans and has now become a grassy steppe with beard grass and thickets of shrubs. Above 1,600 meters, beeches and hornbeams predominate, although some Quercus iberica are still to be found. The linden Tilia parvifolia Ehrh is also typical of this zone. The most common tree of this zone, however is the beech. Above 1,800 meters, these species are replaced by the caucasian oak Quercus macranthera F. et M. It is interesting that this zone has hornbeams (Carpinus betulus L.) growing right up to the timberline.

Conifers do not grow in one specific area in Armenia. Small stands of pine are mostly found on the dry southern slopes. Junipers grow in a number of areas from elevations of 1,200 to 1,500, and even 2,800 meters.

Armenia does not have large areas covered by a single species of tree. Therefore, the term 'vertical zones' will be used here in a special sense, that is, only to designate the dispersal of one or another type of tree within certain elevational boundaries. Vertical zonality appears most distictly in heavily-forested regions.

Great diversity in the configuration of Armenia's mountain environments makes for great variety in the forest covering. Therefore, single-specie stands are relatively rare and usually small. Sometimes even an area as small as one hectare is marked by variety not only in the types of trees, but in their heights and in the thicknesses of their trunks, as well as in the soil cover. Forest stands of northern and southern exposure are especially distinct in this respect. Forests on south-facing slopes are are often marked by the sparseness and shortness of their trees, while the north-facing slopes are often more thickly forested and with taller trees. The difference is most marked in the composition of the stands. South-facing slopes are usually covered by xerophylic and photophylic species (mountain oaks, junipers, and pines), while the north-facing slopes are covered with species favoring moisture and shade. Here we find most often beeches which demand a moister soil.

Soil conditions exert an extremely strong influence on the character of Armenia's forests.

"In high mountainous regions, the decomposition of the soil is extrordinarily slow, with a great concentration of acidic humus which slows its regenerative power, and in the very highest regions, the regrowth of forests is naturally halted. The higher you go, the forest gradually becomes sparser, dying a natural death." (N.S. Zaklinskii).

We find some extremely interesting data about the Transcaucasus timberline in the works of A.G. Dolukhanov. According to his information, the upper limit of tree growth in the eastern part of the Lesser Caucasus varies between 2,000 and 2,800 meters, most often at elevations of 2,350-2,400 meters. According to our data, the average height for the timberline in Armenian is currently 2,300-2,350 meters. Of course, this figure varies over the territory of the country; we can see eveywhere a marked

artificial lowering of the upper tree line.

(I have omitted a further paragraph on timberlines.)

Oak Forests

After beech forests, oak forests are the most widespread in Armenia. They are to be found in every wooded area of the republic. The overall area covered by oak forests exceeds 80,000 hectares. Oak forests stretch from the lower banks of the Araks to the timbeline. Of all the species of oak found in Armenia, only three can be found in independent stands: Quercus araxina (Trautv.)Grossh., Q. iberica Stev., and Q. macranthera F & M. Individual examples of Quercus robur L. can occasionally be found along the Akstafa river in the Delizhan and Idzhevan regions. Quercus longipes Stev. is encountered in similar circumstances in the Stepanavan region.

(I omit here descriptions of the foliage and other features of the Q. araxina, Q. iberica, and Q. macranthera and a paragraph about the 'polymorphism' of these trees.)

The most photophylic and xerophylic oak is the Q. araxina, which grows at up to heights of 800-900 meters. The most frost- and coldresistant is the Q. macranthera, which can be found at the very top of the timberline. This latter tree is tolerant of many different soil conditions. Its strongly marked tolerance of aridity permits it to grow on the dry and rocky southern slopes at heights of 1,200-1,300 meters. The less cold resistant and more moisture demanding Q. iberica is found no higher than 1,800 meters.

All of these are photophylic varieties of oak which do not tolerate being densely crowded together, for which reason, oaks are found mainly in on the lighter and drier south-facing slopes.

Standing alone, an oak sapling in Armenia begins

to bear fruit in its 20th year; in a stand, in its 30-40th year. (I have omitted more material on when oaks begin to bear acorns.)

The root systems of these types of oaks are strong and far- and deep-reaching so that they bear up well not just against drought, but strong winds.

Q. iberica and Q. macranthera are tall trees, sometimes reaching heights of 30-35 meters, with trunk diameters exceeding 1.5 meters. Quercus araxina is a relatively short tree, rarely growing taller than 10-15 meters. In Armenian conditions, oaks live up to 500 years. They reach their maximum height at 120-200 years, but continue growing in thickness for their entire life.

The oak prefers deep, permeable, and fertile soils, but can grow also in dry and stony soil. Quercus macranthera is often found growing even on rock. In unfavorable conditions, however, the oak grows very slowly, and resembles shrubbery.

The wood from Armenia's oaks is highly prized for its strength, hardness, and durability. It has many uses in construction and industry. Its timber, and especially its bark, contains a large amount of tannin, and is therefore widely used by tanneries. Its acorns are used for feeding livestock and to make acorn coffee. Oak wood, especially from the smaller saplings, makes excellent firewood.

Stands of Quercus araxina has received almost no study. The type of Q. araxina endemic to Armenia is found almost exclusively in the lower zone of Zangezur. This type of oak is the most xerophylic of the oaks of the Caucasus. Q. araxina is found in the lower parts of the forested zone of Zangezur at heights ranging from 800-1,000 meters. It grows mainly on the dry, infertile south-facing slopes that receive much sunlight.

(I have omitted a paragraph on how the Q. araxina does not form large closely clustered stands and on how

it is found in formations similar to local varieties of Juniper.)

The following xerophylic plants are often found along with the Q. araxina: Acer ibericum M.B., Celtis caucasica L., Pistacia mutica F.&M., Lonicera iberica M.B., L. orientalis L., and Cornus australis C.A.M.

In places, there is also a large number of the following Xerophytic shrubs: Crataegus orientalis, L., C. melanocarpa M.B., Paliurus spina Christi Mill.

The grassy vegetation of these groves is indistictly characterized by mainly xerophylic types such as Centaurea squarrosa W., Helichrysum armenum D.C., Festuca sulcata (E.Hack.)Rich. and Stachys inflata Benth.

These stands are of very little use to humans. The local populations use the timber and branches for firewood and to make small items. These slopes are used intensively for grazing and livestock, according to the locals, willingly feed on the leaves and young sprouts of Quercus araxina. This systematic feeding aids in the renewal of young shoots.

Quercus iberica is one of the most widespread trees of the mid- and lower mountain zones of Armenia. Stands of Q. iberica are to be found in every one of the republic's forest zones. This broad-leaf tree grows at elevations of 700-1,800 meters, but is occasionally encountered at higher altitudes. Stands of this tree grow on south-facing slopes and only rarely on the drier northern slopes.

Intermixed in forests of Q. iberica are Fraxinus excelsior, Carpinus betula, Acer campestre, Malus pumila, and Pyrus communis. The undergrowth of these forests is made up of Carpinus orientalis, Viburnum lantana, Ligustrum vulgare, and a number of other species. One of the most prominent characteristics of these forests is the presence of the hornbeam Carpinus orientalis.

A consequence of continual felling and livestock grazing is that oaks of the lower zones (up to 1,100

meters) are being replaced by oriental hornbeams. Thus, the current widespread diffusion of Carpinus orientalis as a secondary growth, steadily displacing the original covering of oak that is slowly being destroyed.

G.D. Yaroshenko describes the displacement of the oak by the hornbeam thus, "Stands of oak are being gradually cut down, leaving behind undergrowth of hornbeam. Hornbeam saplings are better able to withstand the grazing of livestock than young growth of oak and other species, morevoer, hornbeam shoots are very tough, so that they are generally avoided by grazing animals, who eat only the tenderest ends of the bud-bearing branches. The hornbeam also suffers much less from human cuttings since its timber is much less prized than that of the oak. After fellings of oak, the hornbeam undergrowth receives direct sunlight, and grows into full stands."

Only small plots of healthy, normal oak forest have survived in the lower regions of Armenia, mainly in inaccessible gorges and on steep slopes. On the other hand, stands of mutilated oaks, with tops or branches lopped off are quite common. However, hornbeams currently cover more area than oaks in the leskhozes of Idzhevan, Akhtalsk, and Tarsachai.

Higher up in the mountains, at altitudes of 1,100 to 1,800 meters, Quercus iberica grows in somewhat moister soil, marked by a deeper stratum of humus. A typical feature of these stands on the south-facing, and less commonly on the western and eastern-facing slopes is a significant amount of hornbeam undergrowth (Carpinus betulus).

On the southeast and southwest slopes, the normal age of hornbeam undergrowth is 5-15 years. When one moves farther east and west, we find alternating stands of oak and hornbeam. .... "This information on the growth of hornbeams indicates that 60-70 years ago, not only the southern, but the eastern and western slopes were

also covered by oaks."

(I have omitted one paragraph on the replacement of oaks by hornbeams containing no new information.)

In the undergrowth of the oak forests of this zone (what zone? unclear from context), we often also find beeches (Fagus orientalis Lipsky), which sometimes outnumber hornbeams. In these cases, the oak forest is being replaced by mixed beech and hornbeam forests.

In the Zangezur of southern Armenia, stands of Quercus iberica are characterized by the same features. The difference is found only in the slightly different species accompanying the oak, most of all in the complete absence of the beech.

As well as hornbeams, we find in the undergrowth Cornus australis, Evonymus verrucosa, E. latifolius, Pyrus syriaca, P. Raddeana, Mespilus germanica, as well as various hawthorns and honeysuckles. Here also is often found secondary growth of oriental hornbeams, but the European hornbeam, present everywhere in Armenia's forests, grows well beyond the limits of the Q. orientalis all the way up to the timberline.

"The site index (?) of oak forests differs widely according to the fertility of the soil, the steepness of the slopes, and the micro-relief features. Trees aged 80-225 years predominate in the typical oak stand." (remainder of paragraph, on heterogeneity of oak stands, is omitted.)

The oak forests here described have fairly widely spaced trees and light-penetrable foliage. The location of these stands on slopes with southern exposure makes for the strong effect of the sun's rays. All of this creates very favorable conditons for the luxurient growth under the leaf cover of grassy vegetation. Not only undergrowth typical to forest floors is found here, but also vegetation usually found in meadows. A number of the following plants are found especially in the lighter

areas of the forest, and in clearings and near the timberline.

(I have omitted a long list of the grasses that grow on the floor of these forests.)

The grasses found on the floor of the forests of Zangezur are basically the same except for the presence of certain unique indigenous species such as Nepeta zangezura Grossh., Centaurea zangezura Grossh. and Erysimum violaceum Steinb. Thanks to its richness and variety, the grass cover has long been used for pasturage and hayfields. The use of these forests as pasture has had the greatest impact since it destroys the saplings of oak and other trees thereby preventing the renewal of the forest, at the same time fundamentally changing the character of the grass cover. The grass cover of intensively grazed areas is getting extremely sparse and the number of tree species is diminishing. Certain xerophylic plants have appeared and begun to thrive on the grazed areas such as Dactylis glomerata, Koeleria gracilis, and even Festuca sulcata. Many types of weeds that hitherto had been absent or rare in these forests are beginning to appear (Bromus commutatus Schrad., Rumex acetosa L., Teucrium chamaedrys L, et al.) Certain areas of the forests of northern Armenia have even seen the intensive growth of beard-grass Andropogon Ischaemum L., which has formed over fairly large areas under the forest leaf cover.

As already noted, Quercus macranthera grows in very large numbers in forests at relatively high elevations (1,800-2,600). However, in many zones, the growth of this tree extends much lower. Such a wide diffusion of this tree at very high altitudes is a result of its special ecological features. Q. macranthera is more resistant to cold than Armenia's other oaks which allows it to grow to the very upper limits of the timberline, where severe climatic conditions permit the growth of

only a very few species (Betula verrucosa, Acer Trautvetteri, et al). Q. macranthera is no less resistant to dryness which allows it to grow on the arid and rocky southern slopes which are largely given over to steppe and other types of xerophylic vegetation. In other areas of the Caucasus, forests of Q. macranthera, which usually form only in the upper heights of the wooded zone, form park phytocoenoses, distinguished by the great sparsity of their growth, the shortness and branchiness of the trees, and the lowness of their crowns. Such park forests are extremely rare in Armenia. In favorable conditions and locations where it is not subject to fellings and grazing, Q. macranthera forms very dense stands of very tall trees with very well-developed crowns.

Q. macranthera grows in many different types of soil. Stands of these oaks can grow in the most diverse substrata, ranging from fissures in rock faces to various soil coverings with depths ranging from 20 cm to 1.5 meters.

A characteristic of most of the stands of Q. macranthera is the relatively low quality of the timber. Most of these oaks that are over 180 years-old are stricken with internal rot or have cavities in the lower part of their trunks. Twisted and branchy trunks give little useful lumber. In many of these stands, the trunks and boughs are covered with an abundance of lichen.

(I omit here a long list of other plant species that appear alongside the Q. macranthera.)

In certain regions of Armenia, along the lower tree lines, stands of Q. macranthera take on the characteristics of a park plantation - widely-spaced growth, discontinuous leaf cover, and short, sometimes shrubby, trees. One may say with certainty that such sparse park conditions are not natural to Armenia. All park-type phytocoenoses in Armenia are the consequences of human activity (fellings and grazing). Species found alongside Q. macranthera

in these conditions are: Sorbus aucuparia L., S. umbellata (Dsf.) Frit., Betula pubescens Ehrh., Fagus orientalis Lipsky, and Ulmus elliptica C. Koch. Forest renewal is also very slow in these areas because of the continual grazing. In regions characterised by a drastic lowering of the timberline, Q. macrathera is sometimes accompanied by a large number of Carpinus betulus L., especially in Zangezur (Geriusa).

The grassy undergrowth of stands made up of Q. macranthera is extremely varied. These stands are marked by the light-penetrability of their leaf cover which allows speedy growth of a multitude of grasses. In the edges and clearings of the sparse oak stands of the lower and middle zones, and also on the dry, rocky southern slopes, one finds xerophytic vegetation, especially of the steppe type.

(I omit here a long list of the grassy undergrowth found in stands of Q. macranthera.)

(I also omit a lengthy section containing a controversy over terminology.)

...We are convinced that the complex of vegetation described above is not a natural phenomenon. The intrusion of xerophytic grasses and shrubs into oak stands has been, and continues to be, the result of human activity. Tree fellings, which thin out the forests, and grazing, which hinders regrowth and hastens the erosion of soil, are the fundamental factors in creating conditions favorable to the spread of this kind of growth. If this destructive human activity continues, then we will have to face up to the fact that these oak forests will die out. The effects of human activity have taken such a toll in some regions that even the strictest ban on grazing and cutting would not lead to the renewal of these forests. The forests in these regions are doomed to total extinction which, we repeat, is in no way the result of some battle between the forest and the steppe which the latter is

winning, but completely and exclusively the work of humans. We will cite the thoughts of A.A. Grossheim in describing similar vegetation in the forests of Talysha (also oak forests) as being completely applicable to the conditions we have described here, "Here the work of humans has created and maintained vegetation of a kind which, it seems, has never existed naturally. And here we see, under the protection of man, photophylic, xeromorphic vegetation conquering land that not long before was forest, and pushing the last remaining vestiges of forest growth into the background."

(I here omit more information on the undergrowth: grasses and lichens.)

An extremely interesting question, and one requiring specialized research, is the natural renewal of oaks. As we have seen, the natural regrowth of Q. macranthera and Q. iberica is almost nil in the Caucasus (especially in the south and east). It is thought that the oak is is almost no longer able to renew itself by its own seeds. According to G.D. Yaroshenko, the number of young oaks in one hectare of typical oak forest ranges from 30-100. Different researchers have offered various explanations for this fact. Some say that climatic changes have proved unfavorable, others attribute it to the effects of overgrazing, while still others say that the acorns are dying before they sprout. Yaroshenko asserts that young oak trees are disappearing on the south-facing slopes and only exist in normal numbers on north-facing slopes, and that acorns are dying before germination in large numbers precisely on the south-facing slopes. This author believes that some acorns are being destroyed by insects, others (up to 90%) are being gathered by peasants to feed their livestock, some are crushed by grazing cattle, some are eaten by mice, some freeze, and others dry out.

The presence of a lush grass covering under oak forests has long encouraged the destructive exploitation

of these areas as hayfields and pasture. The theory that grazing has a destructive effect is supported by the fact that those oak forests where grazing does not take place have a higher rate of tree renewal. Moreover, it has been proved that oaks have a good rate of renewal in beech forests which are little used for by the local population for grazing since they have little grassy undergrowth.

It must also be pointed out that large areas of the oak forests are hit by insect pests. Especially significant are areas affected by the silkworm Ocneria dispar and, to a lesser extent, Malacosoma neustria. As far back as 1932, we discovered large numbers of Ocneria dispar. In 1934, we found enormous numbers of the silkworm in Karny-Yarykh and in the forests of the Abaran region. Finally, in 1938 and 1939 L.C. Mirimanova and I established the widespread presence of silkworms in the oak forests of the Akhtin region, which unquestionably arrived from the neighboring Araban region.

In all of these regions, large sections of the oak forest lost all of their leaves or were left with only a few caterpillar-gnawed leaves. In summertime the naked trees of these regions made a cheerless and pathetic sight. Areas in the Akhtin region that have been most devestated by these pests were studied several times during the growing season. The mass hatching of the silkworm eggs laid by the female in the trunks of the trees began in the spring. "At this time the caterpillars swarmed over the oaks crawling from one branch of the infected tree to another. We witnessed these insects moving great distances along the branches making for a wide dispersal of these pests over large areas of the forest."

(I omit further description of the destruction caused by silkworm caterpillars.)

Massive outbreaks of these insects can bring about

the destruction of 25-50% of the affected forest. This type of insect is harmful not only to oaks, but to some other types of trees, especially fruit trees.

All of this points to the necessity of taking decisive measures to eradicate these insects before they become even more widespread, especially in the fruit-growing regions of Armenia. Experience in South America, where silkworm has become extremely widespread over the past 20 years, indicates that with proper organization, these insects can be quickly eradicated over very large areas. Thus, for example, the Canadian province of Quebec, where silkworms caused great devastation, was able to completely eliminate them by taking the appropriate measures.

Beech Forests

Of all the tree species of Armenia, Fagus orientalis is unquestionably the most common. More than half of Armenia's forest area (109,000 hectares) lies under beech forest. The distribution of beech forest, however, is extremely uneven. Stands of beech may be found only in the northeastern parts of Armenia. The central regions of the republic (Abaran, Alagez, Bashgyarni, Daralagez) have no stands of beech, and Zangezur has no beeches whatsoever, with the exception of a single tree which has been transplated near the village of Yerisatumo in northern Zangezur. Fagus orientalis is one of the largest trees, often reaching heights of 35-40 meters with trunk diameters of 1.5 meters. This tree lives 350-400 years. It begins bearing fruit at 40-50 years. Fagus orientalis has seed years once every 2-3 years and blossoms at the same time that it is losing its leaves. Its fruit ripen in the fall. Seeds planted in the fall give shoots in the spring. (I have omitted further description of its appearance.)

The beech is one of the most photophygous of all

our tree species. It is notable for its slow growth, although in the right conditions, it can sometimes grow very quickly. The beech sapling does not shun light, on the contrary, direct sunlight stimulates its growth.

The beech's wood is quite hard and easily splittable, but is not, however, remarkable for its durability. Beech wood rots especially quickly in warm and moist conditions. This wood burns excellently for which reason it is mainly used of late for firewood, although it has other uses. It is suitable for underwater use and for railroad sleepers and staves. It is a good wood for turning (on lathes) and for bentwood furniture. Beech wood can also be used to make tar and creosote. Beechnuts are widely used in Armenia in the making of oil, and have many other food uses.

There is information indicating that the last 100-200 years has seen an expansion of the area in Armenia under beech forest. Especially noticeable is the replacement of oak forest by beech (and also hornbeam) forest.

"Among dense beech forests made up of trees 100-200 years old on the northern slopes of Armenia, you will still find individual examples of 300-350 year old oaks which testify that once in these regions stood oak forests....The renewal of oaks in these conditions is completely impossible, despite the enormous number of acorns that these trees let drop..."

(Author cites explanations for this phenomenon, including climatic changes.) "The healthy state of the beech forests attests that the current levels of soil moisture are very advantageous to the growth of beech and we are already seeing the process of podzol formation in the soil connected with the increase in precipitation and the development of acidic humus. This would not have occurred in oak forests." In some instances, the expansion of beech forest can only be explained by the influence of humans, who create ideal conditions for

the spread of beech by cutting other species.

* * *

The beech forests are holding up better than any of Armenia's other forests. This is not only because the undurable wood of the beech is little used, but more importantly because the complete lack of grassy undergrowth in beech forests means that they are not used for grazing livestock. Some destruction may be seen only along the edges of young beech forests. For this reason, a significant part of Armenia's beech forests are very, even overly, mature.

Other types of deciduous forest & mixed deciduous forest

The hornbeam Carpinus betulus is one of the most common trees in Armenia's forests. Isolated examples of it are to be met with in every type of forest in the republic. It plays a large role in mixed forests (with beech and oak). In some areas, this tree forms its own stands, the overall area of which exceeds 60,000 hectares.

Carpinus betula is a large tree, reaching heights in Armenaian conditions of 12-15 meters, with trunks of up to 1.5 meters in diameter. Although individual hornbeams of 250-300 years may be found, its average lifespan in Armenia is 150-170 years. It blossoms at the same time that it loses its leaves and almost every year bears an abundance of fruit. Its seeds mature in the fall. Its first growth is slow, but quickens after five years. The hornbeam's stump often gives off large numbers of shoots, and, in some cases produces root offshoots. The wood of the hornbeam, which is dense and very hard and heavy, has many artisanal uses and makes a first-class fuel.

* * *

Mixed beech and hornbeam forest in Armenia are often quite intensively grazed which leads to their thinning out, a lowering of their site indexes, changes in the grass covering, and an increase in the varieties of shrubs.

Armenia's mixed oak and hornbeam forests are subject to the constant and extremely strongly-felt influence of humans. Continual cuttings and grazing has ultimately led to the predominance of hornbeams over oaks in the lower zones. The wood of the hornbeam is considerably less valued than oak so that it is not often felled. The hornbeam stands up very well to the ravages of livestock grazing, since its shoots are exceptionally tough and unattractive to animals. Only goats and donkeys seem not to mind them. As a consequence of the thinning and destruction of the oak covering, homogeneous stands made up uniformly of hornbeam are developing.

* * *

(I have omitted a section containing general information on Armenia's maple trees.)

The heavy, hard, and strong wood of all of these types of maple is very highly prized and is used for cabinetry, furniture, and agricultural implements. The wood of the maple also makes a superb fuel. The maple's sap contains a large amount of sugar. The sap of Acer Trautvetteri Medw. is especially high in sugar content.

The total are of land in Armenia under maple forest is only 201 hectares.

Ash and mixed ash-oak forests. The ash Fraxinus excelsior L. may be found in every forested zone of Armenia up to the top of the timberline. This ash most often grows in mixed stands, but sometimes forms uniform stands in small plots of 2-5 hectares. The ash is a very long-lived tree of the tallest class. It reaches heights of 20-25 meters with a 100 cm trunk diameter. It blossoms in the spring somewhat before it loses its leaves. The ash begins bearing fruit at 30-35 years, after which

it produces seeds every year. It can renew itself through root offshoots from stumps. The ash is a photophylic tree that nevertheless can tolerate a significant amount of shade in its youth. It only grows well in fertile soil. The ash's wood is strong, resilient, and tough, but it does not stand up well to rot. Ashwood has an extremely wide range of uses in industry.

Coniferous Forests

Only one species of pine is found in Armenia - Pinus hamata (Stev.) D. Sosn. (Here follows a description of how this pine differs from the Scotch pine P. sylvestris L.) Pinus hamata grows no higher than 30 meters in Armenia with trunks of 50-60 cm in diameter. This tree renews itself only by seeds, it does not send out shoots. Its wood is one of the most highly valued and is used in many applications.

The pine is not very widespread in Armenia. According to the most recent data, unmixed pine forest covers only 927 hectares of Armenia's land area, while mixed forest containing pine do not exceed 2,400 hectares. P. hamata is only found in northern Armenia, Zangezur has no pine. In the forests of northern Armenia, pines are found growing in smallish groves of 1-35 hectares.

Armenia's pines grow at elevations of 1,000 to 1,700 meters, and sometimes as high as 1,850 meters.

The grass covering of Armenia's pine forests is quite varied and is often badly trampled by livestock that graze there. It is not uncommon to find patches that have been grazed clean and almost denuded of all grasses.

Livestock are pastured in pine forests for a large part of the year, which the result that both the tree shoots and grassy undergrowth are largely consumed and the pine saplings are trampled into the soil.

In the fall of 1926, some of the pine forest was fenced off and grazing was prohibited there. These maesures, according to G.D. Yaroshenko, were very beneficial, and the pine forest showed great regrowth.

* * *

Mixed pine and poplar (Populus tremula L.) stands are found on the southern and southwestern slopes of the Sismandan and Zamanlin gorges. These stands are secondary and seem to have appeared in clearings made by tree-fellings and fires in oak and pine forests.

* * *

G.D. Yaroshenko, who has studied the renewal of pines in all of the principal pine forests of Armenia, has come to the conclusion that satisfactory renewal of pine trees occurs in those areas where the upper stratum of soil is undergoing changes as the result of one or another factor (fellings, fires, etc.). Renewal cannot be satisfactory in dry pine forests of the steep, exposed southern slopes. In these areas, the dry soil which is almost bare of humus does not provide the proper conditions for the growth of pine seeds. On the strength of this, it may be said that in the majority of cases, it is not the pines but the deciduous trees that renew themselves in Armenia's pine forests so that a replacement of species is underway. It is only in a few cases that new pine forests are springing up in the place of pre-existing pine forest. All this gives the basis to state that pine forests are now springing up mainly within deciduous forests, primarily oak and other species that have admixtures of pine.

The main factors assisting in the appearance of pine forests are fellings and livestock grazing.

(All of this seems a bit confused and contradictory to me, but the following paragraph is interesting.)

Despite the fact that current use of Armenia's forests is leading to its ultimate extinction, the pine has an

extremely significant potential in the republic. Armenia, with its abundance of dry and rocky terrain, must rely on a very limited assortment of xerophytic tree species if it wants to undertake reforestation. For these purposes, the pine is almost ideal. It is a very hardy tree and grows on dry stony slopes and even rock face, producing valuable wood even in such unfavorable conditions. The conclusions of the Kirovakan Forest Station deserve special attention: "the pine may be planted in all kinds of areas and soils. In good soils the pine is the most productive tree of all the species found here."

Juniper Forests

A significantly larger portion of Armenia's area is under Juniper forest than pine. In most cases, Armenia's groves of Juniper could not be called forests, since they do not form densely-clustered stands. There is no doubt, however, that at some time in the past, Armenia had genuine forests of juniper that occupied more area than they do now. This is testified by historical accounts, legends, and the numerous vestiges of very large trunks among Armenia's surviving junipers. Other evidence is the discovery in ancient structures of juniper beams and logs more than 10 meters in length and up to 60 cm in thickness. In our times, junipers of this size are completely nonexistent.

Junipers are found at vastly differing elevations from the banks of the Araks to the upper limits of the timberline. They cover a considerable area of Armenia; the figure cited in literature on the subject - 862 hectares cannot be considered as accurate; the area under junipers in Armenia is much larger.

* * *

As has already been mentioned, oak forest has recently been subjected to destructive use in Armenia. Cuttings

and intensive grazing have led to a thinning out of the stands of oak. Juniper shrubs that are not eaten by livestock thrive on the dry, overgrazed soil under the thinner oak leaf covering. Over time, as the leaf covering is gradually destroyed, juniper saplings take over completely. Thus, there is an unquestionable link between the spread of shrubby juniper growth in forests where livestock is put out to pasture.

A lot of information indicates that there has been a drastic reduction in the area covered by juniper saplings in every region of Armenia. Most of this growth is being cut for firewood. Since livestock refuse to eat it, juniper is often cleared or burnt as useless and to increase the quality of pasture grasslands. But the eradication of the juniper is only leading to the complete destruction of mountainsides and the washing off of topsoil, greatly aggravating the process of erosion. Streams of water flow unobstructedly along the gorges eroding the slopes and forming numerous gullies and channels which reduce the useful agricultural land. Moreover, these mudstreams are very harmful to the valleys in that they carry down masses of sand, pebbles, and rock.

Vestiges of Armenia's Yew Forests

There only remains now to say a few words about a tree type extremely rare not only in Armenia, but all over the Caucasus - the yew Taxus baccata L. The yew is a very interesting tree that once was widespread in the forests of the Caucasus, but is now vanishing. The yew's near extinction is accounted for by the outstanding qualities of its wood, its easy workability and tremendous durability. In Armenia, the yew is now only found in the northern forests. It is usually encountered as an undergrowth where the soil is fresh and fertile, and where it is protected from winds. Yew are relatively

plentiful in the vicinity of the Delizhan region.

Vinogradov-Nikitin reports that several hundred large yew were cut up for lumber in 1926.

Interrelations between Armenia's Forests and other Vegetation

If we accept the theory that the climate of the northern hemisphere has grown more humid in recents times, then we could suppose that the climate in the mountains of Armenia has become cooler and more moist which would in turn explain the fact that the boundaries of the republic's forests have been moving downward. Unfortunately, current botanical research has offered nothing to support this theory. Soil specialists, who have more factual information on this subject, have put forth the theory that the forest has been making inroads on the steppe.

The well-known soil researcher S.A. Zakharov has written, "...forest formations everywhere in the Caucasus are moving down from the mountains, supplanting the steppe..." (I omit here a lot of other inconclusive information about the 'degredation of soils and the increase in moisture.)

It is essential to remember that the expansion of forest at the expense of other vegetation in the lower zones is meeting with strong opoosition on the part of humans who reduce the forested area.

In Armenia there are almost no tree stands that have reached the uppermost limit of their natural growth. Everywhere the timberline has been artificially lowered. Not once in this zone have researchers run across the development of turf that would impede the sprouting of tree shoots and the renewal of forests, however everywhere these researchers were confronted by the influence of the balance between different types of vegetation by

the activity of humans.

In conclusion, it must be pointed out that data from many regions of Armenia indicate not an increase in moisture in the climate, but in fact the opposite, its xerophytization. This dessication is the work of man. In these regions, "climatic changes, that impede the renewal of forest growth and create favorable conditions for the spread of xerophylic grassy vegetation, are symptoms of a basic fact - the diminishment of forested area by humans."

The Condition of Armenia's Forests at the Present and in the Past

Armenia is a land with an ancient culture. Its population used its forests destructively over many centuries. Systematic cutting of the best trees and intensive forest grazing have brought about extensive changes in the republic's forests. Currently, Armenia's forests are of extremely low quality. They consist mainly of drastically thinned out stands of young growth which in many areas are little more than scrubby thickets. A large part of the best preserved forest is located on the inaccessible slopes of ravines and rock faces. Almost all of these stands are made up of over-mature trees with very few young growth. Normal renewal occurs in only a few types of forest; most forest stands are renewing too slowly or not at all. Often the more valuable trees are being replaced by less desirable ones. Forested slopes are criss-crossed by innumerable crumbling paths. The large number of large trunks found in every forest stand tell of countless tree fellings which destroyed the best specimens that grew here. The thick, tall stands, which were still in existence in the relatively recent past in region of Abaran, and in the basins of the Bashgyarni, Daralagez, Zangezur, and Gokchin, have now

almost completely disappeared; their remaining vestiges are rotted or consist of pathetic shrubbery.

The past of Armenia's forest is an extremely interesting question, but one that has received very little attention. In the opinion of N.I. Kuznetsov, "in prehistorical times, but especially at the end of the tertiary period, the Armenian plateau was very likely covered with far more trees than it is now..."

Many factors testify that the current lack of trees in many regions of Armenia is not a natural phenomenon. This is attested by isolated groves of what were once part of thick forest growth, and vestiges of former forests now in various stages of decay...This probability is also supported by the existence of certain trees and vegetation typical of forests in areas now completely lacking in forest.

Other bio-geographical evidence is also suggestive. For example, the discovery of the skulls of bison and wood-martens in areas of the Gokchin region that are now absolutely bare of forest. In the same region, a large number of antlers were found belonging to the red deer which is a forest-dwelling animal. Botanical work of the comparatively recent last century also provide evidence that formerly forests covered a larger area of Armenia. For example, Koch's botanical map shows wide forested areas where now there are no trees. Also interesting is historical information scattered throughout ancient Armenian literature and sacred writings. There is, for example, the extremely remarkable information from Arabic sources that wood for building used to be exported from Armenia. According to the Arabic geographer Ibn-al-Fakikh, enormous trees were taken from the forests of Armenia.

It is also fascinating that a number of ancient names for what are now unforested areas are connected with trees: Bidzhut means 'pine', Popoknut 'hazelnut

tree', and Tandzut 'pear-tree'. Many areas and towns that have been renamed in recent times, once bore names indicating the former presence of natural forest or cultivated orchards.

We have already mentioned that the majority of researchers believe that climatic conditions of our times favor the growth of forest, and even the incursion of forest on xerophytic steppe areas, an opinion that is born out by information from various regions. The drastic reduction in the size of Armenia's forests, then, can only be explained by the adverse effects of human activity.

The Importance of Forests in the Life of the Republic. Conservation

The importance of forests from an ~~agricultural~~ economic point of view has already been repeatedly stressed in the work of many researchers.

In mountainous regions, forests serve not only to regulate the level of moisture in both the air and soil, but are themselves important collectors of moisture. Forests regulate the proper feeding of Armenia's rivers. Practically all of the republic's rivers have their source in forested regions. The spring thaw of winter snows built up in forests happens significantly slower than in unforested regions, and the water is almost completely absorbed by the forest bed and soil as by a sponge. The same happens to summer precipitation - it is absorbed by the soil and helps to feed rivers, brooks, and springs throughout the year.

In forested regions the spring time high water in the rivers is not so extreme as in unforested regions because the forests regulate the melting of snows. By the same token, the summer drought is not so severe in forested regions as it is in unwooded areas. With the elimination of forests whose leaf cover retained snow

and rain, these waters do not have time to percolate into the deeper layers of the soil, but rapidly run off of the slopes into gullies and ravines. These waters join with powerful streams and torrents which have destructive effects on the surface of the slopes by carrying off topsoil and uncovering the bedrock. The activity of these streams increases the area of useless land and rocky and rubble-strewn slopes which become covered by worthless vegetation or by none at all. These torrents also have a destructive effect on the lower-lying valleys and plains causing enormous losses to agriculture. The results of all this may often be justly called a national disaster.

Deforestation is especially ruinous in the head-waters of rivers since it causes not only a lessening in the amount of water in the rivers, but because vastly unequal distribution of those waters at various times of the year. Rivers reach their high water point in the spring, and often overrun their banks causing flooding, while in the summer, when there is the greatest need of water for irrigation, rivers run shallow and often cease flowing entirely. The importance of forests for mountainous countries was concisely stated by Engels,

"When the peoples of Mesopotamia, Greece, and Asia Minor cut down their forests to make room for pasture, they did not dream that by doing so, they were laying the groundwork for the devastation of their lands by destroying, together with the forests, centers for the collection and storage of moisture. When the alpine Italians cut down the pine forests on the southern slopes (which are so carefully preserved on the northern), they did not foresee that they were also cutting the roots of cattle-raising in their region, still less did they foresee that they were depriving themselves of their mountain water sources for the greater part of the year, with the side-effect that this water would stream ever more furiously into their valleys in the wet season."

At the present, Armenia has too little land under forest to have a strong effect on the climate of the country as a whole. However, the climate of the northern and also of the southeastern parts of the republic are to a very large degree determined by forests. But the importance of Armenia's forests in the supply of water pertains to the entire country. We must therefore agree with Vinogradov-Nikitin when he writes that, "The conservation and proper maintenance of forests is not only the cultivation and planting of trees for timber, it is the preservation of the country's entire economy and the prerequisite for success in the building of socialism in the Transcausasian Federal Republic. We must devote a great amount of attention to the forests of the transcaucasus for they have suffered much under the extensive capitalistic economy of the previous regime which consumed large portions of their area. The damage can only be rectified through great effort.

In some spheres of the economy, the renewal of what has been destroyed can be accomplished relatively quickly. In forests, however, a tree that can be cut down in ten

minutes takes hundreds of years to grow back, so that the task is not so simple. Forestry organizations must first of all concentrate on the forests that have escaped destruction, cease further unplanned fellings, and carefully concert all measures coordinating them with the general needs of the economy and, in particular, with the planned development of the forest industry, and with the irrigation systems and hydro-stations."

We must on no account consider our forests as naturally-occurring pastures. In the future, hay-making and especially the grazing of livestock in forest areas must be banned, giving to the peasants, of course, some kind of compensation for the amount of fodder which is now obtained in forest pasturage. We must encourage hay-making in those villages near to forests and organize crop rotation with special stress on the cultivation of feed crops. We must at the same time take broad measures to improve and increase the productivity of natural hayfields and pastures in the forest regions of the republic. All of this will permit an increase in the stores of both summer and winter feed on socialist farms and will free forests from extensive use.