shore of the Aral sea, at the summit of the Kara-Sandyk in a typically steppe country imprints of leaves of *J. acuminata* A. Br. have likewise been encountered. The same species has moreover been found on the river Chegan northwest of the Aral sea and with another species of a genus now absent from the Old World except a limited area in Eastern China and Tonkin, but well represented in the New World—*Carya* (*Hicoria*) *bilinica* Ung.—has been met with on the river Krynka, a tributary of the Mius, near Alexandrovka in the Taganrog district; the same *J. acuminata* A. Br. has been found in Miocene in the vicinity of Tim in the Kursk government. *J.* (*Carya*) *bilinica* Ung. has been further recorded from the Tiraspol district of the Kherson government and, lastly, *Pterocarya Massalongii* G. et Str. or a small leaf of *Carya bilinica* in the northern part (Khotin) of Bessarabia. Remains of the Juglandaceae will most probably be found some day still further north within the territory of the Union as they have even been found to occur in Greenland and Spitsbergen.

It thus appears that the former range of the genera *Pterocarya* and *Juglans* in the U. S. S. R. was much more extensive and reached as far as 61° N. Lat. Now members of the Juglandaceae in the wild state occur exclusively in warmer climates extending, however, as far North as Lat. 51° 13′ N. in the Far East. The most extensively cultivated species is *J. regia* L. which is much grown all over the southern European part of the Union. In the neighborhood of Leningrad, i. e. in Lat. 60° N. the following *Juglans* both thrive and bear fruit: *J. cinerea* L., *J. mandshurica* Maxim., *J. stenocarpa* Maxim., *J. cathayensis* Dode and even the Japanese *Pterocarya rhoifolia* Sieb. & Zucc.; the highly frost resistant Japanese *J. Sieboldiana* Maxim. is likewise met with as well as *Pterocarya caucasica* C. A. M., the latter, however, in the form of a shrub.

Of the four sections of genus *Juglans*[1] but two, *Dioscaryon*, comprising about 7 Asiatic species with *J. regia* L. as the type and *Cardiocaryon* containing about ten, also Asiatic species, are met with in the U. S. S. R. Both these sections are easily distinguished by the sculpture of their nuts and in their geographical range. Section *Dioscaryon* which has a smooth nut ranges over western Europe, Asia Minor, the Caucasus, Persia, Turkestan, Afghanistan, the Himalayas, the mountains of India and Yunnan, while *J. sinensis* Dode even reaches the northern provinces of China, and *J. orientis* Dode the province of Senano in Japan. Section *Cardiocaryon* with sculptured nut extends, on the contrary, throughout the eastern part of Asia occurring in China, Manchuria, the Far East and Japan. In Yunnan both sections have their representatives.

As a consequence of such a distribution of these sections *J. regia* L. and *J. fallax* Dode of section *Dioscaryon* are met with in the Caucasus and in Turkestan, whilst *J. mandshurica* Maxim., *J. stenocarpa* Maxim., and *J. cathayensis* Dode of the section *Cardiocaryon* occur in the Far East.

[1] DODE, L. A. Contributions à l'étude du genre Juglans. (Bull. Soc. Dendr. France, 1906, N 2. 1909. N 11, 13. p. 67–112; 1909, p. 23–50, 165–215, figs.).

with a glabrous upper surface, while the narrow elongated leaflets are acuminate, the fruits being ovate, of a dirty brown dull colour and show numerous uneven cavities. The flowers of *J. stenocarpa* Max. are thickly covered with hairs being destitute of glands; the young leaves are tomentose, the mature leaves covered with stellate hairs, the leaflets being short and acuminate, the fruit elliptical, glossy and brown with 4 large equal and several smaller cavities. The third species, *J. cathayensis* Dode, is related to *J. stenocarpa* Maxim, but differs in having hard thick, less hairy leaves with smaller indentations; the venation of the leaves is more pronounced; the testa of the seed dark brown, the fruit having a more constant form and numerous cavities. All these features are described by E. Wolf from his observations of species grown at the nurseries of the Institute of Forestry and at the Botanical Garden of Leningrad.

In the Far East the Walnut grows in the valleys of rivers and small streams being most frequently found in abundantly watered gullies and narrow gorges and occurs in mixed forests containing *Pinus koraiensis, Abies holophylla, Picea ajanensis, Acer mandshuricum, A. Mono, Fraxinus mandshurica, Ulmus campestris* and others, as well as in purely deciduous forests without any admixture of conifers. The Manchurian Walnut likewise occurs on river banks among a growth of various Willows, *Alnus hirsuta, Ulmus pumila, Prunus padus*, all the trees and shrubs there being entwined by the climbing plants of *Vitis amurensis, Calystegia rosea, Cuscuta japonica* and of other lianas; on the northern confines of its range it affects rocky slopes. It should be noted that in these regions the Walnut does not form pure close stands, but occurs in scattered individuals among the trees of the first story and even in the underbrush. It does not seem to ascend the mountain above an elevation of 300 metres. As it recedes from the centre of its range *J. mandshurica* exhibits a tendency to grow on southern well insulated slopes and gradually ceases to produce ripe fruit. The northern limits of its range appear to be the lower reaches of the rivers Bureja and the Girin, the neighborhood of Sofijsk and Borbi (51° 15′ N. L.), while single specimens may be found on the upper and middle reaches of the river Tumdja which falls in to the Soviet Harbor (49° N. Lat.). Outside the Union of S. S. R. *J. mandshurica* Maxim occurs on the mountains of Manchuria (Chan-Guan-Wai-Lin) and of the Small Khingan, in northern Korea and in Jegol on the Eastern frontier of Mongolia. The geographical range of the two other species is not yet ascertained. Maximovicz[1] has recorded *J. stenocarpa* from the boundaries of Korea and, according to Dode, *J. cathayensis* Dode has an extensive range from the Amur to Szechuan and Hupeh, but as many specimens of *J. mandshurica* Maxim. from the Amur have been relegated by this author to *J. cathayensis* Dode, this indication needs further confirmation. Skvortsov[2] who has studied these trees in Manchuria maintains that they are

[1] Maximowicz in Bull. Acad. Sci. St. Pétersb. xviii. 57–59 and in Mél. Biol. viii. 630–632. (Diagn. Plant. Nov. Jap. Mandsh. Dec. xii.) (1872).

[2] Skvortzow, B. W., l. c.

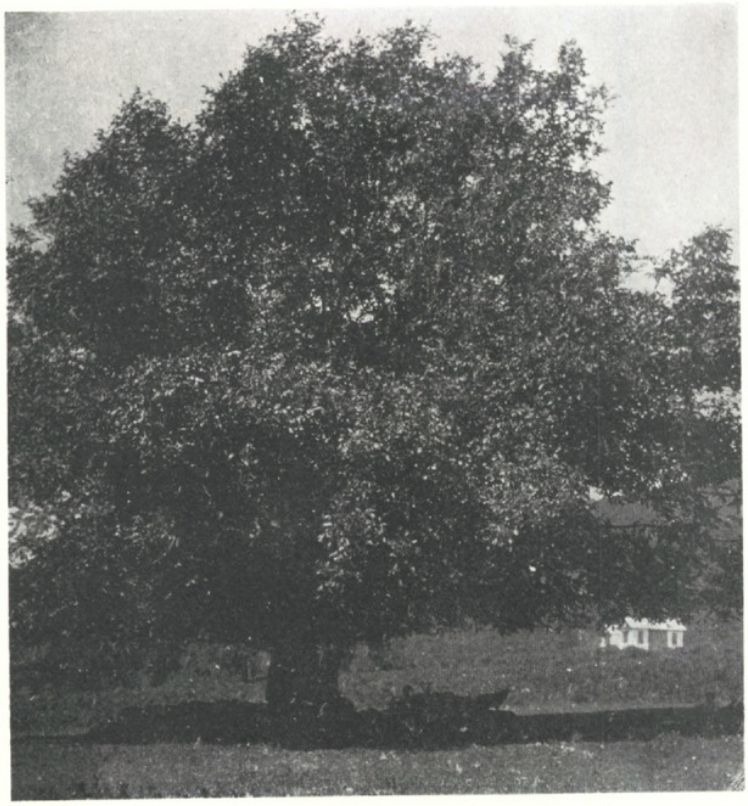
there represented but by *J. mandshurica* Max. which in that region is distinguished by the form of fruit being subject to much variation.

All three species mentioned yield a very valuable wood for cabinet work as well as for aeroplanes and gunstocks but fail to produce burls similar to those of *J. regia* L. and *J. fallax* Dode. On account of the great strength of the timber the Koreans of Nikolsk-Ussurisk manufacture a special kind of wooden shoes called ni-van-seni from this tree. In consequence of the small size of its kernel and the hardness of the shell the nuts, although containing a high proportion of oil are seldom eaten. As an ornamental tree the Manchurian walnut is of much value on account of the rapidity of its growth, its capacity of developing a fine crown when growing in the open, longevity, freedom from infection and adaptability to different climates. Thus, the Manchurian walnut grows, for instance, in those parts of Manchuria where the mean annual temperature is but 2.6°, the winter being extremely cold, the summer hot and rainy and the period of vegetation only lasting 151 days.

Pterocarya, the other genus of Juglandaceae, consists of 7 species occurring chiefly in Central China (5 species), one species in Japan and *P. caucasica* C. A. Mey in the Caucasus and in Northern Persia. Within the Caucasus, *P. caucasica* is, like the Walnut, met with in the forests of Kolkhida and Lencoran, but while the Walnut is always connected with mountain slopes, this tree, on the other hand, grows but in very damp places chiefly along the river valleys. In western Transcaucasia, *P. caucasica*[1] occurs in the Batum lowlands, in Guria, Mingrelia, Imeretia, Abkhazia and the Chernomorsk government, the northern limit being the lower course of the river Shakhé near Sochi and its eastern near the town of Kutais. Within its range in all these regions this tree never ascending even the nearest foot hills occurs exclusively in swampy or low lying country subject to continuous flooding and it grows among alders—*Alnus glutinosa* Gaertn., various Willows and the Caucasian Blackberry, *Rubus caucasicus*, under whose shade flourish innumerable plants of the fern *Matteucia Struthiopteris*. *Pterocarya caucasica* C. A. Mey likewise grows in Georgia all over the valley of the river Alazan; in Azerbeidjan on all the lowlands adjoining the foot-hills as far as the Nukha and probably occurring in the region of the river Kuba. In Talysh[2] *P. caucasica* C. A. Mey grows along the banks of streams as well as on the sea coast in swampy places overgrown with *Alnus barbata* C. A. M. A number of various lianas and the endemic Lencoran Blackberry, *Rubus Raddeanus* Focke, characterize these forests. *Pterocarya caucasica* C. A. Mey thrives also in the forests of the lower and sometimes middle mountain zones, where the soil at the bottom of the gorges is ever moist, and torrential streams appear after heavy rain. The chief denizens of these forests are the "iron tree," *Parrotia persica* C. A. M., and the majestic Ghirkan, *Acer insigne* Boiss., characteristic of these

[1] MEDWEDJEW. Trees and busches of the Caucasus. (1919).
[2] GROSSHEIM, A. The vegetation and the flora of Talysh. (Tiflis, 1926).

Clumps of JUGLANS REGIA L. in the valley of the Abashy River in Mingrelia, Western Caucasus.



Old planted tree of JUGLANS REGIA L. in Krasnaya Polyana, western Caucasus.

woods. Among the elements of the mountain forest should also be mentioned *Carpinus Betulus* L. and *Quercus castaneaefolia* C. A. Mey., as well as the Alder, *Alnus subcordata* C. A. Mey., typical of coast region forests. In the herbaceous covering are conspicuous the endemic plant of Ghirkan, *Solanum Kieseritzkii* C. A. Mey., the rare *Myriactis Gmelini* DC., while the most widely diffused are *Ilex aquifolium* L., *Danaë racemosa* (L.) Moench and various ferns which attain a luxuriant growth and frequently predominate over other types.

Beyond the Union of S. S. R. *P. caucasica* C. A. Mey., occurs but in the damp forests of northern Persia.

Pterocarya caucasica grows with great rapidity, lives long and reaches huge dimensions (up to 1 or 1.5 metres in diameter). Its wood is soft and not durable and is therefore used but for the manufacture of domestic articles such as cups, bowls, trays, tubs, troughs, etc. while shoes and cords for fastening boughs of growing vine as also shingles for roofs are made from its bast. The bark yields a very good tanning material. This tree is now being planted in moist places and along canals and ditches.

Botanic Garden, Leningrad, U. S. S. R.
July 1929.

CHROMOSOME NUMBER AND BEHAVIOR IN THE GENUS SYRINGA

Plate 21

KARL SAX

MOST of the horticultural varieties of *Syringa* have been obtained from the species *vulgaris*, although *S. persica* and some of the Villosae lilacs are of considerable horticultural importance. The majority of the other species are not commonly grown, although some of them have considerable merit especially from the plant breeders standpoint. *Syringa pubescens* is one of the most fragrant of all lilacs but the flowers are not so attractive as those of the Common Lilac. *Syringa pinnatifolia* is also very desirable because of its unusual foliage and habit of growth, but the flowers are borne in small clusters and are rather inconspicuous. These two species should be especially valuable for breeding work. Combinations of the early blooming *vulgaris* varieties with the late Villosae species would undoubtedly be of value if they could be made. The Persian lilacs also offer interesting possibilities if they could be used in crosses with other species.

Considerable breeding and selection has been done with *S. vulgaris* and hundreds of new varieties have been introduced during the past fifty years. The work of Lemoine in France has been most conspicuous. New varieties have also been developed by John Dunbar in Rochester, New York, and by several nurserymen in Germany and Holland. Crosses have also been made between different species but comparatively few

of the horticultural varieties have been originated in this way. *Syringa chinensis*, one of the earliest species hybrids in the genus, is a hybrid between *S. persica* and *S. vulgaris*. Lemoine crossed *S. oblata* and *S. vulgaris* and obtained a number of desirable varieties which are known under the name *hyacinthiflora*. Miss Preston in Canada crossed *S. reflexa* and *S. villosa* and obtained desirable new varieties. The cross between *S. Josikaea* and *S. villosa* is known as *S. Henryi*, after the hybridizer, and some of these hybrids have considerable merit. In all cases the above crosses have been made between closely related species.

Attempts to cross species of the Vulgares group with those of the Villosae group have been made by Lemoine, Miss Preston, Skinner and others but, according to Mrs. McKelvey (4), hybrids have never been obtained between these two groups of lilacs.

According to Rehder (5) there are about 25 cultivated species of Syringa. *Syringa vulgaris* and *S. Josikaea* are native of southeastern Europe, *S. persica* is naturalized in western Asia, and *S. emodi* is indigenous on the western Himalayas. All other species are from eastern Asia.

The genus *Syringa* is divided into two subgenera, Eusyringa (K. Koch) and Ligustrina (Rupr.). The first subgenus is further divided into two groups, Villosae (Schneid.) and Vulgares (Schneid.). The Villosae group contains the species *emodi*, *yunnanensis*, *Josikaea*, *Wolfii*, *Sweginzowii*, *villosa*, *tomentella*, *reflexa*, and *Komarowi*. The Vulgares group includes *Julianae*, *velutina*, *microphylla*, *Palibiniana*, *pubescens*, *Meyeri*, *oblata*, *vulgaris*, *chinensis*, *persica* and *pinnatifolia*. The subgenus Ligustrina contains only three species, *pekinensis*, *amurensis* and *japonica*.

THE VULGARES GROUP

Syringa vulgaris shows some variation in chromosome number. The variety "Beranger" has 24 pairs of chromosomes which divide regularly in the reduction divisions of the pollen mother cells. The chromosomes at the metaphase of the heterotypic division are shown in figure 1. One pair of chromosomes is consistently larger than the others and can usually be identified in most of the Vulgares species.

In the variety "Dr. Nobbe" there are 23 bivalents and one univalent at reduction. In figure 2 the bivalents are shown at the poles, although they cannot be counted in this figure, and the lagging split univalent is shown. In figure 3 the 23 chromosomes are shown at one pole. In this cell 23 chromosomes could be counted at each pole with the lagging chromosome between. The same type of chromosome behavior was found in the variety "Princess Marie."

There are 24 pairs of chromosomes in *S. pinnatifolia* including a large pair similar to that found in the vulgaris varieties. Chromosome behavior is regular during the reduction divisions. Figure 4 shows the chromosomes at the first metaphase. *Syringa pubescens* also has 24 pairs of chromosomes (fig. 5).

In *S. oblata Giraldii* there are apparently 24 paired chromosomes at diakinesis but only 23 could be counted at the telophase of the first reduction division (fig. 6). In no case were lagging chromosomes observed. Only 23 pairs of chromosomes were found in *S. Meyeri*. The chromosomes at first telophase are shown in figure 7. There are 24 pairs of chromosomes in *S. Palibiniana* at the first metaphase as shown in figure 8. There are 23 pairs of chromosomes at first metaphase in *S. velutina* (fig. 14) and in *S. Koehneana* (fig. 12). According to Rehder, *Koehneana* should be classed under *velutina*.

No counts were obtained from *S. microphylla* but the size of the pollen grain is the same as the other pure Vulgares species so that it presumably has 23 or 24 chromosomes.

All of the above species have been found growing spontaneously in Asia or southeastern Europe. *Syringa persica*, however, is usually found only as a cultivated plant and these forms are sterile; Meyer found a form of *persica* which is fertile growing wild in Kansu province, China. This spontaneous plant is similar to the cultivated variety *laciniata*. *Syringa persica* and its varieties *alba* and *laciniata* have sterile pollen and the chromosome behavior is very irregular in the reduction divisions. Unfortunately no chromosome counts were made of the spontaneous form but it has apparently normal pollen and the pollen grain size indicates that the chromosome number is the same as in the species already described.

In *S. persica* there are about 36 chromosomes at diakinesis as shown in figure 9. Similar counts were also obtained in the varieties *alba* and *laciniata*. At the heterotypic division there is usually no pairing of chromosomes and the single chromosomes apparently pass at random to one pole or the other. Such a stage in *S. persica* is shown in figure 10. In a number of cases where the division was almost completed approximately 18 chromosomes could be counted at either pole although in some cases the number varied considerably. In one pollen mother cell there were about 36–39 single chromosomes at metaphase, but occasionally several paired chromosomes could be seen. In *S. persica laciniata* about 44 chromosomes were counted in one cell (fig. 11), but usually the counts were the same as in the other two forms of the species. In the second division there are often from one to three lagging chromosomes but these were usually split. At times all of the chromosomes at the second division seem to be combined in one division figures and diads are found instead of tetrads. When tetrads are formed they usually show some irregularity in the size of the microspores.

Syringa chinensis is supposed to be a hybrid between *S. persica* and *S. vulgaris*. In the variety *Saugeana* there are about 39 chromosomes at diakinesis (figure 24). At metaphase there are usually 24 to 26 chromosomes. In one case there were clearly 24 chromosomes including one large pair typical of the species of the Vulgares group (figure 27). At the heterotypic division it was found that about half of these chromosomes