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REPORT

ON

FORESTS AND FORESTRY.

BY

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MEMBER OF THE SCIENTIFIC COMMISSION OF THE UNITED STATES.

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FORESTS AND FORESTRY.

INTRODUCTION.

ASSIGNMENT OF DUTIES TO COMMISSIONERS; IMPORTANCE OF THIS SUBJECT TO THE UNITED STATES; FOREST-ADMINISTRATION IN EUROPE; LEGISLATION DEMANDED IN THE UNITED STATES; LESSONS TO BE LEARNED IN EUROPE.

1. In rendering this report, it may be proper to refer to the letter of instructions received with the appointment of the writer as a commissioner "to observe and report" at the Vienna Exhibition.

In that paper, the commissioners were directed to be present upon the ground, if possible, by the first of May, and to remain until the end of October. They were instructed to organize as a committee, in the presence of the executive commissioner. Upon this committee devolved certain duties, such as the nomination of jurors. The chairman advised the Department of State of its organization, and of the progress of its labors. It is unnecessary here to recur to that part of the history of the commission and of the committee, further than to express individual regret that it became necessary, in some instances, to nominate its members as candidates for appointments upon the International Jury. In explanation, it may be stated that it was found impossible to engage the services of a sufficient number of fellow-countrymen, and those who were obliged, by the duties of their office, to remain in Vienna were forced to accept these additional burdens.

The display was not in any state of forwardness at the middle of May, when all Americans present volunteered their services, and assisted in making up the American department. To the members of the committee this occupation could not fail to prove an obstacle to the performance of the special duty of observation; and the final opening of the United States department of the exhibition was immediately followed by the calling of the juries, of which the duties for the next six weeks were constant and exceedingly arduous.

True, the jury-work did afford access to the material which members desired to examine and report upon; still, it should be borne in mind, this was an examination for award, rather than for report, and it was necessarily much hurried; and, in the heats of summer, members found themselves exhausted with fatigue before they could begin really to execute their officially-prescribed duties in a regular and systematic manner. When every one, from the highest official down to the humblest commissioner, was retreating to the mountains for refreshment

and relaxation, members were obliged to apply themselves assiduously to the great task before them.

When the committee came to look over the enormous amount of material at this 'world's fair,' it was conceded that division of labor was absolutely necessary; and after consultation as to the several qualifications of members and specialties, assignment of topics was made to the different commissioners, and to other American citizens who kindly consented to accept such appointment; but still many subjects of the deepest interest remained unassigned, and must continue without report. To the writer was given the investigation of the products of the forests, as shown at the International Exhibition, upon which is now rendered this report.

First, however, it must be stated that, at an early period in the summer, a request was unsuccessfully made to the State Department for the privilege of extending these researches into the forests themselves, in order to enable the writer to enrich this report with the result of observations upon living trees, and upon many details connected with *forestry*, an art which has grown to great perfection under centuries of nursing in Europe, though quite unknown as an art in our country, where the energies of the people have been bestowed upon the destruction, rather than upon the preservation and production, of timber-trees.

2. This subject of forestry is now claiming, and must receive, greater attention than heretofore. The increasing scarcity of timber within the first century of the nation's history, and that in a country famous for the richness and value of its sylvia, and for the extent of its woodlands, is a subject that calls for the most serious consideration of the statesman, and perhaps also for the interference and care of government.

In this matter, it may not be wise to imitate the practices of European states. We have no crown-lands, no royal preserves, no imperial forests nor any church and communal reservations of woodlands. We desire no such tenures, but we do need more forests in many parts of the country than the individual greed of private interests has left us.

The government of a republic need not own forests, but by judicious enactments it may and should foster them where they belong, in the possession of the citizen, and by so doing the good of the many will be conserved. On the other hand, while, as American citizens, we cannot advise the state to become a forester, and to hold large tracts of land, (except as public domain, for the use of the community,) we may be very well content to have our people imitate Europeans in the treatment of their forest-lands. We may learn much of deep interest from experience which has been gathered during centuries of successful practice in an art that has received the careful study of many wise and good men.

3. In Europe, it is found advisable to hold international congresses of the forest-managers of different countries, in order to exchange views of practice, to discuss principles, and to suggest regulations for their

respective governments, to be supported by legislative enactments for the good of all countries, especially where the climatic and physical influences of forests are concerned. Toward the close of the exposition, such a congress was held under the auspices of the Austrian government, and it was presided over by the distinguished minister of agriculture of that country. The convention was composed of representatives from nearly every civilized nation, and contained within its ranks the leading foresters, forest-masters, forest-directors, and forest-counselors of Europe.

4. Our own country, comprising great States, drained by the same rivers, flanked by the same mountain-ranges, and bounded by the same oceans, is situated in many respects just as the aggregate of the several countries of Europe which found it necessary to hold this international congress, except that our glorious Union spreads its ægis over us all, and *national* legislation can be made to apply to the whole vast extent.

In Europe, international action is required, because a single river-basin, like that of the Danube, may sometimes belong to several governments, thus greatly increasing the difficulty of having a harmonious legislation for the protection of forests about the mountain-sources of the streams, to sustain and equalize their flow. Legislation is also needed for preservation of rivers near their mouths, to prevent the drifting sands from obstructing their outlets, interfering with navigation, damming them up so as to submerge extensive tracts of valuable farming-lands, and changing them into unhealthy morasses, or covering them with successive layers of shifting sands that destroy their fertility.

5. From the practice and experience of Europe, we may thus learn the most useful lessons, and it is high time that our national legislature should turn its attention to the prevention of these evils before some of the fairest portions of our country become barren wastes, before the navigation of our rivers is impaired in consequence of their irregular floods and their frequent low water, and before their channels are obstructed by the material that is washed down from their banks and the neighboring hills. These declivities should be kept clothed with forests to a much larger extent than the cupidity of man has permitted in his desire to extend the cultivable area of his farms.

In transmitting this report, the writer feels that he has been treating a subject of vast importance to the future of our country; a subject which deserves, and should receive, much more attention than has heretofore been bestowed upon it by our agriculturists and our statesmen.

The whole subject has recently been so forcibly and so extensively presented to the people of the United States, in the valuable report of Mr. Hough, that it is deemed best, in this paper, to confine the report to the strict letter of the instructions, "to observe and report" what was more immediately connected with the universal exhibition at Vienna in 1873.

CHAPTER I.

NATIONAL EXHIBITS OF FOREST-PRODUCTS.

EXTENT AND VARIETY OF EXHIBITS AT VIENNA; DETAILED DESCRIPTION OF THE EXHIBITS OF ALL COUNTRIES; EFFECT OF PASTURING WOODLANDS; DURABILITY OF SALTED TIMBER.

6. The display of forest-products upon the Exhibition-grounds was extremely fine and wonderfully varied.

Within the palace, most of the nationalities exhibited, in Group II, (agriculture and forestry,) extensive *suites* of blocks as illustrations of the various trees and woody plants produced in the several countries. These were usually of uniform size in each collection, and so prepared as to exhibit the natural appearance, as the split or sawed, and the planed or finished surface also. In many, the bark was retained. In the exhibit from Greece, more ingenuity than taste had been exercised to bring out the desired result of showing combined in one specimen all the peculiarities of the wood. In many of the tropical collections, these collections of samples made a grand display of the wealth of the forests. This was especially notable in the extensive exhibitions sent from the British colonies and the rich display from Brazil.

Beginning with our own department of the grand palace of the Exhibition, the forest-products of different countries will be presented in a rapid survey in the same order they were arranged by the Direction, passing from the west toward the east.

7. NORTH AMERICA.—Neither Canada nor the United States were worthily represented by their forest-products, notwithstanding the great wealth of which we may boast in that line—with our 380,000,000 acres of woodland* in the United States alone.

From the States of Indiana and Alabama, there were cross-sections of some fine trees, such as walnut, (*Juglans nigra*,) ash, (*Fraxinus americana*,) and blocks of pine and other woods, that gave some idea of the size, growth, and quality of the forest-trees, but they were few in number, and were not elegantly prepared. From Louisiana were several bales of southern moss, (*Tillandsia usneoides*,) a natural product of the forests that is considerably used in upholstery, and another article of similar use, from New York, a preparation of wood, called "*Excelsior*."

To see American woods, it was necessary to look into other groups to find the products of our forests in an advanced condition—that is, manufactured—as in the beautiful agricultural implements, the highly-finished musical instruments, but especially in the school-furniture intended to illustrate a department quite distinct from the one under consideration,

* Census, 1870.

but which nevertheless afforded an opportunity for inspecting the beauty and other good qualities of our valuable timbers. Besides these, there were some specimens of carriage-making, especially some wheels in an unfinished state, unpainted, that served to illustrate the superior strength and elasticity of the woods we apply to such purposes, and which enable our artificers to excel all others in the lightness and elegance of the American vehicles for transportation. These wheels excited universal admiration from all observers. Our chief regret arose from the unfortunate fact that there was so great a dearth of the means of illustrating the richness of our forest-treasures.

Nor was this sad deficiency supplanted in any degree by charts nor by statistical tables, which should have been prepared to set before the eye, at least by columns of figures, such data as would have shown the wealth of our resources in this department. Nor are the materials for such tables inaccessible; and it is to be hoped that in our coming Centennial Exhibition we shall be able to point to full exhibitions of all these important products, and to extensive statistical tables and chorographical representations, which shall exhibit the extent and value of our forests and the importance of their numerous products.

8. SOUTH AMERICA.—*Chili* sent a collection of woods.

Uruguay.—The government exhibited several kinds of wood. Another exhibitor sent fifty-two kinds of wood, species unknown; still another showed thirty-four woods for various purposes, and charcoal from twelve different species.

Venezuela exhibited two large tables, each composed of fifty different woods named, besides fine specimens of mahogany, (*Swietenia mahogani*.)

Brazil.—The grand display from this country embraced beautiful polished specimens of the woods of the province of Santa Catharine; the valuable woods of Paraná and of Pernambuco; and also a collection from the Dock-Yard Company at Rio de Janeiro.

By the Forest Company of Paraná was exhibited a collection of the woods of that country, shown in boards, planks, and logs of *Araucania*; also a complete tree of this species thirty-three meters high. This magnificent tree, which was erected in the park, and furnished with its upper branches and fruit, though of course destitute of green leaves, was a most interesting object. This very beautiful species, the *Araucania brasiliensis*, abounds in Southern Brazil, notably in Rio Grande do Sul. Santa Catharine, Paraná, St. Paulo, Minas-Geroes, as far as Barbacena. "*Splendor sylvæarum!*" exclaims the enthusiastic writer. "Trunk remarkably straight, 44 meters high, 2.30 meters in diameter; wood rather heavy; specific gravity, 0.814; porous, with rose-tinted veins; suitable for ship-building; equal to the pines and spruces; much used in Rio; indestructible by humidity. The bark is thick and spongy, rich in potash, and used by the soap-makers. The knots are red and beautiful for turners' work, and make an officinal charcoal. The seeds contain as

delicate starch as the tapioca. The age of the tree may be known by the branches, which are produced in whorls successively each year.”*

From the province of Bahia, also, was a fine collection of wood-specimens. One of the finest was from Pereira de Faro, Rio Janeiro. It consisted of one hundred and fifty blocks from the province of Rio, and contained the principal species of the rich sylvia of that country, in which there are said to be three hundred and fifty woody plants.

The forest and other products were also set forth in the literature of the country. The “Chorography of Brazil,” by Joaquim Manoel de Macedo, translated into English by H. Le Sage, printed by Brockhaus, Leipsic, gives a very full account of the country and its products. Besides this were the writings of my agreeable colleague, José de Saldanha da Gama, among which were the “*Estudo botânico dos vegetaes seculares*,” (from which I have quoted,) “*Cartas sobre botânico*,” and “*Synonymia de diversas vegetaes do Brazil*,” all printed in Rio de Janeiro.

9. BELGIUM showed specimens of native woods; the NETHERLANDS, oak-bark and tannin, willow-wood. This country made her forest-exhibit by proxy; having few sylvan treasures of her own, she still brought quite a display from her distant colonies, some of which were very interesting. They represented the woods, bark, leaves, and other products procured from a long list of plants growing in Java and other islands of the East Indies; also illustrations of the quinine-producing trees of different species of cinchona that have been introduced into that country from the western hemisphere; these were beautifully displayed.

10. FRANCE, though possessed of valuable forests, contented herself by exhibiting the products from her colonies, which will appear in their appropriate place, geographically, farther on.

There were, however, some specimens of home growth. These were chiefly secondary products, such as bark, cork, and gums; and the Central Society of Puy-de-Dôme exhibited specimens of various woods from the enterprise of reforesting the mountains of Auvergne. Models of apparatus and works on forestry were also on exhibition.

11. SWEDEN sent sections of timber for resonance-boards; sections from large trees; sections from old spruces, firs, and pines; plank, lath, and boards; walnut boards, and the cross-section of a walnut-tree; also young forest-trees for planting.

12. RUSSIA.—The government forest-master of Wjatha showed various products of forest-culture.

The garden-school of Bessarabia at Kischinew exhibited a herbarium, with a plan and description of their garden; also a dendrological collection of the leading trees.

M. Lindes, of Archangel, showed forest-products.

The Lisino forest-school of St. Petersburg showed various products of forest-art.

* *Configura ção e estudo botânico dos vegetaes seculares, etc., por José de Saldanha da Gama, Rio de Janeiro, 1872.*

Nicholas Meierobiez & Co., of Tver, exhibited birch-gum.

Arcadius A. Kaufmann, of St. Petersburg showed ship-timbers.

The Forest Company of St. Petersburg made an exhibit of forest-statistics, samples of wood from the trees acclimatized on the sands of Alesiena, and models of machines.

Basil Greschner presented impregnated building-timbers.

Basil Epichkin, of Tver, had samples of lumber and a model of a saw-mill.

Prince Paskewitsch, governor of Rjasan, exhibited products of forest-art and turpentine.

Count Anthony Potoki, governor of Wolhynia, a part of Russian Poland, showed resin, oil of turpentine, pitch, and birch-gum.

Michael Rajewsky, of Baltischki, had oak cross-ties on exhibition.

Demetri Kusnezoff, of Kharkov, showed building-timbers.

A. Eklöf had boards, potash, and turf.

Nicholas Shelesnoff, of St. Petersburg, showed a model of apparatus for transplanting trees, and a chart showing the extent of propagation of fruit-trees in European Russia and Siberia.

The Forest Institute of Finland had cross-ties to exhibit.

13. SWITZERLAND.—At the annual meeting of the Forest Society in 1872, it was resolved to take part in the Vienna world's fair by making an exhibit of forest-literature, forest-plats, plans of management, a display of forest-tools, and a sketch of the streams used for transport. The standing committee to whom the matter was referred decided upon the following programme :

1. Draughts, models, and descriptions of wood-transport. 2. Draughts and descriptions of some of the wild streams and avalanche-tracks. 3. Forest-statistics, in accordance with the plans of management and charts. 4. Forest-rules, ordinances, and instruction. 5. Forest-literature of the Swiss. 6. Individual forest-products of the mountains.* The whole matter of the exhibition was intrusted to Professors Kopp and Landolt.

14. PORTUGAL.—Resinous products from the state-forest of Leiria and the plans adopted for gathering the crude resin, and for refining it, with the products—oil of turpentine, spirits of turpentine, resin, colaphane, and yellow resin; seeds and cones of the *Pinus maritima* and *Pinus pinca*; woodblocks of the following species: *Acer pseudo-platanus*, *Alnus glutinosa*, *Arbutus nudo*, *Buxus sempervirens*, *Castanea vesca*, *Cerasus usitanica*, *Corylus avellana*, *Crataegus oxyantha*, *Cupressus glauca* and *lusitanica*, *Erica arborea*, *Fraginus excelsior*, *Hedera helix*, *Ilex aquifolium*, *Laurus nobilis*, *Myrica Faya*, *Myrtus communis*, *Persica indica*, *Phillyrea angustifolia* and *latifolia*, *Pinus maritima* and *pinca*, *Pistachia lentiscus*, *Quercus coccifera*, *lusitanica*, *pubescens*, *racemosa*, and *suber*, *Rhamnus alaternus* and *frangula*, *Salix alba* and *cinerea*, *Spartium alba* and *juncea*, *Ulex europaeus*, *Ulmus campestris*.

* From a brochure entitled "Verzeichniss der Ausstellungsgegenstände des schweizerischen Forstvereins," Zürich, 1873. Professor Landolt.

15. SPAIN had not a very rich display, but there were several entries, among them charcoal, bark, and specimens of various woods; sweet acorns and hazelnuts; selected woods, sundry entries; a display of cork; Forest Guadalajara woods; Forest Lagrono, collection of woods, cherry, chestnut, oak, and walnut-wood; Veterinary School and Institute Leon, woods; province of Burgos, woods, various articles of fir-wood, oak, and beech-wood, charcoal, oak-wood, and holm-oak; Institute Segunda Enseñanza, woods; Cuerpa de Ingenieros de Montes, various woods, olive-wood boxes, oak charcoal, and bark.

16. ITALY exhibited a collection of the leading native forest-plants, (Forest School of Vallambrosa;) xylographic collection of seeds and woods of the leading plants of Friuli, (common school at Udine;) collection from Sassoferrato; collection from Perugia and Forli; cypress-wood from Florence, cones; collection from Royal Park at Caserta and others. Collections of sumac and manna were conspicuous.

Italy has taken a deep interest in the subject of forestry, and is making efforts to restore her sylvan treasures. Extensive collections were exhibited, among which it was easy to see the influence of a milder zone in the character of the plants represented, southern pines, palms, the pistacia, the broom from Mount Etna, (*Spartium atrnense*), the orange lemon, olive, &c. These were from Salvagnoli Marchetti, director of the Institute of Forestry of Vallambrosa. Her intelligent workingmen were there with an exhibition of their writings and publications,* from which it is apparent that there is yet life and progress in the land of the old Romans.

17. GERMANY.—In this part of the exposition were found some of the richest and most complete representations of the forest-wealth of Europe. This is what we might have expected in a country that has for so long a time occupied the first rank among nations by her forethought in bringing skill and science to bear upon the protection and improvement of her forest-lands.

From the Forest Academy of Neustadt-Eberswalde, there was a fine collection of woods, charts, and tables, embracing plans of the forest gardens of Neustadt-Eberswalde and Chorin; the course of study and catalogue of pupils; earth-charts; the natural history of *Pinus sylvestris*, with preparations elegantly shown in glazed tablets; a display of stuffed animals from the forest, and a large collection of insects, in fifty cases, with the results of their work of destruction; organization and working-plans of the forest experimental stations, and the instruments used; soils, rocks, and their analyses.

* *Statistica forestale regno Italia; Il Ministro di Agricoltura, Industria e Commercio; Castagnola, Florence, 1870.*

Manuale teoretico-pratico d'Arte Forestale; Firenze, 1872; Giovanni Carlo Siemoni.

Relazione di risultamenti della coltivazione delle barba bietole zuccherine in Italia, nel 1872, Nicola Miraglia, Roma.

Relazioni dei giurati italiani sulla Esposizione Universale del 1867, volume primo, La Silvicoltura, Giovanni Carlo Siemoni.

By Dr. Ebermayer, Lehranstalt Aschaffenburg, a collection of philosophical and meteorological instruments, such as he had used at the experimental stations; and from the data obtained by them, the most interesting results, showing the influence of forests, have been given to the world by this professor.*

From the Forest Academy at Münden in Prussia were charts and other illustrations in great variety and perfection.

From Alsace-Lorraine was a fine collective exhibition, in a separate building, in which were woods, bark, minerals, abnormal growths, insects, and various illustrative models, &c., (unfortunately burned before they could be fully examined.)

By the Prussian forestry-department:

From Gumbinen tools for setting out young pines; also an essay on the nursing of young Norway spruce, and another on the Zogge or East Prussian forest-plow, with directions for its use.

From Stettin, instruments for cultivating; the double plow for working the soil in beech-clearings.

From Chorin, culture-tools for plantations of pine in Mark Brandenburg; the Rudersdorfer forest-plow; Eckert's forest-plow; Aleman's underground-plow; hand-sowing machine for pine-seeding, (seed-gun;) boundary-ditch-spade; pinch-spade; and an apparatus for planting yearling pines.

Models of the forest-nursery, by Oberförster Rückert, at Schkenditz; an essay on oak-culture (*auf Anboden*) recommends planting oaks of five, six, and seven years from the plant-beds, oaks four to thirteen from the *Bestandsaaten*.

From the Finanz-Direction of Hanover were forest-tools of the province; wedge-spade (*Keilspaten*) for setting yearling pines; hoes of various kinds, &c., a very complete collection.

From Clausthal, models for transport.

The Grand Duchy Hesse-Darmstadt sent models of saw-mills, &c., and apparatus for bark-gathering.

Grand Duchy of Baden at Carlsruhe, models for floating timber in the Black Forest and of the rafts.

Alsace-Lorraine, a model for transport from Kusian to Strasburg, tools and specimen plants.

By the Prussian forest-management, a collection of logs cut into sections, part polished, part natural, with full statistics as to kinds and product per hectare.

From Trier, oak-bark, as peeled and prepared for market, and statistics of the product.

From Aachen, oak-bark from the coppice-woods.

From Wiesbaden, oak-bark sample; Professor Neubauer's brochure on the quantity of tannin, the results of numerous analyses.

* *Einwirkungen des Waldes auf Luft und Boden, und seine klimatologische und hygienische Bedeutung: Dr. E. Ebermayer, Aschaffenburg, 1873.*

From Baden, Carlsruhe, oak-bark.

From Odenwald and Spessart, Hesse forest-direction, oak-barks, fourteen years' growth from the last cutting.

Gross-Schoenebeck, Brandenburg, a model of a kiln for separating seeds from the cones.

From Clausthal in the Hartz, models and specimens of charcoal, shingle-machinery, wood cutting and carving.

From St. Oswald, in Bavaria, wooden ropes.

Oberzwieselau, Bavaria, resonance-boards, and wooden ware of various kinds.

A board, 30 meters long, from near Frankfurt on the Oder.

Prussian Forest-Department, Berlin, statistic tables showing the area of forests, with entire surface; the kind of management and kinds of trees; all sorts of models; collections of seeds, and also of various trees and shrubs.

The collective exhibition of the Grand Duchy of Hesse was presented with description and special catalogue by the Forest and Domain Directory at Darmstadt. This, like other exhibits of the German foresters, was a model of the application of science to the subject; everything was reduced to a formula; the results were all tabulated, and showed the precise condition and yield of the forests.

First were charts of the whole and of the several parts of the different tracts, instruments for leveling the roads and for measuring the height of the trees; for description and mode of applying these, the reader is referred to the work of the inventor.*

One of the tables gives the name of the five districts, the particulars of planting, a description of the soil and situation, the present age, the mean height, the number per hectare, the amount of wood in cubic meters, and the average annual increase. Illustrations of the growth in the forests: a pine thirteen years old, three years cultivated in crops, 19 feet 9 inches; twelve years old, 9 feet 8 inches; eleven years old, 26 feet 2 inches; an oak stem twelve years planted, set at three years old, and cropped three years, 15 feet 5 inches; another oak, eleven years old, 13 feet 6 inches; an oak-sprout of twenty-five years, from an uncultivated copse, as a contrast to those which had been cropped. This showed the advantage resulting from the cultivation, which kept the young trees free from the choking effects of weeds. In a series of years, with two successive crops, taken at intervals of fifteen years, the average yield, on a total of 1,010 hectares, was 79 hundred-weight of bark per hectare. Some coppice yielded as high as 102 hundred-weight. The lowest average was 57. Implements for utilizing the products from the felling to the finishing; also, a tool we may find useful, the "wedge-spade," for setting out yearling pines in the new plantations.

Products.—The *Hochwald* Coppice. For a century, this has been prac-

* *Beschreibung zweier Instrumente zur Niederrung der Waldungen und Messen der Baumhöhen, von H. K. Bose, gross-hesse. Ober-Forstrath, Darmstadt, 1863, Verlag der G. Jung-haus'schen Hofbuchhandlung.*

ticed on the Neckar, especially in the Odenwald. In planting coppice, hazel, oak, hornbeam, and birch are set together. In suitable soils, the oak prevails, and in the cutting of the other woods receives the greatest care for its preservation. Specimens of oak-bark were exhibited.

18. AUSTRIA.—The exhibition of forestry made by Austria was very rich.

The Archduke Albrecht, of Tetschen, Silesia, had a most interesting collection of insects, which was called an "*Entomologisch-biologische Sammlung*." He also had a separate pavilion, containing the product of his estates in Hungary and elsewhere.

The Imperial Royal Agricultural Society in Görz, Küstenland, exhibited ailanthus-plants.

Czernowitz, Bukowina, had a collective exhibition.

The Society for Reforesting the Territory about Triest showed plants, soils, and various kinds of trees.

A collective exhibition of the kingdom of Bohemia was made by R. von Dombrowski and Dr. Lambl.

The Consorzio Agrario of Trient, in Tyrol, exhibited a collection of useful and injurious insects.

The Joint-Stock Company for Forest Industry at Waidhofen on the Ipps made a display of their products. This establishment is noticed in another section.

Count Carl Althun showed forest-products.

Baron John Bruniki, of Galicia, had a display of split woods.

By the chamber of commerce at Rovigno, in Istria, were exhibited woods, lumber, ship-timbers, and charcoal.

A collective exhibition for Styria from Leoben consisted of forest-products.

The forest-products of Carniola were shown as a collective exhibition from Laibach.

Count Wladimir, of Dzieduszycki, Galicia, had timbers of beech and oak.

Geo. Eder, of St. Johann, Tyrol, showed seeds of Norway spruce.

Dr. Henry Flora, of Mals, Tyrol, had forest-seeds and a design or plan for replanting forests.

The Carinthian Forest Union exhibited various forest-products and statistics.

By the forest-officer of Count Buquoy, at Gratz, in Bohemia, were shown a collection of young trees for forest-planting.

From the Academy of Maria Theresa, in Vienna, was a collection of forest-products.

The Lumber Company in Vienna showed a group of forest-products.

From the Huttenberger Eisenwerks-Gesellschaft, at Klagenfurt, Carinthia, were woods, charcoal, and a forest-chart.

Joseph and Michael Jenewein exhibited forest-seeds from Innsbruck, Tyrol.

Sigismund Kentner, of Motling, Carniola, had timber, spunk, and phosphorescent wood.

Simon Kosnac, of Sagor, Carniola, showed the model of a self-acting flood-gate for the reservoirs of the water-transport.

The Imperial Royal Agricultural Society of Vienna had a collective exhibition of forest-products.

Prince John Liechtenstein exhibited split timbers, plants, and bast from his estates.

Graf Heinrich Meir, of Galicia, showed a group of cross-sections of oak, ash, and other timbers.

Ritter von Mioddecki, of Galicia, made a display of forest-products.

Joseph Niederwieser, of Bruneck, Tyrol, showed disks of larch-wood ; and Franz Ortner, of Innichen, Tyrol, specimens of split wood.

Graf St. Potocki, of Brzezany, Galicia, exhibited a fine oak-log.

Karl Ritschl, of Jaispitz, Moravia, showed a large collection of seeds ; also agricultural and forest tools.

L. Rueff, of Salzburg, had a collection of timbers and other forest-products.

Alois Schalhammer, of Ehrenhausen, in Styria, exhibited tan-bark.

Frauz Schgagknitz & Co., of Botzen, Tyrol, had nut-galls.

Gerhard Schinerdorfer, from Upper Austria, exhibited split wood.

From the Societa Agrario Istriana, at Rovigna, in Küstenland, were sent forest-products.

Messrs. Stainer & Hoffman, of Wiener-Neustadt, showed a collection of forest-seeds and a model.

Ludwig Trübel, of Vienna, had good boards of the *Picea pectinata*.

Karl Weissshuhn, of Silesia, showed split timbers.

From Joseph Wenger, of Vöklabrück, Upper Austria, lumber and building-timbers.

Messrs. Wohlfeld & Klarfeld, of Lemberg, in Galicia, showed fine oak-timbers for ship-building and railroads.

The Countess Rosalie Zamojska, of Okladow, Galicia, presented a collection of beautiful oak, ash, and maple lumber.

J. N. Zoller, of Sterzing, Tyrol, showed larch-seed and resin.

19. CARNIOLA claims to have the richest woodlands of Austria, and her exports of wood are very important. There was a collective exhibition of her forests by the Commission of Laibach. This province is divided into *upper*, *middle*, and *lower* portions. *Upper Carniola*, in the northwest or alpine region, has 47 per cent. of its surface productive—341,856 acres. A great deal of the country is wild and romantic. Among the exhibitors is the Carniola Iron Company, which has 52,500 acres of forest, some of which is at an elevation of 9,500 feet. The species are in the following ratio: spruce, 68; beech, 28; larch, 4 per cent., with scattered firs, Scotch pine, hornbeam, maple, *Alnus incana*, &c. The yearly product is 23,400 normal klafters. The company exhibits its young plants from the nurseries, of which there are six, and some

fine logs, various tools, and models of the means of transporting the lumber from the mountains and of the apparatus used; resonance-boards in the rough, split out and finished, and other preparations of wood. Charcoal is an important product. It is made in standing coal-pits, which produce from 84 to 96 cubic feet from a klafter of spruce, and 72 to 84 cubic feet from a klafter of beech. It also exhibited specimens of coal, models, and tools used in the process.*

20. Dr. Anthony Fuchs and son, near Krainburg, have a forest-property of 5,216 acres, at an elevation of from 2,000 to 5,000 feet, part clear spruce, and a part being fir, spruce, and beech mixed. The management is *Hochwald*, with rotation of eighty to one hundred years.

They showed the section of a fir-tree two hundred and sixty years old, of which the stump measured 63 inches; at one-twentieth of its height, it was 60 inches in diameter; height of tree, 120 feet; contents, 1,178.10 cubic feet; annual increase, 4.445 cubic feet.

The section of a one hundred and seventy-year-old spruce, 38 inches diameter; at one-twentieth of its height, it was 36 inches; height, 100 feet; contents, 318.09 cubic feet.

In contrast with these were shown trees damaged by pasturage and stunted:

Sections.	One-twentieth of height; diameter in inches.	Height in feet.	Age in years.	Contents in fractions of cubic feet.	Annual increment.
Spruce	1.00	2.50	30	0.006875	0.000220
Do	1.50	3.00	25	0.018450	0.000738
Do	1.25	2.50	35	0.010625	0.000303
Scotch pine	1.00	2.50	15	0.006875	0.000458
Hornbeam	1.00	3.00	25	0.008250	0.000330
Do	1.00	3.00	20	0.008250	0.000212

Undisturbed growth in a sheltered place—trees of similar age:

Kind.	Diameter one-half of height.	Height in feet.	Age.	Contents in cubic feet.	Annual growth.
Spruce	5.00	23	30	1.910	0.06367
Do	4.25	25	25	1.232	0.04928
Do	5.75	33	35	3.028	0.08651
Scotch pine	3.00	10	15	0.246	0.01640
Hornbeam	3.50	16	25	0.534	0.02136
Do	2.50	11	20	0.182	0.00940
Do	5.00	20	35	1.364	0.03885

* *Katalog der fürstlichen Collectiv-Ausstellung Krains, Landes-Forstinspector Ludwig Dimitz, Laibach, 1873.*

The loss per joch, with 1,600 trees, is thus shown:

	Total contents.	Yearly increase.
Unpastured woods.....	<i>Cubic feet.</i> 3,056	<i>Cubic feet.</i> 101.086
Pastured and scrubby.....	11	0.366
Loss.....	3,045	100.720

or 99 per cent. of possible results. These figures are worthy of the attention of many of our countrymen who advocate wood-pastures.

21. MIDDLE CARNIOLA, lying near the boundary of Kiistenland, has 39 per cent. of its area productive; of this, 142,885 joch are wooded. On Prince Windischgrätz's estate, the forest occupies 16,000 joch, chiefly covered with fir and beech, with hazel undergrowth. The manager exhibited average growth of fir in sections of fine size. At eighty years, the contents per log were 182.67 cubic feet. Hazel rods were shown also. Count Carl Lauthieri, of Wippach, has 9,877 joch of forest-possession, chiefly fir and beech, which yield annually 8,009 normal klafter,* of which 800 klafter of fire-wood and 1,300 klafter of lumber are exported. He exhibited numerous sections of trees, chiefly fir and beech, with their relative situations on different slopes and aspects and elevations noted for comparison. He also showed the various implements used, and the prepared woods.

LOWER CARNIOLA occupies the southeastern part; it is on the eastern foot-hills of the Alps; 43 per cent. is productive, of which 380,675 acres are wooded.

The Prince Auersperg, in Gottschee, has the largest and richest forest-property of the region, being 51,761 acres, occupying the most of the central mountains between Gurk and Kulpa, which are from 1,000 to 4,000 feet high, with a humose calcareous loam on alpine limestone. Beech takes the lead among the trees, then fir. The spruce occurs alone, in patches; maple, hornbeam, scattering; and, when planted, larch and Scotch pine. Cultivation has been continued for fifty years, and about 2,000 joch have been set with the trees named. The annual yield is about 12,300 normal klafter of fire-wood and 7,000 klafter of timber and lumber.

On exhibition were forest-seeds and young plants of larch and spruce; logs of notable size and proportions, with report of their age, contents, height, diameter, annual growth, &c.; prepared woods of various kinds and excellent quality; beech spunk and charcoal, of which 512,000 cubic feet are made for the iron-works. Potash was also shown.

By Moriz Löwenfeld, in Ratschach: This forest contains 3,875 acres; the elevation is from 1,000 to 3,000 feet. Beech constitutes 60 per cent.; spruce, with larch and Austrian pine, 25 per cent.; alder, ironwood,

* The normal klafter contains 100 cubic feet.

and hornbeam, 12 per cent.; and chestnut, 3 per cent. The management is *Hochwald* and clear-cut, (*Kahlhiebs*.) Since 1868, 400 joch have been cultivated with conifers. The annual yield is 800 normal klafter of fire-wood and 100 klafter of lumber. Large quantities are exported as charcoal, fire-wood, and cross-ties.

Exhibited: Fine young conifers from the seed-bed and nursery; models of transport apparatus and wood-ways, one of which is 3,000 klafter long; charcoal from beech.

Baron Gustav von Berg, the Herrschaft of Nassenfuss, has 3,375 acres of woodland, of which 85 per cent. is beech, 10 oak, 5 spruce; altogether *Hochwald*, with a rotation of 100 and of 70 years.

Exhibit: Prepared wood and coal.

Count Gustav Auersperg, in Mokritz, has a forest of 2,000 acres. High beech about 60 per cent., chestnut in *Hochwald* and *Niederwald* 25 per cent., and in the rest oaks and conifers, especially the Weymouth pine, are cultivated. These pines and chestnuts are especially noteworthy.

Exhibited: The results of planting the *Pinus strobus*. This tree has been cultivated in park and forest since 1826, when the plants were brought from the garden of Schönau in Lower Austria. The seeds were shown, of which 30 to 50 pounds are gathered annually. These seeds count from sixty to seventy thousand per pound; from 50 to 70 per cent. of these will grow. A branch with cones and empty cones.

Section of a fifty-year-old tree, 20 inches diameter at one-twentieth of its height; the log is 76 feet long; contents, 59.6 cubic feet. A section of the same log, 33 feet above the stump, is 13 inches in diameter. Young plants from two to five years old from the nursery. The exhibitor recommends planting the *strobus* alone or mixed with the chestnut.

The result of chestnut-coppice, with a short rotation of five years, was shown; grape-stakes of chestnut, round and split; chestnut telegraph-poles, seventeen years old. The chestnut highwood becomes profitable in seventy years, and when cut it springs again rapidly from the stump, and the quality of the next crop is superior to the first.

The following table gives the mean results of the reckoning of a chestnut-forest:

Age of the trees in years.	Average product, in klafter.*	Mean growth in height for each decade in klafter.	Mean growth in diameter for each decade in cubic feet.
20	12		60
30	20	0.8	66
40	27	0.8	70
50	36	1.45	72
60	47	1.45	80
70	65	1.45	93

* The normal klafter contains 100 cubic feet solid contents.

Herr Dimitz well says, as a summary on the chestnut, that its especial adaptation to the coppice of short rotation, to the *Mittelwald* and to the *Hochwald*, its easy reproduction by sprouting, its value as lumber, and the excellence of its nuts, all entitle it to a greater degree of attention from the forester of Southern Austria than it now receives.

22. ACKERBAU-MINISTERIUM.—In the north zone, near the eastern end of the Industrial Palace, there was a complex building erected by the Imperial Department of Agriculture, which, with a large space outside, was prepared especially for the exposition of the products of agriculture, the forests and mines and salines, of Austria, which are under the charge of the very able minister, Herr Ritter von Chlamecky. To many visitors this was an exceedingly interesting part of the exposition, and was familiarly known as the "*Ackerbau-Ministerium*."

The pavilion was quite large and roomy, though very full. It was plainly but strongly built, to sustain the great weight that was put into it. The ornamental was not needed where every square yard of space was occupied by objects of the deepest interest, tastefully arranged, and some of them also of intrinsic beauty. Externally, the pavilion presented rather an attractive appearance, due to some simple architectural ornamentations; but these were lost sight of by those who could appreciate the tasteful arrangement of the articles exhibited in the open air around it.

On one side was an elevation made of rocks and soil, and supplied with water, on which were growing numerous alpine plants.

In another place were great masses of the limestone rocks of the southern portion of the empire lying near the Adriatic Sea; the region which, in past centuries, had been stripped of its timber to supply the wants of Italy to such an extent as to become a barren waste. This is now known as the Karst, or the Küstenland.

The efforts recently made, and making, to restore its fertility by reforesting it will be noticed in another part of this report, and are now only referred to on account of the exhibit made by those who have the matter in charge. Among these bare rocks were growing young trees, of the several species reared in nurseries, to the amount of millions, and already planted to a very large extent among the bare rocks of that desolated region.

The following young plants were growing on the rocks from Istria to illustrate the means of reforesting the desolate regions of that part of the empire:

Pinus austriaca, *Pinus maritima*, *Robinia pseudo-acacia*, *Fraxinus excelsior*, *F. ornus*, *Catalpa syriaca*, *Amygdalus communis* and *persica*, *Pinus sylvestris*, *Abies excelsa*, *Larix europæa*, *Pinus pinæa*, *Acer pseudo-platanus*, *Acer negundo*, *Ostrya vulgaris*, *Æsculus hippocastanum*, *Tilia grandifolia*, *Ulmus campestris*, *Gleditschia triacanthus*, *Ailanthus glandulosa*, *Hibiscus syriacus*, *Melia azedarach*, *Maclura aurantiaca*, *Pyrus malus* and *communis*, *Prunus avium* and *mahaleb*, *Juglans regia*, *Castanea vesca*, *Morus alba*.

To prevent confusion, the articles will be taken up in groups, according to the several countries or provinces in which the state-forests are situated, following the catalogue, in which copious notes were made as they were examined.

23. BOHEMIA.—*From the Joachimsthal forest.*—In the pavilion were full descriptions and charts, with tables of resultant products and prices for a period of years. Outside were grouped the great logs, timbers, and other preparations of lumber, some of which are worthy of note.

Logs.	Age.	Diam-eter.	Length.	Contents.
	Years.	Meters.	Meters.	Cub. meters.
Spruce.....	140	0.84	34.00	7.15
Do.....	125	0.79	33.50	5.83
Do.....	138	0.71	30.30	3.47
Do.....	116	0.36	17.00	1.033
Do.....	116	0.375	15.00	0.349
Do.....	70	0.47	33.50	2.49

Then came the lumber of very fine quality, as timbers, boards, posts, shingles, &c., and a collection of tan-bark from the spruce-trees.

From Schönberg, in the northern part of Moravia, near the southern base of the Riesengebirge, was a collection of forest-products, including plants from the high mountains, sent by the Forest Association; also sections of logs of different kinds taken from the highest, the middle, and the lowest altitudes, to show the relative wood-growth; these were spruce, fir, maple, and elm; mosses from the heights of the snowy mountains; resonance or sounding boards, made from two hundred and fifty year old spruce that grew 4,100 feet above the sea; a miniature model of a charcoal-establishment; beech-staves, felloes for wheels, spunk, and articles prepared therefrom.

24. BUKOWINA.—In the pavilion, models of ship-masts, yards, and timbers; models of wagons; shovels, trays, and bowls of maple-wood and beech; staves; resonance-boards; shingles from fir; spruce tan-bark; crude potash; crude tar and seeds; spunk from the beech; a collection of insects by the forester Schirl in Zuczka.

Among the timbers outside were some very fine masts and yards, some of great length; and logs.

	Age.	Diameter.	Length.	Contents.	Elevation.
	Years.	Centimeters.	Meters.	Cub. meters.	Meters.
A. Fir.....	250	105	53.	37.7	800
Spruce.....	210	76	53.	16.64	800
Beech.....	120	68	11.3	4.2	150
Oak.....	160	78	18.9	9.31	150
Oak.....	120	73	17.	3.63	125
Sorbus torminalis.....	60	36	10.9	1.2	250
Acer pseudo-platanus.....	100	52	11.3	3.31	125
Ash.....	315	95	30.3	12.06	1,149
Maple.....	280	87	18.9	4.98	950
Beech.....	280	63	20.8	5.11	250
Hornbeam.....	130	50	11.3	2.52	250
Maple.....	190	68	11.3	5.4	250
Linden.....	150	94	11.3	9.6	250
Alder.....	130	47	13.2	2.35	100
Fir.....	182	81	53.	11.68	950
Aspen.....	65	37	8.5	1.26	130

25. GALICIA.—*Statistical description and charts*.—A model of a long raft, with all its appurtenances; model of a mountain saw-mill, with circular and gang saws; model of a colliery; model of a galley made from spruce, such as carry from 800 to 1,000 hundred-weight to Odessa; models of ox wagons and sleds; various wooden articles for domestic use, very fine; resonance-boards; and many fine preparations of wood for various purposes, shingles, &c. Forest-tools of all kinds, for felling, cutting, splitting, shaving, and coaling-tools.

Outside were abnormal growths of pine, oak, elm, birch, showing very curious irregularities, and some starved trees of considerable age, but little height, and very small diameter. Other logs, of great beauty of form and of good size, give a much better idea of the Galician forests. An exhibit of the durability of wood under certain circumstances was made from the salines of Wiechezka; a stick 3 feet long by 18 inches, since 1695; one 3 feet long by 18 inches, set in the year 1600; one 7 feet long, salt-incrusted, set in the year 1636; one 3 feet 6 inches by 18 inches, set in the year 1696; a pine stick hewed in the fourteenth century; an aspen-stick set in the sixteenth century. These were all taken from the mines, where they had been exposed to moisture and pressure.

26. GÖRITZ AND ISTRIA.—Chorographic charts, production-tables, and maps representing the several portions of the imperial estates in these countries that we call Illyria.

In the pavilion was a model of charcoal-ovens, such as are used in Ternova, where they have no water to control the fire. A very extensive collection of woods in book-form, showing the rate of growth, the specific gravity, and the elevation on which they grew, to the number of one hundred and fourteen kinds, all classified according to de Candolle. The common and botanical names of this interesting collection were also given, with the place where they grew, prepared by Forstmeister Redl.

A very extensive and elegantly-prepared collection of beetles injurious to the forests, amounting to two hundred and sixty-four species, by Oberförster Franz Miklitz; and a small group of six species of beneficial insects. These are grouped according to the injury they effect: eleven are destructive to the young trees in the nursery and seed-beds; one hundred and sixty-eight do their work of destruction in the standing forest; and one hundred and seven consume the fallen wood and lumber.

These insects were collected in various provinces; all of which places are indicated by different colored cards attached to the insect-pins.

Outside was a collection of wood, sections of logs, with the several particulars given in the annexed table.

Species.	Exposure and soil.	Above sea.	Specific gravity.	Age.	Height.	Diameter.
		<i>Meters.</i>		<i>Years.</i>	<i>Meters.</i>	<i>Cubic meters.</i>
Fir	Sheltered, humose	1,000	0.4549	74	30	39
Fir	Sheltered, stony and shallow	1,000	0.5282	80	28	31
Fir	Northeast exposed, poor	906	0.5541	84	10	16
Fir	Southwest sheltered, humose	906	0.4501	84	24	56
Fir	Northeast exposed to the northers, poor	1,230	0.6482	85	12	14
Fir	Sheltered, humose	1,090	0.5369	125	37	73
Fir	Northeast exposed, stony	1,290	0.5943	150	12	21
Fir	Northeast exposed, stony	1,330	0.4918	150	10	13
Spruce	Sheltered, deep and sandy loam	1,100	0.4497	77	25	50
Spruce	Northeast exposed and stony	1,330	0.6128	136	13	14
Spruce	Sheltered, deep sandy loam	1,100	0.5327	140	19	40
Spruce	Sheltered, humose	1,250	0.5436	147	25	60
Beech	Sheltered, humose	1,000	0.8528	125	33	56
Beech	Northeast exposed to northers, poor soil	1,000	0.7355	170	9	11
Beech	Sheltered, humose	1,000	0.9589	145	33	50
Beech	Sheltered, stony, poor	1,000	0.9487	145	17	31
Beech	Northeast exposed to northers, stony, poor	1,290	0.8575	174	16	32
Beech	Southerly sheltered, good soil	1,300	0.9351	190	23	41
Beech	Northeast hardest northers, poor soil	1,200	0.7019	190	12	18
Beech	Sheltered, rich in humus	1,050	0.8356	192	29	45
Sorbus aria	Northers, poor	1,200	0.9380	150	9	21
Q. pedunculata	Sheltered, sandy loam	100	1.0084	110	24	50
Austrian pine	Somewhat exposed to northers, humose	100	0.6710	56	14	44
Q. pubescens	Somewhat exposed to northers, thin	150	1.2310	35	8	26
Q. pubescens	Sheltered, humose, chalk	100	1.1051	35	8	21
Cork-oak	Sheltered, humose, Karst soil	33	0.9523	40	8	20

Collection of woods, split pieces.

Name of tree.	Soil and situation.	Elevation.	Specific gravity.
		<i>Meters.</i>	
Oak, <i>Quercus pedunculata</i>	Sheltered, sandy loam	100	1.0084
Oak, <i>Quercus pedunculata</i>	Sheltered, wet land	15	0.9943
<i>Quercus pubescens</i>	Sheltered, stony, but humose, chalky soil	120	1.1226
Spruce	Sheltered, stony, humose, chalky soil	1,250	0.5446
Fir	Sheltered, stony, humose, chalky soil	1,015	0.5283
Larch	Sheltered, humose sandstone	490	0.6694
Beech	Sheltered, humose, chalky	880	0.9009
Sorbus aria	Sheltered, humose, chalky	996	0.8903
Austrian pine	Rather exposed, humose sandstone	100	0.6710
Cork-elm	Sheltered, humose, wet soil	15	0.8616
<i>Acer pseudo-platanus</i>	Sheltered, stony, humose, chalky soil	1,015	0.8545

Here are some sections of logs of remarkable dimensions, from the Ternova forest, at an elevation of 1,000 meters :

Height of tree.	Length of log.	Diameter, breast-high.	Diameter, small end.	Cubic contents.	Formzahl.
<i>Meters.</i>	<i>Meters.</i>	<i>Meters.</i>	<i>Festmeters.</i>	<i>Festmeters.</i>	<i>Festmeters.</i>
41.15	22.15	1.765	0.737	30.336	0.32
41.00	20.55	1.264	0.758	21.140	0.41
39.50	15.12	1.238	0.800	16.400	0.36
40.44	16.74	1.238	0.822	17.854	0.40
39.81	16.46	1.212	0.798	17.000	0.37
40.76	20.22	1.238	0.764	21.582	0.44

A collection of timbers prepared for ship-building, knees, keels, beams &c., and the model of a ship.

Young plants from the nurseries, ready for planting in the Karst-lands.

A collection of ship-builders' tools.

These specimens from the existing forests of this region prove the adaptability of the soil and climate for the production of this staple,

and furnish great encouragement to those who have wisely undertaken to reproduce the sylvan garniture of the extensive wastes of the Küstentland.

27. CARINTHIA.—In the pavilion, we find the usual charts and tables, and also photographic representations of interesting portions of the forests; models in relief of the valley of the Drave; and specimens of prepared wood in various forms.

Outside was a collection of logs of different kinds, from various elevations, with their several dimensions and contents, age, specific gravity, &c.; some of these grew at an elevation of 1,600 meters; prepared lumber and materials.

28. CARNIOLA.—In the pavilion were models of log-ways, and water-ways for transport, with their reservoirs of supply; photographic illustrations of the works; forest-charts dating back to 1760; tools for forest-culture; tools for felling and preparing the timbers, and for moving and handling them; apparatus and tools for making the ways and roads in the forests.

Outside was a collection of logs and timbers, some of the former of great size and showing by the annual rings a remarkable growth; a beech two hundred and fifty-eight years old that grew at an elevation of 950 meters was 55 centimeters in diameter at breast-high, 34.12 meters long, with 14.50 cubic meters contents; a chestnut sixty years old, at an elevation of 570 meters, diameter at breast-high 32 centimeters, length 22.75 meters, contents 1.06 cubic meters.

The chestnut grows rapidly and is very durable, and the stem remains sound until seventy years old. It is used for grape-stakes, staves for wine-casks, and other purposes. For grape-stakes, it may be cut when five and six years old, and it makes telegraph-poles in seventeen years.

There was a remarkable stump of fir, which had sprouted after having been cut, and another that had grown so as to heal over completely; specimens showing the serious injury inflicted upon trees by pasturing.

29. LOWER AUSTRIA.—In this region, the Wienerwald, so near at hand and so well known by the curious, furnished a large collection.

In the pavilion were numerous charts, maps, and relief-models of various parts of the forests, representing the surface, the water-ways, the roads, and the kinds of trees.

Tools used in felling and preparing the wood and in transporting it; also the apparatus employed in the gathering of the pitch from those portions devoted to the Austrian pine.

Outside were sections of various kinds of trees, and logs of handsome appearance and good size; their age, height, thickness, and contents were given with each.

The Austrian pines that had been felled for the tar were also shown in different stages of the process.

Various preparations of wood for use in the arts, especially for the wagon-maker.

Many abnormal growths were exhibited that were exceedingly curious and interesting.

30. UPPER AUSTRIA.—*Salzkammergut*.—In the pavilion were a collection of all kinds of forest-tools. Resonance boards of spruce; the annual production amounts to 2,500 cubic meters. A cubic meter was worth about \$12 at the stump, and when worked up it was worth \$163.

Models of log-ways used in that region, and of water-ways with their reservoirs, maps of the several forests, and relief-charts.

Outside was a collection of logs, showing the character of growth in that region.

31. DUCHY OF SALZBURG.—In the pavilion, maps, statistic tables, pans, and model; a complete set of forest-tools, &c.

The following table shows the injurious effects of grazing in the woods, which, on account of the servitudes, is still practiced to some extent.

	Elevation.	Situation and soil.	Age.	Height.	Average diameter.	Contents.
			Years.	Meters.	Meters.	Cubic meters.
1	1,300	Northern slope; rather humose soil, on chalk...	30	12.5	0.053	0.056
2	1,300	do.....	25	4.4	0.039	0.009
3	1,200	do.....	53	16.7	0.158	0.327
4	1,200	do.....	53	13.9	0.079	0.069
5	1,070	From a north slope; on a strong soil on mica-schist	43	8.8	0.092	0.058
6	1,170	Southeast slope; stony, rather strong soil.....	70	18.9	0.197	0.581
*7	1,170	do.....	80	25.9	0.263	1.405
8	1,170	do.....	90	17.0	0.158	0.334
9	1,170	do.....	90	14.8	0.118	0.164
10	1,050	North slope; loam and lime.....	95	12.9	0.131	0.176

* Normal.

Contrast the second with the third, the fourth with the sixth and seventh, as to their relative contents.

32. ILLUSTRATIONS OF THE DURABILITY OF TIMBERS IN THE SALT-WORKS.—A piece of spruce which had stood twenty-five years in a dry place under great pressure, 190 meters deep; a cross-beam of spruce, which had borne a severe vertical pressure fifty years in a damp place at the same depth; another under similar circumstances for one hundred years, and a piece of flood-gate from one of the oldest establishments, from two to three hundred years old; logs of stone-pine of different ages up to two hundred and sixty years, grown in elevated places from 1,430 to 1,850 meters above the sea, and other kinds of logs; larch cut into cross-ties, usually 6 by 5 inches. The tree was five hundred and thirty years old; diameter, breast-high, 86 centimeters; 25.43 meters long; contents, 6.75 cubic meters.

Tree.	Elevation.	Age.	Diameter.	Length.	Contents.
	Meters.	Years.	Centimeters.	Meters.	Cubic meters.
Larch.....	1,580	575	16.5	4.93	
Spruce.....	1,250	290	105	38.40	8.72
Fir.....	900	335	119	19.	11.94

33. STYRIA sent models of reservoirs and water-ways, of shelter-huts, of ice-ways, sleds, and collieries; also tools of all kinds for preparing wood and timber, and for coaling.

34. TYROL AND VORARLBERG.—In the pavilion were tools and apparatus for cutting and transporting lumber; models of reservoirs and water-ways of collieries; statistic tables, and an album of the views of constructions and interesting objects connected with the land and water transport.

These representations of the modes of overcoming difficulties incident to an alpine forest-region could not fail to attract attention.

Outside was a collection of logs and timbers; among them some fine sticks of Scotch pine and spruce cross-ties, and logs for masts and spars; abnormal growths of several kinds.

35. DALMATIA.—In the pavilion, sections of different woods, especially of southern kinds, unknown to the forests of other parts of the empire.

36. STYRIA.—The collective exhibition from Styria was another of the exceedingly interesting groups of forest-products. It was placed in and around a neat building erected for the purpose, with open sheds on either hand for the coarser products. In the front, outside, were groups of forest-plants of many kinds; among them spruce, pines, and larches from the seed-bed and nursery, where they are prepared for planting in the high mountains. These are preferred when from three to five years old, as then they can better withstand the growth of grass to which they are exposed. Ash, maples, and firs were also present. These contributions were from the Vordernberg Company; Baron Sessler-Herzinger, from the Leoben Society; and the Stock Company of the Innerberg Establishment.

Forest-culture in the high mountains of Styria, which is situated from 1,400 feet to 4,500 feet above the sea, is quite a difficult matter. Notwithstanding the excellence of the soil, the scarcity of suitable labor, the shortness of the period of growth, the unfavorable influence of the climate and atmosphere, and the practice of pasturing requires for success the application of pecuniary sacrifice, great assiduity, and patience. This culture began to attract attention about twenty years ago. In many clearings, the method of Beerman and Butler was applied. In the highest places, the tuft-planting* was tried, and planting in the usual way where, from the character of the soil, every intricate method of great cost was excluded. The country people, who occupy the greatest area, are enemies of forest-culture; to them pasturage offers a higher profit. The culture costs from 3 to 8 florins per joeh in the higher places, and in the worst soils, (*verfitzen*), from 5 to 15 florins.† Culture, be it understood, consists in planting the trees, and does not imply what we should consider cultivation afterward. With the European forester, a

* *Buschelpflanzung*, planting in bunches.

† We may read this, 40 cents to \$3 per acre, and \$1.90 to \$5.50 per acre.

cultivated forest is one artificially stocked, and not the natural growth. More recently attempts are made to mix the species in these plantations, since in the Styrian mountains the deciduous trees are generally wanting and frequently desired.

Logs.—From the Innerberg Company, there were some fine logs; a spruce 16 klafter (96 feet) long by 32 inches thick; a larch of the same length and 30 inches thick; and a fir of similar length, by 42 inches in diameter; beautiful and remarkable shafts they were. These trees were felled on the boundary of Styria with Upper Austria, brought to the river Enns without the aid of machinery, and floated by it and the Danube to Vienna.

There was a spruce log 51 inches diameter, from Vorderberg, which grew at the height of 5,400 feet on gneiss, and in an open situation. This remarkable log was 118 feet long, but in falling it broke into three pieces. It was taken to the railroad by means of sleds.

From the Vorderberg Society was a fir-log, 72 feet long by 32 inches diameter; one of larch, 60 feet by 34 inches; and others very fine. Here were also to be seen logs of yew and of the Swiss stone-pine (*pinus cembra*) from the elevated alpine regions; also some spruce and larch poles for high building, remarkable for their length and strength.

The export of long timber has recently assumed a remarkable importance in Styria. It is carried on by rafting, chiefly on the Mur, the Enns, and the Traun Rivers. The spruce and firs go to Vienna and Gratz; the larch, for ship-timbers and for masts and spars, to Triest, Venice, &c. Great quantities of props for the mines are taken to the mining-regions of Upper Austria.

The first transport of the long timbers from the mountains is effected chiefly by hand, aided by artificial slides and ways. The carriage of the smaller pieces is tedious and laborious in the mountains, and necessarily expensive.

In the sheds which were erected, on either end of the pavilion, were collections of prepared woods, split, hewed, and sawn, chiefly of spruce, fir, and larch. Among them were cross-ties sawn in peculiar form, so as to economize the timber. Some were cut 6 by 8 by 10 inches, and intended to rest upon the broadest side; here were also squared timbers.

From Graf von Luchesi were oak posts, boards of elm, maple, linden, birch, alder, walnut, and ash, of unusual dimensions, intended for the cabinet-makers and were remarkable for their texture and perfection; finely-split material for the Triest market, and for various purposes.

From Vorderberg were boards of the stone-pine of extraordinary dimensions, planed and polished for furniture and for carving, for which they are well adapted, because of the firmness of the fibers; on this account, they excel all other lumber. Such trees grow only on the highest mountains, near the timber-line. This species grows also in lower situations, but it prefers the summits.

Graf Luchesi showed oak staves and other split oak-wood of remarkably fine texture; grape-stakes elegantly split and dressed, made from spruce and also from our favorite black locust; the latter was produced in the lower forest-lands.

Baron Sessler-Herzinger had grape-stakes made from larch, which were very good; also shingles made from larch. These were of remarkable size, and made without the usual groove, common to the European shingle, by which they are joined laterally on the roof. These larch shingles are sought for on account of their greater durability and their resistance of the influence of the weather.

From the Hohenwanger Company were charcoals from spruce and fir, and sections of larch and spruce intended to show the growth of wood in various places in the high mountains.

A very important industry in Upper Styria is coaling for the use of the iron-manufacture, especially as there is no stone-coal. The two great smelting-establishments at Eisenerz and at Hieflau, belonging to the Innerberg Stock Company, and that at Vordernberg, have used 21,000,000 cubic feet of charcoal in a year, two-thirds of which they make, and one-third is purchased. Besides these, the scythe-works, the steel-works, and machine-works consume great quantities. So important an interest is this that the Vordernberg Company exhibited a table of the production, in cylindrical form, of the coal from a given quantity of wood of different kinds, that had been cut from one to three years. The measure and weight of the wood are given, then the amount of the coal, and lastly the percentage in measure and weight of the result.

In traveling among these collieries, there seemed to be nothing like our charcoal-ovens, nor was there seen at the exposition any model of such a contrivance. Great care and skill are exercised in putting up the kilns; but they are all conducted upon the primitive plan of piling the wood, and covering with earth to control the fire.

Another admirable illustration of the care with which the coaling of wood is studied consisted in a group of thirty-three cubes of definite size, beside which were placed the resultant cubes of charcoal produced by burningsimilar blocks. This was illustrated by a table, showing the name of the wood, the part of the tree, whether stem, stump, or branch, the size, the relative weight of a cubic meter of wood and coal; next, how much coal is produced by a cubic meter of wood, and the percentage; next, the percentage of loss in measure and weight. These thirty-three cubes represented as many different kinds of wood. The experiments were made by the Innerberg Mining Company, and the tables enable them to make very close calculations on their results in coal-burning.

The same association also presented another valuable table, with illustrations in wood, showing every important element connected with the results of the process of coaling; giving the name of the tree, station as to elevation, place, direction of exposure, sheltered or otherwise, the rocks subjacent, character of soil, &c.; then the age, height,

strength, amount per hectare; the ascertained measure of the trunk, stump, and branch in cubic meters; the last year's height, strength, and mass, and the entire contents in cubic meters; then the successive growths in periods of twenty-five years up to two hundred and twenty-five years. There were twenty-five of these representations.

Among the curious and interesting things which attracted the attention of strangers were articles of dress; the green felt hats and the green velvet and fustian or velveteen jackets with showy buttons innumerable; the short breeches of buckskin, with knee-buckles, not quite reaching the long green woolen stockings and the heavy shoes armed with iron points to keep them from slipping on the ice or smooth rocks. Thus equipped, the mountaineer still needs his *Alpenstock* when taking an excursion, with his fowling-piece slung over his shoulder, and a good field-glass suspended from his neck.

In this beautiful room, there were many objects of interest. The walls were ornamented with photographs of some of the establishments for mountain-industry, of the mountains themselves, and of some of the most picturesque *Thäler*, or valleys, and ravines, some of which, deep and narrow, nearly closed in by the almost vertical rocks, resemble the wild cañons of the Rocky Mountains of our own country.

A group of rocks covered with alpine plants occupied one side of the room, and here were placed the fauna of the Styrian Alps, elegantly prepared and tastefully arranged by the Rev. H. Blasius, of Mariahof, near Neumarkt.

The Emperor has a fine hunting-lodge in the wild Thal Radmer, and here were also some of the trophies of the chase, taken by himself and by the young crown-prince Rudolf. Graf von Meran also had a large collection of horns of deer and chamois, trophies of the chase in these mountains, as had several other exhibitors, for the Styrians are all mountaineers and hunters; those who do not sport the horns or foot of a chamois will have at least the flower of the *Edelweiss* in their hat-band or button-hole as a trophy from their alpine heights.

37. HUNGARY.—The extensive and very rich exhibition made from the forests of Hungary required the erection of special and commodious apartments. The main forest-pavilion was erected in the form of a wooden church, such as embellish the Eastern Carpathians among the inhabitants of Svathmar and Marmaros. This illustrated the peculiar Hungarian architecture, and was quite oriental in its style. The positions for wood-industry were a little to the south of the main building, and a large area on all sides was occupied by immense logs, normal and abnormal growths, and the coarser kinds of prepared lumber, both split and sawed. This immense exhibition, in the collection, transporting, and exhibition of which the government expended about \$100,000, represented the forest-products of the Hungarian countries, including the provinces of Croatia and Slavonia; the articles exhibited were drawn from the government forests and also from private estates.

Besides this great group, there are some very rich collections, such as those from Archduke Albrecht, from the Duke of Coburg, from the Austrian Railway Company, and others, which occupied separate pavilions, or were placed in the agricultural halls; these will be treated separately.

In such a grand collection as was here presented, it will be impossible to particularize, as the details would occupy too much space. Among the various objects of such deep interest, however, a few must be brought into this report.

The primary products of the forests, such as bark, wood, sawed and and split, were presented in great abundance from all parts of the kingdom of Hungary. The tools used in felling, transporting, and preparing the lumber; models and plans for transport, in their minutest details, were exhibited. Abnormal and diseased growths were contrasted with healthy products. Here were the results of experiments on the strength of material, accompanied by a pamphlet,* showing the effects of numerous trials in this important branch of physical investigations.

Charts, plans, and statistic tables, showing the condition of the forests, their cost and returns, and propositions for their improvement, were numerous upon the walls. Everything of this kind that could thus be addressed to the eye was here presented; as were herbaria, showing not only the forest-botany in the usual way by a collection of the plants, but also similar plants, particularly young forest-species, grown on various soils, exhibiting the different character of the roots produced in each.

Among these last, some of the most remarkable were little tree-plants, with their roots, that had been brought from the region of blowing sands of the Lower Danube; these show remarkable growth of tops and roots. They consist of pines and other trees; notably of our own invaluable black locust, (*Robinia pseudo-acacia*.)

Numerous collections of wooden blocks were sent by various contributors. These are generally of uniform size in each group, and are elegantly prepared; one or more sides polished so as to bring out the grain and characters of the wood. Some of these are made to resemble books, and are named on the part corresponding to the back of the volumes. A favorite product appears to be thin layers, like veneers, which are marked as articles to be used by shoemakers and book-binders. They are so thin that it requires sixty thicknesses to make an inch, and in one sample sixty layers measured only three quarters of an inch in thickness; this is like our wooden wall-paper, but is not used for that purpose.

Seeds of forest-trees were very extensively exhibited from various parts of the country; and oak-bark, very nicely peeled and prepared in rolls, or quills; this is taken from young trees. The copse is cut over every fifteen to twenty-five years, and allowed to spring up again for another crop.

* *Untersuchung über die Festigkeit der Hölzer*; Jos. Vessely, Domäne-Inspector.

Mr. Franz Schmitt had prepared a pamphlet,* in which the whole process is described; and the subject may become one of importance to us whenever the now abundant supplies of rock-chestnut oak of the Alleghanies shall have been destroyed. The young trees (copse) of this species grow very rapidly.

In the wood-industry pavilions were innumerable articles of wooden ware of various kinds, from cross-ties to barrel and hogshead staves, of the finest quality. These last were of dimensions to make the largest sized casks, such as were shown, great tuns, to rival that which has rendered Heidelberg famous. One of these great casks would hold 2,500 eimer, an Austrian measure of nearly $9\frac{1}{2}$ gallons; so that its contents, in our measure, would be 23,325 gallons. This cask is made of 71 staves, each $21\frac{1}{2}$ feet long. At the end it measures 17 feet across, and in the middle $19\frac{1}{2}$ feet. The staves are $7\frac{1}{4}$ inches thick; the head-pieces, $6\frac{1}{2}$.

Among the preparations of wood that are associated with art were woods elegantly prepared for inlaying floors, (parquetry,) which are very much used in Europe; sounding-boards (*Resonanz-Hölzer*) for pianos; garden-furniture, rustic work made chiefly from the stems of hazel or filberts; narrow strips of thin stuff for making screens, (*jalousies*, as they are there called,) and much used in eastern architecture.

Outside these pavilions there was an extensive space, occupied by specimen logs from various sections of the country that were really remarkable. Some of these must be noticed, with their dimensions.

From the Carpathians were an ash log 44 inches thick, a Norway spruce 44 inches, an elm 36 inches, an oak 30 inches, a fir 48 inches. A larch log was 65 feet long, 6 and 15 inches thick; another was 50 feet long, 6 and 23 inches thick; a Scotch pine was $83\frac{1}{2}$ feet long, 4 and 13 inches thick; another was 50 feet long, 15 and 20 inches thick; a beech $72\frac{1}{2}$ feet long, 11 and 21 inches thick; an oak 60 feet long, 8 and 14 inches thick; a spruce 126 feet long, 48 inches at base; a fir 134 feet long, 13 and 58 inches diameter.

From Siebenbürg was a spruce 148 feet long by 11 and 35 inches thick; sections of Scotch pine, 21 inches; of *Q. cerris*, 22 inches; of bird-cherry, 17 inches; of hornbeam, 13 inches thick.

From the Carpathians were sections 22 to 31 inches: alder, 22 inches; silver-fir, 43 inches; maple, 37 inches; beech, 40 inches; silver-fir, 45 inches; elm, 31 inches; spruce, 44 inches; elm, 30 inches; maple, 39 inches; birch, 16 inches; chestnut, 26 inches; walnut, 19 inches; bird-cherry, 16 inches; larch, 27 inches; Scotch pine, 28 inches; silver-fir, 34 inches, and Norway spruce 32 inches.

Of timbers handsomely dressed: Scotch pine, 48 feet long, squared 10 inches; a larch, 56 feet, squared 11 inches; a silver-fir of 60 feet, squared 13 inches; a Norway spruce, 60 feet, squared 12 inches; an oak, 60 feet, was squared 18 inches; another oak of 60 feet, 15 inches;

* *Die Gewinnung der Eichenlohe.*

a spruce 70 feet long was dressed to 18 by 32 inches. There was also in the same group a fine collection of logs from the famous forests of Croatia and Slavonia, whence great quantities of cooper's stuff are exported to all parts of Western Europe.

Logs.—Oak, (*Quereus pedunculata*), 90 feet long, 14 and 42 inches diameter; oak, (*Q. sessiliflora*), 69 feet long, 17 and 32 inches diameter; silver-fir, 133 feet long, 10 and 44 inches diameter; spruce, 133 feet long, 8 and 34 inches diameter; beech, 75 feet long, 17 and 39 inches diameter; maple, 58 feet long, 25 and 40 inches diameter; Austrian pine, 76 feet long, 7 and 20 inches diameter; Scotch pine, 89 feet long, 4 and 32 inches diameter; elm, 90 feet long, 15 and 30 inches diameter; ash, 88 feet long, 16 and 32 inches diameter. From the same forests were beautiful dressed timbers, the dimensions of some of which are here given: Norway spruce, 74 feet long, 11 by 33 inches; silver-fir, 81 feet long, 22 by 58 inches; maple, 47 feet long, 26 by 27 inches; hornbeam, 29 feet long, 26 by 37 inches; oak, (*Q. pedunculata*), 91 feet long, 10 by 30 inches; elm, 84 feet long, 11 by 31 inches; ash, 84 feet long, 13 by 44 inches; Norway, 70 feet long, 30 inches square; fir, 70 feet long, 30 inches square; beech, 50 feet long, 18 inches square; Norway, 70 feet long, 20 inches square; fir, 70 feet long, 20 inches square; oak, (*Q. sessiliflora*), 60 feet long, 16 inches square; Scotch pine, 45 feet long, 11 inches square; Scotch pine, 64 feet long, 10 and 17½ inches square; Austrian pine, 66 feet long, 9 and 15 inches square; oak, 60 feet long, 15 inches square; oak, 63 feet long, 16 and 51 inches square; elm, 75 feet long, 11 and 30 inches square; ash, 74 feet long, 10 and 33 inches square; linden, 30 feet long, 10 and 17 inches square; alder, 30 feet long, 8 and 15 inches square.

There was also a group of sections of logs, from places whence, on account of the extreme mildness of the winter of 1872-'73, it was impossible to transport great logs over the roads. Among them were the following: oak, (*Q. pedunculata*), 53 inches diameter; oak, (*Q. pedunculata*), 65 inches diameter; oak, (*Q. sessiliflora*), 42 inches diameter; chestnut, 47 inches; beech, 46 inches; ash, 43 inches; ash, 36 inches; elm, 62 inches; elm, 38 inches; elm, 56 inches; hornbeam, 32 inches; maple, 40 inches; linden, 34 inches; silver-fir, 54 inches; silver-fir, 60 inches; Norway spruce, 43 inches; another, 52 inches; Austrian pine, 22 inches; and a pine, 28 inches.

Mr. Zellen, of Galetten, showed bast from the mulberry-tree.

Bachmeyer & Co., of Temesver, had various forest-products.

The Countess Anthonia Bathyanyi, of Élesd, exhibited a fine log from her estate.

Mr. John Bibel, of Orawitz, had a collection of staves for barrels.

From Baron Borneufizza, of Maros-Illye, Transylvania, was a group of forest-products.

From the Dominion of Bakotra was exhibited, by the Baranyaer Company, barrel-staves and beech-felloes.

From the forest-office of Bellovár were some boards.

Mr. Copony, of Rosenau, exhibited some logs.

William Dapsy, of Rima-Szombat, showed gall-nuts.

From the domain of Diakovar, in Slavonia, were some forest-products.

Eugene Dvihálly, forester, Huszt, showed a table and settle of mahaleb-cherry and cherry-wood.

Count Erdody, of Marcovecz, had a linden log on exhibition.

John Erlitz, of Zirtz, had a collection of spunk.

Count Paul Esterházy, of Ugod, exhibited forest-products.

Anton Freistadter, of Kaposvar, and Albert Fekker, Royal Head-Forestmaster at Abrudbánya, showed collections of similar articles.

The Hungarian department of finance at Ofen exhibited their forest-products.

The chamber of trade of Fiume had a collection of woods from Hungary.

The chapter of Gran, at Szobb, exhibited a group of forest-products.

Oberförster Julius Grachey, of Gros-Kanizsa, made a similar display.

Pitomaca Gyurgyevics, of Bellovár, forest-products.

Geo. Hoffmann, of Weidenthal, showed beech-spunk.

Adolf Ludwig Hessheimer, of Kronstadt, and F. W. Hoffmann and Ignacz Hartl, of Essegg, exhibited various forest-products.

Christian Herrmann, stave-dealer in Vienna, showed woods from Hungary.

John Horváth, of Kronstadt, had a very interesting collection of hats and caps made of spunk.

Adolf Moritz Kanitz, of Pesth, had forest-products and gall-nuts.

Count Alois Karolyi, of Erdöd, showed building-timbers and boards.

Count Albert Keglevich, of Bodoka-Toma, had woods, boards, and shingles.

Graf Guido Karacsonyi, of Bodra in Bánlak, showed transverse sections of wood and seeds of trees.

Graf Gustav Königsegg, of Pruszkau, had a plan for forest-improvement.

C. A. Kraetschmar, of Rima-Szombat, showed galls and acorns.

George Kueres, of Zeiden, exhibited veneers.

The Agricultural Society of Bistritz showed a group of cross-sections of wood.

The Agricultural School of Debreczin presented "Studies on the Robinia," with graphical delineation, tables of production, and sections of the wood.

The Agricultural School at Keszthely exhibited articles from the forests.

Michael Loewe, of Csácza, showed pitch from the spruce-tree.

I. C. Ritter & Co., of Szlatina; L. Nenwirth & Co., of Essegg; and Leopold Ritter von Popper exhibited forest-products.

Joseph Pfeiffer, of Vienna, showed forest-products from Slavonia.

The Agricultural Society of Pressburg had a collective exhibition.

Baron Bela Piret showed products from the domain of Drós-Jenöer.

George Ratz, of Debreczin, had galls and tan-bark.

John Reitzner, of Kasehau, and M. Roth, of Kronstadt, showed yew-wood.

Franz Schnitt, of the Administration at Szokola-Hutta, Count Ervin Schönborn, of Munkács, and Nicholas Alexander Schulz, of George's Garden near Rába-Hidvég, exhibited forest-products.

Baron Simon Sina showed the products of his forests at Baan and Teplieska, and from Simongüt he had galls, deciduous and evergreen plants, and logs.

Ch. Wallfisch & Sons, at Arad, showed various woods.

Count Albert Zay, of Zay-Ugrócz, had oak-bark.

Alexander Gliederer, of Sissek, and Gilbert Pierre, of Rečica, exhibited barrel-staves.

From the parish of Dubrava an oak log was brought.

Joseph Schmidinger, of Warasdin, exhibited samples of maple and red yew, bushes of ivy, and larch-plants.

August Duke of Saxe-Coburg-Gotha made a grand exhibit of the productions of his forests at Belegvár, Csepreg, Kapsdorf, &c., in a separate and beautiful pavilion.

38. ROMANIA.—From her broad area of fifteen millions hectares, of which about eight millions are in forest, there was quite an extensive collection of woods, but they were not remarkable except as showing the kinds of forest-trees produced, as Norway spruce, silver-fir, oaks, ash, cherry, beech, birch, elms, poplar, walnut, mulberry, holm-oak, yew, dogwood, hornbeam, maple, pear, serviceberry, thorn, hazel, linden, alder, &c. These were shown in logs, boards, timbers, shingles, and also as blocks.

39. TURKEY, among 2,696 entries, had fifty or more of forest-products. Among these were very extensive collections, embracing hundreds of elegantly-prepared blocks, some of which were marked with Arabic characters, but none of them so named as to be intelligible to us. Others exhibited acorns, bark of different kinds, but especially gall-nuts, dyes and dye-stuffs, and spunk.

40. GREECE.—Theodore Orphanides, of Attica, had a collection of woods artistically and very elegantly prepared, showing the form, the bark, rough-cut wood, and polished, and also the botanical characters. The Public Nursery in Attica had an extensive illustration of forest-trees and ornamentals; specimens of ramie and other valuable plants. This was a good nursery exhibition or advertisement.

41. PERSIA.—From this ancient land, we have had such sad accounts of famines, resulting from the destruction and present scarcity of forests, notwithstanding the oft-quoted maxim of its own wise philosopher, Zoroaster, that we had not expected an exhibition. We had at Vienna, however, evidence that there are still trees in Persia in the interesting show of their products.

Despite the scarcity of trees in the table-lands, the plane-tree, which is especially trained by the people, makes a high stem, and furnishes valuable lumber. Two different species of ash and the *Prunus mahaleb* yield beautiful wood for veneers.

The trunks of the *Amygdalus orientalis* are much esteemed for their straight growth, for their strength, and for their silvery-white color.

On the lowlands of the Caspian Sea, and on the slopes of the *Elbarg* Mountains, are found beautiful oaks, especially the *Quercus castaneifolia*, the cypress, varieties of maple, the walnut, box, beech, gleditschias, and mimosas; so that Persia has a sylva of value and importance.

Numerous examples of these woods were shown by the minister of agriculture, Hassan Chou Geras, in the name of the Persian empire; of these, few had the botanical names; but the oak, walnut, maple, ailantus, alder, lemon and orange, cypress, pine, plane-tree, and others could be identified; seeds of the cypress and of the *Melia azedarach*, also acorns of the *Quercus vallonii*, which are sweet, and, when roasted, are used for making bread. The same species furnishes useful wood as well as galls and tan-bark.

42. SIAM furnished its quota by presenting specimens of teak and other woods in considerable numbers, but unknown by their native names.

43. CHINA showed a small collection of woods, but without any indications as to their names or qualities.

44. BRITISH COLONIES.—CEYLON.—From the forests of this island were specimens of cinnamon, the bark of the *Laurus cinnamomum*; also cinchona-bark by Mr. Layard, who exhibited, besides, quite a collection of tropical woods, most noted for their value in building, for cabinet-ware, and other construction; all shown with their botanic names.

45. MAURITIUS.—This gem of the Indian Ocean furnished an exceedingly rich collection of fibers and woods, mostly native. Of these, there were sixty-two kinds, presented with their botanical names, shown by Mr. J. Horne, of the Botanic Gardens; by the same exhibitor, descriptions of these woods, their qualities and uses, and the characters of the trees which produce them.

46. BRITISH INDIA.—From the rich forests of this country, which are now better managed than heretofore, we found, from Madras, woods for wagon-making, and the woods of South India; from Malabar, teak-plants set between 1844 and 1863, and woods; also woods and bark from Coimbatore, and from the Nielgherry Hills. There were forest-products from Salem, from Madura, from North Arcot, from Cuddapah, from Tinnevely, from South Arcot, from Kurnool, and from Gowalpara, in the Himalayas; also woods from the central provinces, and from Mysore, and timbers from Berar.

47. AUSTRALIA.—VICTORIA.—From Melbourne was a collection of native woods and sections of trees.

48. NEW ZEALAND furnished a large collection of native woods, sections of the trunk of the *Dammara australis*, ship-timbers, section of the *Leptospermum scoparium*, of the "yellow pine," and botanical collections.

49. From TRINIDAD, (West Indies,) there was a very rich collection of tropical woods of two hundred and twenty-two kinds, of which the English names, with the French and Spanish names, were given, as well as their botanical titles, and the natural families to which they belonged. These furnished evidence of a very rich sylva in this island, most of which are native, though several have been introduced. Shown by Mr. S. Devenish.

50. JAPAN.—The exhibition from this far-off and wonderfully interesting country was highly creditable. Among the forest-products were wood-specimens of one hundred and seventy kinds, presented with their botanical names, carefully prepared, no doubt, by the celebrated botanist Siebold, whose son, Henry, was a member of the Japanese commission at Vienna. These trees embrace many species and some genera peculiar to the eastern hemisphere, but among them were recognized many names already familiar to American ears as those of plants now cultivated by ourselves. The bambusas were shown in quantities and of great size; and, though rather grasses than trees, they perform the office of the latter in construction, as was illustrated by the pavilions and other structures and fences in the park and garden, as well as by the furniture and apparatus shown within the palace, by these interesting and industrious people. There were also large collections of plant-products in different kinds, of dye-stuffs and tanning-material, consisting of galls and bark, charcoal from different trees, and the ashes from certain species that are employed in the glazing of porcelain.

In the garden, in the park, there was a large collection of plants, among which, besides those with beautiful flowers, there were many young trees peculiar to the country; among these, the *Quercus glauca*, for feeding silk-worms, and the *Acer palmatum*, with variously-colored foliage, were remarkable.

CHAPTER II.

SPECIAL EXHIBITS AT VIENNA.

THE SCHWARZENBERG PAVILION; ITS LOCATION AND THAT OF THE ESTATES; CHARACTER, EXTENT, AND STATISTICS OF THE EXHIBIT; THE SAXE-COBURG-GOTHA PAVILION; THE LOCATION AND CHARACTER OF EXHIBIT AND STATISTICS; FOREST-CULTURE; FACNA; ORES; THE EXHIBIT OF THE AUSTRIAN STATE-RAILROADS; EXTENT AND CHARACTER OF EXHIBIT; FOREST-INDUSTRY.

51. THE SCHWARZENBERG PAVILION.—This was truly one of the gems of the exhibition on account of the architectural beauty of the building, its tasteful arrangement, both internally and externally, as well as for the varied character and richness of the exhibition of the products of the estates of the proprietors.

This pavilion was happily situated in the north zone, but a little eastward from the great dome, fronting upon the common thoroughfare on that side of the Industrial Palace, so that it was brought prominently before the passing throng, who could not avoid being attracted by the extensive and well-filled parterres through which it was approached.

These enterprising princes—father and son, John Adolf and Adolf Joseph Schwarzenberg—have possessions in Bavaria, in Styria, in Salzburg, in Upper and in Lower Austria, and also in Bohemia; the latter being the most extensive, occupying more than 387,000 acres. In Styria, they have 43,000 acres; in Bavaria, more than 6,000; in other places, 220 acres.

These diverse and widely-separated possessions embrace a great variety of climate, soil, surface, and geological formation; hence the diversity of products here exhibited, which are derived from the forests, quarries, and mines, and their manufactures, as well as from the rich fields of agriculture and horticulture, and also from their fisheries.

52. Confining myself to the notice of forest-products alone, these were found to be very extensive.

The doorway of the pavilion was ornamented with sections of great trees, and on entering the hall the visitor was delighted with the wild woodland and rock scenery, in which the native animals and birds of the forests were exhibited in their natural postures, showing the skill of the taxidermist.

The left transept contained the agricultural products in great variety, while turning to the right one found the products of the mines and forests.

Here were all sorts of finely-prepared woods; veneers for parquetry and other purposes, for bindery, &c.; round splinters for matches; resonance-boards for pianos and other musical instruments; specimens of parquetry-work with differently-colored woods, such as white pine

and larch; wooden shoes; wooden shovels and various other implements; finally, Faber's celebrated lead-pencils, made from their own famous graphite and cased in red-cedar wood grown in the country and declared to be better than that imported from America for the same purpose. Unfortunately, however, little or none of this valuable wood has ever been grown in European forests.

Tree-seeds.—These were exhibited in great variety, in buckets that were made of the very wood from which the seeds had been gathered: *Acer pseudo-platanus*, *Acer platanoides*, *Æsculus hippocastanum*, *Alnus glutinosa* and *incana*, *Betula alba*, *Carpinus betuls*, *Fagus sylvatica*, *Fraxinus excelsior*, *Quercus sessiliflora*, *Robinia pseudo-acacia*, *Spartium scoparium*, *Tilia grandifolia* and *parvifolia*, *Ulmus campestris*, *Quercus cerris*, *Abies pectinata* and *excelsa*, *Pinus sylvestris*, *uliginosa*, and *cembra*, *Larix europæa*.

Wagon-maker's lumber of every kind was exhibited, and cooper's stuff; also, the withes used in securing logs together in the rafts; secondary products, such as tan-bark from the spruce and oak, natural and pressed for transportation; turpentine, in flasks; tar; charcoal; and bast, from linden.

There were forest-models of means of transport, of rafts on the Elbe, of log-roads in the Boehmer-Wald, &c.

Tables represented the various subdivisions (*Reviere*) of the forests, with their different kinds of trees, ages, and management; and charts of the domains of Krumman, Wittingau, Winterberg, Steubenbach, Frauenberg, Protiwin, Liebiejitz, Netolitz, Labositz, and other forest-regions were hung on the walls, with photographs of various interesting points, such as the sawmills and workshops, parts of the famous *Urwald*, which has not been invaded by the ax for centuries, and of the terrible windfall that desolated part of the forests with the furious storm of October 26-27, 1870.

Herbariums of forest-plants from different domains, and collections of insects, and of the results of their injuries, were extensive and interesting objects of study.

The zoological collection of the wild animals and birds embraced more than a hundred specimens; and there were prepared fish from the numerous *Oeiche* and lakes of these estates, besides having specimens in the ponds outside, where also were living beavers.

Outside and in the rear of the pavilion was quite a lumber-yard of forest-material, some of which must be mentioned in this report, beginning with the logs of trees.

53.—TABULAR STATEMENT OF NAMES AND CONDITIONS OF EXHIBITS.

Name.	Age.	Diameter.	Height.	Contents.	Baum.	Elevation.	Remarks.
	Years.	In.	Ft.	Cu. ft.	Formzahl.	Ft.	Soil, &c.
Spruce.....	225	34	144	420	.48	1,350	With fir and beech on gneiss, in gravelly humose loam, easterly slope.
Silver-fir.....	180	24	132	250	.60	1,400	Do.
Oak, (<i>Q. sessiliflora</i>)	195	27	96	224	.58	1,300	Gneiss, stony, humose loam; southerly; with spruce, Scotch pine, linden, &c.
Winter-linden	180	30	90	240	.54	1,300	Do.
Birch	75	20	78	104	.61	1,450	As above, with linden, aspen, some beech and oak, very thick bark.
Beech.....	120	18	66	93	.56	1,350	Northern slope; soil as above; beech-woods, with some spruce and fir.
Scotch pine	215	24	96	156	.50	1,400	Loamy sand, Tertiary formation.
Oak, (<i>Q. pedunculata</i> .)	230	21	84	105	.52	1,340	Loamy sand, Tertiary, with fir, spruce, and some ash.
Scotch pine	230	29	108	234	.47	1,350	Loamy sand, with fir, spruce, and some ash.
Moor-pine, (<i>P. montana</i> .)	215	10	39	10	.47	1,300	Turfy soil.
Do.....	140	13	55	23	.45	1,300	Turfy soil, with <i>Carpinus</i> .
Alder.....	80	12	54	17	.40	1,300	Turfy soil, alone.
Black poplar.....	62	42	60	294	.51	.....	Low, wet land; in park at Wittingau.
Spruce.....	340	18	36	39	.51	3,250	Frosty place.
Do.....	320	11	36	11	.46	3,250	Frosty, on gneiss.
Do.....	580	26	66	90	.37	3,350	Gneiss, stony loam, northwesterly slope, fir-wood, <i>Urwald</i> .
Do.....	245	40	108	260	.27	4,030	Granite, stony, humose loam, westerly slope, fir-wood.
Do.....	530-550	17½	.....	.....	.....	3,500	Gneiss, large stones, easterly and northeasterly slope; sheltered from storms; sandy loam, rich in humus of centuries; spruce, fir, some beech, occasionally a maple.
Do.....	350	60	150	1125 (.65-.35*)	.38	2,300	This and the next seven are from the famous <i>Urwald</i> of the Schat-tawa Revier.
Do.....	300	48	126	687 (.59-.41)	.43	3,000	
Fir	350	52	132	935 (.72-.28)	.48	2,800	
Do.....	320	54	120	693 (.72-.28)	.36	3,500	
Beech.....	360	36	78	373 (.73-.27)	.68	2,600	
Do.....	280	39	108	385 (.72-.28)	.43	2,900	
Maple.....	330	25	66	119 (.72-.28)	.53	300	
Do.....	250	92	54	92 (.52-.48)	.64	3,500	
Spruce.....	115	12	39	7	.24	4,290	This and the four following are from the <i>Kelm-Revier</i> , Winterberg, the north slope of Klebani Mountain, 4,296 feet high, on gneiss, sandy loam, with much feldspar,* clear spruce-forest, unmixed.
Do.....	120	12	65	28	.43 .54-.18†	3,880	
Fir	140	12	83	30	.46 .60-.21	3,460	
Do.....	130	19	131	112	.47 .93-.86	2,920	
Do.....	130	21	127	131	.43 .97-1.00	2,920	

* These figures in parentheses () signify the proportion of timber, (*Nutzholz*), shown by the first figures, to that of mere fire-wood, shown by the last figures.

† The first of these numbers represents the *Höhenzuwachs*, and the second the *Massenzuwachs*.

Tabular statement of names and condition of exhibits—Continued.

Name.	Age.	Diameter.	Height.	Contents.	Baum.	Elevation.	Remarks.
	Years.	In.	Ft.	Cu. ft.	Formzahl.	Ft.	Soil, &c.
Maple	450	31	84	337 (.85-.15*)	.76	3,000	Easterly slope, with fir, spruce, and beech, in the <i>Urwald</i> of Krummian, Revier Schwarzwald. Next ten from same district-domaine.
Spruce	110	13	105	50	.50 .92-.46	2,350	Granite, coarse sand, humose loam, much feldspar, with some fir and beech. This and the five next are from the easterly slope of the Ploekenstein, which is 4,351 feet high, the highest point of Balnewald, granite; soil, coarse, sandy loam, with abundant feldspar; forest is spruce, with some beech and fir, the first reproduction of the <i>Urwald</i> .
Do.	100	12	63	31	.62 .63-.31	2,560	
Do.	107	12	48	14	.37 .45-.13	3,350	
Do.	297	12	42	13	.40	4,300	
Beech	215	12	87			2,450	
Silver-fir	60	21	48	17	.45	3,410	
Spruce	90	21	162	101	.41 1.13-1.12	2,840	This and the two next are specimens of the relative growth of spruce, fir, and beech in the mixed forest of the Plankerswald, a spur of the Balnewald, of which the highest point is 3,416 feet; granite.
Fir	100	17	84	50	.38 .84-.50	.....	
Beech	110	12	78	23	.44 .71-.21	.....	
Spruce	70	12	51	18	.44 .73-.25	3,400	This and the next are from clear spruce forest, on the northeasterly slope of Plankerswald.
Do.	65	12	75	27	.46 1.17-.41	2,800	
Do.	100	13½	60	50	.63 .60-.50	1,520	Chalk formation, clear spruce forest, with the next six, come from district Domanschitz, in Northern Bohemia, from Reviers Domanschitz and Rotsehow.
Larch	75	16½	72	66	.61 .96-.88	1,520	Chalk formation, Pläner kalk, clear larch forest.
Locust	30	12	31	15	.....	1,300	<i>Rothliegendes</i> , exposure northwest a wide-row plantation.
Walnut, (<i>Juglans nigra</i>)	30	11	12	15	.....	650	Alhuvium, avenuetree, (<i>Alleebaum</i> .)
Ash	75	30	33	146	.....	700	Dihuvium, in a bowl-shaped sink-hole.
Spruce	75	21	97	112	.48 1.23-1.49c	1,100	Clear spruce forest at the foot of a western slope, <i>rothliegendes</i> , strong, loamy soil.
Larch	70	21	73	96	.48 1.04-1.22c	.....	<i>Rothliegendes</i> , strong loam, at base of western slope.
Field-elm	90	38	69	193	.....	.....	Northwestern slope, on basalt, a shade left in undergrowth of oak-forest.
Service-tree, (<i>Sorbus terminatis</i> .)	140	22	29	66	.....	.....	Do.

* These figures in parentheses () signify the proportion of timber, (*Nutzholtz*.) shown by the first figures, to that of mere fire-wood, shown by the last figures.

Tabular statement of names and condition of exhibits—Continued.

Name.	Age.	Diameter	Height.	Contents.	Baum.	Elevation.	Remarks.
	Years.	In.	Ft.	Cu. ft.	Formzahl.	Ft.	Soil, &c.
Oak, (<i>Quercus cerris</i>)	195	40	77	293	.44	1,000	Gentle easterly slope, in loamy, coarse-grained sand, Vienna sandstone, grew in a sheltered forest of beech and hornbeam, of one hundred and sixty years' growth.
Larch.....	125	36	101	226	.31	2,400	Diluvium of the Mur River, on a northern slope.
Do.....	125	28	114	166	.34	4,800	Mica-schist, steep northern slope.
Do.....	180	42	95	300	.33	5,200	Mica-schist, steep southwest slope.
Stone-pine.....	300	21	84	90	.44	5,200	On a steep southern slope, protected by a thick plantation.
Do.....	165	26	49	94	.52	5,600	(<i>Kohlenschiefer</i> .) north-westerly gentle slope.

The next are curiosities and abnormal forms.

Name.	Age.	Diameter.	Height.	Contents.	Baum.	Elevation.	Remarks.
	Years.	In.	Ft.	Cu. ft.	Formzahl.	Ft.	
Moor-pine.....	130	7	24	35.	.....	1,200	From the turfy lands of Wittingau.
Do.....	105	2½	16	0.4	.....	1,200	
Firs.....	110	8	24	3.	.....	3,350	From the higher parts of Balmurwald, very frosty place.
Firs, b.....	150	7	18	1.6	.....	3,350	Do.
Firs, c.....	260-280	6	15	1.3	.....	3,000	On high moor.
Firs, d.....	100-110	3½	9	.....	.....	.....	
Firs, e.....	220	7	18	2.5	.....	3,200	
Firs, f.....	185	5½	.....	.....	.....	4,350	From the Plockenstein.
Mountain-pine, 6 sticks, (<i>P. montana</i> .)	70-150	3-5	.....	.....	.....	3,250	{ From Stubenbach.
Mountain-pine....	130-140	5½	.....	.....	.....	3,550	
						4,300	From the high moors of Domain Stubenbach, between the great rocks on the Suzen Mountain.
Mountain-pine, c...	165	8	.....	.....	.....	3,350	From the Stone Lake of Plockenstein, in Domain Krummhu.
Mountain-pine, d..	120	3½-3¾	.....	.....	.....	6,000	Grew on the mica-schist of the Alps of Domain Murau.
Alpen erle, (mountain-alder.)	70-90	3-4½	.....	.....	.....	6,000	Do.
Juniper.....	95	8	.....	.....	.....	.....	At Frauenberg in Bohemia.

Abnormal and injured or diseased.—Curious and misshapen roots: An enlargement on the stem of a spruce; a union of a maple ninety years old, 11½ inches in diameter, with a beech of eighty years, 8 inches in diameter.

54. Sawed, hewed, and split lumber of fine quality was shown; lumber for farming and for ship-building; of the latter, some timbers were from 40 to 60 feet long, 10 by 10 inches, and 12 by 14 inches square;

and there were spruce boards, from 111 to 126 feet long and 23 inches wide.

The split boards were most remarkable for their perfection and for their great length, being from 15 to 18 feet long, 10 to 14 inches wide, and from half an inch to two inches in thickness, as regular and even as though sawed. These were from spruce, fir, and larch. Those from oak and beech were thicker.

55. I cannot leave this most interesting place without referring to the very rich collection of living plants in the parterres in front of the pavilion. Passing by the representations of all the grain, forage, and other plants of agriculture, and the flowering representations of the horticulture of these estates, let us take a glance at the orchard and forest representatives here present :

Young plants of fir, from the seedlings, produced upon the ground, to those of one, two, and three years, once transplanted; yearling Scotch pines; of firs, seedlings of plants of from one to three years; of larch, seedlings and two-year old stone-pine plants of one and two years.

Oaks; an exceedingly rich collection of species and varieties.

Quercus pedunculata.—Seedlings and nursery-grown, two years and up to eight years old.

Quercus sessiliflora.—Seedlings and nursery-plants to five years old.

Quercus cerris.—Seedlings to four years.

Quercus pedunculata-pyramidalis.—Four years and from four to eight years.

Quercus pannonica.—*Tri-color maculata*. (?)

Quercus fenessi and *macranthera*.—From six to ten years.

AMERICAN SPECIES OF OAKS.

Quercus rubra.—From two to four years and seedlings.

Quercus macrocarpa.—From four to ten years old.

Quercus coccinea.—Four years old.

Quercus alba.—A rare species in Europe.

Quercus "castanea".—This, I think, is *discolor*.

Quercus palustris and *Quercus nigra*.

Our oaks are highly prized in Germany for park-planting; but, unfortunately, great confusion exists in the naming among some of the propagators.

Fraxinus excelsior.—Seedlings and nursery-plants of three and four years.

Fagus sylvatica.—Seedlings and plants from four to eight years.

Carpinus betula.—Seedling and plants from three to four years old.

Ulmus campestris.—Five years old.

Acer pseudo-platanus.—Seedlings four to six years.

Acer platanoides.—The same.

Tilia grandifolia.—In seed-bed, and from three to eight years old.

Alnus glutinosa.—In seed-bed, and four year old plants.

Also plants, forest-seedlings from the *Urwald* or original native ancient forests of Bohemia, attached to the decaying logs, to illustrate the natural reproduction of these forests.

Altogether the spaces allotted to these young forest-trees were admirably arranged in their grouping, so as to be not only beautifully attractive to all who passed by, but peculiarly instructive to those who could appreciate their importance to the great study of forestry.

I cannot leave without referring to parterres devoted to fruit-trees in pots, dwarfs, espaliers, cordons, and high stems. These were shown in quantity, beautifully arranged in groups that displayed the ripening fruits during the season. Of these, there were more than two hundred apple-trees, about one hundred pear-trees, chiefly dwarfs, and bearing, plums, cherries, peaches, apricots, and other fruits and nuts.

56. To those who enjoyed the privilege of studying this exceedingly rich and practically interesting collection, no apology will be needed for occupying so large a space in this report with the foregoing sketch of the collective wealth of the estates of these eminently representative men.

Fortunate the government that has its territory owned and occupied by such practical and useful princes, who direct their energies to the utmost development of all the resources of their land.

I have dwelt the more willingly upon these forest-products, here so richly displayed, not merely because of their unquestioned merit, but also because of a sort of personal interest in them, fostered by a careful examination of extensive portions of the estates in Southern Bohemia, where, during a week's excursion, I was enabled, by the exceeding kindness of the proprietors and their officers, to see the arrangement and practical workings of some of the best forest-management of the country, the details of which may become very useful in our own land if properly appreciated and applied.

57. PAVILION OF PRINCE SAXE-COBURG-GOTHA.—Immediately to the north of the Schwarzenberg pavilion was another very pretty structure, containing the collective exhibition of agricultural, forestal, and mountain industries from the estates of Prince August of Saxe-Coburg-Gotha, which lie in Austria and Hungary.

Passing the extensive collection of agricultural products, we come to those of the forests, both natural and prepared.

Here was a very extensive collection of wooden blocks, in book-form, embracing almost every kind. There were two hundred and fifty-four of these pieces, many of which of course were duplicates; but they included all the species cultivated, and were a most interesting study.

Next was a very large group of the same species in cross-sections of the stems, amounting to more than three hundred pieces, a few of which will be mentioned. Some of them are of good size relatively to their ages and species, and some are cited to show how small was their growth compared to the same kinds in our own land.

58. In this collection also will be noted the occurrence of some trees not usually found in the forests of Europe.

The diameter, age, and character of soil were given, and, in some cases, the elevation above the sea-level.

	Diameter, inches.	Age, years.	Elevation, feet.	Soil, &c.
Silver-fir.....	47	330	.....	Clay.
Do.....	2	114	3,090	Chalk.
Norway spruce.....	21	190	.....	Do.
Do.....	34	90	.....	Do.
Norway maple.....	23	185	.....	Do.
Beech.....	31	230	.....	Do.
Do.....	6	65	.....	Chalk soil.
Birch.....	22	100	2,000	Clay.
Do.....	16	125	.....	Do.
Do.....	23	190	.....	Sand.
Larch.....	27½	130	.....	Clay.
Do.....	12	134	2,600	Do.
Do.....	6	120	.....	Chalk.
Scotch pine.....	28	100	3,000	Clay.
Do.....	3	24	.....	Loam.
Do.....	15½	115	2,370	Chalk.
Oak, (<i>Q. robur</i>).....	23½	140	.....	Clay.
Do.....	37	106	.....	Loam.
Oak, (<i>Q. pedunculata</i>).....	35	230	.....	Clay.
Oak, (<i>Q. cerris</i>).....	15	153	.....	Loam.
Do.....	7	60	.....	Do.
Ash.....	12	50	.....	Do.
Elm.....	18	100	.....	Chalk loam.
Hornbeam.....	15	60	.....	Do.
Do.....	4½	36	.....	Loam.
Black poplar.....	63	300	.....	Sand.
Do.....	18	33	.....	Loam.
Lombardy poplar.....	46	200	.....	Sand.
Aspen-poplar.....	44	200	.....	Do.
White willow.....	18	80	.....	Do.
Black willow.....	11½	31	.....	Do.
Apple.....	9	67	.....	Sandy loam.
Pear.....	11	36	.....	Do.
Field-elm.....	17	100	.....	Do.
Do.....	8	74	.....	Do.
Plum.....	10	60	.....	Do.
Field-maple.....	9	86	.....	Do.
Hazel-nut.....	4	34	.....	Do.
Yew.....	5	80	2,800	Chalk.
Do.....	3½	118	2,800	Do.
Do.....	6	46	2,800	Do.
Do.....	1½	85	2,800	Do.
Thorn.....	6	46	.....	Sandy loam.
Black locust.....	23	27	.....	Sand.
Do.....	2	28	.....	Loam.
Do.....	1	1	.....	Sand.
Do.....	2	2	.....	Do.
Ailanthus.....	13	24	.....	Do.
Pine, (<i>Pinus pumilio</i>).....	6	85	4,900	Clay.
Juniper.....	5	60	2,600	Do.
Do.....	3	60	.....	Do.

Various abnormal and diseased growths were also present, some of which were very curious and interesting.

Numerous charts, plans, and photographs illustrated the different forest-reviers, and the tables of statistics showed their annual expenses and production.

59. Forest-products and apparatus, specimens of charcoal made from different kinds of wood, and from the same woods of different ages, made a group for study. The coaling-apparatus used, coal-wagons, &c., were also exhibited, and wagons for the transport of logs and wood. A raft, composed of eleven spruce logs, 10 klaffer long, (60 feet,) with

its appurtenances, oars, levers, pulleys, &c., was shown. This was loaded with all sorts of prepared lumber, shingles, &c., ready for transport; among the products, locust posts were observed.

There were railroad-sleepers, some of which were of larch. Their size was from 6 by 9 inches to 6 by 12. Those 8 by 11 to 8 by 14 inches were called extra. Also wagon-lumber of oak, beech, and hornbeam; and wagon-wheels made from a combination of elm, locust, and ailantus. The latter is used for the felloes, while the spokes were of locust and the hubs of elm. Ox-yokes and tool-handles also were made from the ailantus.

There were various implements made of wood, such as shovels for different purposes, meal-troughs, bread-bowls, &c.

Very pretty rustic tables and seats were made from birch and hazel, and especially noteworthy was a garden-table, the top of which was a section of poplar 42 inches in diameter. The feet, of crooked spruce stems, were of alpine growth.

60. Forest-culture was illustrated by various seeds and seedling-plants; acorns of the different species, and seeds of other forest-trees. Living plants of spruce, fir, pine, larch, and others, deciduous species, such as maples, oaks, and black locusts from two to six years old, were growing in the soil.

The wild animals belonging to the forests were represented by more than one hundred specimens elegantly set up.

Then came a large collection of the iron-ores of the estates, and the iron-production in various stages up to the finest iron and steel.

Altogether, this pavilion was a very attractive place.

61. EXHIBIT OF THE AUSTRIAN STATE-RAILROADS.—In the north zone was a pretty pavilion erected by the Austrian State Railroad Company, in which were displayed not only the machinery and apparatus connected with their great organization, but also the products of the mines, lands, and forests of their extensive and widely-scattered possessions.

It is with the latter that we have now to concern ourselves, leaving the rest of this very interesting display to the care of the appropriate reporter.

62. From the forests of Banat in Southern Hungary, near the line of Turkey, on the Theiss and Danube Rivers, was a collection of sections of logs of useful trees.

A collection of similar woods was exhibited in three-sided prisms.

Young trees for forest planting were also shown, among which were oaks, larch, beech, firs, spruce, pines, (including our white pine,) and the *Pinus cembra*, or stone-pine, with other plants of forest-culture.

An herbarium of various forest-growths, and a collection of forest-seeds, embracing 92 species.

Among the secondary products of forest-industry were timbers, cross-ties, of course, with various other forest-wares, rustic furniture, &c.,

besides pieces of wood in cubes and other forms, with corresponding specimens of the charcoal, so important in their steel-works.

There were models of the water-ways for transporting wood to the collieries, and for floating the hewed timbers from the mountains.

Statistical tables of the products, of the annual yield, and of the growth or increase of the forests, as well as of the production of wood and coal, produced by them, were presented, with maps of the company's domains and forests.

When will our great railway-companies become creators and conservators as well as consumers and destroyers of the forests ?

CHAPTER III.

FOREST-AREAS OF EUROPE.

GREAT BRITAIN: AREA OF BRITISH FORESTS, AND THEIR MANAGEMENT: EXTENT OF FOREST IN OTHER EUROPEAN COUNTRIES; GERMAN AND AUSTRIAN ADMINISTRATION AND METHODS OF INSTRUCTION IN FORESTRY; COLONIAL FORESTRY.

63. GREAT BRITAIN.—Great Britain is not so famous for her woodlands as the continental countries of Europe; and, although many of her historical forests are of a very inferior character so far as their quality and productiveness are concerned, there has been a great improvement in this respect, and many private plantations, as well as some that are managed by the state, have been conducted upon more scientific principles within the present century, and have been made very profitable. Captain Walker gives an aggregate of the royal woodlands of England at 58,606 acres, covered with productive forests, in an area of 169,306 acres. To much of this latter the title is mixed, and it is often hampered by servitudes to such an extent that it is unworthy the name of forest. In Scotland, the properties of the Earls of Seafield and Mansfield and of the famous Duke of Athole amount to 60,000 acres of veritable forest-lands, in which the Scotch pine and the European larch are largely grown.*

These figures, in a total of 118,606 acres, do not include the many smaller plantations of numerous private individuals.

From my own observations in the so-called Epping forest, there was very little to be seen that deserved the name in comparison with the well-managed and cultivated forests of Germany. There were trees old and young; some are very ancient. There were numerous coppices, some of which were looking well, but the mass was simply an extent of neglected commons, with patches of woods badly managed, and with frequent openings of cultivated lands, and other wide spaces that are partially covered with useless bushes. These furnish a meager pasture, and provide a favorite resort for wandering gypsies.

64. The first feeling was one of surprise and regret that so much land should be lying idle and unproductive near the great metropolis of the world, where many thousands of its inhabitants were suffering for the need of supplies, which might be furnished by this land if it were properly cultivated.

The traveler recently from the Continent cannot avoid contrasting

* Forest Management; By Capt. Campbell Walker, F. R. G. S., Deputy Conservator Forests, Madras. Parliamentary report, London, 1873.

the well-managed forests he has left behind him with these unproductive woods, and estimating the favorable results that would follow a judicious planting and cultivation of these tracts. Upon inquiry, however, he will find that nearly all the forests of England were originally hunting-parks, and a little investigation will show him that this was the original meaning of the term *forest* in our language. The antiquity of the tenure of some of these tracts is so great that it is lost in oblivion. Even in the time of the Saxons, a great part of the crown-lands were devoted to animals of the chase, and were kept for the amusement of the king, and from which all other persons were excluded. William the Conqueror is said to have had 68 forests, 13 chases, and 781 parks; the latter only were inclosed. In those days, the forest was a preserve for game, not a place for the production of timber. The forest-laws were very oppressive, and, at the time of the issuing of Magna Charta, King John found it necessary to make other concessions to the demands of the people, and, with certain reservations of favorite forests, "he gave up all others in quiet to the churches and the kingdom." In Magna Charta itself it was granted that all the lands which had been afforested (devoted to the chase) in his time, should be disafforested, or restored to cultivation and occupancy by the people.

Even now it seems a source of trouble to the citizens, who are very jealous of any trespassing by inclosures of the smallest portions of this public property, and questions are constantly arising where the occupants of ancient leaseholds are required to give up their possessions by their jealous countrymen.

As already observed, however, a great change has been effected in the forest character of these demesnes within the present century, and extensive plantations have been made in the endeavor to improve the productiveness of these lands. This is very manifest in the woods attached to the great park at Windsor, which is not only a very beautiful estate, but contains some admirably-managed woods.

Here one may see both systems; the park with its numerous deer pasturing among the venerable oaks of centuries' growth, which are "stag-headed" and gnarled enough to please the painter and the lover of the picturesque, is contrasted with younger plantations of the same species that have been reared under the most judicious management.

Here, too, you may see groups of various kinds of trees from many lands, that have received proper care; among these the groves of tall chestnuts are remarkably fine, and the American oaks are growing beside the cedars of Atlas, of the Himalayas and Lebanon, while the firs of Asia and America equally assert their claims to admiration.

The undergrowth, too, is beautiful and abundant; acres of rhododendrons and laurels furnish a perennial green, contrasting in winter with the russet of the brackens, and with them providing a perfect cover for the pheasants.

The following are the leading forests of England: Windsor forest

and Waltham forest in Essex; the forest of Dean in Gloucester; in Hampshire are New forest, Woolmer, and Aliceholt; in Northamptonshire, the Rockingham, Whittlewood, and Saleey forests; in Nottinghamshire is the Sherwood forest; and in Oxfordshire is Whichwood.

England does not appear by any means a treeless land. Excepting upon the downs, the traveler will find plenty of trees, which contribute in no small degree to set off the beauties of the landscape; these are often in the helgerows, in clumps, in coppices, and in small woods.

65. HOLLAND AND THE NETHERLANDS.—Holland has her forests. Notwithstanding the advanced state of her agriculture, she produces some wood and timber. The trees consist chiefly of beech, fir, poplar, and ash in woods and coppices; willows and poplars are grown along the canals. In the coppices, there are also maples, hornbeam, birch, and oaks. In Guilderland, there are extensive forests of firs and American white pines, and hundreds of acres have been planted with acorns. At Rhenen and at Arnhem are thick woods, and plantations have been made on the Upper Yssel. The proportion of woodland could not be ascertained, but it cannot be large.

BELGIUM.—In 1866, this country had 1,074,393 acres of forest in her territory of 6,796,800 acres, or less than one-sixth of the whole in woodland.

66. FRANCE.—France has many fine forests, and is favorably situated for the production of a variety of useful trees. The woods are distributed over the country. Most of the provinces have considerable tracts of woodland; some have from one to two hundred thousand acres each; a few have from two to three hundred thousand, and some as much as from four to six hundred thousand, while the department of Dordogne alone has more than a million acres. There is a total of 21,983,000 acres of forest in her territorial area of 133,380,000 acres, being rather less than 17 per cent., or say one-sixth, wooded. This estimate has been put as low as one-seventh of the total area.

67. SWITZERLAND.—Switzerland, according to Püschel,* has 1,513,492 acres, being more than one-sixth of the whole area, much of which is bare mountain-tops.

68. SWEDEN and NORWAY together have a large area of forests. South of latitude 64°, one-fourth of the surface is covered by woods. Sweden has 17,568,000 hectares† of forest-surface, from which is derived annually $\frac{1}{2}$ 1,150,000,000 cubic feet of timber, 890,000,000 cubic feet of which is burned chiefly as charcoal. The lumber is largely shipped to England, France, and Belgium. Norway has 13,000,000 hectares in wood, from which she draws timber for sale to the value of \$8,000,000 annually. The author of the descriptive catalogue already referred to sug-

* *Forst-Encyclopoedie von Al. Püschel, Leipsic, 1830.*

†A hectare is equal to 2.47 acres.

‡*Schweden Statistiske*, von Dott. Elis Sidenbladth Stockholm, 1873.

gests the division of Norway and Sweden into three zones, according to the character of their flora, as follows :

First zone.—The region of the beech and the hornbeam. This is Southern Sweden, and extends from the most southerly part, in latitude $55^{\circ}.20$, to $57^{\circ}.5$, on the eastern, and to the fifty-ninth parallel on the western coast. In this region, wheat and other grains grow well, as do all the fruits that succeed in England; with some care, such tender plants as the *Aucuba japonica*, *Broussonetia papyrifera*, *Bignonia radicans*, *Catalpa syringifolia*, *Hibiscus syriacus*, *Paulownia imperialis*, and others. The *Robinia pseudo-acacia* thrives as well here as in Southern Europe. The *Castanea vesca* is to be found one hundred and fifty years old; the box between two hundred and three hundred years, and with a diameter of 8 inches. Many conifers, such as *Thuja plicata* and *occidentalis*, *Salisburia*, Irish yew, and Lawson's cypress, grow finely. The liriiodendron is to be seen 30 feet high and bearing its blossoms, and in one place is the *Magnolia acuminata*, 40 feet high and 1 foot in diameter. At Göteborg, on the west coast, the climate is milder. *Amygdalus communis*, *Azalia spinosa*, *Wistaria sinensis*, *Hydrangea hortensis*, *Ilex aquifolium*, *Chamaecyparis*, *Cephalotaxus*; the pines from the western coast of North America, such as *Douglasii*, *grandis*, *Menziesii*, &c., and even the *Sequoia gigantea* of California thrive well. The natural sylvia is characterized by the *Sorbus aria*, *Acer campestre*, *Euonymus europæus*, *Cornus sanguinea*, &c.

Second zone.—The region of the oak extends northward to latitude $62^{\circ}.20$ on the east coast. Rye, barley, and oats are the leading grains produced. Fruits are grown; the apple does well. In favorable summers, the walnut ripens, and even grapes, especially the American sorts, and apricots. In the region about Stockholm, among others, the following trees succeed well: *Acer negundo*, *Æsculus macrostachya*, *Ailanthus glandulosa*, *Castanea vesca* as a bush 8 to 10 feet, *Crataegus pyracantha*, *Cupressus lawsoniana*, *Cydonia japonica*, *Liriodendron tulipifera* as a bush 6 feet, *Mespilus germanica*, (fruits annually,) *Abies canadensis*, *Abies orientalis*, *Picea ephalonica*, *Cilicium nordmaniana*, *Quercus coccinea*, *Rhododendron catawbiense* and *dakuricum*, *Ribes*, *Spiræus*, *Wiegelia*, &c. The native growths consist of *Fraxinus excelsior*, *Acer platanoides*, *Ulmus montana*, *Tilia europæa*, *Alnus glutinosa*, &c.

Third zone.—The region of the *Alnus incana*, the conifers, and birch, occupies Norsland to the bounds of the Swedish mountains in Lapland. Barley is the chief grain, but rye is sown, and sometimes wheat also. Flax and hops are produced even in high latitudes. Red and black currants and other kinds of berries are native. The season of growth is very short, being from two to three months at most. The snow is deep and the winters severe. The ash is often killed. The sylvia of this region consists of low-growing plants that may be covered by the snow, and only the most hardy trees, among which the following stand unprotected: *Picea balsamea*, *Pinus austriaca*, *P. cembra*, *P. mughus*, *Populus balsamifera*, *P. laurifolia*, *P. candicans*, *Pyrus baccata* and *pruni-*

folia, *Thuja occidentalis*, *Sorbus aria*, &c. Besides the native conifers and the birch, there are the *Alnus incana*, *Prunus padus*, *Sorbus aucuparia*, *Populus tremula*, and willows, from all which a pretty good native forest is made up. These particulars have appeared so interesting as to justify their introduction into this report, as showing how in this northern region there appears a mixture of the arctic sylvia with that of South-eastern Europe, a mingling of the Caucasian flora with that of the extreme north. It might be an interesting query, How much of this is owing to the influence of the great ocean-stream flowing from the coasts of tropical America?

69. RUSSIA.—Russia has very extensive forests, especially in her northern provinces. They amount to nearly 500,000,000 acres, or more than one-third of the whole territory of that empire; but much of this is said to be in a comparatively unproductive condition.

Russia has more forests than other European countries. Birch abounds to the fifty-fifth parallel; pine and firs are found in great extent farther north. In the government of Perm, there are 47,000,000 acres of forest in an area of 50,000,000 acres. Conifers extend to latitude 57°; birch, aspen, and linden reach to 54° and 55°; oak succeeds at 51° to 52° on the plateau, but is best in the valley of the Volga at 55°.

Finland has extensive forests of firs and pine in the southern portion, interspersed with oaks, elms, &c. In Northern Lapland, these are replaced by the birch until trees cease altogether in the coldest districts. The mountains are generally bare or covered with low growth.

The wild crab is found to the sixtieth degree; the oak, to the sixty-first; the ash, to the sixty-second.

Finland has a special forest account or bureau for the management of the state-woods, the extent of which is 29,681,088 tonnes, or 36,210,927 acres. This is divided into 52 reviers and 565 districts. The districts are managed by forest-masters; the reviers, by over-forest-masters, all under the control of an upper director.

A forest-institute for theoretical and practical training is to be found at Ewois.

“According to recent statistics,* the extent of the forests of Russia in Europe is about 442,897,500 acres, or 40 per cent. of the whole area. The forests are very unequally distributed, and internal communication is still very imperfect in many parts of the empire; hence much of this wealth is at present unavailable. Every year, however, the facilities for transport are increased, and there is a corresponding augmentation in the amount realized. Nearly 65 per cent. of the forest-land is situated in the four governments of the North Archangel, Vologda, Olonetz, and Perm; this equals sixty-five acres to each inhabitant. The governments of the south are relatively poor in timber, and in some parts almost treeless; but since 1842 the forest-administration has been engaged in remedying this defect by planting largely. Between 1866 and 1870

* “Notice sur les forêts et leurs produits,” etc., par P. N. Werckha, quoted in “Nature.”

upward of 20,000 acres were planted, exclusive of the action of private owners.

"The value of the forest-products exported in 1871 amounted to 16,026,553 rubles, of which more than one-third came to this country, (England.) But the internal consumption gives a better idea of the immense wealth of these forests. It is only possible to give an approximate estimate of the value, which Mr. Werekha states must be at the very least 265,450,000 rubles per annum.

"The most destructive industry, so far as the forests are concerned, is the manufacture of bast mats, bark shoes, (*lapti*,) cordage, and other articles prepared from the liber or inner bark of the lime, birch, and willow, chiefly of the former tree. It is computed that 100,000,000 pairs of *lapti* are made annually, each pair requiring the bark of four young trees; thus 400,000,000 trees are cut down every year for shoes! Lime-trees, from five to ten years of age, and half-grown birch, are employed for this purpose. Such reckless waste is much to be regretted; and Mr. Werekha observes that the pines are tapped for their resin, and bled to death in from ten to fifteen years, in the same way as the Landes of Gascony were denuded of their pine-forests during the last century."

70. SPAIN.—Spain has 11,725,213 acres of forests, which are classified as belonging to the state, to the communes, and to establishments or endowments. They are also characterized by their contents, as of pine, of oak, and of beech. Compared to the total area, her forests occupy nearly 10 per cent., but much of the wood is said to be scattering and indifferently managed.

The following trees are either native or naturalized, and are now growing in the forests of Spain:

Abies pectinata and *pinsapo*, *Acer pseudo-platanus*, *Alnus glutinosa*, *Amygdalus communis*, *Betula verrucosa*, *Buxus sempervirens*, *Castanea vesca*, *Celtis australis*, *Ceratonia siliqua*, *Cerasus capro* and *juliana*, *Cercis siliquastrum*, *Citrus medica*, *limoni*, and *aurantiacum*, *Corylus avellana*, *Cydonia vulgaris*, *Daphne*, *Erica scoparia* and *stricta*, *Fraxinus angustifolia*, *Genista florida* and *tridentata*, *Ilex aquifolium*, *Juglans nigra*, *Juniperus macrocarpa*, *phœnicia*, *sabina*, *sophora*, and *thurifera*, *Laurus nobilis*. *Melia azedarach*, *Mespilus germanica*, *Morus alba* and *multicaule*. *Pinus elusianus* or *hispanica*, *P. halepensis*, *P. hispanica*, *P. maritima*, *P. pinea*, *P. pinaster*, *P. sylvestris*, *P. uncinata*, *Persica vulgaris*, *Phoenix dactyliflora*, *Platanus orientalis*, *Populus alba*, *fastigiata*, *nigra*, and *tremula*, *Prunus domestica*, *Punica granatum*, *Pyrus communis* and *mabus*, *Quercus coccifera*, *Q. ilex*, *Q. lusitanica*, *Q. pedunculata*, *Q. sessiliflora*, *Q. ruber*, *Q. trua?* *Robiniapseudo-acacia*, *Salix alba*, *Aurita biennialis*, &c., *Sorbus aria* and *aucuparia*, *Faxus baccata*, *Ulex europæa*, *Ulmus campestris*.

Also the following shrubs:

Berberis vulgaris, *Chamarops humilis*, *Cistus albidus*, *lanceifolius*, *ledrui*, *la laniformis*, *monspeliensis*, *populifolius*, *salicifolius*, &c., *Daphne lamilla*,

Erisma pungen, *Machrolea tenacissima*, *Nerium oleander*, *Phylisnea argentifolia*, *Pistachia lentiscus* and *terebinthus*, *Rhamnus alaternus*, *Ulex pro-rinsia*, *Viburnum lantanoides* and *tinus*. This is given on the authority of a jury-colleague, Don Francisco Garcia Martino.

The following table shows the character of the growth, (species,) and the ownership of the woodlands of Spain:*

Proprietors.	Pine.	Oak.	Beech.
The state	591, 111	67, 941	34, 546
Communes	5, 231, 776	4, 290, 765	1, 134, 481
Establishments	264, 764	99, 087	.....

71. PORTUGAL.—The area of forest is computed at 5.3 per cent. of the total superficies. The state-forests embrace 20,013 hectares; besides these, there are 100,000 hectares in the possession of communes and individuals. The largest forest is that of Leiria, containing 9,914 hectares of sand-dunes, in which the *Pinus maritima* abounds. The other species are *Pinus pinea*, different species of oak, evergreen oaks, chestnut, alder, plane-tree, poplar, willow, mulberry, ash, &c. There are also trees of the second class that attain good size, such as laurel, arbutus, viburnum, holly, walnut, cherry, box, and others. There are also great patches of shrubs and bushes, among which are myrtle, broom, and thorns.

In the forest of Leiria, the *Pinus maritima* attains sufficient size and such excellent quality that it is highly esteemed for construction, both naval and civil. The fire-wood is in great demand at the glass-works of Manuha-grande. A portion of the forest, 1,632 hectares, is devoted to the production of resin, with an average of 132 trees per hectare, which yield 150,000 kilograms, or 330,000 pounds.

The country is poorly wooded, and individuals have exerted themselves to increase the plantations, especially in the western portions of the provinces of Beira and Estramadura, where there are stretches of idle land and hills covered with broom.

The cork-oak is much planted and yields a large income.†

The forest of Busaco is in the western portion, on the mountains of Alcoba, a few miles northwest from Coimbra. Its area is small, not more than 100 hectares, but it has fine woods and a historical interest, having been a religious retreat, founded in 1628 by Bishop D. Joao Manoel, for the Carmelites. After the abolition of religious orders, this was attached to the royal forests, and great pains have been taken to preserve and improve it. Here have been established a great nursery of indigenous trees and a garden of acclimatization for exotics. The oaks of different species are colossal. Many other trees of the second rank here attain their largest dimensions; but the glory of this forest is the so-called cedar of Busaco, the *Cupressus lusitanica*, (Tournefort,) said to

* Siemoni, *op. cit.*

† *Le Portugal*, Alphonse Fiquieriedo, Lisbonne, 1873.

have been introduced from the Azores in 1680. There are specimens 40 meters high and 5 or 6 meters in circumference at breast-high.

The recent plantations contain numerous specimens of many species of the leading forest trees from all countries.

72. ITALY.—Italy has 12,413,955 acres of forest-land, or in the proportion of less than one sixth of the whole territory of the peninsula.*

Siemoni gives a table of the sixty-eight provinces, with their respective population, territorial area, and forest-area; also the relative proportions of these latter to the population.

The forests of Italy occupy an extent of 5,025,893 hectares, which is 17.64 per cent. of the whole surface; less than that of Germany, which is said to be 26.50 per cent., but greater than that of France, which is 16.79 per cent. It is claimed by writers on forestry that the best proportion for the prosperity of the state is 20 to 25 per cent. of woodland.

Italy has 0.20 of one hectare of forest to each inhabitant; Germany has 0.37; and France has 0.27. The annual consumption of wood amounts to 30,342,220 cubic meters, of which 12,136,888 cubic meters are for construction, and 18,215,332 cubic meters for combustion.†

In a report ‡ on the forest-interests of Italy, very minute details are given of all particulars of this important branch of industry. With regard to their elevation and situation, forests-lands are divided into the alpine, found in the northern provinces, and the apennine, in the peninsular provinces, besides which there are those of the plains and the islands; in all of these, there are some differences in the sylvia.

The alpine region covers about a million hectares. The species are *Pinus cembra* in small masses, at a height of from 4,250 to 7,860 feet. *Abies excelsa* grows in considerable masses at from 3,000 to 7,867 feet, and is often associated with the *Pinus cembra*, *Picea pectinata*, and the beech. *Larix europæa* is found from 3,000 to 6,500 feet, sometimes as low as 1,600 feet, forming extensive woods, either alone, or mixed with the *Pinus cembra*, spruce, fir, and beech. Fir (*Abies pectinata*) reaches from 3,300 to 5,800 feet in dense woods, alone, or associated with the preceding species. Beech (*Fagus sylvatica*), grows at a height of 4,250 to 5,300 feet, in close woods, alone, or associated with the species named. This is the most valuable deciduous tree of the mountains. *Pinus sylvestris* reaches from 900 to 4,900 feet, and even to 1,900 meters in woods of small extent. *Pinus pumilis* is seen in the mountain-tops. *Pinus uncinata*, perhaps a variety *sylvestris*, at 4,000 to 5,800 feet. Ash (*Fraxinus excelsior*) grows at 4,800 feet. *Sorbus aucuparia* is found from 3,590 to 5,800 feet. *Sorbus aria* and *Sorbus terminalis* occur at 5,800 feet. *Betula alba* thrives at 6,500 feet; *Cerasus avium*, at 5,200 feet; *Acer pseudo-platanus*, at 5,400 feet; *Acer platanoides*, at 4,250 feet. *Ulmus campestris* is seen at 4,000 feet; *Car-*

* Government report on forest gives the total area of Italy 70,351,343 acres.

† *Relazione di Giovanni Carlo Siemoni sui boschi ed i loro prodotti all'esposizione universale di Vienna, 1873.*

‡ Official report, *supra*.

pinus betulus, at 3,700 feet. *Tilia europæa* and *Alnus incana* thrive at 4,000 feet; *Alnus glutinosa*, at 3,270 feet; *Corylus avellana* and *Castanea vesca*, at 4,000 feet; *Hippophae rhamnoides*, at 4,500 feet. *Taxus baccata*, which is rare, reaches 5,200 feet, and other shrubs are found with it. *Quercus robur* is only seen on the southern slopes at 3,600 and *Quercus pedunculata* at 2,900 feet in moderate amount.

73. THE APENNINE REGION.—In this subdivision, the leading species of trees are: *Fagus sylvatica*, generally seen at 3,200 feet elevation, but sometimes as low as 1,400 feet; *Abies pectinata*, at 2,100 to 6,200 feet, in great forests; *Acer pseudo-platanus*, at the same elevation, and *Acer campestre* at 3,000 feet; *Cerasus avium* grows from 2,600 to 6,500 feet; *Taxus baccata*, at 10,000 feet; *Alnus incana*, 2,600 to 6,500 feet; *Alnus glutinosa*, at 3,300 feet; *Betula alba*, 3,300 feet and rare; *Fraxinus excelsior*, about 5,000 feet; *Fraxinus ornus*, at 2,000 feet; *Sorbus aucuparia*, *Sorbus aria*, and *Sorbus turbinalis*, from 2,000 to about 6,500 feet; *Ulmus campestris*, 5,000 feet; *Corylus avellana*, 5,600 feet; *Tilia europæa*, about 5,500 feet; *Ilex aquifolium*, about 9,000 feet; *Castanea vesca* and *Quercus robur*, at 3,300 feet; *Quercus pedunculata*, about 2,500 feet; *Quercus ilex*, 2,500 feet; *Quercus census*, about 3,300 feet; *Carpinus betula*, 6,500 feet; *Robinia pseudo-acacia*, at 2,000 feet; *Pinus laricio*, at 6,600 feet. Other species, less abundant and at lower elevations, are: *Pinus bintia*, *Pinus halepensis*, *Pinus maritima*, *Cupressus sempervirens*, &c.

On the plains, the forests, which are scattered, have a combined area of 1,000,000 hectares. The rotation varies from three to eighteen years while in the elevated regions it is from twenty to eighty years. The reproduction of the forests is generally natural, occasionally artificial.

74. THE ISLANDS.—*Sicily*.—The treatment of the forests is similar to that of the southern apennine region, and often much worse.* The sylvia also is very similar. On Mount Etna, the beech reaches 7,000 feet. *Quercus robur* is seen at 7,000 feet on the southern slopes, and only reaches 5,600 feet on the northern. Of the chestnut, there is a specimen which reaches such a colossal size as to hold 100 horsemen in its hollow trunk; it has a circumference of 210 feet. This species reaches 5,400 feet on the south and east, and 3,800 feet on the north and west sides.

Sardinia, with an area of 2,425,018 hectares, has 1,045,522 hectares of woodland, or 43 per cent. These forests have not been well managed. The species correspond to those of the middle and lower portions of the Apennines. The most valuable tree is the cork-oak, (*Quercus suber*.)

75. These divisions correspond to the three zones of Siemoni.*

First zone, having an elevation of 7,900, down to 3,000 feet, is called alpine, and is characterized by the *Pinus montana*, *Pinus cembra*, *Pinus larix*, *Pinus picea*, *Pinus ubies* or *pectinata*, *Betula*, *Fagus*, *Acer*, &c., abounding in conifers.

Second zone, called the apennine, having an elevation of 3,000 to 1,300 feet, and is characterized by the *Castanea vesca*, *Quercus census*,

* *Manuale teorico-pratico d'arte forestale di Giovanni Carlo Siemoni, Firenze, 1872.*

Quercus robur, &c. Chestnut, either alone or with the *Quercus cenis*, occupies the upper portions of this zone.

Third zone, from 1,300 feet to the sea-level. This is the region of the *Pinus pinea*, *Quercus suber*, *Quercus ilex*, *Pistacia lentisca* and *Pistacia terebinthus*, *Chamaerops humilis*, *Erica multiflora*, &c. Near the sea-level is the *Pinus pinaster*, and near the upper portions the oaks.

M. Siemoni refers to Professor Schouw's six zones of Italian sylvia :

1st. The region of broad-leaved evergreens, 1,200 feet high.

2d. The region of the oaks and chestnuts, from 1,200 down to 300 feet.

3d. The region of pines and firs, from 3,000 to 5,000 feet.

4th. The subalpine region, from 5,000 to 6,000 feet.

5th. The lower alpine region, with distinctly alpine flora, elevation 6,000 to 7,500 feet.

6th. The upper alpine zone, from 7,500 to 8,900 feet.*

In Italy, there is provision of 1.25 cubic meters of wood to each inhabitant; of this, one-half a cubic meter is lumber for construction, and three-quarters of a cubic meter for fuel, either as wood or charcoal.

The proportions of the several classes of forest are thus compared with to whole area in hectares:† Total forest-area, 5,025,893; deciduous, 4,473,365; conifers, 347,946; mixed, 204,582.

The average annual increase of the wood is 3 cubic meters in the *Scelta*, and 3.09 cubic meters per hectare in the close, tall, timber plantations, (*alto fusto*.)

76. GERMANY.—Because of the wealth of its production and the extent of population employed by it, as well as on account of the protection and ornament which it renders to the country, forestry is properly considered one of the most important departments of the German economy. • Since the days of Charlemagne, who afforested the Ardennes and established the woods of Osnabrück, the sovereigns of this country have bestowed especial attention upon the forests, so that now German forestry is superior to that of all other countries.

Of the entire area of 2,600 square miles of woodland, 34 per cent. is held by the state, fully one-sixth by the communes, and not quite half belongs to private individuals.

Hochwald management prevails, being 81 per cent.; *Niederwald*, 19 per cent. Of this extent of forest, 55 per cent. consists of conifers and 45 per cent. of deciduous trees.

For the production of tanning-material, there are 125,000 hectares of oak-coppice, chiefly in the southwestern divisions. The net returns of the forests amount to from 2 to 12 thaler per hectare, so that, at 5 per cent. interest, we may assume the value of the land and its crop is $53\frac{1}{3}$ thaler per hectare. The forests therefore represent a capital of 666,000,000 thaler.‡

* Grundzüge einer allgemeinen Pflanzengographie, Berlin, 1823.

† Official report, *cit. supra*.

‡ Amtlicher Catalog der Ausstellung des deutschen Reiches, Wiener Weltausstellung, T. Bödiker, Berlin, 1873.

77. The data here following have been gathered from various sources; the best that were at hand, and they suffice to give a glimpse of the acknowledged importance of forestry in European countries.

From these statements and tables, much instruction may be drawn, and it will appear that quite a large proportion of the country is wisely reserved for the production of timber, for the influence of the forests upon the climate, and also upon the consequent water-supplies of the continent.

*Forest-area and annual yield of the German empire, reduced to acres and dollars.**

Countries.	Area in acres.	Annual product.
Prussia	20,666,349	\$29,113,316
Bavaria	6,414,328	13,601,274
Saxony	1,166,875	2,933,721
Württemberg	1,469,902	3,054,962
Baden	1,261,922	2,820,300
INLAND STATES.		
Between Rhine and Elbe	1,228,772	2,632,822
Thuringian States	970,856	2,440,895
Baltic States	667,396	1,305,070
Alsace-Lorraine	1,114,802	3,238,754
Totals	34,961,273	61,141,114

The total area of the empire being 111,688,600 acres, the forests bear the ratio of 0.315, or less than one-third.

Of the Rhine and Elbe States—

	Acres.
Hesse has.	593,005
Brunswick	282,864
Anhalt	137,952
Waldeck	100,685
Schaumburg-Lippe	21,444
Lippe	83,822
Total	1,228,772

Of the Thuringian States—

	Acres.
Saxe-Weimar	224,614
Saxe-Meiningen	230,762
Saxe-Altenburg	98,343
Saxe-Coburg-Gotha	146,545
Schwartzburg-Rudolstadt	95,334
Schwartzburg-Sondershausen	62,301
	28,311
	84,644
Total	970,855

* *Die forstliche Ausstellung des deutschen Reiches auf der Wiener Weltausstellung, 1873, von Bernhard Danckelmann, königlich-preussischen Ober-Forstmeister, etc., Berlin, 1873.*

Of the Baltic States—

	Acres.
Mecklenburg-Schwerin	404, 010
Mecklenburg-Strelitz	143, 134
Oldenburg	110, 639
Lübeck	7, 479
Bremen	413
Hamburg	1, 722
Total	667, 396

Forest-area of Alsace-Lorraine.

	Hectares.	Reduced to acres.
Exclusively state-forests	133, 811	320, 512
Undivided state and other	17, 995	44, 448
Commune-woods	197, 314	437, 365
Endowments of institutions	2, 215	5, 471
Total	351, 337	867, 802

78. The following very instructive table is condensed from one prepared by Oberförstmeister Danckelmann, Academy-Director at Neustadt-Eberswalde, &c. It shows the kind of tree and the forest-management, the elevation at which it was produced, the formation and soil, the age, height in meters, contents in cubic meters, the number of trees standing upon each hectare, the contents in cubic meters per hectare, and the annual increment by the same measures.*

* *Op. cit. supra.*

Species.	Elevation in meters.	Rock and soil.	The stons.		The forest.			Place where grown.
			Age in years.	Height in meters.	Contents in cubic meters.	Number of trees per hectare.	Contents per hectare in cubic meters.	
Oak, H*	Lowland	Diluvium sandy loam	170	30.1	3.78	372	732	Westphalia.
Oak, H	Lowland	Alluvial river-loam	150	26.3	3.35			Oderwald.
Oak, M	63	Diluvium loam	55	18	4.41	756	411	Westphalia.
Oak, H	174	Clay-slate	200	25.7	3.72			Saarburg.
Oak, H	500	Clay-slate	75	19	1.63	1,036	299	Königsstein.
Beech, H	Lowland	Diluvium sandy loam	100	24.6	1.75	330	292	Müldenbeck, Pomerania.
Beech, H	164	Fora	103	33	3.77	388	1,064	Springe.
Beech, H	300	Clay-slate	102	38	3.12	361	789	Coblentz.
Beech, H	500	Diluvium loam	75	20.5	1.60	1,036	299	Königsstein.
Hornbeam, H	Lowland	Diluvium loam	112	21.9	.50	84	388.04	Astrawischpen.
Elm, H	Lowland	Diluvium river-loam	122	27.2	3.59	82		Peisterwitz.
Maple, H	Hilly land	Diluvium loam	110	22	1.53	173	243	Borken.
Maple, M	345	Muskelkalk	96	23	1.00			Lohra.
Ash, H	Lowland	Alluvium sandy moor	100	25.5	2.061			Hünichen.
Birch, H	Lowland	Alluvium sandy moor	58	23.2	.42	1,680	172.8	Karwien.
Birch, H	Lowland	Sandy loam	49	23	.603	716	201.24	Liepe.
Alder, N	Lowland	Alluvium sandy loam	53	22	.887	1,052	341	Liepe.
Alder, N	Lowland	Alluvium sandy moor	53	19	.553	1,616	216	Liepe.
Alder, N	Hilly land	Alluvium turf	56	21	.31	800	247	Borken.
Scotch pine, H	Lowland	Diluvial sandy	105	26	1.491	400	384	Bresenthal.
Scotch pine, H	Lowland	Alluvium sandy loam	101	29	1.500	336	612	Liepe.
Scotch pine, H	Lowland	Alluvium turf	96	15	.68	1,372	167	Steplitz.
Scotch pine, H	Lowland	Alluvium sand	111	34.9	2.917	292	519	Cyffmitten.
Scotch pine, H	8 to 10	Alluvial moor-dunes	104	31.2	2.14	560	474	Popplau.
Scotch pine, H	Lowland	Alluvial sand-dunes	53	10.6	.08	680	133	Grünhaus.
Spruce, H	Lowland	Alluvial moor-sand	75	27.4	1.62	624	632	Proskana.
Spruce, H	230	Bunter sandstein	95	31	1.93	800	892	Grossera.
Spruce, H	314	Planerkalk	54	28.3	1.67	1,916	1,064	Baddecken.

* The capitals in the first column indicate the management. H., Hochwald; M., Mittelwald; N., Niederwald.

A view of the Prussian states' forests, showing their extent, the kind of trees, age, &c.

	Hectares.	Reduced to acres.
Total area.....	2, 616, 972	6, 463, 921
Pine and larch.....	1, 371, 405	3, 087, 370
Spruce and fir.....	261, 015	644, 707
Oak.....	129, 450	319, 741. 5
Beech.....	398, 735	884, 875
Alder, birch, &c.....	98, 741	243, 891
Amount of <i>Hochwald</i>	2, 259, 346	5, 380, 315
Amount of <i>Mittelwald</i>	33, 179	81, 946
Amount of <i>Niederwald</i>	41, 242	103, 868
Oak-coppice.....	15, 440	38, 127
Pasture, (<i>Weidenheger</i>).....	2, 625	6, 384

Age by classes:

Over eighty years.....	548, 969	1, 343, 953
Forty-one to eighty years.....	734, 726	1, 814, 773
One to forty years.....	897, 328	1, 716, 400

79. AUSTRIA.—The forests of Austria cover 1,606 square miles, or 33 per cent. of the productive surface. Compared to the population, this gives one acre of woodland to each inhabitant. But this is not evenly distributed, since the great body of woods is in the alpine regions of the south, and in the Carpathians, where the percentage is from 46 to 70, and the per capita is from 3 to 11 acres for each person. There is, indeed, in some regions a surplus, as in Galicia and Bukowina.

*Total productive forest-area of Austria.**

	Acres.
Lower Austria.....	1, 381, 250
Upper Austria.....	826, 825
Salzburg.....	458, 125
Tyrol and Vorarlberg.....	1, 640, 000
Styria.....	2, 191, 875
Carinthia.....	808, 125
Carniola.....	933, 125
Küstenland.....	396, 750
Dalmatia.....	961, 250
Bohemia.....	3, 277, 500
Moravia.....	1, 258, 125
Silesia.....	433, 125
Galicia.....	4, 450, 000
Bukowina.....	984, 375
Total.....	20, 000, 450

* *Die Bodencultur Oes'erreichs, im Auftrage des k. k. Ackerbau-Ministeriums, redigirt von Sectionsrath Dr. Jos. R. Lorenz and General-Domänen Inspector Josef Wessely, Wien, 1873.*

BY TERRITORIAL SUBDIVISIONS.

Alpine lands	7, 393, 250
Northwest land	5, 663, 625
Northeast land	5, 434, 000
Karst land	1, 640, 000

80. The following tables show for each of the provinces in the first column the area of forest-lands; the next, other productive property not wooded; then the sum of these; the next shows the amount of unproductive or waste; and the last, the total area of the crown and foundation estates of Austria. It has been collated and reduced to acres, from a comprehensive work on the agriculture of Austria, by Messrs. Lorenz and Wessely,* to the latter of whom, a jury-colleague, I am indebted for a copy.

The first table gives the figures for each of the several provinces; the second shows the proprietorship of the several foundations.

Crown and foundation lands of Austria.

	Forest-lands.	Otherlands.	Total.	Unproduct-ive.	Total.
Lower Austria	65, 209	5, 906	71, 234	478	71, 715
Upper Austria	159, 792	16, 440	176, 282	83, 172	269, 455
Salzburg	203, 899	22, 516	264, 915	152, 110	430, 525
Tyrol and Vorarlberg	299, 246	31, 260	330, 506	359, 009	680, 515
Styria	126, 240	26, 464	154, 954	54, 069	206, 522
Carinthia	44, 415	9, 153	56, 317	9, 477	65, 791
Carniola	34, 119	1, 934	36, 056	835	37, 029
Coastland	31, 728	2, 519	34, 246	311	34, 557
Dalmatia	6, 250	23, 806	35, 326	317	35, 644
Bohemia	20, 711	5, 840	26, 551	189	26, 740
Galicia	481, 873	28, 746	510, 349	14, 377	524, 726
Bukowina	481, 500	81, 645	563, 145	8, 019	571, 164
Total	1, 955, 252	260, 959	2, 259, 881	682, 363	2, 942, 244
This area is divided as follows:					
The state	1, 437, 375	138, 324	1, 578, 699	652, 347	2, 230, 091
Church foundations	75, 748	29, 494	105, 241	22, 200	127, 479
Greek church foundations	481, 500	81, 645	617, 596	8, 019	625, 615
Students' foundations	10, 150	9, 557	19, 683	34	18, 716
Invalid foundations	3, 130	-----	3, 130	-----	3, 130
Military academy foundations	1, 416	356	1, 772	-----	1, 772

The imperial and endowment forest-property of Austria, with other estates, amounts to 1,371,311 hectares, as represented in a chart in the pavilion of the department of agriculture; of which extent 935,295 hectares, or 68 per cent., are productive forest-land; 123,170 hectares, or 9 per cent., farming-lands; and 312,846 hectares, or 23 per cent., are unproductive.† These possessions are scattered from the northern to the

* *Op. cit. supra.*

† For the valuable information contained in this section of the report, I am indebted largely to the "special catalogue" carefully prepared by my very agreeable colleague, Dr. Arthur Freiherr von Seekendorff, professor at Mariabrunn, the author of some standard works on forestry, a gentleman whose charming manners and many kindnesses to an unknown stranger from a far-off land quite captivated the recipient of his attentions.

southern boundary of the empire, in both Eastern and Western Austria, and they rise from the level of the Adriatic to the limit of vegetation in the alpine regions. Some of the alpine forests are still hampered with servitudes, though many of these have been released since 1853.*

81. ARCHDUCHY OF AUSTRIA BELOW THE ENNS—LOWER AUSTRIA.—In this province, we find the Wiener-Wald lying to the west and southwest of the imperial city of Vienna. It contains 26,677 hectares of woods, besides 1,200 of other lands; also near Neustadt, by the boundary of Hungary, is the so-called Kaiser-Wald, or Ofenbach forest, with 893 hectares of wood and 8 hectares of other lands; making in all 28,783 hectares, or 71,092 acres. The Wiener-Wald or forest has belonged to the Austrian government since the earliest times; but its economical importance dates from the latter part of the seventeenth century, and its management has culminated in a plentiful supply of wood and timber for the city, besides furnishing a charming resort for the citizens in summer time,—a grand park.

The surface is generally hilly or mountainous; the highest point, called Schopfel, is 893 meters, or 2,924 feet, above the sea-level. The soil of the Wiener-Wald is chiefly derived from the Wiener sandstone, with a mixture of finer and coarser masses of quartz; besides, in some of the districts, the Alpenkalk limestone is found. The Ofenbacher forest lies on schist, gneiss, and granite, with abundant pebbles from the mountains.

On the sandstone, generally, is found a clay soil, very favorable to the growth of trees, especially the beech. This changes according to the varying hardness of the sandstone, and the greater or less amount of lime it contains. A striking appearance is the frequent coming to the surface of the sandstone, especially on the north and northwest slopes. Above the limestone is a light and fertile soil, especially adapted to pines.

Deficiency of water is a characteristic of the Wiener-Wald. The principal river is the Wienfluss, which is liable to sudden floods at times of heavy rains.

Besides the Wienfluss, the Schwechatbach is to be mentioned as one of the most important, since it furnishes the chief water-way for transporting wood by means of dams or reservoirs, that are opened at intervals to flood the channel and carry the wood to its destination.

82. On the sandstone is a mixed wood-growth; the beech prevailing on the loamy soils. This is often the only tree, but is frequently mixed with firs and hornbeam, the common kinds of oak, Austrian and Scotch pine, and, in smaller quantities, spruce, ash, larch, elm, maple, birch, *Sorbus torminalis*, alder, aspen, and poplar.

The management is *Hochwald*, with a rotation of one hundred to one

* Some discrepancies may be noticed by the critical observer of these figures, which are given as they were found, presented by different authorities; but they do not materially invalidate the results.

hundred and twenty years. Near Weidlingan is a small portion of *Mittelwald* management, with a rotation of forty years. It is attached to the Forest School of Mariabrunn. The annual yield is 163,540 cubic meters from the chief product, and 33,390 cubic meters from the thinnings; together, 196,930 cubic meters, or 46,422 cords, chiefly fire-wood, about 5 per cent. only being utilized as timber.

The income for 1871 amounted to 1,131,754 florins, about....	\$565, 877
The expenditure	217, 368
Excess of income	348, 509

About \$5 per acre.

The actual product, nevertheless, generally exceeds the estimated quantity by several thousand cubic meters, which is due to the improvement of the forests.

The valuable varieties of wood are divided into three principal groups:

The first group on the north and northeast, which lies between Kir-ling and the public road that passes through the Wien and Gablitz valleys, contains deciduous trees almost exclusively. These are principally beech, with more or less mixture of oak, hornbeam, ash, elm, maple, aspen, poplar, alder, &c.

To the second group belong the forests south of this road, with the exception of the Anninger and a part of the Kaltenberger reviers. Here, also, the beech prevails, though pines are mixed with it in varying proportions, so as even to preponderate in some places. In the more elevated situations of this group, the spruce and larch are found in natural growth.

On the limestone of the Anninger forest is the third group, composed of the native Austrian pine, mixed with the Scotch pine, (*Pinus sylvestris*.)

As regards the different modes of transportation, the forests of the Wiener-Wald are divided into *Achsforste*, which means where the wood is transported by land to its place of destination; and into *Schwemforste*, from which it is transported by water to some point where it is either sold or sent on farther, by rail or otherwise. These *Schwemforste* occupy 8,136 hectares, (four districts,) and the *Triftholz* amounts yearly to from 150,000 to 65,000 cubic meters of fire-wood.

The wood is chiefly sold by auction in the forests; most of it is consumed in Vienna, to which point it is carried by the West and South Railroads.

Incidental products.—Among these, the leaves are most important, and they yield relatively large products, amounting in the year 1872 to 6,129 florins 75 kreutzers.

Next to the leaves comes the resin from the Austrian pine. Besides these are the rents for wood-pastures, meadows, quarries, and for hunting, which last does not amount to much.

83. *Management*.—Since the new organization of the Austrian government forests, the management of the woods and domain in the Wiener-Wald is controlled by the minister of agriculture, under whom are also the Fonds forests and domain, situated in Lower Austria.

The forest-direction is made up as follows: one *Oberforstmeister*, two *Forstmeister*, one *Forstsekretär*, one *Oberforstingenieur*, one *Conceptsförster*, one *Rechnungsrath*, and various assistants.

The body of the real Wiener-Wald is divided into sixteen forest-districts, whose managers, with the title *Forst- und Domaenen-Verwalter*, are immediately under the direction.

For the protection of the forests, there are forty-eight *Forstwärter*, or guards, for the same number of districts.

84. The Wiener-Wald, being so near Vienna, afforded a good opportunity for studying Austrian forest-management, in which great assistance was rendered by the amiable and intelligent professors of the Mariabrunn Academy, who are very enthusiastic in the pursuit of forest-studies. Besides this, the Forest-Jury was favored with a pleasant excursion through some of the best and most interesting portions of the estate. This entertainment was given by the administration, and under the special guidance of Herr Robert Micklitz, *K. K. Oberlandesforstmeister*, (who was also a member of the jury,) accompanied by the Mariabrunn professors and the *Oberforstrath* of Austria. The occasion was a delightful one, and it afforded an opportunity of making observations under the most favorable circumstances, as the visitors were attended by the most intelligent *eicerones*, who were ready to answer all questions and to explain all difficulties. The whole trip was an example of the peripatetic forest-school.

As a means of conveying instruction, however, its only fault was, perhaps, that the course of study was too full for the time allotted to it. What might have occupied months was necessarily crowded into one day. But text-books were provided for us in the way of maps, and a full description of the *Wald*, especially prepared for the occasion, which have served an admirable purpose by enabling us to con over the details at leisure in our own homes.

85. The Students' Endowment Forest, at Grosspappen, contains 800 hectares of woods lying on the watershed of the Thaja River, about sixteen German miles northwest from Vienna. The surface is undulating, sometimes hilly, in part flat. Elevation from 500 to 600 meters. It is on the *Urgebirgsformation*, crystalline schist, mixed with gneiss, limestone, and granite. The soil a deep loamy clay. The climate is trying; the winters are long and snowy; the winds are often heavy, and hurricanes sometimes occur. All this requires the most careful planning of the clearings or culling of the timber. The principal kinds are spruce, fir, and Scotch pine, with birch, aspen, and linden. The rotation is one hundred years; the reproduction is by artificial planting. The annual yield is 4,680 cubic meters, of which, since the opening of the railroad, 50 per cent. is useful timber; the rest, fire-wood.

86. ARCHDUCHEY OF AUSTRIA ABOVE THE ENNS RIVER—UPPER AUSTRIA.—The beautiful river, Enns, which furnishes a natural outlet for the rich products of the mines and forests of a part of the mountains of Styria, is also the eastern boundary of the province to which this part of my report refers; a region of varied surface, traversed by the Danube and drained by the Traun, the Salza, and other streams that flow from the snowy tops of the Austrian Alps.

This archduchy extends from the Enns to the Inn River.

The state forest contains—

85,220 hectares of woods;
1,807 hectares cultivated ground;
61,262 hectares unproductive;

148,289 hectares, or 466,274 acres.

The Salzkammergut is famous for its salt-works, and also as a summer resort for the Viennoise, as well as for its forests.

Indeed, the leading motive for purchasing these possessions by the government was the preservation of the woods to furnish fuel for the imperial salt-works in the valley of the Traun. On the west, south, and east, the region is inclosed by the Alps of Salzburg, Styria, and Upper Austria.

87. With regard to situation, soil, and climate, the forests of the Salzkammergut may be divided into three regions: the first and largest of these is composed of the high mountains of limestone, which rear their mighty crests of unproductive lands, with rocks and precipices, on which only the *Pinus montana* is found.

The highest point of this group is the Dachstein, that raises its head, covered with eternal snow and ice, to an elevation of 8,900 feet, while the lowest is the surface of the Traunsee, that is 1,270 feet above the ocean-level.

Throughout this region, tree-growth is arrested at 1,510 meters, (4,945 feet,) and is confined to the valleys and sheltered places; where exposed and on the poorer soils, the trees are gnarled and twisted.

The next group embraces the foot-hills of clay-slate, and sandstone, of which the highest point is 1,074 meters, or 3,517 feet. The soil is not favorable for tree-growth.

The third group is level, of small extent, being the alluvial of the valleys; a sandy loam. The climate varies with this grouping. Snows fall early and abundantly, and in the spring they disappear very slowly.

Besides the mountain-streams flowing out by the Traun, which afford a convenient means of transport for the wood, the Salzkammergut is rich in lovely lakes of beautifully clear water, which lie embosomed among the mountains, and add to the beauty of the landscape, so that this region has well been called one of the most attractive in Europe. The largest of these lakes are the Halstättersee, the Wolfgangsee, the Mondsee, the Zellersee, the Attorsee, and the Traunsee.

The leading tree in the forests is the spruce; next to which are the beech, fir, and larch. Others, deciduous kinds, are scarce; but in cultivation, in the valley at Ischl, quite a number of American trees are growing well; among them the liriiodendrons are remarkably fine. Near the town, a very thrifty chestnut was also seen.

Plenterbetrieb prevails, with rotation of one hundred and twenty years. Annual product is 230,840 cubic meters, or 7,714,739 cubic feet, natural reproduction; with little planting, on account of the shortness of the season.

88. THE ARCHDUCHY OF SALZBURG.—The state-forest here occupies an extent of 125,688 hectares of productive woodland, besides 250 hectares in farms and meadows, 2,296 hectares high pastures, and 5,870 hectares of alpine wastes; the whole property contains 134,104 hectares.

Most of the tract lies in the high mountains, composed of crystalline slates and gneiss, upon which lie grauwacke, sandstone, and alpenkalk.

Diluvial and alluvial formations are found in the valleys. The disintegration of the rocks has formed a rich, productive soil.

The climate varies: in the sheltered valleys, it is warm enough for the walnut, (*Juglans regia*;) on the more elevated places, and on the northerly and easterly slopes, the winter begins early, lasts longer, and has more snow. Long winters, short and cool springs, rainy summers, and warm falls characterize the climate.

89. The spruce constitutes the leading tree, alone or with fir, beech, and larch, a mixed, close forest, reaching a height of 1,600 meters, 5,244 feet. The highest wooded point is the Honikogel, 1,855 meters high; it is stocked with a beautiful dense forest of spruce. In the sheltered places, indeed, the spruce is found at a height of 1,900 meters, but the stems are short and small.

The fir does not occur massed by itself, but mixed with spruce and beech; nor does it reach so high as the spruce, seldom exceeding 1,300 meters. Fine specimens of the beech are rarely found so high. On the northern slopes of the Tannengebirg and on the west slopes of the Stuhlgebirg, at a height of 1,600 meters, the beech occurs in masses with the *Pinus pumilis*; the stems, however, are gnarled and short.

The larch is usually mixed with other trees. Clear patches are of small extent. It is found in all situations, but prefers the north and east slopes, and reaches the height of 1,900 meters.

The Scotch pine is seldom seen except in dry and hungry soils, and seldom over 1,450 meters in elevation.

The Swiss stone-pine is found in many valleys quite abundant, sometimes in fine stems. In a good situation, handsome trees may be found at 1,900 meters; but its favorite locality is between 1,450 and 1,750 meters above the sea, where it is found in small compact groups.

The *Pinus pumilio* occurs on all the high mountain-tops, and reaches to 2,200 meters in sheltered places.

The common alder is found in the valleys by the streams, occasionally rising to 1,300 meters.

Maple, ash, elm, birch, oak, &c., are not sufficiently numerous to be of much importance, and they generally stand singly.

In some of the lower altitudes, with deep, rich soil, we find here and there a wood of remarkable beauty and with an abundant growth that would yield 600 to 650 cubic meters per hectare. In this region, the harvesting of the forest is done by clean clearing (*Kahlhiebe*) of the entire side of a valley.

The product of 1871 consisted of—

	Cubic meters.
Fire-wood	108,880
Coal-wood	17,030
Logs	5,150
Total.....	131,060

Most of this is consumed at the salines of Hallein. The charcoal goes to the furnaces and founderies.

90. KINGDOM OF BOHEMIA.—The Joachimsthaler forest lies near the boundary of Saxony on the Erzgebirg. It contains 5,616 hectares, and lies from 900 to 1,000 meters above the level of the North Sea. Consequently, these elevations, combined with their northern position, have on their summits a severe climate, which is milder and the vegetation more promising only in the sheltered valleys. The angle of incidence of the sun's rays on various slopes and mountain-tops falls between 20° and 40°. The soil consists of clays and the *detritus* of schist and granite; and, in consequence of abundant precipitation, it is usually moist and well adapted to vegetation.

91. The leading forest-trees are the spruce, with some firs, and occasionally beech and larch.

The forest-management is high timber, (*Hochwald*), and the annual yield is:

	Cubic meters.
First quality.....	15,036
Inferior	1,232
Total	16,268

92. THE DUKEDOM OF BUKOWINA.—The area of the Eastern Greek church endowment amounts, in round numbers, to 230,240 hectares, or forty German square miles = 568,693 acres, divided into five districts. This property is scattered in larger or smaller tracts over the whole of the crown-lands of Bukowina. Some is among cultivated lands; the rest lies on the high Carpathians.

Among the usual species, the spruce occupies the first place, next comes the fir, and then beech. Oaks are only found in favorable situations. In the lower lands are the ash, maple, elm, alder, linden, &c., and, where introduced artificially, the larch and Scotch pine. On the heights, at elevations of from 1,650 to 1,850 meters, the *Pinus pumilio* and *Pinus uliginosa* are found.

The proportions of woods are represented by spruce, 50; fir, 23; beech, 20; oak, 1.5; ash, maple, elm, alder, linden, birch, aspen, and willow, 1.5 in 100.

The chief forests are *Hochwald*, with a rotation or term of from eighty to one hundred and twenty years. The reproduction of the woods is chiefly natural, by self-seeding; but some planting is done from nurseries.

Ship-timbers are an important product. They are floated on the Bistritz and Dorna to Galatz on the Lower Danube. The mainmasts are from 26 to 32 meters long by 57 to 68 centimeters thick. The mizzenmasts are from 47 to 55 meters long by 47 to 55 centimeters diameter. The foremasts are from 24 to 28 meters long by 36 to 44 centimeters thick. The yards are from 19 to 23 meters long by 21 to 36 centimeters thick. Beams are from 13 to 19 meters long by 16 to 19 centimeters thick at the upper end. The annual product equals 556,738 cubic meters, or 18,606,143 cubic feet.

To offset this abstraction, the calculated increase by growth in the same districts amounts to 1,338,050 cubic meters, or 45,817,631 cubic feet, so that only about one-third part is utilized.

93. KINGDOM OF GALICIA.—The state and endowment forests are comprised in nine divisions, which have a total area equaling 229,182 hectares, or 556,079 acres, of forest, and 40,530 acres of farming-land. Of this, the state holds 438,250 acres of the former, and 24,402 acres of the latter; the rest is endowment-land, (*Fondsbesitz*.)

In the sandy lands, the Scotch pine is the chief tree; on better and loamy soils, the oak comes in with fir and beech, birch, &c.

Of all these divisions, that of *Bolechow* and *Dolina* furnish the best example of a Galician forest. It is a mountain-region, with broad levels on the summits, and in the elevated valleys, which are from 650 meters to 1,600 meters above the sea-level. The lower slopes have deciduous trees, mixed with the conifers; the latter, chiefly spruce, in the higher grounds, are of remarkably fine quality.

94. EARLDOM OF GÖRITZ AND THE MARGRAVIATE OF ISTRIA.—*The Coast-land forests*.—In his report upon the plans for reforesting this region, M. Scharnagl says* that perhaps in no part of the Austrian empire, with the exception of Dalmatia, is the forest so much reduced as in the Küstenland, nor does any other country suffer so much from the consequences of this scarcity of woods as these provinces; because of their southern position, and of the prevailing limestone rocks, they require especially a permanent forest for the preservation of the earth moisture.

It is well known that the deforesting of this territory is the cause of the severe drought and the consequent scarcity of pasture and bad crops. The impoverishment of the land is referable to natural causes.

In consequence of its mild climate, and of its being accessible to the

* "Kartbewaldung," von Simon Scharnagl, Forstinspector in Triest.

markets of all the great states, this was one of the richest lands of Europe in the times of the Romans.

Within a few years, the reforestation of this extensive, desolate, and really unprofitable Karstland has been undertaken in earnest, as will appear from the report of the contents of the nurseries to supply the plantations.

The total extent of the Küstenland amounts to 1,385,476 joch = 1,731,845 acres.

95. An intelligent writer from this country, who was met at the forest congress to which he refers, gives the following graphic description of the region under consideration :

“Immediately after leaving Triest, the train passes through miles and miles of the most barren, rocky mountain-scenery that it is possible to imagine. It seems as if some terrible curse hangs over these miles and miles of hills, literally covered with stones; even shrubs being scarcely able to take root among the rocks. Five hundred years ago, as an intelligent gentleman informs me, all these hills were covered with grand old forest-trees, of which, however, none remained at the end of the last century.

“The Venetians had been in the habit of sending their galleys to this coast, bordering as it does on the Adriatic, to fetch all the wood they needed, until they had finally completely deforested the entire region. So it remained for centuries, and the hills having lost their protectors, the soil was washed away by the storms, leaving the bare rocks, on which no vegetation could cling.

“Thus the vast stony wilderness remained until some twenty years ago, when the attention of the Austrian government was called to the matter, and eminent economists were confident that the waste district could eventually be reclaimed and restored to its former usefulness.

“The Austrian government then caused miles and miles of olive-trees to be planted among the rocks, although first of all the very soil had to be carried to the roots of the trees.

“The young trees took root, but at first suffered severely for lack of moisture, since it had been noticed that with the destruction of the forests the rain-fall had constantly diminished, until finally scarcely any fell during the hot summer months.

“By and by a pleasant verdure again covered the hills, and the clouds took compassion on the gasping plants as they passed over them; for it is a fact that whereas heretofore rain scarcely ever fell upon the barren hill-sides, now it falls in sufficient quantity, and a pleasant climate will soon return to the once barren district. The phenomena here related are by no means isolated in the history of deforested districts. They have been observed at Cairo and in other countries.

“I think it well to call attention here to the fact that one of the most important international congresses to be held at Vienna during the

Exposition will be devoted, on the one part, to the question of forest-culture.

"The great chemist Liebig, whose death at Munich occurred a few days ago, spoke once to me on this very subject. He expressed the view that the decay of ancient empires—of Greece and Rome—was due, more or less, to the neglect of the peoples to take care of the land and its fertilizer and climate-regulator, the forest."—(Correspondence New York Herald.)

96. In 1872, the following plants were in the central seeding-nurseries of conifers: such as Austrian pine, white pine, maritima, Aleppo pine, pinaster, stone-pine, spruce, larch; at Rodik were 3,682,500, of which 1,150,000 were ready for planting; at Capo d'Istria, 211,000, of which 73,500 were ready to set; at Göritz were 15,930 ready to plant; altogether ready for planting in 1873, 1,239,000.

Of deciduous trees: such as robinia, Norway maple, sycamore-maple, field-maple, box-elder, beech, hornbeam, ash, *Fraxinus ornus*, alder, *Quercus pedunculata*, *pubescens*, and *suber*, (cork,) horse-chestnut, linden, field-elm, *Ulmus effusa*, *Laburnum*, *Gleditschia*, *Catalpa*, &c. Of these there were at Rodik 810 not yet ready to plant; at Capo d'Istria, 1,351,600, of which 338,000 were ready for planting; at Göritz, 4,891,200, of which 3,872,000 were ready—total, 4,210,000 ready to set out in the year 1873. Besides which there were 660,500 nut and fruit trees, of which 486,700 could be planted—total plants, 10,817,741.*

M. Scharnagl gives in tabulated form, representing all the above-named varieties, the number of young trees that have been sent out from the nurseries for planting up to the autumn of 1872. Without going into the details of the proportion of conifers and deciduous forest and fruit trees, the grand total is here presented: for planting in the Karst, 1,019,945; sold to other provinces, 1,740,500.

Total of plants produced by these nurseries:

Conifers.....	3,909,466
Deciduous.....	6,247,676
Fruit and nut trees.....	660,599
Total	10,817,741

97. DUKEDOM OF CARINTHIA.—The state and endowment forests lie in the western part, and extend from the levels of the valleys to the alpine heights as far as forest-vegetation is possible. They are drained by the Drave and its numerous branches.

The area of the four districts amounts to 42,481 acres, which, with the sterile alpine heights, makes a total of 53,948 acres. With deep and long valleys separated by high mountains, this is essentially an alpine region. The servitudes of wood, litter, and pasturage make a heavy drain upon these possessions.

* Scharnagl.

On the foot-hills, the forests consist chiefly of conifers, spruce, fir, Scotch pine, and larch, with deciduous trees, such as beech, hornbeam, alder, poplar, maple, and birch, scattered through them. The land is well stocked, and the trees make a good healthy growth. Their harvesting generally occurs by clearing entirely, (*Schlagweise*), and the management is *Plenterbetrieb*, with a rotation of eighty years.

In the higher grounds, the deciduous trees give place to the conifers, spruce, fir, and larch. The Swiss pine (*Pinus cembra*) appears in the central alpine chain, in the highest timber-region, mixed with stunted spruce and larch, as warders of the highest forest-production. These forests, which are seldom more than 1,700 meters high, and from their being scattered, and with their rugged character, it is assumed that they generally have a rotation of one hundred to one hundred and twenty years.

98. DUKEDOM OF CARNIOLA.—The state-forests of Carniola are divided into five districts, which cover 12,167 hectares, or 30,052 acres. The imperial forest of Idria is from 300 to 1,300 meters above the sea. The rotation is one hundred to one hundred and twenty years, with either the entire clearing or gradual cutting. The area is 7,735 hectares. The yearly production is 28,078 cubic meters.

The mountain-forest of *Lanczowa-Illoucze* is an elevated plateau of square form. The highest point is 1,400 meters, and still within the line of wood-vegetation; the soil is rich in humus. The woods are made up of spruce and fir, with some beech on the northerly slopes. The rotation is eighty years, and the annual yield is 4,422 cubic meters from an area of 1,863 hectares.

99. ARCHDUCHY OF STYRIA.—The Neuberg-Mariazell state-forest contains 33,493 hectares forest; 7,796 hectares productive land; 4,246 hectares unproductive land; total, 45,535 hectares, lying in the forest-region, and extending in part into the alpine heights. The surface is all mountainous. In the Neuberg-Wald spruce and fir are the most numerous, about 60 per cent.; next, larch in mixture, 20 per cent.; then follow the Scotch pine and beech, and a small amount of maple, birch, and alder. In the alpine region the *Pinus pumilis* abounds.

In the Mariazell district, spruce is the most frequent and important tree, mingled with larch. In the deeper and more sheltered places, the fir bears itself well, and the birch and *Alnus incana* assume importance. The management is altogether high timber, (*Hoehwald*.)

The state-forests in Tyrol and Vorarlberg cover a space of 138,115 hectares, besides 196 hectares of endowment-lands. These are still much hampered by servitudes, in spite of the efforts to free them. These amount annually to an abstraction of timber and lumber, about 7,581 cubic meters; fire-wood, 45,489 cubic meters; litter and brush, 40,435 cubic meters; pasture of about 74,000 head of cattle, horses, and mules, and about 22,000 sheep and goats. The forests are chiefly stocked with conifers, and have a rotation of one hundred to one hun-

dred and sixty years. They lie from 650 to 1,960 meters above the sea. In the valleys, the rotation is twenty years.

The leading trees are spruce, fir, Scotch pine, larch, cembra pine, beech, *Alnus incana*, yew, *Pinus pumilio*, and *Pinus obliqua*. The proximate yield is 238,082 cubic meters. Resonance-boards of superior quality are prepared here. Excepting some small reviers in the valley of the Inn, the management of the forests is chiefly *Hochwald*, and this is mostly cut by *Kahlhieb*, (clean cutting.) So far as appears, the *Plenterbetrieb* prevails. The felling is done from spring to fall. Coaling is largely carried on. After the clearing, the reproduction is chiefly effected by plantations, which permit a choice of kinds and proper admixture. The larch is highly esteemed, and its increase is thus secured. In 1870, there were 150 nurseries of young trees.

100. HUNGARY.—Of the total area, being 32,988,795 acres, the forests cover 9,082,434 acres, of which, according to the minister of finance, the state-forests compose more than one-half, or 4,383,244 acres,* from which it appears that rather more than one-fourth of the territory is wooded, and yet there are extensive tracts of open country, resembling the steppes of Asia, and devoted to agriculture and pasturage.

101. The following tables convey much information as to the kind of forest, their productiveness, and relative area compared with the total of the different provinces of the kingdom.

In Hungary, we find the relative distribution of forest-lands as follows:†

Provinces.	Forest area.	Total area.
	<i>Acres.</i>	<i>Acres.</i>
Presburg	2,183,505	6,216,496
Buda-Pesth	770,506	6,659,703
Odenburg	1,888,259	6,949,780
Kaschan	2,844,920	6,539,952
Grasswardein.....	1,395,144	6,622,863
Totals	9,082,334	32,988,794

The next table shows the area and the annual production of the Hungarian state-forests, with the several species by which it is furnished.

Annual product of each species in normal klafter of 100 cubic feet.

Area in acres.....	4,373,241
Spruce	499,540
Fir	259,848
Scotch pine.....	570
Oak, (<i>Q. robur</i>).....	357,470
<i>Quercus cerris</i>	27,490
Beech	1,350,940

* Statistische Daten aus den ungarischen Staatsforsten, Budapest, 1873.

† Lorenz and Wessely.

Hornbeam.....	10, 122
Ash and elm.....	49, 360
Poplar, birch, and willows.....	21, 630
Chestnut.....	4, 600

Making a grand total of 2,581,570,000 cubic feet of lumber; the annual product of 4,373,241 acres of forest,* at the rate of 590.31 cubic feet per acre annually.

Pinus austriacus, *Pinus cembra*, maples, and larch, &c., are found mixed with the others in small quantities.

102. The endowment-forests of the Hungarian kingdom are scattered widely, in many pieces, and in several parts of the country, especially on the Carpathians. Mr. Alexander Hoffmann furnished a sketch of these estates, showing their extent and the quantity of their annual production.†

The area of these forests amounts to 101,536 joch, equal to 126,920 acres, of which 27,100 acres belong to the university; 27,311 acres to students' endowment; 68,850 acres to religious institutions; and 3,681 acres to vacant church-property.

In regard to the surface, these forests have 39 per cent. flat-rolling or low land, 36 per cent. moderately mountainous, and 25 per cent. of quite mountainous land.

As to species, they produce 8 per cent. of conifers, 3 per cent. of soft-wooded deciduous trees, and 89 per cent. of hard woods. 48 per cent. is *Hochwald*, 52 per cent. *Niederwald*. The rotation is one hundred and twenty years on 4 per cent., one hundred years on 10 per cent., sixty years on 6 per cent., forty years on 4 per cent., thirty years on 2 per cent., twenty-five years on 2 per cent., and fifteen years on 1 per cent. of the whole area.

Of the product, 19 per cent. is in timber, 25 per cent. lumber, 55 per cent. fire-wood, and 1 per cent. bast from the linden. Of the fire-wood, 2 per cent. is yielded by the coppices; from this, the tan-bark has been stripped.

103. EGYPT.—Though not by any means a timbered country, Egypt has an extensive sylvia of native and introduced trees, among which are those from a wide range of latitude.

The ornamental and forest trees embrace the *Acacia nilotica*, which is quite common in Egypt and the Upper Nile, sometimes forming forests. It is planted along the irrigating canals. This tree yields the gum-arabic of commerce. The wood produces charcoal, and is used for agricultural implements.‡

*Statistische Daten aus den ungarischen Staatsforsten, Verlag des kön.-ung. Finanz-Ministeriums, Buda-Pesth, 1873.

† Die Productionsverhältnisse der königlich-ungarischen Fondsdomänen-Forste, verfasst von Alexander Hoffmann, k. u. F. D. Forstmeister, etc., Karte, 10 Beilagen, Buda-Pesth, 1873.

‡ Siemoni, vide ante.

Pinus halepensis.—This magnificent conifer is adapted to the warm climate of Egypt. Large trees are to be seen about Cairo. The wood is valuable for building. The *Casuarina*, from Mauritius, is a tall tree, that was introduced in the reign of Mehemet Ali. About Cairo are plants 60 and 70 feet high. It also succeeds well on the sands of the Isthmus of Suez. There are already large specimens at Ismailia.

The "American oak"* has been naturalized in Egypt, and succeeds at Cairo. There are large specimens at the Garden of Choubiak, which fruit annually, and thus this valuable tree is being rapidly increased.

The *Cocos flexuosa*, a palm from the tropics, has been introduced, grows vigorously, and makes a beautiful tree.

The *Tamarix orientalis* reaches a height of 45 feet. It is planted along the roads and as shelter-belts against the sands of the desert. The wood is used for charcoal.

The *Robinia pseudo-acacia* does not seem to thrive well, and makes only a low tree, cultivated in gardens as an ornamental for its fragrant flowers.

Several trees are grown for cabinet-making and for use in the arts. Among these are the *Acacia melanoxyton* and the *Dalbergia melanoxyton*, native of the Upper Nile; have been introduced into Egypt about Cairo; the wood of the latter is beautiful and useful.

The *Santalum album* about Cairo attains a good size; flowers and fruits every year. The wood is esteemed on account of its agreeable odor, to make fancy articles, and for carving.

The *Cedula odorata* has been introduced to a limited extent in the gardens of the viceroy. The wood is known as cedar and is used for cigar-boxes.

The *Swietenia mahogani*, a tall tree of fine foliage, was introduced in the reign of Mehemet Ali, and has already attained the size of the largest trees of the country. It is not yet disseminated, and is found only about Cairo.

Cupressus pyramidalis, *Fraxinus*, *Chloroxylon*, *Diospyros*, and other naturalized species, are used by the cabinet-makers.

The *Acacia lebbek* is an elegant tree of persistent foliage, planted along the roads and avenues; the heart-wood is black like ebony, and is used for agricultural implements.

The *Tectona grandis*, the teak, with its large and beautiful leaves, will be very ornamental for avenues when more largely propagated; the value of its timber in naval architecture is well known.

The *Ficus bengalensis*, the banyan or pagoda tree, has a large multiplex stem, formed of the adventitious roots united together, and enlarging the trunk.

The *Platanus orientalis* has been planted in the gardens of Cairo and Alexandria; the wood is valuable.

The famous *Eucalyptus globulus* was introduced some years ago by

* The species I have not identified.

Gastinel Bey, and, with some other species from Australia, succeeds well.

Among the poplars, our own *P. canadensis* is highly esteemed. Other American plants that have been successfully introduced are the *Catalpa*, valued for its blossoms, and the *Magnolia grandiflora*.*

104. Dr. Charles Beke, in the Athenæum, writes from Cairo, June 24, 1874, that there were 2,500,000 trees in cultivation in 1860, and now 5,000,000 had been planted. He found trees along the road, and planted so extensively as to give the appearance of a well-wooded country.

Already, there seems to be a change of climate as a consequence of the increased tillage and forest-culture. He says, "Egypt is fast losing its proverbial rainless character;" rain has begun to be felt an annoyance at Alexandria, and is markedly increasing at Cairo, where Dr. Beke enjoyed "four-and-twenty hours of rain, as heavy and continuous as any in London; in fact, a regular English wet day."

105. ALGERIA.—The forests cover 1,440,000 hectares, of which 800,000 belong to the state. The rest is held by private individuals, by the communes, or remain as commons, (*terres de parcours*.) The portion covered with the wild olive has been assigned to cultivation.

The following statement, taken from the special catalogue of the products of Algeria prepared for the minister of the interior of France for the Universal Exposition at Vienna, 1873, shows the characters of several kinds of woods, and the area occupied by each :

Cork-oak, (<i>Quercus suber</i>)	797, 203
Chestnut-leaved oak, (<i>Quercus castaneifolia</i>)	98, 568
Aleppo pine, (<i>Pinus halepensis</i>)	496, 964
Cedar, (<i>Cedrus atlantica</i>)	788, 570
<i>Quercus ilex</i> , var. <i>ballotta</i>	249, 435
<i>Thuja</i>	133, 101
Elms, ash, willow, poplar, tamarix	8, 640
Evergreen oak	1, 298, 726
Wild olive	74, 578
Bushes, various kinds	220, 023

The leading products of these forests which enter into trade are cork, timbers, worked lumber, such as parquetry, resins, and tanning-materials. Of cork, it is estimated that the eastern portion of Algeria contains as much as all the rest of the world, and of superior quality. In 1872, the export of cork amounted to 5,426 tons.

The different species of oaks furnish the building-timbers. The *Quercus ilex* and the *Q. Mirbeckii* are the most valued. The latter is superior in density and strength to the oaks of Europe. So, also, the *Q. castaneifolia* furnishes excellent lumber for ship-building and other

* For the items of this section, I am indebted to the admirable "Catalogue raisonné" of an agreeable jury-colleague, M. Dilchevalerie, Directeur de l'École Vice-Royale d'Agriculture de Caire, etc.

purposes. The holm-oak (*Quercus ilex*) and the *Mirbeckii* (Zeen) could be used to advantage in the manufacture of furniture.

The cedar is equally adapted to joinery and for building. When used for the lining of furniture, the odor prevents the inroads of insects. The wood of the southern ash (*Fraxinus australis*) is superior in beauty and quality to the ash of Europe, so much esteemed by wagon and carriage makers.

The Aleppo pine (*Pinus halepensis*) rises to a height of 60 feet; might supply the deal which France buys from other lands.

The Thuja, *Callitris quadrivalvis*, has an established reputation. Furniture made from the knots is wonderfully beautiful and universally admired. The olive (*Olea europæa*) is very common. It is used in the preparation of choice furniture, and also in carriage-making.

The *Ceratonia siliqua* and the *Pistacia atlantica* are also very suitable for the cabinet-maker. The latter is especially adapted for cog-wheels. The other woods used in cabinet-work and for inlaying are the Phœnician juniper; for boxes, the jujube; the lemon especially for fancy-work; and pipes are made from the roots of broom.

But it is not yet sufficiently known how important a part is to be played in this branch of manufactures by the *Quercus ilex*, var. *ballotta*, which is spread over the surface of 100,000 hectares in Algeria, where it acquires a great size. The wood is of a beautiful deep red, black at the heart, with brilliant layers of fine and close grain; taking a most perfect polish, retaining the varnish, it must become prominent in the manufacture of furniture for dining-rooms and libraries, for wainscoting, and for parquetry.

106. FRENCH COLONIES.—GUIANA.—Guiana is one of the richest countries in the world in woods for cabinet-work, for building, and for wagons. Certain species possess elasticity and durability in a remarkable degree, as will appear from the following table:

Kinds of wood.	Comparative numbers, oak as a unit.		Loss of strength after lying six months in the dung-heap. (Jucmier.)
	Elasticity.	Resistance to fracture.	
Common oak, France	1. 000	1. 000	Per cent. 0. 354
Tenk, superior quality	2. 000	1. 920	0. 164
Tender, India	1. 000	1. 330	0. 25
Angelique	2. 250	1. 820	0. 05
Coupi	1. 560	1. 660	0. 0
violet	2. 250	2. 650	0. 0
Wacapou	2. 000	2. 000	0. 0
Walata	3. 325	3. 150	0. 10
Courbaril	4. 000	2. 825	0. 124
Taoub	2. 008	2. 000	0. 313
St. Martin	2. 000	2. 325	0. 113
Black cedar	1. 820	2. 325	0. 235
Beech, injected in France	1. 420	1. 100	0. 30
Poplar, injected	0. 665	0. 830	0. 10

French Guiana extends from the river Maroni to the Amazon, and measures about 72,000 kilometers. The interior is covered with extensive forests. Angelica-wood is considered superior to teak for the broadsides of sheathed vessels; it rates high in the preceding table.

107. MARTINIQUE contains about 20,000 hectares of wood suitable for building, cabinet-ware, and wagon-making, but the means of transportation are deficient, so that the most valuable materials are often reduced to charcoal with little profit.

108. GUADELOUPE, one of the Lesser Antilles.—The forests cover the mountainous parts of the island to the extent of 40,724 hectares, which produce abundantly of material that is admirable for cabinet-ware, though as yet it is little utilized. There are also many species well adapted to carpentry and other arts. The timber should be cut in January or August, and immediately stripped of the bark and split through the heart.

109. SENEGAL.—This country does not produce any considerable quantity of wood, though some of its shores are covered with *Acacia Adansonii*, suitable for ship-building; but this is not the case with the French station at the mouth of the river Casamanza, on the west coast of Africa, whose forestal resources are immense.

Besides Senegal, France has other possessions on the west coast of Africa, among which are Gaboon, under the equator, and establishments on the Gold-Coast. The forests of Gaboon are very rich, but are little used. The export of sandal-wood and ebony amounts to 25,000 tons annually.

110. NEW CALEDONIA is in great part covered with forests containing woods well adapted to cabinet-work and wagon-making.

111. OCEANICA.—The woods of Tahiti and its dependencies contain few species, which are only used in the country. Several kinds have been introduced from other lands.

CHAPTER IV.

ESTATES OF LANDED PROPRIETORS.

THE VIENNA JOINT-STOCK COMPANY; FOREST-AREA; TOPOGRAPHY; CLIMATE; FLORA
ADMINISTRATION.

112. THE VIENNA JOINT-STOCK COMPANY FOR FOREST-INDUSTRY.—This company made an exhibit of the productions from their extensive estates in Lower Austria, situated near Waidhofen, on the Ipps River, at Gaming, and in other smaller tracts.

The possessions cover 27,330 hectares, of which 24,907 hectares are in forest. This property is situated in the mountainous parts of Lower Austria, extending from Zellerhütten, near Mariazell, in the east, along the Alpine range which forms the border of Styria, to the line which separates Upper from Lower Austria. Of course, much of the surface is very elevated, and the mountain-peaks are nearly 6,000 feet above the level of the Adriatic sea. The valleys are high; the market-town of Scheibbs being 1,046 feet, and other places are higher, till you reach Neuhaus, which is 3,168 feet above the sea. The slopes are sharp and steep, and cliffs rise in abrupt precipices.

The Ipps and the Erlaff flow for many miles through the estate. The former from Neuhaus, below Zellerhut, flows seventeen miles to its confluence with the Danube at Stadt Ipps, with a very rapid descent; the total fall from the source to the Danube being 3,526 feet.

113. *Climate*.—In the valleys, spring opens in April, while the snow continues to cover the mountains, where the pastures can seldom be used before the 25th of June, nor later than the 29th of September. The first snows fall in the mountains in the middle of September; but in the valleys they do not occur until the middle of November, or even as late as December.

At Waidhofen, they have 108 rainy days and 30.5 snowy, yielding 32.6 inches of rain and 67 inches of snow. They have 21 days that are perfectly clear.

Forest-vegetation seldom begins earlier than May 15 on the mountains, when the snow is often from 6 to 12 feet in depth, forming drifts of from 20 to 30 feet, and often remaining until July and even till August. Snow and sleet frequently damage the trees quite seriously. The heaving of the soil with repeated thawing and freezing, particularly where exposed to the sun, injures the young trees, so that it is often difficult to reproduce the forest in such places. This is the explanation of the great difference observed in the appearance of the forests between

the shady and the sunny sides of the mountains. The southern slopes, with all possible care, will often remain bare, while on the shaded sides the clearings reproduce their growth in spite of the browsing of the cattle.

Elevations of forest-growths.

	Lower, feet.	Upper, feet.
Pines.....		2, 200
Beech.....		3, 000
Fir.....		3, 000
Larch.....	1, 000	3, 200
Spruce.....	1, 000	4, 500
Mountain-pine.....	2, 000	5, 500

The pines (*sylvestris*) are found on the southwest and south sides; the beech usually on the east and northeast; the fir is found highest on the southwest, south, and southeast; the larch is found higher on the north and northeast slopes than on the southerly or westerly exposures; the spruce reaches its greatest elevation on the western, southwestern, and southeastern situations; the mountain-pine is found at its highest limits on the southwesterly, westerly, and southerly exposures.

Among the trees, the larch is especially the species for the high mountains and for northern exposures; its elasticity and its strong roots enable it to withstand the wind-storms; a stony but humose soil is suited to it, and particularly the limestone formations. For the first twenty years, the larch grows rapidly, but afterward the spruce overtakes it. In a forest of eighty years old, the larches will have an average diameter of 12 to 18 inches, while the spruce measures only from 9 to 12 inches.

The excellence of the larch timber is well known and universally admitted, and may be rated as equal in value to oak. The influence of the situation upon the quality, however, is greater than with other kinds of trees. The mountaineers are so well aware of this that they speak of the *joch*, the *grass*, and the *stone larches*. The *joch*-(field-) larch has a dark-red wood which is soft and brittle, with little power of resistance, and is the least durable. The grass-larch from the lowest part of its native zone, grown on firm soil, has small rings of growth, a pale yellow-brown color, and rates in value with the spruce. The stone-larch bears the palm, and, when grown in its favorite mountain home, it has decidedly yellow-brown wood, with strong, dark, and hard rings, and in this character it supplies the place of oak to the alpine people.

The fir is not particularly desirable in these mountains. It is branching and knotty, so that the boards are inferior. It is rarely found alone, but usually mixed with beech.

114. *Forest-management*.—On these estates, natural reproduction is the rule. Conifers abound, hence the *Hochwald* prevails almost exclusively. The beech seeds itself more frequently than other trees, and

comes naturally in places suitable to it; but this is not objected to, as the wood is valued, especially for fuel and for coaling.

Artificial reproduction is practiced where the natural process is unsatisfactory or slow. It has many advantages, especially in the mountains, in its quicker and more satisfactory results.

The sunny side is not favorable for the seed-beds. The young plants may thrive the first year; but he who expected to find them in good condition the following spring would be disappointed, for they would be heaved out of the ground by the repeated freezing and thawing. Besides, the sun's rays fall too directly upon these slopes for the successful germination of the seeds; hence the shady side is preferred. This is shown us by nature's indications; the intelligent forester will observe that he finds most young plants in a clearing sheltered by the stumps and large stones, where they are protected from the direct rays of the sun, from the sharp winds, and drowning floods, as well as from the tramping of cattle at pasture. These indications should be our guide in the selection of the site for the nursery of seedlings, and this method of stump-seeding deserves consideration on all the exposures of the high mountains. Therefore, when any elevated tracts have to be planted, the reproduction will be quick and certain if this hint be observed and followed.

In alpine regions, there is another practice which has proved very satisfactory; this consists in burning over the clearing; the rubbish is gathered and burned, and one or two crops of grain are taken, or, where grain will not ripen, at least a cattle-fodder-crop may be cut from this fallow ground. Good rye has been grown at an elevation of 3,500 feet on these burned tracts, and the poor woodman is thus rewarded for his labor. A light sowing of forest-tree seeds with the grain is often followed by good results. The intelligent forester will select the method he thinks best adapted to the circumstances by which he is surrounded. Sometimes he may even prefer the "hill-planting," which consists in setting the little tree upon the surface of the ground and piling mellow earth about its roots; this is practiced in wet and boggy lands.

Tuft-planting, three or more in a place, is found to furnish security from both sun and frost; nor are these bunches so apt to be damaged by the browsing of game as trees set out singly, and they shade the ground sooner, which is a matter of great importance, as it encourages the rapid growth which is desired by every forester.

It is, however, a mistake to plant too thickly in the high mountains; the trees should be at least six feet apart, to give room for the snow, which might smother them. Thick sowing and close planting are liable to suffer beneath the snow-drifts, especially on mountain-slopes which lie to the west and north, where the snow accumulates in great quantities. Nor can the same regularity be maintained in setting out as in the level country.

Instead of extensive nurseries, as practiced in the lowlands, the mount-

ain foresters have smaller patches, at convenient distances from the land to be planted; these are called seed-camps, (*Saat-Kampen*), and obviate the necessity of laborious transportation, at the risk of exposing the roots of the seedlings. For this purpose, a small level place of from 20 to 30 quadrat-klafter (say 100 square yards) is selected; from this the stones and roots are cleared off, the grass and rubbish burned, and the soil stirred in the fall. Next spring, the seed is sowed in rows from 12 to 18 inches apart, and must be protected from birds, mice, and insects.

In the fall, the plants must be covered with moss. Cultivation is begun after the snow has disappeared and the weather is settled; but it is unwise to begin operations too early, lest the germinating seeds be nipped by late frosts. The sowing should not be done till the nights are warm, when they will quickly germinate; and the plants do best if the seed be sown in the month of May or early in June. The transplanting may be done even after the young shoots have appeared, but care in handling the young trees is necessary.

These points, of the situation of the estate, and the practical management of the forests, with much other detail respecting the business of the company, are contained in a brochure which accompanied their extensive exhibition of material at the Exposition. It is called "Die Ausstellung der österreichischen Actien-Gesellschaft für Forst-Industrie in Wien auf der Wiener Welt-Ausstellung, 1873. Verfasst von der Forst-Direction."

115. SCHWARZENBERG FORESTS AT WITTINGAU.—The following memoranda show how carefully the forests on some of the estates have been guarded for centuries.

These are selected because opportunity was afforded for observing parts of the Schwarzenberg domains; and they can be taken as samples of others which may be quite as good.

In the basement of the family-mansion at Wittingau, in Bohemia, was a large fire-proof room, filled with archives embracing a history for the centuries that this property has been in the possession of the family of its present princely owners.

In many respects, this was an exceedingly interesting collection; but for our present purpose it was particularly valuable for the accounts of the forests and other improvements of the lands.

From these archives, it appears that even in the fourteenth century a careful oversight of the forests was exercised.

With the increase of the people, the forest-master found it necessary to regulate the forestal privileges and pasturing; to determine the boundaries of the forest-range; to charge them with rents; and to sell off pieces of woodland so as to reduce the soil to cultivated fields.

The first notice of wood-sales is given in 1409, when it is stated that 20 schock of groschen were paid to the Wittingau official for wood.

In 1523, the woods were divided into separate districts, or tracts, and most of the names then applied still serve to designate the reviers, or divisions, of the forest-land.

Measures for the preservation and melioration of the forests began to be taken at the end of the seventeenth century. At the same time, certain pieces of wood were cleared and turned into farms and meadows. The wood was mostly burned and the ashes sold. The drainage of the morasses near Wittingau and Borkowitz was also begun at this time.

The oak was a great favorite with Prince John Adolf the First, and it appears that he ordered the people "to plant acorns in inclosures, to transplant the young trees at four and five years old, and to establish fine oak-woods." Being well aware that this would require time, he exhorted them to go on with the work; "though the trees would not reach perfection for many years, let not this discourage you, but remember that we are working for posterity rather than for the present generation."

The numerous magnificent and beautiful oak-trees now to be seen at Wittingau are the living and silently eloquent witnesses of the correctness and wisdom of the views contained in these citations from the family-archives.

In 1703, the woodlands of this estate were divided into seven tracts, or circles, (*Reviere*s.)

From 1715 to 1730, new forest-ordinances were issued; goats were forbidden to pasture in the woods, and young trees were not allowed to be cut.

In 1748, it was ordered that no more May-poles should be cut, and birch-saplings were no longer to be taken for the celebration of the holiday of Corpus Christi.

In 1769, the authorities directed that the forests should not only be strictly preserved, but that they should also be carefully nursed and cultivated or encouraged.

With this view, experiments were then first made in the use of turf for fuel; and, as this substance abounds in the extensive morasses, these wastes began to be drained for tree-planting in 1776 to 1783.

In the beginning of the present century, thorough surveys and descriptions were made, and the boundaries were definitely settled by practical engineers.

The drainage near Wittingau was carried on vigorously, so as completely to change the character of the soil and its productions in the morasses of Hrolorezer, Borer, and Gratzner. Next followed the drainage of Borkowitz, with the preparation of the turf for fuel. It is remarkable that none of these improvements were required by a scarcity of wood, but they were conducted for the sake of the future betterment of the forests. There was then no systematic utilization of the forest-products, and there was an abundance of fuel because of the limited demand which was long felt.

A demand had to be provided; except the glass-house at Sachenthal, there was no market for wood within reach.

In 1830, attempts were made to encourage other similar establishments; but they failed on account of deficient means of transportation.

The water-ways to reach a more distant market with the wood required great outlays for their improvement. When these were opened, dealers were attracted, and a large trade was opened for the products of these well-preserved woodlands; and from that time the cultivation and management of the forests have been perfected and brought up to the standard of the best modern practice.

116. The forest-area now amounts to 25,688 joch, 32,110 acres of wood land, and 1,007 joch of clear or cultivated soil.

The annual increase is rather more than three-fourths of a klafter per joch, equal to 52 cubic feet, or 3.4 cubic meters per hectare.

As to the land, the subsoil has sand, gravel, and clay, with some lime and iron, so that the water of the marshy places is obnoxious to vegetation. The top-soil is in great part boggy and peaty; the rest is sand, sandy clay, and stony clay, a tertiary formation.

These varieties of soil are accompanied by a great difference in the growth and species of trees, which is especially the case in the boggy land, particularly where it has been meliorated by exposure to the air, so that there is an advance in the annual yield from nothing to two klafter per joch.

The poorest growth is found on hungry sand, and on deep, boggy soils that are not drained, or insufficiently drained, while the best growth occurs on the drained and improved bogs and on deep, humose clays.

On the large bogs, not yet drained, and where it has not been possible to introduce improved forestry, the *Pinus uliginosa* * is the leading product.

The surface is generally level, except near the Moldau. The plains are higher to the west, where they form the water-shed between the Moldau and the Luschnitz.

Most of the trees are conifers, and chiefly the Scotch pine. The planting of oaks has greatly increased in the recent decades, wherever the soil is suitable. The bog-pine (*Pinus uliginosa* or *mugho*) is abundant in the swamps. It differs from the sprawling *Pinus montana* in its erect growth, and from the *sylvestris* in its compact habit. Though a small tree, it is useful. The swamp-birch (*Betula pubescens*) abounds in the marshy lands, and is short-lived.

Next to the bog-pine comes the common pine, at first mixed, then alone, or nearly so. This species is found on the thinner portions, where the bog soil is not so deep.

The Scotch pines are not so large nor so thrifty as in some other soils, but some portions look well and furnish good logs; the trees grow high enough, but are not large.

The spruce and oaks are not found on the marshy tracts; but the latter grow very well on the higher flats of the bottoms of the Alsbach, which are occasionally overflowed.

The sandy ridges, poor in humus, produce only a slender growth of the pine, while upon them the oaks never reach perfection; but on deep

* *P. mugho*, Bauhin, or *P. uliginosa*, of Wimmer.

sandy land, well supplied with humus, the spruce, pine, and oak form very fine forests, in which also are found beech and linden, and occasional aspens and birches are to be seen doing well.

The stony loams are the favorite localities for the spruce-trees, which are planted alone, and produce ship-timbers. The *Quercus sessiliflora* is the favorite oak, and predominates, producing tall stems without branches or knots when they are planted with pines; but it does not compare in size or strength with the common form, (*Quercus pedunculata*), which requires more space, and, branching lower, gives less length of log; both kinds are produced on the plains about Wittingau.

During an excursion of the Bohemian Forest Society to these estates in 1863, the following measurements were taken:

Oaks measured at Wittingau in 1863.

Diameter in inches.	Height in meters.	Contents.	
		Cubic klafter.	Cubic feet.
96	26.46	24	1,663
102	-----	25½	1,767
72	-----	16	1,108.8
84	-----	19	1,316.7

Among the injurious climatic agencies affecting these forests, the north-westerly, westerly, and southerly winds are most dreaded by the foresters; for not infrequently trees are destroyed in a few minutes even in sheltered or protected woods. The frosts often seriously injure the roots of the young trees. Insects, also, are injurious; the pine-moth (*Tortrix dorsana*) is frequently seen; beetles are troublesome, small and large; the May-bug and the mole-cricket are common; and the oaks are affected by the *Tortrix viredana* and the *Cerambyx heras*.

The Saxon system of management has been adopted, and at Wittingau the forests are divided, according to their age, into—

Classes.	Age.	Proportion.
I.....	From 1 to 20 years	16.3
II.....	From 21 to 40 years	19.2
III.....	From 41 to 60 years	17.8
IV.....	From 61 to 80 years	14.8
V.....	From 81 to 100 years	17.2
VI.....	Over 100 years	14.7
		100.0

Of these, 19 per cent. belong to the first three classes; 56 per cent. to the fourth; and 25 per cent. to the fifth and sixth classes.

The forest-territory is divided into 17 reviers; of these, Hrdlovez, Schloss, Cep, Kollenetz, and Wall are adjacent, and comprise a forest-complex of 19,093 joch, or 23,866 acres, extending from the south to the north, along the eastern boundary of the demesne. The reviers are subdivided into regular sections of similar area for the convenience of their cultivation, management, felling, &c. The forests are surveyed

every ten years, and the portions to be successively cut are then indicated.

117. ESTATES IN BOHEMIA.—The following notices of the general tenure of lands in Bohemia, and especially of some large estates, will give an idea of the care with which the forests are guarded by the landed proprietors.

The tables, and indeed all the facts, have been taken from a pamphlet accompanying the collective exhibition by the kingdom of Bohemia, made at the Vienna Exposition. It was prepared by A. E. Ritter von Komers.*

Tenure.	Agricultural.	Forest.	Unproductive.	Total.
Feudal.....	1, 387, 116	2, 276, 764	156, 735	3, 822, 610
" Rustical".....	6, 670, 390	615, 580	189, 645	7, 465, 015
Total acres.....	8, 057, 506	2, 892, 344	346, 380	11, 285, 625

The total of the feudal properties, 3,822,610 acres, is divided among 1,086 estates. Of these, 350 hold less than 1,250 acres; 212 have from 1,250 to 6,250 acres; 53 have from 6,250 to 12,500 acres; 33 have from 12,500 to 25,000 acres; 14 have from 25,000 to 37,500 acres; 5 have from 37,500 to 50,000 acres; 5 have from 50,000 to 62,500 acres; 4 have from 62,500 to 75,000 acres; 3 have from 75,000 to 81,250 acres; 1 has from 81,250 to 87,500 acres; 1 holds over 87,500 acres.

On the other hand, there are estates graded in regard to size, as follows: 552 places of less than 1,250 acres; 360 places of from 1,250 to 6,250 acres; 108 places of from 6,250 to 12,500 acres; 50 places of from 12,500 to 25,000 acres; 7 places of from 25,000 to 37,500 acres; 5 places of from 37,500 to 50,000 acres; 1 place of from 50,000 to 56,250 acres; 1 place of from 56,250 to 62,500 acres; 2 places of more than 62,500 acres.

The following shows the number of estates held by the land-holders: There are 536 persons who hold but one estate; 69 hold two estates; 23 hold three estates; 21 hold four estates; 7 hold five estates; 8 hold six estates; 5 hold seven estates; 4 hold eight estates; 4 hold nine estates; 3 hold ten estates; and 1 holds more than ten properties. A few of these domains will be mentioned more in detail.

118. Count Franz Thun's domain embraces—

Tetschen	25, 189 acres.
Freehold Perac.....	4, 264 acres.
Freehold Gros Zdikau.....	11, 201 acres.
Freehold Skalicz and others.....	605 acres.
Total.....	41, 259 acres.

* *Skizzen über die Verwaltungs-Organization von Grossgrundbesitz-Complexen in Böhmen.—Als Beitrag zur land- und forstwirthschaftlichen Collectiv-Ausstellung des Königreiches Böhmen auf der Welt-Ausstellung in Wien, 1873. Prag, 1873.*

119. *Tetschen*.—Of this, the forests cover 19,140 acres, and most of this is an area of 17,347 acres, bounded on the east by the Elbe; the rest is scattered in parcels over the estate. These woods are divided into ten reviers.

The formation is quaternary sandstone, with some basalt. The surface of the great forest is mainly composed of slopes to the north, south, and southeast. The soil on the sandstone is somewhat stony, on a sandy loam, with sufficient humus in the valleys. On the basaltic rocks, it is stony but rich. Since the elevation is from 350 to 2,300 feet above the sea, the climate is favorable, in the lower parts adapted to deciduous trees, but on the elevations only spruces are produced. Conifers are the leading sorts, chiefly the spruce alone or mixed with firs, pines, and beech of various ages.

The Scotch pine is next to the spruce in respect to numbers. It grows both mixed and in masses by itself, especially on the dry, sandy southerly slopes near Tetschen. The fir is seen only in the valleys in scattered groups, especially on the basaltic soils; the larch and *Pinus strobus* appear in small patches.

Beech is most numerous among the deciduous trees, and is not only found in a liberal mixture with the spruce, but also in extensive woods alone in some of the reviers. There is not much oak, maple, nor ash; but care is now taken to increase these kinds where they will not be injured by game. The rotation is usually about one hundred years. The reproduction is commonly that following a clean cut, either natural growth or by seeding.

Classification.—A portion is divided as follows as to age:

Classes.	Years.	Acres.
I	1 to 20	3,288
II	21 to 40	2,235
III	41 to 60	2,439
IV	61 to 80	3,784
V	81 to 100	3,736

About 185 acres are felled annually, yielding a total of 17,025 klafter, or 1,123,650 cubic feet, being an average of 6,074 cubic feet per acre.

The lumber is mostly sold to dealers, who take it by the Elbe; and much of the fire-wood goes to market in the same way. The inferior wood and the stumps and roots are made into charcoal for the Saxon iron-works.

The production may be divided thus: soft woods—lumber, 71.6 per cent.; fire-wood, 28.4 per cent.; hard woods—lumber, 18.6 per cent.; fire-wood, 81.4 per cent.

Annual production.—Ship-timbers, 25,872 cubic feet; building-timbers, 201,432 cubic feet; tan-bark, spruce, 22,968 cubic feet. Each acre of a clearing will average, if spruce, fir, and beech, of one hundred and fifteen years, 17,417 cubic feet; if Scotch pine, at seventy-five years, 3,365 cubic feet.

120. *Forest-culture*.—Since 1785, surface-drainage by open ditches has been extensively carried on. Since 1830, 48,000 running-klafter have been dug.

Planting and seeding are both practiced; in the former, the plants are grown in home nurseries, and set out at one and two years old; latterly, good results have followed from transplanting spruces at one year. As a rule, the planting is in rows; on good soil, the rows are 6 feet wide and the plants set 3 feet apart; on thinner soils, the rows are 5 feet apart and the plants from 2 to 2½ feet apart. The seed rows, or beds, are from 18 inches to 2 feet wide; and the plants should stand from 4 to 4½ inches apart.

The annual planting amounts on the average to 175 acres, consisting of conifers from 450,000 to 500,000; deciduous kinds, 12,000 to 14,000; seeds sown annually, 350 to 400 pounds.

These forests are damaged by the game gnawing and peeling, by the *Cureulio pini*, and by snows and sleet, as well as by occasional storms of wind.

In January, 1834, 42,625 trees were prostrated; also, in 1868, there was a widely-extended storm in Bohemia that destroyed 4,194,515 cubic feet of wood in this forest.

Fishery.—Within the forest, there are nine ponds and mill-dams for the saw-mills, where trout are bred in large numbers; these fish abound also in the brooks.

121. *Peruc*.—This estate has been enlarged by successive additions within the present century. The forests are not large, and are divided into two reviers; a part is *Hochwald*, with eighty years rotation; part *Mittelwald*, with thirty years; and part *Niederwald*.

Species grown: chiefly the Scotch pine, and oak; then spruce, beech, larch, and birch mixed together.

122. *Gros Zdikau*.—This extends westwardly to the bounds of Bavaria, joining the state-forests; eastward and southward it joins the estate Winterberg, (Schwarzenberg's.) The elevation is considerable, and the mountains form the water-shed between the North Sea and the Black Sea; the Moldau descending to the one and the Daube to the other. The mountains rise to more than 4,000 feet.

Gneiss abounds, and the soil is good, a stony loam; but the climate is unfavorable; the winters are long and severe; the summers cool, so that vegetation often suffers from late frosts and from the early approach of winter; snows do considerable damage. The storm of December, 1868, destroyed 30,000 klafter of wood, and that of October, 1870, 90,000 klafter.* Spruce is the leading forest-tree on these elevations; fir and beech, however, take a very prominent rank. The Scotch pine is seen only about Gros Zdikau, mixed with spruce and fir; the mountain-pine is found on the high moors. Maple, ash, birch, aspen, &c., are occasional.

* A cubic klafter is equal to 66 cubic feet, rather more than half a cord.

Age-classification.

Class.	Years.	Acres.	Estimate.
			<i>Cubic feet.</i>
I.....	1 to 20.....	2,562	807,840
II.....	21 to 40.....	1,185	1,414,320
III.....	41 to 60.....	1,928	4,271,160
IV.....	61 to 80.....	725	2,380,140
V.....	81 to 100.....	286	1,118,100
VI.....	Over 100.....	2,289	14,733,300
		1,030	552,300
Totals.....		10,005	25,277,160
Besides from scattered trees.....			48,000
			25,325,160

Under the present management, with a rotation of one hundred years and a clearing of 72 acres annually, the product should amount to 522,000 cubic feet. The proportions are: Of soft wood, timber, 39 per cent.; fire-wood, 61 per cent.; of hard wood, timber, 34.3 per cent.; fire-wood, 65.7 per cent. Of the timber, nearly 3 per cent. is made into resonance-boards; the mass of fire-wood is used by the glass-houses, which consume more than three thousand cords annually. A large quantity of stump-wood is made into charcoal.

The reproduction is chiefly done by planting, a small part by seed; the plants are set 6 feet by 3 in rows. In the decennial 1866 to 1875 they are planting 153 acres each year, using about 2,150,000 plants, and 6,000 pounds of seed; of these, the largest proportion is spruce.

The nurseries occupy $3\frac{1}{4}$ acres, and furnish 400,000 two-year old plants annually.

123. *Skalicz*.—The freehold of Skalicz, lying near Zdikan, was purchased in 1862 by the present proprietor, for the sake of clearing off some troublesome servitudes on his other possessions.

The surface is mountainous; it lies chiefly on the right bank of the Volinka, and, being so near the Boehmerwald, the climate is raw, except in sheltered valleys. The rock is gneiss and lime, and the soil tolerably good, according to elevation, better below; from 7 to 12 inches cultivable or surface soil.

There is not much forest, about 75 acres of *Hochwald*, chiefly Scotch pine, with some spruce and larch.

124. COUNT RUDOLF CHOTEK'S POSSESSIONS.—These embrace:

Weltrus.....	10,680 metzen	5 mssln.
Neuhof.....	19,059 “	3 “
Kélošic.....	3,143 “	13 “
Total.....	32,884 “	5 “

125. *Weltrus*.—The forests are divided into three reviers. The soil is sandy to loamy in different parts, and adapted to deciduous trees; a portion of one of the reviers is appropriated to the park, where oaks

prevail, partly alone and partly mixed with ash, maple, poplar, birch, and locust.

In the other reviers, the Scotch pine prevails, either alone or mixed with spruce.

There are 950 metzen *Hochwald*, 444 park, 335 coppice-wood, and 42 bushes and waste, (*Remisen*.)

The amount to be cut annually is fixed at 440 klafter, or 29,040 cubic feet. The planting in the park is with five and six year old deciduous trees; in other reviers, with one and two year transplanted conifers from the nurseries.

126. *Neuhof*.—The forests are divided into seven reviers; the soil is loose sand, varying to a productive loam.

The Scotch pine prevails; in some reviers alone; in others mixed with spruce, oak, and birch.

The pine reaches its perfection on the higher grounds in eighty and in lower places in sixty years.

In the total area of 2,650 acres, 2,125 is *Hochwald*; 197, coppice; 107.5, unproductive; deer-park, 195; aviary for pheasants, 25 acres.

The rotation is eighty and sixty years for the *Hochwald*, and thirty years for the coppice.

The annual production is limited to 2,137 klafter. The reproduction is effected by planting, and large trees are set to avoid damage by the game; these are grown in the nurseries.

127. *Bělošic*.—The forest-area of this estate amounts to 265 metzen, (7 miles,) of which but a small part is in conifers; it is chiefly oak-coppice, with a term of twenty years.

The yearly product is about 2,600 cubic feet, or $37\frac{1}{2}$ cubic feet per acre.

128. COUNT THEODORE THUN-HOHENSTEIN'S ESTATE CHOLTITZ.—This embraces, in farms, meadows, lakes, and forest, 6,055 acres. A portion, which is on the boundary between Bohemia and Moravia, is mountainous; the lower parts have a rich alluvium, stretching northward to the Elbe.

The hedge-rows and the plantations, beside the ponds and the wooded slopes, give the whole a park-like aspect. The forest is divided into four reviers; in all, 2,467 acres, chiefly *Hochwald*, in which fir is most abundant; next spruce and pine, then oak, and less birch. Home nurseries supply plants for the reproduction of the forests.

129. PRINCE MAX EGAN FÜRSTENBERG'S DOMAIN PÜRGLITZ.—Lying westward from Prague, this large estate of 84,125 acres has 66,750 acres in forest, divided into 25 reviers. A large portion of this was natural production of the previous century. Beech occupies the greatest extent, partly mixed with fir; then oak.

In some reviers, the forest is chiefly oak; in others, fir. Scotch pine comes naturally in the oak-woods. Spruce was a stranger here, but, in

later years, it is much extended; next to spruce and fir comes the pine, alone and mixed.

Within fifty years, the larch has been introduced with good success.

Among the deciduous trees, the beech, hornbeam, and oak are most common. Some birch and aspen are found. Maple, oak, elm, linden, and mountain-ash occur on the hilly places; alder, in the valleys. The forest may be divided thus: *Hochwald*, with spruce and fir, 34 per cent.; pine and larch, 33 per cent.; mixed deciduous and conifers, 18 per cent.; all deciduous, 13 per cent.; coppice, 2 per cent.

The oak succeeds remarkably well, alone, and mixed with beech and fir.

In 1867, the reckoning of the forest gave the following classes by age: Over 100 years, 7.8 per cent.; from 80 to 100 years, 7.4 per cent.; from 60 to 80 years, 12.2 per cent.; from 40 to 60 years, 18.5 per cent.; from 20 to 40 years, 18.1 per cent.; from 1 to 20 years, 28.6 per cent.; uncultivated and cleared, 7.4 per cent.

The average estimates of all these periods:

Hochwald.	Klafter.	Acres.
Fir and spruce.....	2, 066, 480	22, 776
Pine and larch.....	1, 670, 215	21, 149
Mixed deciduous and conifers.....	787, 795	12, 437
Deciduous.....	617, 270	8, 801
Coppice-wood.....	118, 415	1, 307
	<hr/> 5, 260, 175	<hr/> 66, 470

130. *Forest-culture*.—The spruce is largely planted; next come the pine, larch, and deciduous trees, of which class are oak, maple, ash, alder, elm, and locust. In the last three years, an average of 1,812 acres have been planted with—

Spruce, two to three years old, nursery.....	3, 400, 000
Pines, one year old, from seed-bed.....	1, 300, 000
Larch, two to three years, nursery.....	560, 000
Deciduous, three to six years, nursery.....	250, 000

Total	5, 510, 000
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Seeds sown in open ground, in rows, and seed-beds: fir, 40 hundred-weight; pine, 10 hundred-weight; fir, 200 metzen, (pecks;) acorns, 100 metzen; beech-nuts, 50 metzen; various deciduous, 20 metzen.

The seed-beds and nurseries cover thirty-two and a half acres.

There were used at the sowing 20 hundred-weight spruce; 10 hundred-weight pine; 5 hundred-weight larch; 50 hundred-weight deciduous seeds.

Four million and two hundred thousand seedlings are annually transplanted in the nurseries; and the average number of plants on hand is 12,000,000.

131. PROPERTY OF A. E. RITTER VON KOMERS, MOSTAU.—Situated near Eger, and on the Eger River, not far from the western border of

Bohemia. The surface is various, being in the valleys and on the hill-sides; so also the soil varies from a rich alluvium to sandy loam, underlaid by rock and clays, the latter of fine quality for pottery. The estate covers 965 acres, of which 302 are woodland.

The forests had been cleared off, and are now being reproduced with great care. Fir and spruce are the favorites, and, on poorer land, birch, pine, and larch are cultivated.

The plantations are being made chiefly on the clearings of the former woods. On the whole property, there is not a rod unfit for other crops that is not to be occupied by trees. Thirty thousand plants, large and small, are set yearly from the nursery, which has an average of 80,000 plants, and 15,000 more are purchased.

A hasty survey of these estates is all that can be given, and, indeed, all that could be obtained in a rapid transit by rail through parts of some of these properties; but the figures are reliable, and are given on the authority of A. E. Ritter von Komers, the Counsellor and Central Director of Estates for Bohemia.

CHAPTER V.

FOREST-SCHOOLS.

GENERAL ORGANIZATION OF SCHOOLS OF FORESTRY; GERMAN EMPIRE; PRUSSIA, BAVARIA, SAXON, WÜRTENBERG, BRUNSWICK, SAXE-WEIMAR, HESSE-DARMSTADT, BADEN; MINOR SCHOOLS; AUSTRIAN EMPIRE; SCHOOLS ESTABLISHED BY THE STATE; MARIENBRUNN, WEISSWASSER, ENTENBERG, KREUZ, HINTERBRUHL; OTHER EUROPEAN SCHOOLS.

132. FOREST-SCHOOLS.—Forestry is considered so important an interest in most parts of Europe that especial attention has been bestowed to advancing the proficiency of those who are to be engaged in the care of this branch of agriculture. Forest-schools have been organized in various countries, and sylviculture is taught in the agricultural schools. A brief notice of some of these establishments will now be given, so far, at least, as they were brought to my notice by the Exposition and its associations.

133. GERMAN EMPIRE.—Here, as might have been anticipated, the greatest attention has been paid to this kind of instruction.

In *Prussia*, there are two important forest-schools, one at Münden, the other at Neustadt-Eberswalde. The latter was founded in 1821, under the care of Alexander Humboldt. It has been presided over by Pfeil, by Grünert, and more recently by Dankelmann.

Here is situated the chief forest meteorological station of all Germany.

The course occupies two years and a half. There are a director and two professors, one of whom conducts the labors of the experimental station. Then there are a professor of natural sciences, with his assistant, a superintendent of the physico-chemical station, a teacher of zoology, a professor of botany, one of geology, one of mathematics and of jurisprudence, and finally one of architecture; making eight professors. This academy costs the state 12,500 thaler, equal to about \$9,375 annually.

Captain Walker, in his report,* refers to the admirable museum connected with this school. It is now under the care of Prof. Dr. Altum, the successor of the distinguished entomologist and author, Ratzeburg,† its founder. "It is rich in specimens of all sorts of birds, animals, and insects found in the forests, very neatly arranged. In case the animal or insect damages the tree, specimens of the branch, bark,

* Report of Forest Management of Germany, Austria, and Great Britain, by Capt. Campbell Walker, F. R. G. S., deputy conservator of Forests, Madras, India.

† *Die Waldrederber und ihre Feinde, oder Beschreibung und Abbildung der schädlichsten Forstinsekten und der übrigen schädlichen Waldthiere, etc.*, von Dr. J. T. C. Ratzeburg, Prof. Naturwissenschaft, Neustadt-Eberswalde, Berlin.

leaf, root, or cone, both in a healthy state and injured, are exhibited together, so that the student can see at a glance the nature of the damage, and connect it with the animal that causes it. Insects are shown in the several stages of their existence—larva, chrysalis, caterpillar, moth—with their erosions of the leaves, branches, stems, and bark of the trees.”

The school at Münden, in Hanover, was opened in 1866, having a director, with several professors and assistants.

The programme of instruction is like that at Neustadt-Eberswalde.

134. *Bavaria* has its famous “Central Forest Institute” at Aschaffenburg, founded in 1807, suppressed in 1832, and re-opened in 1844.* Its course embraces two years and a half. Its director, Mr. Stumpf, has associated with him five professors. The annual expenditure is about \$12,000, (24,000 florins.)

This is the source of the valuable labors of Dr. Ernst Ebermayer on the Physical Influences of the Forests on the Earth and Air,† a book which analyzes the results of all the meteorological forest-stations of Bavaria.

There are also subordinate schools in Bavaria at Weihestephana, and at Lichtenhof, near Nuremberg, where forestry is taught.

135. *Saxony* has its famous Forest Academy of Tharandt, of which the distinguished Dr. Judeich is now the worthy director.‡ This institution was privately founded in 1811 by the distinguished Henry Cotte, and became a government-school in 1816. The course embraces two years and a half, and its *personnel* consists of the director and four professors, with two assistants. The annual cost amounts to about \$9,000.

136. At Hohenheim, in *Württemberg*, well known as the famous school of agriculture, in 1820, two chairs of forestry were founded.

137. In *Brunswick*, at the College Carolina, there are also two chairs of forestry. The course occupies two years.

138. In the *Grand Duchy of Saxe-Weimar* is a forest institute, at Eisenach, with three professors. The scholastic term occupies one year and a half.

139. At Giessen, in *Hesse-Darmstadt*, the university has had two chairs of forestry since 1825, with a course of three years.

140. The *Grand Duchy of Baden* has erected two chairs since 1832 for teaching forestry at the Polytechnic at Karlsruhe, where the course is four years.

141. Most academies teach the principles of forestry, besides which there are numerous experimental stations.§

* Baierische Central-Forst-Lehranstalt in Aschaffenburg.

† *Die physikalischen Einwirkungen des Waldes auf Luft und Boden und seine klimatologische und hygienische Bedeutung*, von Dr. Ernst Ebermayer, Professor der Agriculturchemie, Geognosie und Bodenkunde, in der Central-Forst-Lehranstalt, Aschaffenburg, 1873.

‡ Herr Dr. Judeich was president of the jury that examined the exhibitions of forestry at Vienna.

§ For further information, the reader is referred to *Deutscher Forst- und Jagd-Kalender*, 1874, or to the *Allgemeine Forst-Jagd-Zeitung*, 1873.

In Germany, there are also many private associations in the interest of forestry, among which may be named the Association of Agriculture and Forestry, (Tedeschi,) established in 1837, at Dresden; a similar society at Heilbronn, in Würtemberg, founded in 1839; the Silesian Association at Gorkau, founded in 1841; the Forestal Company of the Harz, in Ballenstedt, founded in 1848.

The Society of Hils-Sollins is another such association, which published a bulletin in 1853.

The Forestry Association of the Palatinate of the Rhine, established in 1854; that of Saxony, founded in 1851; that of Baden, created in 1839, but re-organized in 1861.

The Society of Thuringia in 1870, and that of Gotha in 1854.*

142. AUSTRIAN EMPIRE.—In Austria and its dependencies, there are also many establishments where instruction in forestry is given more or less thoroughly; but it was to be observed that many of the leading foresters of that empire were either Germans or had pursued their studies at the celebrated and long-established schools of that country.

As there are extensive forests in Austria, it was natural that the government should have long ago established schools for the preparation of the officers under whose care they were to be placed.

143. One of the first was the Forest School of Mariabrunn near Vienna, established in an old monastery, in 1813, by Emperor Franz Joseph. This was re-organized in 1867, and has since been in a flourishing condition, with extensive museums, laboratories, a nursery, with the neighboring Wiener-Wald, for illustration, and a corps of excellent and devoted professors. The course covers three years. By a decree of April, 1872, this is to be united with the Agricultural College of Vienna, which is to have two sessions, one agricultural and one forestal. The new organization was to have gone into effect in October, 1874.

144. After personal inspection, I can indorse what Capt. Campbell Walker says of Mariabrunn:

"The museums and collections are particularly fine and interesting to the forester, especially the sections known as the 'Forst-Betrieb' and 'Ingenieur's Museum.' In the former are collected specimens of all instruments and appliances made use of in felling, squaring, sawing, carting, and preparing timber; models of saw-mills and machinery of all descriptions, from the rude and simple apparatus of former centuries, still in use in some of the remote mountain-forests, to the more effective, but at the same time more complicated, methods of modern times.

"Here, also, are plans of river-beds, improved and embanked for floating, models of sluices of all sorts, of dams and weirs for directing rafts in their course, and for catching the fire-wood which is floated in billets; accurate models of the rafts themselves, showing exactly how they are constructed; specimens of timber of all sorts, prepared in various ways.

* Siemoni, p. 35.

"The damage done by animals and insects to timber-trees is also exhibited here in a comprehensive manner."*

145. The Forest School of Weisswasser was founded in Bohemia in 1855. The course occupied two years.

146. In Entenberg, near Sternberg, is a middle forest school, established in 1852. In 1872, it had 42 pupils. The course continues two years.

A school was established by the state at Kreuz in 1860, called the Agricultural and Forestal Institute, with a three-years' course and five professors.

There is an elementary school of forestry and arboriculture at Hinterbrühl, near Vienna, founded in 1865, for training foresters practically. Another like it, at Schneeberg, was established in 1869.

Besides the chair of forestal science at the Polytechnic at Prague, there is one at the Technic Institute of Brünn, and that of Lemberg, in Galicia, one at the Academy of Mountain Affairs (*Montanistica*) at Leoben, and others have been established at Pibramm in Bohemia, at the Agricultural Institute of Tetschen in Bohemia, and at Grossau in Lower Austria.

147. In *Hungary*, also, there are forest-schools; one at Schemnitz was started in 1852, which is maintained at an annual expense of \$9,500.

The Austro-Hungarian empire also has many organized companies and societies in the interest of forestry, which must aid its progress; among these are: the Forestry Society of the Austrian empire, founded in 1852; that of Tyrol and Vorarlberg, re-organized in 1852, by fusion of the society of the South with that of North Tyrol, the association above the Enns existing since 1854; the Forestry Association of Manhartsberg in Lower Austria; the Vienna Joint-Stock Company for Forestry at Waidhofen on the Ipps, noticed in another portion of this report; and the Actien-Gesellschaft für Haupt-Industrie of the Innerberg, with its extensive domains of mines and forests on the borders of Styria, are among those which attracted attention.

Besides these are the Forestry Company of Styria and Carinthia, established in 1851; the Association of Moravia and Bohemia, since 1849; that of Moravia and Silesia, founded in 1845; the Society of Western Galicia, in 1850, at Cracow; and the Hungarian Forest Company at Gran, in 1851.

148. SWITZERLAND.—The confederation of the cantons established the Polytechnic School at Zürich in 1855. This embraces the following divisions: a school of building and architecture; one of mechanics; one of chemistry; one of civil engineering; and one of forestry.† They have also a society of forestry, that prepared the articles and superintended the display of the forest-products of Switzerland at Vienna.

* Report of Forest Management in Germany, Austria, and Great Britain, by Capt. Campbell Walker, F. R. G. S., deputy conservator of forests, Madras, London.

† *Catalogue de la Section Suisse de l'Exposition Universelle à Vienne, 1873*, page 30.

149. ITALY.—In Italy, instruction in forestry has of late years been introduced.

The Forest Institute of Vallambrosa has been established, with a meteorological station, under the care of Professor Bechi, well furnished with the best instruments.

Other stations have been organized at Florence, at Genoa, at Turin, at Aquila, and at Cuneo.

From the first, large numbers of plants of conifers have already been distributed for planting.

150. FRANCE.—France has an institute for forestry, founded in 1824, at Nancy. Besides the director, there are ten professors. The course embraces two years.

For the education of subaltern foresters, there is an inferior forest-school at Grenoble and another at Villers-Cotterets.*

151. RUSSIA.—Russia, with her immense extent of forest-lands, has an imperial forestry institute at St. Petersburg, founded in 1813, improved in 1828 and 1833; it is known as the Forest School of Lissino. The number of pupils has reached 600, and of professors 66.

There is another forest-school at the village of Stor-Evois, with director and three professors, and a two-years' course.

A chair of forestry has also been established at the Institutes of Kalazin, Wologda, Lipetsk, at Marymont in Poland, and at Mitau.

At Grodno and at Moscow there are schools for the instruction of the under-foresters and guards.

152. SWEDEN AND NORWAY.†—A forest-school was established in Sweden in 1828, with a director and four professors. The course embraces two years. Besides this, there are, in different parts of the kingdom, four private forest-schools aided by government, and a chair of forestry in the agricultural school of Afra; also five inferior schools for the instruction of the subalterns of the forest-establishment.

153. BELGIUM.—Belgium had one forest-school, that of Bouillon, erected by royal decree in 1864, but recently suppressed.

154. PORTUGAL.—The Agricultural Institute at Lisbon embraces a course of study in sylviculture and forest-topography.

155. SPAIN.—This country had a forest-school at Villaviciosa, near Madrid, from 1846 to 1869; it was then transferred to S. Lorenzo d'Ecnrial. The course extends to three years. It has a director, nine professors, and two assistants.

156. TURKEY.—Turkey has a forest-school at Constantinople, about which I could learn nothing.

* Gustave Henzé's report.

† *Schweden Statistche*, &c., 1873.

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