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PŘÍSPĚVEK KE SVĚTOVÉ SPOLUPRÁCI V LESNICKÉ VĚDĚ

Náš vědecký časopis *Lesnictví* předstupuje tímto tematickým číslem před domácí a zejména před zahraniční čtenáře s krátkým výsekem lesnické vědecké a výzkumné činnosti, který má naznačit snahu zpřístupnit tvůrčí činnost malé země světové veřejnosti.

Od časů našich buditelů jsou známy potíže, které mají malé národy s velkými úkoly všelidského i specializovaného charakteru. Pokrok v naší zemi je třeba prezentovat především činy a jejich pozitivními výsledky. Nicméně ne každý je může objektivně shlédnout a seznat. Proto je třeba překládat častěji zajímavé a zejména stěžejní práce z našich oborů do světových jazyků, aby se tak staly známými, a budou-li náležitě úrovně, i uznávanými a upravdě světovými. Přitom se nám automaticky dostane do obecného povědomí náročnost mezinárodních děl, která se opět musí odrazit v kvalitě a intenzitě naší činnosti.

Jen si vzpomeňme, kolik českých a slovenských autorů bylo prakticky přisvojeno nebo asimilováno cizinou. Kdybychom ponechali stranou národnostně utrakvistického lesníka — vynálezce Josefa Resslera, poslouží za přesvědčivé příklady osudy děl průkopníka výběrného hospodářství Antonína Tichého, zalesňovací a probírkové metody rodu Bohutinských a zejména pak milimetrová probírka Josefa Bohdaneckého.

Ze všech těchto i jiných důvodů se snažíme po řadu let v našem vědeckém časopise být i sporadicky publikovat výsledky mezinárodních sympozií, všechny naše práce doplňujeme cizojazyčnými souhrny a vydali jsme již řadu vícejazyčných odborných slovníčků, které mají velký ohlas domácí i internacionální, takže se oprávněně uvažuje o jejich monografickém vydání.

Jak je patrné, je toto cizojazyčné číslo našeho časopisu polytematické a samozřejmě nemůže vyhovět všem požadavkům. Nicméně je považujeme za přínos v našem úsilí po plodné mezinárodní spolupráci a po dosažení takového místa naší lesnické vědy ve světové vědě lesnické, jakého si zaslouhuje.

INTERNATIONAL COOPERATION IN FOREST SCIENCE

The present epoch is characterized by a rapid advance of scientific knowledge enhanced by the exchange of scientific experience, results and methodologies among research workers and scientists throughout the world.

It is also in silviculture that the relations and contacts among scientific workers are strengthened, and that an ever closer world-wide cooperation now prevails in research and scientific activities.

In Czechoslovakia, it is the task of the scientific periodical *Lesnictví* to inform Czechoslovak as well as foreign readers about the progress of forestry research in Czechoslovak research organizations and institutes. Original scientific papers prepared by experts in forestry provide survey of the latest data and knowledge obtained during the solution of research problems and accomplishing of projects concerning the basic forestry science disciplines: economics of forestry technology, pedology, amelioration, silviculture, forest management, forest protection, forest utilization.

Efforts are made to meet the requirements of foreign readers and to promote the understanding and a closer cooperation between Czechoslovak and foreign foresters. For these purposes, *Lesnictví* has published foreign-language dictionaries on the basic silvicultural disciplines since the year 1965. The Editors intend to publish an aggregative dictionary in the form of a special-purpose number in the year 1970 or 1971. Since these efforts have met a favourable response among foreign readers, another attempt will be made to enhance the cooperation with foreign scientists by means of an English edition of the mentioned number of *Lesnictví*. A digest of original scientific papers by well-known experts informs Czechoslovak and foreign readers about their latest findings in continuity with forest science in the world.

Prof. Dr. Ing. J. P e l í š e k, DrSc., devotes his pedological study to the possible proportion of spruce in forest stands which does not result in a deterioration of the properties of soil. The study is based on the results obtained in comparative parallel areas. Prof. Dr. Ing. M. V y s k o t, DrSc., gives a detailed account of J. Bohdanecký's work whose "Czech thinning" gave rise to the forced growth system (*Schnellwuchsbetrieb*) which represents a topical question even now. Doc. Dr. G. V i n c e n t, DrSc., evaluates provenance tests to solve the problem of the transfer of seed in Europe, with respect to the necessity of the formulation of national and international principles for the transfer of forest seed. Prof. Dr. Ing. A. K a l a n d r a, DrSc., presents an article on the destructive effects of *Phellinus pini* in the Třeboň region, and Ing. B. U r o š e v i ć, CSc., discusses the relations between bacteria and fungi and the symptoms of diseases caused by the mixture of these microorganisms. Ing. J. P a ř e z, CSc., presents an economically oriented treatise of the possibilities of the use of percentage assortment tables for the analysing of the assortment structure of wood production and for its financial assessment. The closing report by Ing. M. B u m e r l, CSc., deals with the new method of wood barking; the method is based on the introduction of electric current in the subcortical layers of trunk (a Czechoslovak patent).

We believe that this informative number will meet the world forestry public's interest, and it is our aim — depending on our possibilities — to present other similar numbers to our foreign readers.

Ing. M. S t a ň k o v á,
vedoucí redaktorka

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předseda redakční rady

■ During the recent years a great deal of attention has been given to the research and survey of forest soils, both here and abroad. In our country the research work in this respect has been concerned mainly with recognition of the formation or genesis of our forest soils, with characteristics and classification of our major soil types and their vertical zonalities, with dynamics of the water and temperature regimes, humus composition, structure of the living components in the soil, further with the influence of spruce stands on the soil, with classification and improvement of the degraded forest soils, and finally with questions referring to the cycle of nutrients and to the nutrition of forest stands and soils. From the results obtained have subsequently been drawn conclusions applicable in the forestry practice, to serve the purpose of good management and utilization of the forest soil.

The above research projects have partly been conducted under the National Research Plan, partly outside this Plan, as the necessary basic investigation of theoretical character without which no practical applications would be possible. In the past period, our forest soil science has achieved significant results, both in the basic and applied lines of research.

The studies conducted here on the effect of spruce stands upon forest soils cover one of the important problems investigated. The influence of spruce stands on soils, or on either the maintenance or reduction of the productive capacity of forest soils, is of great importance from the point of view of national economy, for spruce represents today essential raw material, not only for the production of pulpwood but also for other branches of our industry.

Results of the research work carried out in the past years and the experience of forestry practice have indicated increased acidity and impoverishment of the top layers in soils under spruce monocultures in the lowland and hilly areas, and thus also aggravated conditions in the soil properties which are of moment in respect of ecology.

In connection with this problem some of our experts in the field of phytocoenology studied the questions relative to the origin of spruce stands in the lowland and hilly regions of Central Bohemia and the Bohemian-Moravian Upland. Of the authors be mentioned here mainly V. Samek, K. Plíva, K. Mráz (1957, 1959), and J. Málek (1958); while professor A. Zlatník (1955) extended his study of this question to cover the entire area of Central Europe. Also B. Mařan (1938, 1939, 1948, 1959) was concerned with the influence of pure spruce stands on the soil here, whereas H. Genšler investigated the same problem abroad. The downward trend in total increment

per 1 hectare of land due to the effect of spruce monocultures has especially recently been the object of interest in the forests of Saxony, Germany; of the investigators be mentioned here H. W e c k in the first place.

In this country, the process of degradation of forest soils occurs primarily in the lowland and hilly areas; as a result, such state of things interferes with the efforts of transforming the present spruce monocultures into mixed crops. It has been the aim of the research projects hitherto pursued to study the processes of degradation which go on in soils under pure spruce stands, and to compare these soil conditions with those under mixed crops, characterized by a more or less natural composition of species or by different admixtures of spruce. From the results thus obtained were then derived scientific conclusions and applications in forestry practice, in particular with regard to the allowable or possible representation of spruce in the forest stands without the effect of degradation on the soil.

One partial task within the above research programme was also the study of the action of spruce stands on forest soils in the mountain regions of Czechoslovakia, special attention being given to their role as the water-holding factor, and a comparison of the effect of pure spruce stands on soils in the lowland and hilly areas and on those in the mountain regions. All research work in this connection was conducted using parallel comparative test pits, located not far from one another in the site under study; the pits were in places under spruce stands and under broadleaved crops characterized by a more or less natural composition of species. In the soil profiles were observed changes in the soil morphology and in the physical, chemical, biochemical, and microbial properties.

The research work on the comparative sites was made in accordance with the concept of the climatic and soil vertical zonalities, from the lowland areas subject to inundations up to the mountain regions, in a variety of places of the territory of Czechoslovakia, including both the Bohemian Massif (western part of Czechoslovakia) and the Carpathian regions (eastern part of Czechoslovakia), at elevations ranging from 200 to 1500 m. The territory of Czechoslovakia, because of its clear-cut vertical zonality relative to the climate and soil, represents an ideal area for comparative studies of this kind, including both the aspects of science and the applications of theoretical achievements in practice as well.

For our study of the changes in soils were first considered and estimated especially the following characteristics: acidity, content of humus and its quality, content of physical clay, dynamics of soil moisture, status of sorption complex, status of readily available nutrients and biological cycle of nutrients, alterations in structure and in porosity, and the like.

All results obtained from the comparative parallel test pits in the sites under study were arranged according to the climatic and soil vertical zonalities, to form comparative tabular summaries; these were to serve our establishment of respective changes and the numerical estimation of mutual differences between the observed soil components under the forest stands being compared.

Climatic conditions in the lowland and hilly areas of our territory are characterized by annual averages of precipitation ranging from 500 to 650 mm and by annual averages of temperatures varying between 7.5^o and 10^o C; in the uplands the values are 700—900 mm precipitation and 5^o—7.5^o C temperature, while in the high-mountain regions the precipitations largely attain averages from 900 to 1400 mm and the temperatures vary between 2^o and 5^o C approximately.

The comparative parallel twin test-pits made under different forest stands revealed predominance of the lowland podzol and the lowland brown soil, developed on different soil-forming rocks and displaying a variety of grain size composition.

Of the morphological properties, appreciable differences were detected particularly in the thickness of the humic superficial A₁ or A horizon and in the structure; soils under broadleaved crops with a more natural composition of species had, in the majority of cases, well-developed superficial humic horizons of 10–20 cm thickness, while those under spruce stands averaged but 3–6 cm thickness in their superficial humic horizons. This low thickness of the superficial humic A horizons developed under spruce monocultures is explained as due to poor humification and to accumulation of the superficial raw humus. Textures of the superficial horizons under artificial spruce plantations were found much finer; as a result, these layers were also more settled. The subsoil layers under spruce stands likewise exhibited a much higher degree of settlement and were less water and air permeable when compared with the same layers under broadleaved crops. Our comparisons of the thickness of superficial horizons revealed a conspicuously increased thickness of the superficial, largely dry humus (A₀ horizon) under spruce monocultures in the lowlands and hilly countries, where the annual amount of precipitation averages about 500–600 mm and temperatures vary between 9° and 10°C.

Of the physical properties of our soils, elevated differences were found to exist in their porosity, capillary water capacity and minimum air capacity. In general, it may be stated that the topsoil layers displayed the greatest differences in their physical properties. Porosity of the topsoil layers under spruce monocultures was found lower roughly by 20–30 per cent, their minimum air capacity by about 10–20 per cent, while their capillary water capacity showed relatively elevated values, by about 10–20 per cent, due to the settlement.

Appreciable differences between the sites compared under different types of crops were also detected in their annual dynamics of the water regime, and this again above all in the superficial soil layers. In Czechoslovakia, the lowest contents of soil water are recorded towards the end of August and during September, which fact is also utilized as an important criterion when the water regime in different soils is evaluated as a whole and its indicators for the soils are compared. Thus, for instance, our measurements made during the above months revealed contents of water in the superficial layers of loamy soils under spruce stands in the lowland and hilly areas to average 5–8 per cent, while in those under broadleaved trees the average values varied between 12 and 16 per cent. This finding points to the desiccation action of spruce monocultures on the superficial soil layers in our lowland and hilly regions, which may be explained as due to the root system spread, in this species, at the soil surface.

In the deeper-lying subsoil layers situated under spruce monocultures there occur gleyed soils at places; this being the consequence of temporary accumulation of the rain water in the subsoil, which spruce is incapable to utilize because of its flat root system developed at the soil surface.

With regard to the physical clay content (particles smaller than 0.002 mm) there appeared, in terms of the vertical zonality, a certain regularity, in that the enriched subsoil horizons of ilimeric podzols under spruce stands revealed larger quantities and thus also larger accumulations of physical clay in the lowland and hilly podzols which overlay loamy and clay-loamy materials;

this state of things resulting also in formation of settled and little drained, enriched horizons in the underlying strata, followed by gleying due to the rain water temporarily accumulated there. Towards the high-mountain situations this accumulation of physical clay in enriched horizons was found diminishing, the subsoil layers being less settled and even loose, well water and air permeable, with a large capacity to intercept or retain the rain water.

The results hitherto obtained relative to physical properties of the soils, important in respect of ecology, have indicated that an aggravation in porosity and in the water and air regimes does occur in soils under artificial spruce plantations established in the lowland and hilly regions of Czechoslovakia, which in particular holds true for the superficial soil layers.

Material changes and differences were established in the status of acidity; the superficial soil layers under spruce monocultures revealed increased levels of acidity.

As indicated by the measurements hitherto made, the greatest differences (as much as 2.5 pH) in soil acidity, both under forest stands with the more natural composition of species and under pure spruce crops as well, were found for the lowland and hilly zones. With increasing elevation, towards the climatic and soil zones of higher situations accordingly, these differences in soil reaction revealed considerable diminishing, despite the upward trend in total acidity of the forest soils. Concerning the lowland and hilly zones, the greatest differences in reaction were recorded for superficial humus layers which, under the spruce crops, were in all cases much more acid than those under mixed stands. The differences in acidity were found appreciably diminishing with increasing soil depths.

From our numerous comparative measurements of soil acidity it may be concluded that pure spruce stands, when compared to those composed of broadleaved species, acidify most soils in the lowland and hilly zones, which are characterized in our forest regions accordingly by a drier and warmer climate, up to elevations of about 500 m.

Our results concerning the status of humus, i.e. the contents of raw and true mull humus and its changes on the sites being compared, likewise revealed existence of significant differences. Of the analytical data it proved to be of importance the regularity with which humus content augmented in the forest soils from the lowland to the high-mountain areas; at lower elevations the soils under spruce stands showed less true humus in all cases than this was the case with soils under crops characterized by a more natural structure of tree species.

Results of the laboratory analyses likewise indicated the superficial humus layers under pure spruce stands in the lowland and hilly zones to contain much lower amounts of the colloidal true humus than those developing under mixed and more natural crops. Towards the high-mountain forest regions these differences in the amount of true humus were found diminishing to an appreciable degree. For the lowland and hilly zones of the country the larger differences in humus are explained as due mainly to the accumulation of raw, dry humus under pure spruce stands, where the process of humification does not attain the desired level because of poor microbial activities, as the result of water deficiency in the topsoil during the summer season.

Accumulation of the superficial raw humus on sites under spruce stands in the lowland and hilly country results in aggravated soil chemistry and distinct reduction of the biological cycle of nutrients in the system: soil —

forest stand. This effect manifests itself also as a reduction of microbial activity in the superficial layers under spruce stands.

The status of nitrogen likewise displayed differences. In the topsoil layers, contents of available nitrogen, occurring in forms of ammonia and of nitrate, revealed considerably reduced levels on sites under spruce monocultures than they did on those under broadleaved crops.

Marked differences were found especially in the contents of readily available nutrients — CaO, K₂O, and P₂O₅. The compared sites of the lowland and hilly areas showed distinctly lower levels of readily available nutrients (by 30—50 % on the average) in the surface soil layers under spruce stands than did those under broadleaved crops. This in particular held true for the level of readily available phosphoric acid (P₂O₅), which recorded a strong drop. The profound decrease in the readily available nutrients in soils under spruce stands of the lowland and rolling-ground areas is explained as presumably due to the reduced rate of humification, to accumulation of the superficial raw humus and thus strongly weakened biological cycle of nutrients in the soils.

The above described extensive comparative studies, using parallel pairs of experimental sites for the purpose, allowed a rough solution of the problem relating to different representations of spruce species in the forest areas of Czechoslovakia, without the degradation effect on particular soils. The comparative studies were therefore conducted on the basis of the climato-soil and the vegetation vertical zonalities. The information hitherto gathered from our comparative surveys has indicated that, in this country, spruce may be planted and grown at elevations ranging from high mountains down to lowlands, but always only on certain sites and at definite representations in the forest stands.

Results of the studies on spruce representation in forest stands with no danger to cause aggravation of the soil properties have suggested the soil water regime all year round and the supplies of nutrients to be factors of high importance. Increased levels of soil moisture during the summer season in the valley, lowland, and hilly areas allow incorporation of higher admixtures of spruce trees in the forest stands without aggravating the soil properties important in respect of ecology.

As indicated by our results for the lowland zone, at elevations 100—250 m, an admixture of 20—40 % spruce in the stand does not aggravate soil conditions in moist peats, peaty gleys and gley soils, further in fresh-moist, gleyed podzols and semigley soils. The forest vegetation zone of oak is the point here.

In the hilly zone, at elevations of about 250—500 m, an admixture of 30—50 % spruce in the stand does not aggravate soil conditions in fresh-moist gley podzols, in moderately up to intermediately moist gleyed podzols or in gleyed ochreous forest soils. The forest vegetation zones of beech-oak and oak-beech are concerned here.

In the upland zone, at elevations of about 500—750 m, an admixture of 40—65 % spruce produces no degradation to soil conditions in fresh-moist, gleyed podzols and gleyed brown forest soils. The forest vegetation zone of beech, partly also that of fir-beech, is concerned here.

In the lower mountain zone, at elevations of 750—1000 m, an admixture of 60—90 % spruce is found producing no degradation to soil conditions in fresh-moist up to moist ochreous forest soils, rusty forest soils, humus podzols,

and peaty gley soils. The forest vegetation zone of spruce-fir-beech is the case here.

In the higher mountain zone, at elevations exceeding 1000 m, pure spruce stands cause no degradation at all to soil conditions (moist peaty soils, peaty gleys, moist humus podzols, and rusty forest soils are involved). It is the spruce vegetation zone.

The above results of our studies also allow to consider respective increases in the admixture of spruce in our forest areas, in dependence upon the vertical climate-soil zonality, without running the risk of degrading their soil conditions. Accordingly, the results may be utilized to good advantage in advising the spruce representation on definite sites of the area under forest and thus also for definite production types. The data hitherto gathered indicate that much higher percentages of spruce in the forest stands may be reckoned with than are those given in some estimates hitherto published as part of the typological survey of forests in which phytocoenological considerations predominated.

The augmented representation of spruce in our areas under forest, mentioned above, is important from the view of national economy, because its realization simultaneously involves potential extension of the production of timber without the degrading effect upon the soil and thus without any decrease in the production capacity of our forest soils.

SUMMARY

This paper presents one part of the results of our studies concerned with the influence of spruce monocultures on soils on the territory of Czechoslovakia, with particular regard to those in the lowland and hilly areas of the country. The research proper was conducted on comparative parallel plots, according to the concept of the vertical climatic and soil zonality and the vegetation zonality; the areas under study were situated at elevations ranging from 200 to 1500 m. Actual observations were made of changes in the soils under pure spruce monocultures and under forest stands with more or less natural tree species composition.

Results of the comparative studies revealed the following facts:

1. The soils under spruce monocultures displayed but a thin superficial horizon of humus, whereas the layer of raw humus at the surface was found fairly thick.

2. The soils under spruce stands in the lowland and hilly areas featured accumulations of raw humus (aggravated humification), and they contained less true mull humus. With increasing elevations the differences in the content of true humus were found relatively diminishing and the level of total humus was increasing.

3. The podzol soils under spruce crops in the lowland and hilly areas featured relatively larger accumulations of physical clay in their enriched horizon and a higher degree of compaction, if compared with the B horizon of the mountain humus podzols.

4. The soils under spruce stands in the lowland areas were found to have an aggravated water regime during the year; they became dry in the superficial layers, while in the subsoil ones an excessive moisture content was sporadically observed.

5. The soils under pure spruce stands in the lowland and hilly areas were found much more acid (the difference amounting to 2.5 pH) than those under crops characterized by a more natural tree species composition. With

increasing elevations these differences in the pH value tended to decline although total acidity showed the upward trend. It follows therefore that pure spruce stands produce the relatively highest degree of acidification in soils of the lowland and hilly situations in such areas that are climatically drier and warmer.

6. The soils under spruce cultures in the lowland situations showed an aggravated regime of nitrogen (in particular a decrease in the readily available forms of nitrogen) and markedly reduced supplies of the readily available nutrients (CaO , K_2O , P_2O_5); this is explained as due mainly to reduced humification, accumulation of the superficial and raw humus forms, and decrease in the biological cycle of nutrients.

The results hitherto obtained indicate the process of aggravation for certain characteristics of the soils under spruce stands in the lowland and hilly areas.

Results of the studies concerned with the allowable percentage of spruce representation in our forest stands without causing degradation to the soil characteristics pointed to the all-year water regime in the soil and to its supplies of nutrients as factors of high importance. It is concluded that higher contents of soil moisture during the summer season in the lowland and hilly areas allow larger admixtures of spruce in the forest stands without causing degradation to the soil characteristics which are of importance to ecology.

With increasing elevations, from the lowlands up to the mountain situations, the degradation effect of spruce stands on soils was established as diminishing. It is concluded therefore that increased admixtures of spruce in forest stands are possible. In the high-mountain elevations spruce probably does not exert any degrading effect upon the soil.

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Vliv smrkových monokultur na půdy v oblasti Československa

Práce podává část výsledků o vlivu smrkových monokultur na půdy, zejména v nížinné a pahorkatinné oblasti Československa. Výzkumné práce byly konány na srovnávacích paralelních plochách pod smrčínami a pod smíšenými listnatými porosty podle výškové klimaticko-půdní a vegetační pásmitosti v nadmořských výškách 200—1500 m. Byly zjišťovány změny v půdách pod čistými smrkovými monokulturami a pod porosty s více nebo méně přirozeným složením.

Srovnávací výsledky studií ukázaly:

1. Půdy pod smrkovými monokulturami mají jen slabý povrchový humózní horizont a naopak dosti mocnou vrstvu surového povrchového humusu.

2. Půdy pod smrkovými monokulturami v nížinných a pahorkatinných oblastech vykazují zvýšené hromadění surového humusu (zhoršená humifikace) a obsahují méně pravého mulového humusu. Se stoupající nadmořskou výškou se rozdíl v obsahu pravého humusu relativně zmenšují a celkový obsah humusu se zvyšuje.

3. Podzoly pod smrčínami v nížinných a pahorkatinných polohách vykazují relativně větší hromadění fyzikálního jílu (částice menší než 0,002 mm) v obohacených horizontech a zvýšenou slehlost proti horizontům B v horských podzolech.

4. Půdy pod nížinnými smrčínami mají zhoršený vodní režim během roku. Ve svrchních vrstvách dosti silně vysychají a ve spodinách jsou naopak místy převlhčené.

5. Půdy pod monokulturami smrčín v nížinných a pahorkatinných polohách byly mnohem kyselejší (až o 2,5 pH) než půdy pod porosty s přirozenější dřevinnou skladbou. Se stoupající nadmořskou výškou se tyto rozdíl v pH zmenšovaly, i když celková acidita stoupala. Smrkové monokultury tedy relativně nejvíce zakyselují půdy v nížinných a pahorkatinných a tedy klimaticky sušších a teplejších oblastech.

6. Půdy pod umělými smrčínami nížin vykazují zhoršený režim dusíku — zejména pokles lehce přístupných forem dusíku — a výrazně snížené zásoby lehce přístupných živin (CaO, K₂O, P₂O₅). Je to způsobeno hlavně sníženou humifikací, hromaděním povrchového a surového humusu a sníženým biologickým koloběhem živin. Dosavadní získané výsledky ukazují tedy na zhoršování některých půdních vlastností pod smrkovými monokulturami v nížinných a pahorkatinných oblastech.

Výsledky studií o možném zastoupení smrku v lesních porostech bez zhoršování půdních vlastností ukazují na to, že velmi důležitým faktorem je celoroční vodní režim v půdě a zásoby živin. Zvýšený obsah půdní vlhkosti v letním období v nížinných a pahorkatinných oblastech umožňuje větší příměs smrku do lesních porostů bez zhoršování ekologicky důležitých půdních vlastností.

Se stoupající nadmořskou výškou od nížin do horských oblastí ubývá degra-dačního účinku smrčín na půdu, a proto je možno zvyšovat příměs smrku do lesních porostů. V horských oblastech asi nepůsobí smrk na půdu degra-dačně.

Влияние чистых еловых насаждений на почвы в области Чехословакии

Предложенная работа подает часть результатов исследований влияния чистых еловых насаждений на почвы, особенно в низинной и холмистой областях Чехословакии. Исследовательские работы производились на параллельно сравнимых площадях под ель-

никами и под смешанными лиственными насаждениями согласно климатическо-почвенным и вегетативным поясам в областях на высотах от 200 до 1500 м над уровнем моря. Определялись изменения в почвах под чистыми еловыми насаждениями и под насаждениями более или менее естественного состава.

Сравнительные результаты изучения показали следующее:

1. Почвы под чистыми еловыми насаждениями имеют лишь тонкий поверхностный гумусовый горизонт и, наоборот, значительно толстый слой сырого поверхностного гумуса.

2. Почвы под чистыми еловыми насаждениями в низинных и холмистых областях отличаются повышенным накоплением сырого гумуса (ухудшенная гумификация) и меньшим содержанием настоящего тонкоземного гумуса. С возрастающей высотой над уровнем моря разница в содержании настоящего гумуса сравнительно уменьшается, а общее содержание гумуса увеличивается.

3. Подзолы под ельниками в низинных и холмистых местоположениях в более богатых горизонтах отличаются сравнительно более значительным накоплением физического ила (частицы меньше 0,002 мм) и повышенной полегаетостью в противоположность к горизонтам в горных подзолах.

4. Почвы под низинными ельниками имеют в течение года ухудшенный водный режим. В верхних слоях они довольно сильно высыхают, а в подпочвенных слоях они, наоборот, переувлажнены.

5. Почвы под еловыми монокультурами в низинных и холмистых местоположениях были значительно кислее (даже на 2,5 рН), чем почвы под насаждениями с естественным породным составом. С возрастающей высотой над уровнем моря эта разница рН уменьшалась, хотя общая кислотность и повышается. Итак, еловые монокультуры сравнительно больше всего повышают кислотность почвы в низинных и холмистых местоположениях, следовательно, в более сухих и более теплых областях.

6. Почвы под искусственными ельниками в низинах отличаются ухудшенным режимом азота — особенно понижением содержания более доступных форм азота — и ярко выраженным понижением запасов легкодоступных питательных веществ (CaO , K_2O , P_2O_5). Причиной этого, главным образом, являются пониженная гумификация, накопление сырого гумуса и ослабление биологического круговорота питательных веществ. Следовательно, полученные до сих пор результаты указывают на ухудшение некоторых почвенных свойств под еловыми монокультурами в низинных и холмистых областях.

Результаты изучения возможного участия ели в лесных насаждениях без ухудшения почвенных свойств указывают на то, что весьма важными факторами являются годовой водный режим в почве и запасы питательных веществ. Повышенное содержание почвенной влажности в летний период в низинных и холмистых областях дает возможность более высокой примеси ели в лесных насаждениях без ухудшения важных экологических свойств почвы.

С увеличивающейся высотой над уровнем моря от низин до горных областей деградиционное влияние ельников на почву уменьшается и поэтому можно повышать примесь ели в лесных насаждениях. Повидимому, в горных областях ель не оказывает деградиционного влияния на почву.

Einfluß der Fichtenmonokulturen auf die Böden im Gebiet der Tschechoslowakei

Die Arbeit bietet einen Teil der Ergebnisse über den Einfluß der Fichtenmonokulturen auf die Böden, besonders in dem Tiefland- und Hügellandgebiet der Tschechoslowakei. Die Forschungsarbeiten wurden auf den vergleichenden parallelen Flächen unter den Fichtenwäldern und unter den gemischten Laubholzständen laut der höhenklimatischen Boden- und Vegetationszonenverteilung in den Gebieten von 200—1500 m Seehöhe durchgeführt. Es wurden die Änderungen in den Böden unter den reinen Fichtenmonokulturen und unter den Beständen mit mehr oder weniger natürlicher Zusammensetzung ermittelt.

Die Vergleichungsergebnisse der Studien zeigten:

1. Die Böden unter den Fichtenmonokulturen haben nur einen schwachen Oberflächenhumushorizont und im Gegenteil eine genug mächtige Schicht des rohen Oberflächenhumus.

2. Die Böden unter den Fichtenmonokulturen in den Tiefland- und Hügellandgebieten erwiesen erhöhte Anhäufung des Rohhumus (schlimmere Humifizierung) und sie enthalten weniger echten Mullhumus. Mit der steigenden Seehöhe werden die Unterschiede im Gehalt des echten Humus relativ niedriger und der Gesamt-humusgehalt erhöht sich.

3. Die Podsolböden unter den Fichtenwäldern in den Tiefland- und Hügellandgebieten erweisen eine relativ höhere Anhäufung des physikalischen Tons (Teilchen kleiner als 0,002 mm) in den bereicherten Horizonten und eine erhöhte Setzung gegenüber den B-Horizonten in den Gebirgspodsolböden.

4. Die Böden unter den Tieflandfichtenwäldern haben im Verlauf des Jahres ein verschlechtertes Wasserregime. In den Oberschichten trocknen sie genügend stark aus und in den Unterböden sind sie im Gegenteil stellenweise überfeuchtet.

5. Die Böden unter den Fichtenwäldermonokulturen in den Tiefland- und Hügellandlagen waren viel saurer (bis um 2,5 pH) als die Böden unter den Beständen mit natürlicher Baumartenzusammensetzung. Mit der steigenden Seehöhe verringerten sich diese Unterschiede in pH, auch wenn die Gesamtazidität stieg. Die Fichtenmonokulturen tragen also relativ am meisten zu der Bodenazidität bei, und zwar in den Tiefland- und Hügellandgebieten und also auch in den klimatisch trockneren und wärmeren Gebieten.

6. Die Böden unter den künstlichen Fichtenwäldern der Tiefländer erweisen ein verschlimmerte Stickstoffregime — besonders die Herabsetzung der leicht aufnehmbaren Stickstoffformen — und die ausdrucksvoll herabgesetzten Vorräte der leicht aufnehmbaren Nährstoffe (CaO, K₂O, P₂O₅). Das ist verursacht hauptsächlich durch die herabgesetzte Humifizierung, durch die Anhäufung des Oberflächen- und Rohhumus und durch den herabgesetzten biologischen Kreislauf der Nährstoffe. Die bisher erzielten Ergebnisse zeigen also auf die Verschlimmerung einiger Bodeneigenschaften unter den Fichtenmonokulturen in den Tiefland- und Hügellandgebieten.

Die Ergebnisse der Studien über die mögliche Vertretung der Fichte in den Waldbeständen ohne Verschlimmerung der Bodeneigenschaften weisen darauf hin, daß ein sehr wichtiger Faktor das ganzjährige Wasserregime im Boden und die Nährstoffvorräte sind. Der erhöhte Gehalt an Bodenfeuchtigkeit in der Sommerperiode in den Tiefland- und Hügellandgebieten ermöglicht einen größeren Zusatz der Fichte in die Waldbestände ohne die ökologisch wichtigen Bodeneigenschaften zu verschlimmern.

Mit der steigenden Seehöhe von den Tiefländern bis zu den Berggebieten vermindert sich die Abbauwirkung der Fichtenwälder auf den Boden und man kann deshalb den Fichtenzusatz in die Waldbestände erhöhen. In den Berggebieten wirkt wahrscheinlich die Fichte nicht abbaulich auf den Boden.

Influence des monocultures d'épicéa sur les sols des régions de Tchécoslovaquie

Le travail présente une partie des résultats, relatifs à l'influence des monocultures d'épicéa particulièrement sur les sols des terrains bas et des régions accidentées de Tchécoslovaquie. Les travaux de recherche étaient effectués sur les parcelles parallèles comparatives, sous les peuplements d'épicéa et les peuplements mélangés feuillus, par zones d'altitude, caractéristiques par la végétation et les conditions climatiques du sol, et cela dans les régions à des altitudes depuis 200 à 1500 mètres. On identifiait les changements dans les sols sous les monocultures d'épicéa pures et sous les peuplements dont la composition est plus ou moins naturelle.

Les résultats comparatifs des études ont montré ce qui suit:

1. Les sols sous les monocultures d'épicéa n'ont qu'un faible horizon humique superficiel et au contraire, une assez puissante couche de surface de l'humus brut.

2. Les sols sous les monocultures d'épicéa dans les régions de plaine et accidentées accusent une accumulation augmentée d'humus brut (humification moins bonne), comprenant moins d'humus doux véritable. A mesure que l'altitude augmente, les différences quant à la teneur en humus vrai (doux) diminuent et la teneur totale en humus s'élève.

3. Les podzols sous les peuplements d'épicéa dans les régions de plaine et accidentées accusent une accumulation relativement plus grande de l'argile physique (particules ne dépassant pas 0,002 mm) dans les horizons enrichis et un tassement plus fort, comparativement aux horizons-B dans les podzols de montagne.

4. Les sols sous les peuplements d'épicéa en plaine accusent au cours de l'année un régime d'eau empiré. Dans les couches superficielles ils se dessèchent assez fortement, étant au contraire dans les sous-sols par endroits trop humides.

5. Les sols sous les monocultures d'épicéa dans les régions de plaine et accidentées étaient beaucoup plus acides (même de 2,5 pH) que les sols sous les peuplements accusant une structure d'essences plus naturelle. A mesure que l'altitude augmente, les différences entre les pH diminuent, bien que l'acidité totale augmente.

Les monocultures d'épicéa acidifient par conséquent relativement le plus les sols dans les régions de plaine et accidentées, à savoir dans les régions climatiquement plus sèches et plus chaudes.

6. Les sols sous les peuplements d'épicéa artificiels des plaines accusent le régime d'azote empiré — notamment la réduction des formes d'azote facilement assimilables — et des réserves considérablement abaissées des matières nutritives facilement utilisables (CaO , K_2O , P_2O_5). Ce fait est dû notamment à l'humification réduite, à l'accumulation de l'humus superficiel et brut et au cycle biologique affaibli des substances nutritives. Les résultats jusqu'ici obtenus montrent par conséquent qu'il se produit une altération de certaines propriétés de sol sous les monocultures d'épicéa dans les régions de plaine et accidentées.

Les résultats des études, concernant la représentation possible de l'épicéa dans les peuplements forestiers, sans altération des propriétés de sol, montrent que ce sont le régime hydrique dans le sol pendant toute l'année et les réserves en matières nutritives qui constituent le facteur très important. La teneur en humidité augmentée dans le sol pendant la période d'été permet, dans les régions de plaine et accidentées, une admixtion plus grande d'épicéa aux peuplements forestiers, sans pour cela altérer les propriétés du sol importantes au point de vue écologique.

A mesure que l'altitude augmente, depuis les plaines jusqu'aux régions de montagne, l'effet dégradant des peuplements d'épicéa sur le sol s'affaiblit et on peut par conséquent augmenter l'addition de l'épicéa aux peuplements forestiers. Il est probable que dans les régions de montagne l'épicéa n'agit pas sur le sol d'une façon dégradante.

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■ The method developed by a Czech forester, Josef Bohdanecký, which is referred to as the Czech or Orlik or Three-millimeter Thinning, still excites a great deal of interest among professional circles, especially the assumption of and the requirement for the so-called Management for Rapid Growth the method involves. Bohdanecký's System is based on the principle of the so-called spatial silviculture; this strives for a maximum of increment over a relatively short interval of time by means of the vigorous apparatus of assimilation. Depth of the live (green) crown, as claimed by Bohdanecký, is to exceed one half of the mean stem height during the greater part of the growth process.

Author of this Czech Three-millimeter Thinning was inspired, better compelled to apply the mode of heavy silvicultural treatment in dense spruce stands of the area Orlik nad Vltavou. He compared the excessively dense stands obtained by artificial regeneration (seeding) with those characterized by an open canopy, deriving his views from the condition of the Boubín Virgin Forest Park, Šumava region (Ger.: Böhmerwald) and from the Orlik Castle Park stands.

Josef Bohdanecký made a statistical-topographical and silvicultural description of the Orlik Forests, to serve aims of the excursion organized by the Bohemian Union of Foresters as a part of their 42nd Plenary Session held August 4–6, 1890. For the year 1903 an excursion was planned to the Orlik Forests for the International Union of Forestry Research Organizations. Unfortunately, the violent hailstorm of July 19, 1903, which caused appreciable damage to stands in the areas to be inspected, practically made the excursion impossible. Nevertheless, a guidebook to the Orlik Forests, compiled by Josef Bohdanecký, has come down to us.

The question might be raised why attention is drawn at present to this apparently historical method. Our reason is not only the piety to Bohdanecký's work which, unquestionably, is worthy of esteem, but primarily because his system of increment stimulation in spruce stands has not lost its efficiency in many a respect. In essence, Bohdanecký applied the "C" Thinning Grade, i. e. Heavy Thinning according to the Kraft or Konšel Classification. It is true that the thin crown cover results in greater tapering and knottiness of stems; but, unlike the "B" Grade (Moderate Thinning), its enormous advantage lies in that hardness of even-aged spruce stands improves and the average stem attains a larger size in a shorter period of time. In his studies Bohdanecký reports to have attained, due to permanently

applied system of spatial management in stands with a thin crown closure, an average growth ring accretion of 3.50 mm per annum, while applying the so-called close canopy in stands produced by broadcast sowing, only 0.90 mm accretion was recorded. A comparison of stands of the same type and developing under equal environmental conditions made Bohdanecký draw the following conclusion: "It is therefore not the soil fertility but exclusively the method of stand tending which accounts for the different yields obtained from these forests".

INVESTIGATION PROPER

Unfortunately, it is to be stated that the original sample plots laid out by Josef Bohdanecký to allow judgment of the results obtained by his own method and to serve for excursions of forestry scientific associations were not followed up during the subsequent years, and neither were they preserved in the original state.

Therefore, during the 1965—67 summer seasons, preserved remainders of the sample plots and stands where Bohdanecký had demonstrably applied his concept were examined by means of the retrospective method. In this connection, a technique developed by us and described in our paper, Method of Foundation and Evaluation of Thinning Sample Plots (Vyskot 1966), was used. Moreover, analyses were made in groups of trees from which cores of wood had been extracted by the increment borer.



1. Spruce stand near the Mausoleum, 1967

Three model stands were selected and examined as the representative units; one of them being the stand called "U Mauzolea", in the Orlík Castle Park, while the other two, designated 93p and 97g, are located in the Karlov forest section, Ostrovec Forest District, Písek Forest Unit.

In 1967, our estimation of the "U Mauzolea" spruce stand in the Orlík Castle Park revealed the following values: age 112 years, age class VI, intermediate site index 4, mean stand diameter 31.6 cm, mean stand height 28.3 m, number of trees per hectare 525, mean stem volume 1.15 cu. m., and growing stock per hectare 606.25 cu. m;

the 93p stand was found to be 102 years of age, its age class was VI, intermediate site index 2, mean stand diameter 39.0 cm, mean stand height 30.3 m, number of trees per hectare 413, mean stem volume 1.82 cu. m, growing stock per hectare 772.64 cu. m;

the 97g crop showed to be in 1967, 101 years of age, its age class was estimated as VI, intermediate site



2. Sample plot in the stand near the Mausoleum, 1967



3. Stand 93p — sample plot, 1967



4. View into the crowns of the stand 97g, 1967

index 3, mean stand height 29.7 m, mean stand diameter 35.8 cm, number of trees per hectare 561, mean stem volume 1.46 cu. m, and growing stock per hectare 822.15 cu. m.

Photos 1—5, made in 1967, show conditions of the forest stands examined.

Table I presents an example of the growth ring measurements over the period 1881—1902.

Figures 6—11 are representations of the increment polygons relative to growth rings for the forest stands under study.

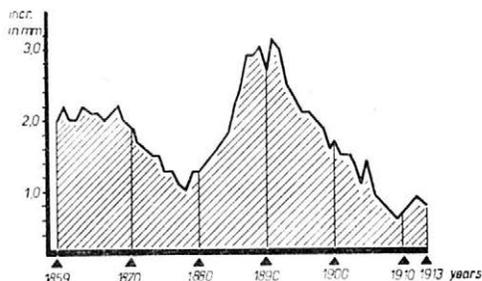
Diagrams 6 and 7 refer to the "U Mauzolea" stand. The highest values attained are clearly seen within the range of 1830—1900, the peak being about the year 1890. Influence of the B o h d a n e c k ý method of thinning is



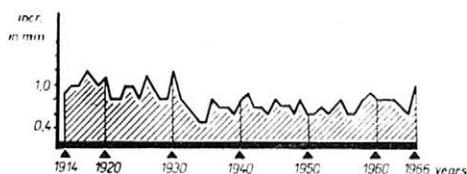
5. Stand 97g — east view, 1967

1. An illustration of the table showing the current annual increment of the annual rings of Spruce in the stand "Near the Mausoleum" in the years 1881-1902

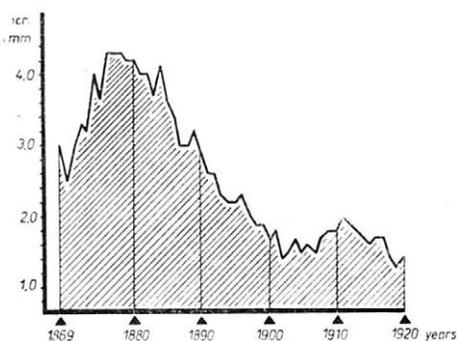
Tree Nr.	years																					
	1881....																	...1902				
3	0,5	0,5	0,5	0,5	1,2	2,0	3,0	3,0	3,5	4,0	5,0	5,0	5,0	3,0	3,0	3,0	2,0	3,0	2,5	2,0	1,5	2,0
5	1,0	0,8	0,5	1,0	1,5	1,5	2,0	3,0	3,0	4,0	4,0	4,0	3,0	2,0	2,0	3,0	3,0	2,0	1,5	2,5	2,5	3,0
8	2,0	2,0	3,0	2,5	2,5	2,5	2,0	2,0	2,0	2,0	3,5	3,5	2,5	1,0	2,0	2,0	2,5	2,0	1,0	2,0	1,5	1,0
12	1,0	1,5	1,5	1,0	2,5	3,5	3,0	5,0	4,0	3,0	3,0	3,5	2,5	3,5	2,5	2,0	1,0	2,0	2,0	2,0	2,0	1,5
21	1,5	1,5	1,5	2,0	2,5	3,0	3,0	2,0	3,0	2,5	2,5	3,0	2,5	2,5	1,5	2,0	1,5	2,0	1,8	1,5	1,5	1,5
25	2,0	1,0	2,5	4,0	4,0	2,5	2,0	2,0	1,5	2,0	2,0	2,0	1,5	3,0	2,5	2,5	2,0	1,0	2,0	1,0	0,5	0,5
37	0,5	1,0	1,0	1,0	2,0	4,0	5,0	5,0	3,0	2,0	2,0	2,0	1,5	3,0	2,0	1,5	1,0	1,0	1,0	1,0	1,5	1,0
38	1,5	2,0	1,0	2,0	2,0	2,0	3,0	2,5	3,0	2,5	3,0	2,5	2,5	1,5	2,0	2,0	2,0	2,0	1,5	1,5	1,5	1,5
39	2,5	3,0	2,5	2,5	1,5	1,0	3,0	2,0	3,0	2,0	2,0	2,0	1,5	1,0	1,5	1,5	1,5	2,0	1,5	1,5	1,0	1,0
Sa:	12,5	13,3	14,0	16,5	19,7	22,0	26,0	26,5	26,0	24,0	28,0	27,5	22,5	25,0	19,0	19,5	17,5	17,0	14,8	15,0	13,5	13,0
∅:	1,4	1,5	1,6	1,8	2,2	2,4	2,9	2,9	3,0	2,7	3,1	3,0	2,5	2,3	2,1	2,1	2,0	1,9	1,6	1,7	1,5	1,5



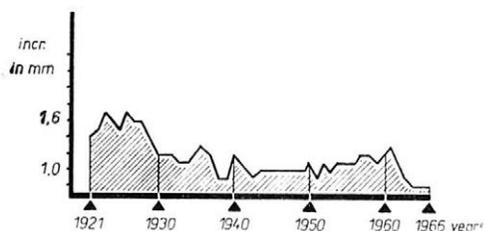
6. Current annual increment of the annual rings in D.b.h. in the stand near the Mausoleum, in the years 1859-1913



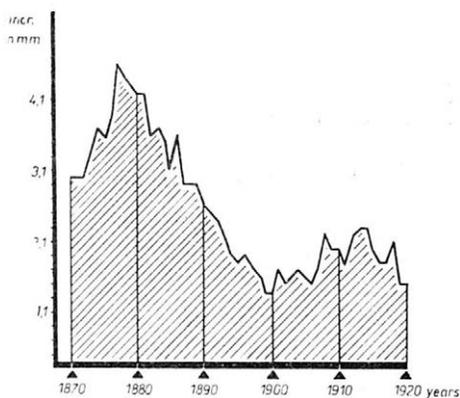
7. Current annual increment of the annual rings in D.b.h. in the stand near the Mausoleum, in the years 1914-1966



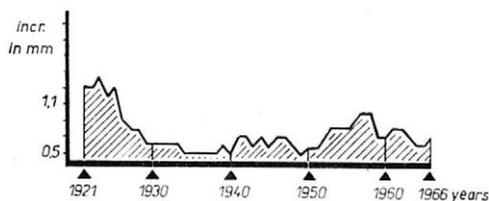
8. Current annual increment of the annual rings in D.b.h. in the stand 93p, in the years 1869-1920



9. Current annual increment of the annual rings in D.b.h. in the stand 93p, in the years 1921-1966

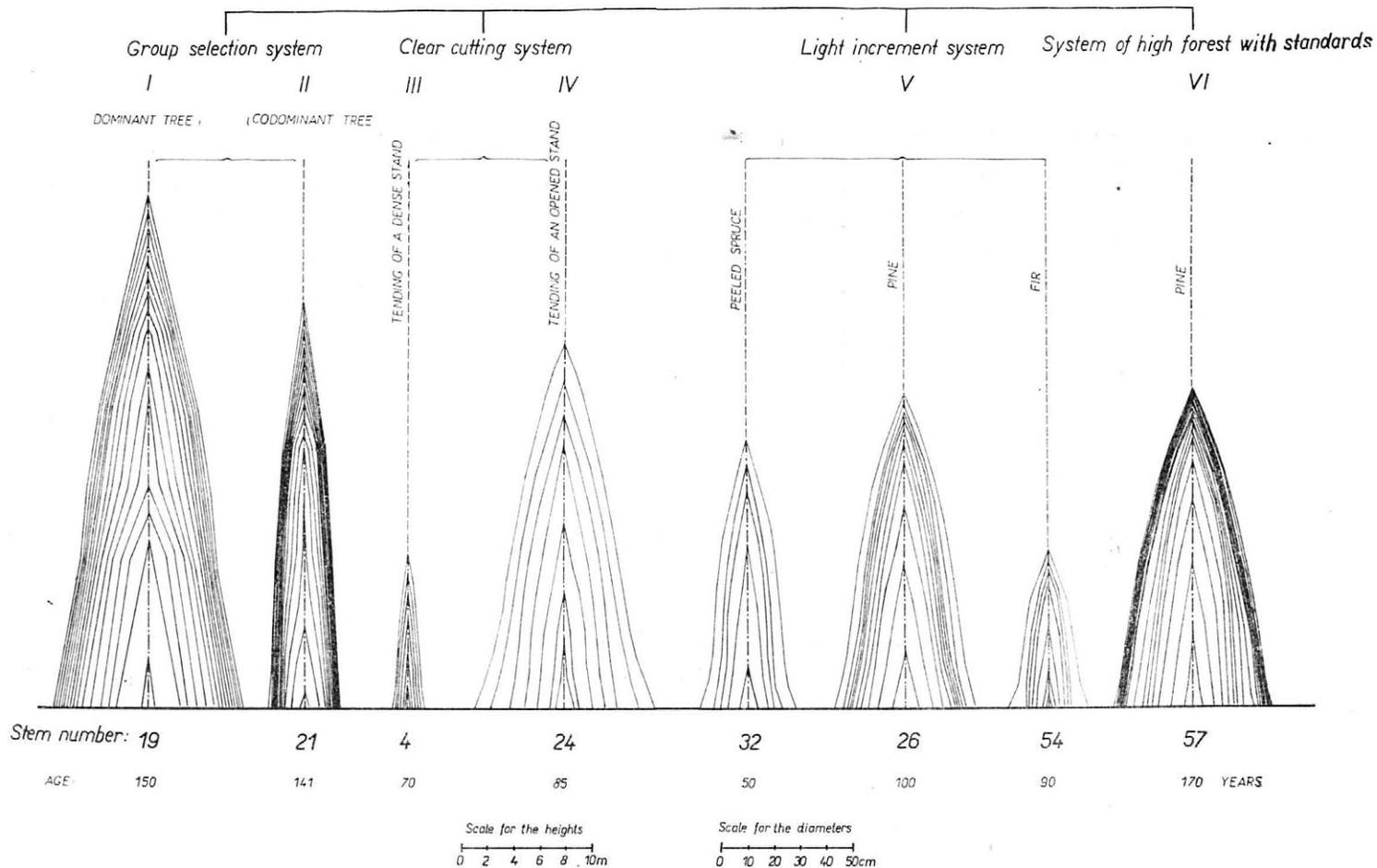


10. Current annual increment of the annual rings in D.b.h. in the stand 97g, in the years 1870-1920



11. Current annual increment of the annual rings in D.b.h. in the stand 97g, in the years 1921-1966

12. Characteristical types of the stems formed within the same site class and different stand quality



II. Ist group. Increments of the dominant and suppressed trees in the system of successive regeneration fellings

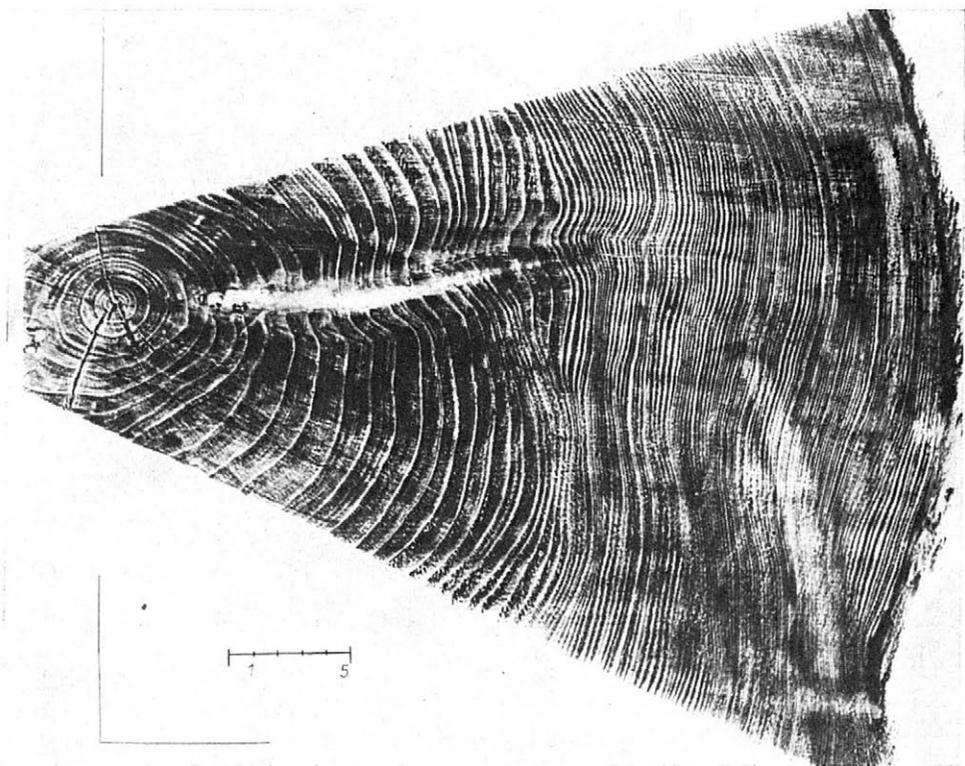
Sample tree number	Tree species	Local name	Age	Thickness						Length of the stem	Volume of large timber	Increment during last 10 years		Notes
				stump	1,3	5,7	11,4	17,0	23,0			cm	%	
			years		in m of length						m			
				cm										
19	Spruce	Kaly	150	76	66	61	55	47	38	38,2	5,86	2,0	0,9	Main trees
20	Pine	Kaly	140	60	56	45,8	40,5	37	29	33	3,18	3,4	1,9	
21	Spruce	Kaly	141	30	27	24	22	19	14,5	31	0,87	0,8	0,9	Suppressed trees
41	Fir	Kaly	161	62	53	47	44	37	28	33,6	3,71	3,0	1,6	Main trees

III. IInd group. Increments in even-aged stands in which light thinning followed the cleaning

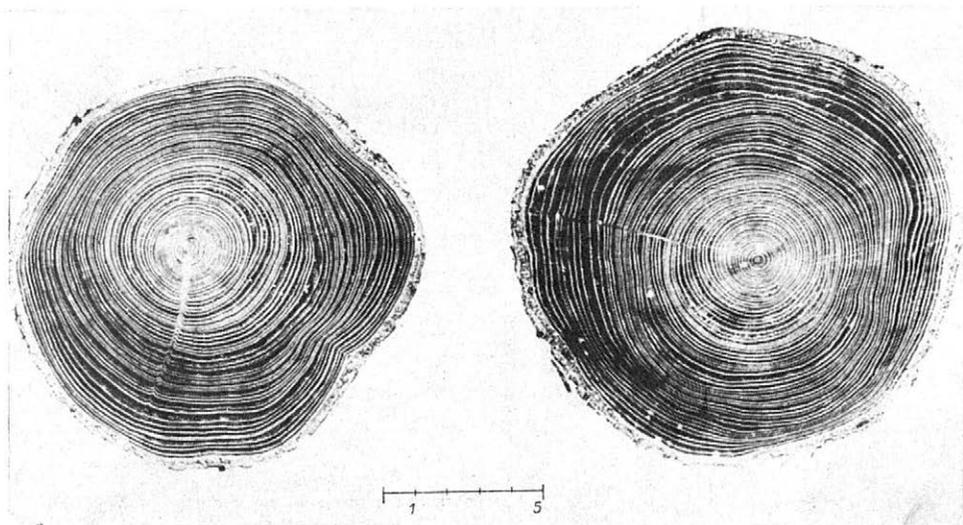
Sample tree number	Tree species	Local name	Age	Thickness					Length of the stem	Volume of large timber	Increment during last 10 years		Notes	
				stump	1,3	5,7	11,4	17,0			23,0	cm		%
			in m of length											
			years	cm					m	m ³	cm	%		
				a) Mean sample trees										
1	Spruce	District Sobědraž "Babí Loužek"	60	10,0	7,5	4,2	—	—	—	8,4	0,019	1,0	3,4	Section cut of the stock
2		Karlův les "Kaly"	40	8,4	6,7	4,4	—	—	—	9,0	0,016	3,8	16,0	
4		Malé "Hluboký"	70	11,8	10,3	7,3	—	—	—	12,0	0,049	1,6	3,02	
5		Malé "Staré záduší"	75	18,2	14,2	11,6	5,1	—	—	14,3	0,115	1,6	3,02	
					b) Main sample trees									
1		Sobědraž "Babí Loužek"	60	14,4	11,2	8,5	—	—	—	11,0	0,051	2,4	5,6	
2		Karlův les „Kaly“	40	17,0	12,4	9,2	—	—	—	12,0	0,075	4,5	10,8	
4		Malé "Hluboký"	70	13,0	11,3	8,6	—	—	—	12,0	0,064	2,0	5,6	
5		Malé "Staré záduší"	75	22,2	20,0	16,5	11,3	—	—	18,6	0,274	2,0	3,06	
7		Sobědraž "Vojtovky"	75	31,0	22,1	17,8	15,1	—	—	21,9	0,420	4,0	6,0	

IV. IIIrd group. Increments in even-aged stands in which heavier thinning followed the cleaning

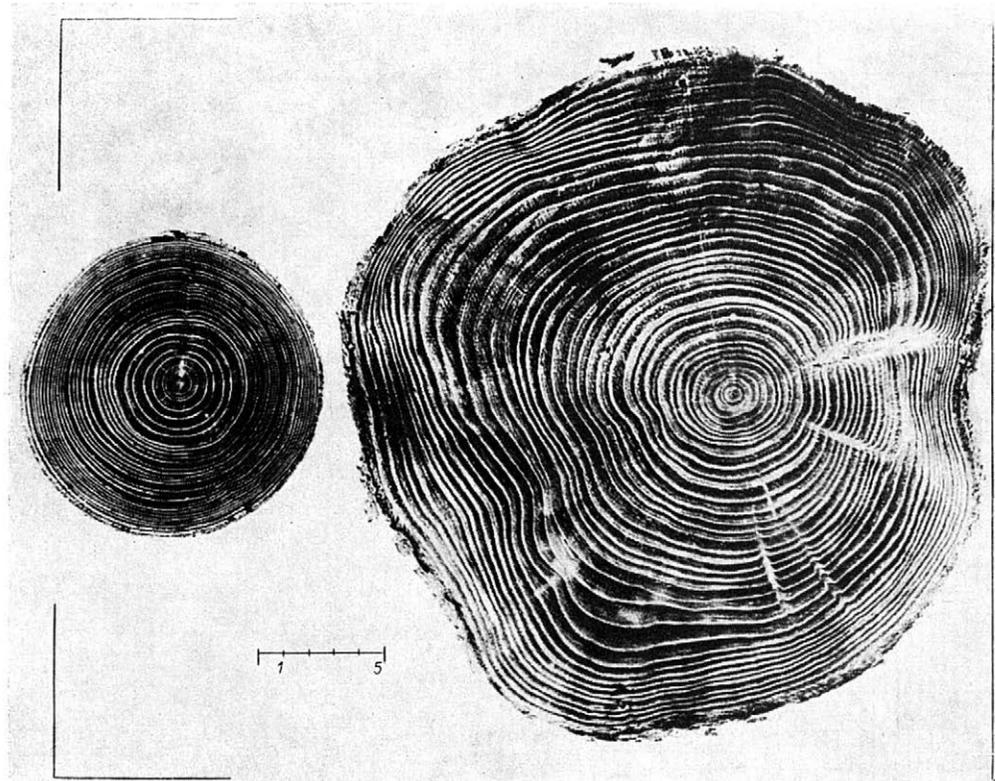
Sample tree number	Tree species	Forest district	Local name	Age	Thickness					Length of the stem	Volume of large timber	Increment during last 10 years		Notes	
					stump	1,3	5,7	11,4	17,0			23,0	cm		%
						in m of length									
				years	cm					m	m ³	cm	%		
a) Mean sample trees															
11	Spruce	Šerkov	Park	27	15,8	12,7	9,2	—	—	—	12,0	0,078	5,2	10,8	} cut of the stock
12	Spruce	Nový Dvůr	Karlův les	27	16,5	12,0	9,8	4,8	—	—	15,0	0,086	5,6	13,0	
13	Spruce	Sobědraž	Paseka	39	16,0	11,6	10,0	3,9	—	—	14,1	0,070	2,4	8,2	} cut in D. b. h.
14	Spruce	Sobědraž	Laciny	39	19,0	14,9	13,2	10,0	—	—	17,5	0,180	3,2	7,0	
15	Spruce	Sobědraž	Březová	41	23,0	16,5	14,5	9,8	—	—	18,5	0,210	4,9	8,3	
17	Spruce	Rukávec	Jedlí	38	18,0	16,0	13,0	9,0	—	—	17,1	0,150	6,0	10,8	} cut of the stock
18	Spruce	Rukávec	Boubelka	46	23,0	17,5	15,0	9,5	—	—	16,6	0,190	4,6	7,7	
b) Main sample trees															
11	Spruce	Šerkov	Park	27	25,0	20,0	16,5	8,6	—	—	15,3	0,250	8,0	10,8	} cut of the stock
12	Spruce	Nový Dvůr	Karlův les	27	30,0	20,8	16,6	9,0	—	—	15,0	0,264	9,4	12,0	
13	Spruce	Sobědraž	Paseka	39	27,0	20,6	17,8	10,7	—	—	17,0	0,280	5,0	6,69	
14	Spruce	Sobědraž	Laciny	39	27,0	22,6	19,7	12,6	—	—	17,3	0,330	6,0	7,69	
15	Spruce	Sobědraž	Březová	41	35,0	25,0	21,0	15,8	9,0	—	22,0	0,470	6,8	8,64	
17	Spruce	Rukávec	Jedlí	38	32,0	26,0	21,0	15,0	4,0	—	19,5	0,440	6,4	7,40	
18	Spruce	Rukávec	Boubelka	48	34,0	26,0	22,0	17,5	9,0	—	21,1	0,520	5,0	5,20	
22	Spruce	Rukávec	Šupanda	76/111	59,0	49,0	43,4	37,8	31,6	20,0	32,0	2,670	3,2	2,00	
23	Spruce	Žbonín	Hrubé čekáni	85	57,0	47,0	41,0	33,0	27,0	—	25,0	1,995	—	—	
24	Spruce	Žbonín	Hrubé čekáni	85	66,0	58,0	52,0	42,6	30,0	—	27,8	3,280	7,0	3,00	
25	Pine	Nový Dvůr	Šoš	85/90	60,0	56,0	46,0	38,5	29,0	—	26,0	2,670	—	—	} incl. the 25years' under-growth
45	Pine	Rukávec		50	36,0	28,0	23,0	17,0	9,0	—	21,0	0,570	6,8	7,40	
48	Spruce	Rukávec		57	49,0	40,0	34,0	28,0	17,0	—	23,5	1,300	8,0	5,80	



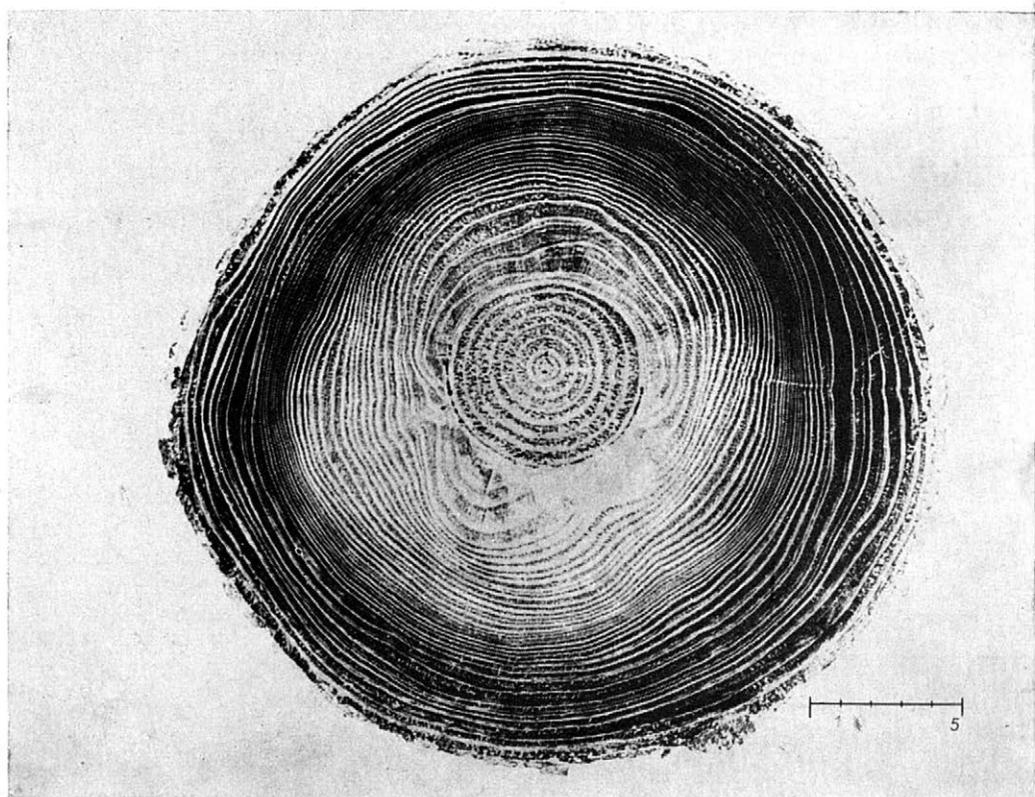
13. Ist group — sample tree No 19 — Spruce



14. IInd group — sample tree No 4 — Spruce



15. IIIrd group — sample tree No 13 — Spruce



16. IVth group — sample tree No 28 — Spruce

V. IVth group. Spruce stands in the light increment system

Sample tree number	Tree species	Forest district	Local name	Age	Thickness						Length of the stem	Volume of large timber	Increment during the decade			
					on the stock	1,3	5,7	11,4	17,0	23,0			1869/79		1879/89	
				in m of the length												
				years	cm								m	m ³	cm	%
27	Spruce	Sobědraž	u Sobíku	55	34,0	25,0	17,2	12,1	—	—	17,0	0,350	3,4	5,0	3,5	4,8
28	Spruce	Sobědraž	u Sobíku	51	34,0	24,0	18,5	14,4	—	—	18,0	0,403	2,3	3,5	5,9	8,8
29	Spruce	Sobědraž	u Sobíku	51	32,0	22,0	17,9	12,5	—	—	18,0	0,353	2,2	4,0	5,1	8,2
30	Spruce	Sobědraž	u Sobíku	51	31,0	22,0	17,1	11,3	—	—	17,0	0,330	2,2	3,9	4,2	6,9
31	Spruce	Sobědraž	u Sobíku	66	33,0	27,0	21,9	15,5	—	—	19,5	0,535	2,4	3,5	5,2	7,2
32	Spruce	Sobědraž	u Sobíku	50	42,0	30,0	25,5	18,2	—	—	20,3	0,680	4,3	6,0	8,5	9,7
33	Spruce	Sobědraž	u Sobíku	52	34,0	24,0	21,0	14,6	—	—	19,2	0,435	2,6	4,0	5,3	7,6
34	Spruce	Sobědraž	u Sobíku	63	40,0	26,0	24,6	16,1	—	—	18,2	0,560	3,3	5,1	5,6	7,6
35	Spruce	Sobědraž	u Sobíku	65	39,0	26,0	24,2	18,0	—	—	19,6	0,590	3,1	4,5	5,4	7,3
36	Spruce	Sobědraž	u Sobíku	60	40,0	26,0	23,3	15,9	—	—	19,0	0,565	4,1	6,2	6,2	8,4
37	Spruce	Sobědraž	u Sobíku	64	35,0	27,0	22,3	15,8	—	—	18,0	0,492	3,5	5,3	6,8	8,8
38	Spruce	Sobědraž	u Sobíku	72	35,0	26,0	22,7	17,4	—	—	18,9	0,520	3,0	4,2	4,8	6,4
39	Spruce	Kostelec	Zahůrka	61	46,0	33,0	28,0	20,0	9,6	—	21,0	0,820	—	—	8,7	7,4
40	Spruce	Kostelec	Zahůrka	57	45,0	36,0	31,5	21,0	9,0	—	21,0	0,980	—	—	9,6	8,0
42	Spruce	Rukávec	Dubí	50	34,0	27,0	24,0	18,0	10,0	—	21,6	0,600	—	—	5,0	5,9
43	Spruce	Rukávec	Dubí	50	38,0	29,0	25,0	21,0	11,0	—	22,8	0,710	—	—	8,0	8,0
44	Spruce	Rukávec	Dubí	50	40,0	32,0	28,0	21,0	11,0	—	21,6	0,800	—	—	7,4	8,3
46	Spruce	Rukávec	Vlčí jámy	80	62,0	49,0	41,0	34,0	24,0	9,0	27,0	1,980	—	—	5,2	3,6
47	Spruce	Rukávec	Vlčí jámy	90	57,0	47,0	39,0	34,0	25,0	12,0	28,3	2,020	—	—	7,6	5,0
53	Spruce	Kostelec	Zahůrka	53	51,0	43,0	37,0	29,5	18,3	—	23,5	1,540	—	—	8,4	6,1

quite evident here. Things are also similar with the 93p forest crop, except that the highest values are recorded about the year 1880. Diagram 10, which refers to the 97g stand, present a similar pattern.

For illustration, some results are presented of the analyses made by B o h d a n e c k ý in the sample trees from stands under different systems of tending, over the decennia 1869—1879 and 1879—1889; pertinent data are shown summarized in Table V and in Figs. 12—16.

The objects of our study were the characteristic types developed under equal site quality and stand quality under the shelterwood and the clear-cutting system, and further with the use of the light increment system in sample trees (Fig. 12).

From the Second Group where the increment was examined of even-aged stands under the Moderate Thinning Grade, sample trees No. 4 are demonstrated; the former being the average sample tree, the latter representing the main stem, both expressed by the B o h d a n e c k ý print method.

In the Third Group, spruce tree No. 13 appeared most illustrative for and typical of the whole series; it represents a pair of the average sample tree and the main stem of a spruce aged 39.

In the Fourth Group, spruce tree No. 28, aged 51, indicates in an illustrative manner the so-called light increment system.

The above data give evidence that even B o h d a n e c k ý was able to demonstrate, through the results of his studies, marked differences between the various silvicultural systems applied.

EVALUATION OF THE RESULTS AND CONCLUSIONS

Development of a new thinning method, which made our forestry famous and has, since its introduction, been known in the world as the Czech or Orlik or Three-millimeter Thinning, is due to Josef B o h d a n e c k ý. His method laid the foundations of a new concept, the so-called Management for Rapid Growth (Ger.: Schnellwuchsbetrieb). Despite the fact that origin of the B o h d a n e c k ý System dates back to the end of 19th century, the idea has proved to be far from a historical event only; just the opposite being the truth, it has shown to be highly up-to-date at present from the view of our requirements and their solution, not only here but also and mainly abroad.

The original forest stands under the B o h d a n e c k ý System were, at a later time, not tended by his method; obviously, no long-term home evidence is now available concerning results of this interesting idea. The more is it therefore urgent now to reconsider the method and to delimit its positive effects and results in the light of the present and future needs of forest management.

It is well known that B o h d a n e c k ý was inspired by differences in the annual increment of growth rings; in open stands this increment was found surpassing the value of 3.5 mm, while in those under the dense canopy and established by seeding, the value did not exceed 1 mm. Therefore, he advised to practise in essence the Heavy Thinning Grade in forest stands from their early years already, in order to maintain the crown large and thus providing for its full production. The heavy thinning was involved in essence, according to the Classification System introduced by K o n š e l (C-Grade).

In order to obtain factual evidence on the B o h d a n e c k ý System we made use, on one hand, of the retrospective method, while on the other, comparative thinning plots have been established where his System becomes part of

the comparative series. It goes without saying that, in applying the retrospective method, preference was given to those stands where Bohdanecký had actually practiced his System and which may serve our aims as model crops. In this respect the requirement was met best with by the "U Mauzolea" spruce stand, part of the Orlick Castle Park, and by two other stands designated 93p and 97g and located within the Karlov forest section, Ostrovec Forest District, Písek Forest Unit. Concerning the other purpose research plots have already been established within the Řásná Forest District, Telč Forest Unit, and within the Plešný Forest area controlled by Management of the Military Forests and Estates at Horní Planá.

For the retrospective studies (these being the object of our paper) we made use mainly of the historical and analytical methods, including the analyses of sample trees and of growth rings. It follows from the documentary material available that during the time Josef Bohdanecký was applying his System in forest around the Orlick Castle, i. e. from 1880 and up, the diameter increment increased, due to his thinning method, from the 1-mm growth ring up to the 3–4 mm growth ring per year, individual trees recording as much as 6 mm increment. This finding allows to state that the aim Bohdanecký had set to himself, i. e. to improve resistance in the excessively dense spruce stands of the Orlick region against destructive agents and to produce well marketable assortment of timber, was reached.

Naturally, well-founded objections were also raised relative to unsuitability of his method for the production of assortments characterized by high quality parameters. After all, Bohdanecký himself was quite aware of this shortcoming. Yet, the useful and topical contribution of his System which, as a matter of fact, has expanded the scope of thinnings, is to be seen in promotion of the resistance of spruce monocultures and in production of thicker assortments in a shorter rotation. Similar results have also been reported from sample plots abroad, even with spruce stands of higher elevations, such as is the Thuringian Forest (Thüringer Wald). Accordingly, the method developed and introduced by Bohdanecký is to be considered still up-to-date and worthwhile paying attention to, both as a theory and its practical application as well.

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Prosté hospodářství přírůstné v pojetí české probírky Bohdaneckého

Josef Bohdanecký proslavil naše lesnictví probírkovou metodou, která je ve světě známa pod názvem probírka česká, orlická nebo třímilimetrová a dala základ novému směru tzv. prostého nebo urychleného hospodářství přírůstného (Schnellwuchsbetrieb). I když Bohdaneckého systém vznikl koncem minulého století, není historismem, nopak se stává znovu velmi aktuální z hlediska soudobých potřeb a jejich řešení u nás a zejména pak v zahraničí.

Původní Bohdaneckého porosty nebyly dále pěstovány jeho způsobem, takže nám chybí dlouhodobý domácí důkaz o výsledcích této zajímavé metody. Tím spíše je třeba věnovat jí znovu pozornost a vymezit její pozitivní vlivy a výsledky v soudobé i perspektivní potřebě lesního hospodářství.

Je známo, že Bohdaneckého inspirovala rozdílnost ročního přírůstu letokruhů, která přesahovala u uvolněných porostů 3,5 mm, zatímco u hustě pěstěných porostů vzniklých sítí nepřekračovala 1 mm. Proto v podstatě doporučil pěstovat porosty od mládí zásahy silné intenzity, tak aby byla udržována velká koruna a mohla plně produkovat. Šlo v podstatě o silnou probírku podle Konšelova třídění (stupeň C).

Abychom získali faktické důkazy o Bohdaneckého metodě, použili jsme jednak metody retrospektivní, jednak zakládáme srovnávací probírkové plochy, kde je jeho způsob součástí výzkumné řady. Pro retrospektivní metodu byly přirozeně zvoleny porosty, v nichž Bohdanecký pracoval a které mohou sloužit jako srovnávací objekty. Jsou to smrkový porost „U Mauzolea“ v parku u zámku Orlika nad Vltavou a porosty 93p a 97g lesnického úseku Karlov, polesí Ostrovec, Lesní závod Písek. Pro druhý účel jsme již založili výzkumné plochy na polesí Řasná, Lesní závod Telč, a na správě Plešný, ředitelství Vojenských lesů a statků v Horní Planě.

Pro retrospektivní šetření, které je předmětem našeho sdělení, jsme použili především historické a analytické metody včetně rozboru vzorníků a letokruhů. Z dokladového materiálu vyplývá, že v době působnosti Josefa Bohdaneckého v lesích kolem Orliku, tj. od roku 1880, se zvýšil tloušťkový přírůst porostů v důsledku jeho probírky z 1mm letokruhu ročně na letokruh 3–4mm, přičemž u jednotlivých stromů činil až 6 mm. Je možno konstatovat, že Bohdaneckého záměr zpevnit přehoustlé smrčiny orlické oblasti proti bořivým činitelům a vypěstovat v nich dobře zpeněžitelné sortimenty dřeva byl splněn.

Samozřejmě, že se vyskytly oprávněné námitky o nevhodnosti jeho způsobu pro vypěstění sortimentů s vysokými jakostními parametry. Toho si byl ostatně vědom i sám Bohdanecký. Za pozitivní a aktuální přínos jeho systému, který vlastně přerůstá rámeček probírek, je nutno uznat posilování rezistence smrkových monokultur a dosažení tlustších sortimentů v kratší obmětné době. Obdobné výsledky také přinesly zahraniční výzkumné plochy i ve smrčínách vyšších poloh, jako je např. Duryňský les. Proto je třeba považovat Bohdaneckého metodu i nyní za aktuální a hodnou pozornosti jak v teoretickém smyslu, tak i v praktickém uplatnění.

Простое природное хозяйство в понятии чешской рубки прожеживания Богданецкого

Иозеф Богданецкий прославил наше лесное дело методом проходных рубок; эта рубка получила в мире название чешская, орлицкая или трехмиллиметровая и положила основу новому направлению так наз. простого или ускоренного природного хозяйства (Schnellwuchsbetrieb). Хотя система Богданецкого возникла еще в конце прошлого века, все же она не является историческим прошлым, а, наоборот, она снова становится с точки зрения современных нужд народного хозяйства и их решений очень актуальной не только у нас, но и за границей.

Подлинные насаждения Богданецкого в последствии не развивались по его методу и поэтому отсутствует долговременное отечественное доказательство о результатах этого

interessanten метода. И поэтому тем более необходимо снова обратиться на него внимание и определить его положительные влияния и результаты в современной и будущей потребности лесного хозяйства.

Известно, что Богданецкого заинтересовала разница в приросте годичных колец, которая в прореженных насаждениях превышала 3,5 мм, в то время как в густых сеяных культурах она не превышала 1 мм. Поэтому он в сущности рекомендовал выращивать насаждения уже с молодости с применением интенсивных рубок ухода, так чтобы все время поддерживалась большая крона с полной продукцией. В сущности дело касалось сильной проходной рубкой согласно классификации Коңшела (степень С).

Для ретроспективного исследования, которое является предметом настоящего сообщения, мы использовали, прежде всего, исторические и аналитические методы, включая анализ образцов годичных колец. Из документов вытекает, что во время деятельности Й. Богданецкого в лесах вокруг Орлика, т. е. с 1880 года, диаметр прироста насаждений в результате проходных рубок увеличился с 1 мм годичного кольца на 3–4 мм, причем у отдельных деревьев он достигал даже 6 мм. Можно констатировать, что цель Богданецкого укрепить чрезмерно густые ельники орлицкой области против разрушающих факторов и вырастить в них сортименты древесины с хорошим финансовым эффектом, была достигнута.

Естественно, что возникали обоснованные возражения о непригодности метода Богданецкого для выращивания сортиментов с высокими качественными параметрами. Это сознавал и сам Богданецкий. Положительным и актуальным вкладом системы Богданецкого, которая собственно, выходит из рамок проходных рубок, необходимо признать усиление устойчивости еловых монокультур и достижение более толстых сортиментов за более короткий срок оборота рубки. Аналогичные результаты дали также заграничные спытные площади даже в ельниках, расположенных на большей высоте над уровнем моря, как напр. Дуринский лес. Поэтому метод Богданецкого можно и в настоящее время считать актуальным и заслуживающим внимания методом не только в теоретическом смысле, но и с точки зрения практического применения.

Einfache Zuwachswirtschaft in der Auffassung der tschechischen Durchforstung nach Bohdanecký

Josef Bohdanecký machte unsere Försterei durch die Durchforstung, die unter dem Namen die tschechische, Orlik oder dreimillimeter Durchforstung bekannt ist, berühmt. Diese Methode legte die Grundlagen zur neuen Richtung, zu so genanntem einfachen Schnellwuchsbetrieb. Obzwar das Bohdanecký's System auch am Ende des vorigen Jahrhunderts entstand, ist es kein historisches System, im Gegenteil, es wird wieder sehr aktuell aus dem Gesichtspunkt der gleichzeitigen Bedürfnisse und ihrer Lösung bei uns und besonders im Auslande.

Ursprüngliche Bohdanecký's Bestände wurden nicht weiter nach seiner Art erzogen, sodaß uns langfristiger einheimischer Beweis über die Resultate dieser interessanten Methode fehlt. Desto eher ist es notwendig auf sie einen Augenmerk wieder zu richten und ihre positive Einflüsse und Resultate im gleichzeitigen und perspektiven Bedürfnisse der Forstwirtschaft zu bestimmen.

Es ist bekannt, daß Bohdanecký mit der Verschiedenheit des Jahreszuwachses der Jahresringe, die bei den freigemachten Beständen 3,5mm überreichte, während sie bei den dicht erzogenen Beständen, durch die Saat entstandenen, nicht 1 mm überreichte, inspiriert war. Deshalb hat er empfohlen im wesentlichen die Bestände von der Jugend mit den Eingriffen von starker Intensität zu erziehen, sodaß eine große Krone immer erhalten wäre und völlig produzieren konnte. Im wesentlichen handelt es sich um die Durchforstung, die nach der Koңšel's Klassierung stark war (Grad C).

Für die retrospektive Erforschung, die ein Gegenstand unserer Mitteilung ist, haben wir vor allem die historische und analytische Methode einschließlich der Analyse der Probestämme und der Analyse der Jahresringe benützt. Aus dem Beweismaterial folgt, daß in der Zeit der Bohdanecký's Tätigkeit in den Wäldern um Orlik, das ist vom Jahre 1880, hat sich der Durchmesserzuwachs der Bestände infolge seiner Durchforstung nach aus 1 mm des Jahresringes jährlich auf den Jahresring 3-4 mm erhöht, wobei bei einzelnen Bäumen hat er bis 6 mm betragen. Man kann konstatieren, daß die Bohdanecký's Absicht, die sehr dichte Fichtenwälder des Adlergebirge-Gebietes gegen die zerstörende Faktoren fest zu machen und aus ihnen gut in Geld umzusetzende Holzsortimente erziehen, erfüllt war.

Es ist selbstverständlich, daß begründete Einwendungen über die Unschicklichkeit seiner Methode für die Erziehung der Sortimente mit hohen Qualitätsparametern

tern vorkamen. Auch Bohdanecký selbst war sich dieser Wirklichkeit übrigens bewußt. Es ist notwendig als positiven und aktuellen Beitrag seiner Methode, welche eigentlich den Rahmen der Durchforstungen überwächst, die Stärkung der Resistenz der Fichtenmonokulturen und Erziehung stärkeren Sortimente im kurzen Umtriebsalter, anzuerkennen. Analogische Resultate haben auch ausländische Forschungsflächen auch aus den Fichtenwäldern in den höheren Lagen, wie zum Beispiel der Thüringerwald ist, gebracht. Deshalb ist es notwendig die Bohdanecký's Methode auch jetzt für aktuelle und der Aufmerksamkeit würdige sowohl im theoretischen Sinne, als auch in der praktischen Durchsetzung zu halten.

Le traitement simple d'accroissement en hauteur, en conception de l'éclaircie de Bohdanecký (l'éclaircie tchèque)

Josef Bohdanecký rendait notre sylviculture célèbre par la méthode d'éclaircie, qui est connue dans le monde entier sous le nom l'éclaircie tchèque ou trois millimètre ou l'éclaircie d'Orlík et celle a posée les fondements d'une direction nouvelle, ce qu'on appelle traitement simple ou traitement d'accroissement accéléré. Bien que la méthode de Bohdanecký tirait son origine dans le siècle passé, elle n'est pas une méthode historique, mais au contraire, elle devient très actuelle au point de vue des besoins contemporains et de leur solution chez nous et surtout à l'étranger.

On n'a pas continué à cultiver les peuplements originaux de Bohdanecký par sa méthode, et c'est pourquoi nous n'avons pas une preuve indigène de longues années des résultats de cette méthode intéressante. C'est pourquoi nous devons prêter notre attention à de nouveau et définir ses influences positives et les résultats dans le besoin contemporain et perspectif du traitement forestier.

On sait, que Bohdanecký était inspiré par la différence de l'accroissement de cerne annuels par an qui dépassait 3,5 mm dans les peuplement libre, pendant qu'elle n'avait pas dépassé 1 mm dans les peuplements dru cultivés faits par un semis. C'est pourquoi, au fond, il a recommandé de cultiver les peuplements depuis la jeunesse par les coups d'une intensité forte, de sorte qu'une couronne grande soit maintenue et pourrait produire pleinement. Au fond, il s'agit de l'éclaircie, forte d'après le classement de Konšel (degré C).

Pour les recherches rétrospectives, qui sont l'objet de notre rapport, avant tous, nous avons utilisé une méthode historique et analytique inclusivement les analyses des arbres d'essai et les analyses des cerne annuels. Il s'ensuit du matériel de document que pendant l'activité de Bohdanecký dans les forêts autour d'Orlík, c.-à.-d. depuis l'année 1880, l'accroissement de diamètre des peuplements s'est élevé en conséquence de son éclaircie du cerne annuel 1 mm par an au cerne annuel 3-4 mm, et le cerne annuel de chaque arbre était près de 6 mm. Nous pouvons constater, que l'intention de Bohdanecký de raffermir les lieux plantés d'épicéas, qui sont très épais dans le territoire à Orlík contre les facteurs démolissants et d'y faire les assortiments de bois, qui peuvent être très bon convertis en argent, a été rempli.

Evidemment, on a trouvé beaucoup d'objections fondées, que sa méthode de cultivation d'assortiments avec les paramètres d'une haute qualité n'était pas favorable. Bohdanecký lui-même avait une très bonne confiance de cela. Il est nécessaire de prendre pour un apport positif et actuel de sa méthode, qui en réalité dépasse le cadre des éclaircies, l'augmentation de la résistance des monocultures d'épicéa et la formation des assortiments à l'âge de la révolution plus court. On a obtenu les résultats analogiques sur les surfaces de recherches à l'étranger aussi aux lieux plantés d'épicéas sur les places plus hautes, comme il y a dans le Forêt de Thuringie. Pour cette raison, il est nécessaire de prendre la méthode de Bohdanecký jusqu'à présent pour une méthode actuelle, qui mérite l'attention tellement dans la signification théorique, tellement dans l'application pratique.

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The forest tree species do not produce seed evenly in individual years. For making a planned forest regeneration possible, it is necessary to store seed of the major tree species obtained in the years with full seed crops up to the years with meagre crops. If the forest enterprises have not adequate equipment for the storage of greater seed amounts, the seed transfer from the areas of abundant crops to the areas of small crops becomes a regular solution. However, from the economic point of view, it is necessary to proceed in this transfer¹⁾ in such a way that the ecotypes applied in the establishment of forest stands must show a sufficient resistance on their planting site and their wood production must not be of worse quality than that of the autochthonous ecotypes.

Already in the first half of the 19th century, the renowned breeder Vilmorin successfully planted out and produced in western France straight and relatively rapidly growing pines originating from Baltic coast near Riga. Recently, Rohmder (1960) reports that Norway spruce, autochthonous in the Bavarian forest, grows there slower than the spruce provenances originating from the lowland regions of Poland situated farther north. It is also well known that larch of the Sudetes (varietas Sudetica) is successfully grown in the West European countries, the beech-nuts from East Slovakia are applied for forest regeneration in Denmark and many Central European spruces grow more quickly in southern Sweden than the native Swedish spruces.

We may therefore pose a question, under what site conditions the individual ecotypes of major tree species show a favourable development, i. e. when the transferred ecotypes of forest tree species respond to the changed site conditions with satisfactory hardiness, suitable growth and valuable wood production.

This question may be answered either by the observations made for elucidating the origin of subpopulations of the economically valuable forest tree species, or by the results of sample plantations of the ecotypes transferred from various latitudes, longitudes or elevations.

ORIGIN OF SUBPOPULATIONS (ECOTYPES)

The forests of Europe became during their migration in the Glacial and Interglacial Ages, as well as in the Postglacial Age poorer in the number of species, but at the same time, they were enriched by the new subpopulations resistant

¹⁾ When introducing seeds or seedlings of certain species inside of its natural range, we generally speak about the transfer of ecotypes. On the other hand, the plantation of wood species outside their natural range is called introduction.

to the climatic of individual regions. Natural selection was a chief factor of the process leading to the mentioned changes and to the origin of new subpopulations in various geographic latitudes or in various altitudinal zones of the natural range of a given species.

This follows yet from the works of Charles R. Darwin (1859) who, basing on numerous observations made in various continents, showed that the organisms bring forth much more progenies as to be able to hold out in a given living space and that this overproduction of organisms is manifested by the competition for life, by the "competition for sun" of higher plants. We can read in the Darwin's work *The origin of species*, page 61: "When we travel from south to north, or from a damp region to a dry, we invariably see some species gradually getting rarer and rarer, and finally disappearing; and the change of climate being conspicuous, we are tempted to attribute the whole effect to its direct action. But this is a false view; we forget that each species, even where it most abounds, is constantly suffering enormous destruction at some period of its life, from enemies or from competitors for the same place and food; and if these enemies or competitors be in the least degree favored by any slight change of climate, they will increase in numbers; and as each area is already fully stocked with inhabitants, the other species must decrease."

The presumptions of Lamarckists and Neolamarckists, according to which the adaptation of organisms is not caused by natural selection, but directly by external conditions, have not been proved. It was experimentally not proved even the heredity of morphological adaptations which the Neolamarckists referred to. Lysenko (1952, 1953) tried to "supplement" the conception of Neolamarckists by darwinism. Nevertheless, his theory did not contribute to the classification of the processes determining the evolution of organisms (see Čížek, Hodáňová 1966). On the contrary, Darwin's conception, according to which the natural selection is the main factor or even the driving force of the evolution, has been generally confirmed by recent studies in the field of molecular genetics, without regard to the fact that the substance of this selection has been recently sought in the mutual complete action of heredity, mutability and competition for life.

The results of recent genetic studies give evidence on the significance of mutations in natural selection. They indicate that the mutations grown in a given environment to sexual maturity are often easily subject of crossing with the individuals possessing non-mutated genes and that the progeny of such crossing may give rise to new subpopulations, which may be characterized by the common hereditary physiological and morphological qualities and the individuals of them may be included in the ecotypes of a given origin.

Turesson (1931) states that the subalpine ecotypes of the same species did not arise in all mountain massifs. For instance, the ecotype *alpestris* (or *alpinus*) by *Solidago virga aurea* L. or *Polygonum bistorta* L. was found only in the Altai Mountains but not in the Alps or in the Carpathian Mountains. Even this proves that the subpopulations were stabilized through the natural selection, which could not be the same in mountains of different continents. If the subpopulations developed by direct adaptation, their beginning would be necessary in all mountainous sites of approximately equal climatic conditions.

Because of sporadic occurrence of mutations in the populations of forest tree species, the mutation rate of individual alleles is lower than 10^{-6} . A more frequent occurrence of mutations may be assumed under extreme site conditions, where the frequency of individual alleles changes and the new subpopulations arise more frequently as a result of a more severe natural selection. Therefore,



1. International experimental provenance plot in forest district Hůrka near Písek. Plot with 26-year-old pines (*Pinus silvestris* L.) from Poland, Bolewice (52°21' l. N., 26°10' l. E.). An example of continental pine-ecotype which excelled on the sites in Southern Bohemia over pines from maritime climate not only by their growth, but also by shape of their trunk. At their 19th year the height of continental ecotypes was by 20,6 % greater than the height of maritime pines. Photo Říčný
2. International experimental provenance plot in forest district Zámecký near Třeboň. Plot with 26-year-old maritime pine-ecotype from Elmstein, FGR (49°20' l. N., 7°55' l. E.). Photo Říčný



3. International experimental provenance plot in forest district Zámecký near Třeboň. Plot with 26-year-old North pine-ecotype from Modum, Norway (60° l. N., 10° l. E). In Southern Bohemia the height of pines from latitude 59° – 62° was in their 19^h year by 29,2% smaller and at 20 years of age at the breast high diameter by 29,9% thinner than pines from latitude 50° – 53° . But specimens from the North had upright trunks with thinner side branches than the pines from Central Europe. Photo Říčný

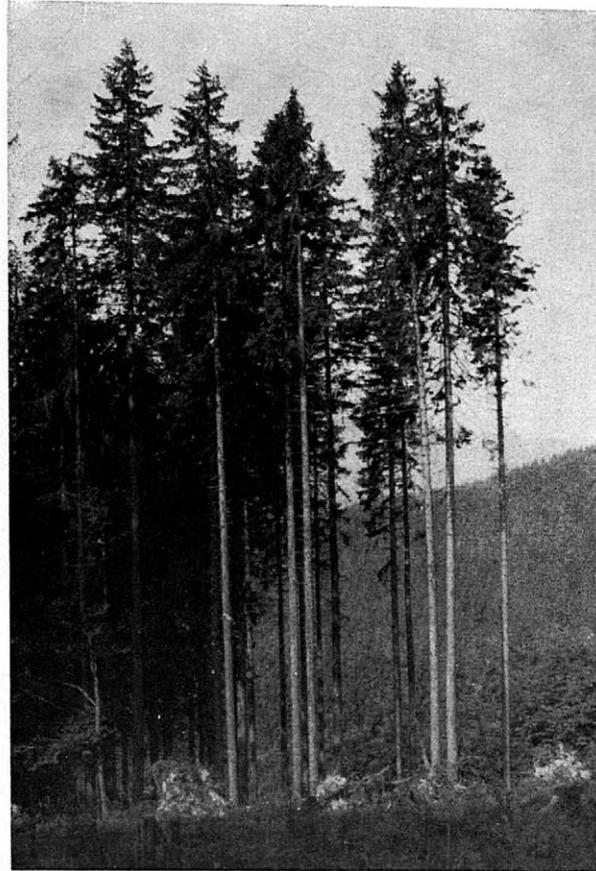
4. Forest management at Třeboň, pine seed trees indigenous in Southern Bohemia. An example of Central-European hilly pine-ecotype with stem of high quality. Photo Říčný



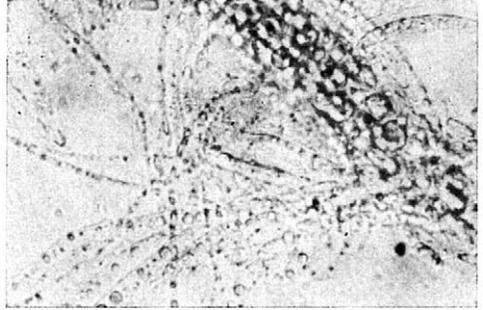
5. Praděd ("Great-Grandfather") — mountain massif of North-Moravia, group of spruces (*Picea excelsa* Lk.) of subalpine ecotype at 1250 m above sea-level. Photo Hauk



6. Forest district Cep near Třeboň, 25-year-old pinewood of hilly ecotype indigenous in Southern Bohemia. Photo Vincent

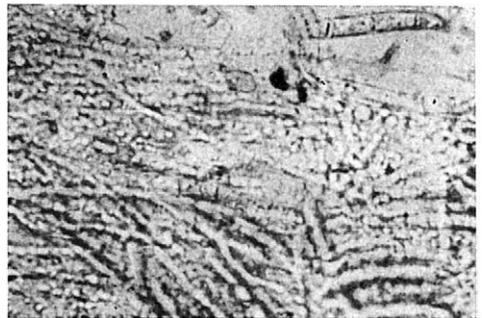
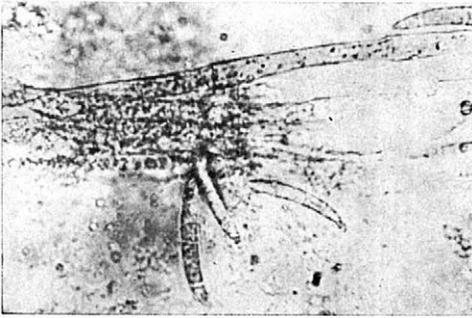


7. Forest management at Pražmo in Silesian Beskyds, indigenous spruce-stand of exploitable age in 850 m above sea-level. An example of the ecotype of medium-quality sites in Central-European mountain massifs. Photo Vincent



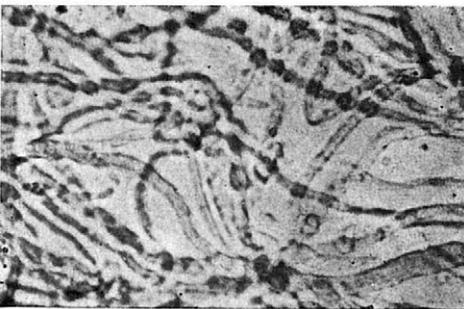
1. *Fusarium solani* (control) orig.

2. *Fusarium solani* contaminated by bacterium *Erwinia cancerogena*, orig.

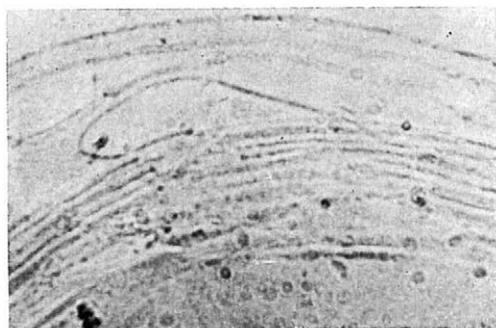


3. *Fusarium solani* contaminated by bacterium *Pseudomonas syringae*, orig.

4. *Fusarium solani* contaminated by mixture of bacteria *Erwinia cancerogena* and *Pseudomonas syringae*, orig.

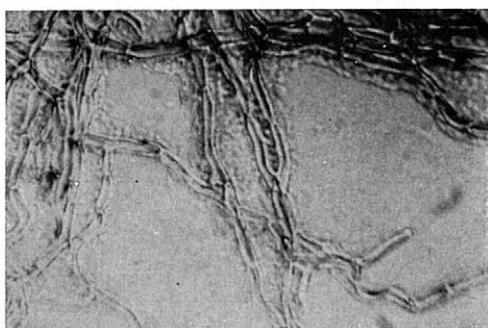


5. Mycelium of *Hypoxylon* sp. (control) orig.



6. Mycelium of *Hypoxylon* sp. contaminated by bacterium *Erwinia cancerogena*, orig.

7. *Dothichiza* (*Chondroplea*) *populea* – control, orig.



8. Mycelium of fungus *Chondroplea* with coat of bacterium *Erwinia cancerogena*, orig.

9. Germinating spores of fungus *Chondroplea populea* contaminated by bacterium *Erwinia cancerogena*, orig.

the origin of a great majority of ecotypes in individual regions or altitudinal zones of the natural range of major forest tree species is placed into the Glacial Ages.

The fact that in the origin of subpopulations the natural selection was a determining factor deciding on the occurrence of some mutation deviations or their hybrids with non-mutated genes, the subpopulations became relatively independent of the environmental conditions under which they arose. This fact explains why many ecotypes may be successfully grown even in the more distant regions.

THE RESULTS OF TEST PLANTING OF ECOTYPES TRANSFERRED FROM VARIOUS LATITUDES, LONGITUDES OR ALTITUDES

THE HORIZONTAL TRANSFER

a) Planting of ecotypes from the more southerly latitudes into the more northerly ones and vice versa

In the European range of Norway spruce (*Picea excelsa* Link) the ecotypes from the medium and low elevations of the Carpathians, Hercyne mountain massifs and the Alps belong to the spruces which rapidly grow in their youth. On the contrary, the northern spruces, i. e. the ecotypes from Norway, Sweden and Finland are the slowly growing ones.

According to the investigations made in Sweden, L a n g l e t (1948) maintains that Scots pine (*Pinus silvestris* L.) and Norway spruce from southern Sweden may be successfully grown within their natural range in the locations distant not more than 250 km to the north or 200 km to the south, supposing that they are at a nearly same altitude a. s. l. as that of the mother stand or tree.

This conclusion is conform with the results of investigations made in Czechoslovakia. The pines from the locations situated not more than 2° N. l. to the north and the spruces from the locations situated not more than 2° N. l. to the south developed favourably on the trial plots in southern Bohemia and in the Silesian Beskids (V i n c e n t, F l e k 1953, V i n c e n t, P o l n a r 1953).

These findings were also confirmed by the observations made in Romania. L a z a r e s c u, N i t u and C a l u g a r e s c u (1963) studied the transpiration of 9-year-old ash (*Fraxinus excelsior* L.) of different provenances on the trial plot at Mihaiesti. They found that the individual climatotypes did not transpire differently, as far as the difference in the geographic latitudes from which the ecotypes originated, did not exceed 2° N. l. and the altitude a. s. l. was nearly equal.

On the contrary, the northern spruces from 62–65° N. l. planted out on the trial plots in the Silesian Beskids in 49°35' N. l. showed at their age of 20 years

d.b.h. by	30 % smaller,
height by	25 % lower and,
wood production ²⁾ by	69 % smaller.

than the Central European spruces from 47–50° N. l. (V i n c e n t 1963). The ecotypes originating from the geographic latitude distant more than 2° N. l.

²⁾ Wood having over 7 cm in diameter at the smaller end.

from the planting site to the north or to the south were injured by early or late frosts and hindered in their growth.

The trial planting results indicate that in the individual latitudinal zones of the natural range of tree species the subpopulations prevail, the vegetation rhythm (photoperiodism) of which corresponds to the day-length and to the vegetation period of the mentioned zones.

b) The transfer from east to west

According to the measurements made by Bouvarel and Lemoine (1957) on a trial plot in northern France and by Gathy (1960) on trial plots in Belgium, the most rapid growth up to the age of 16—19 years, under maritime climate of West Europe showed the late-flushing spruces originating from the continental climate of the Bielorussian Republic and from the medium elevations of the northern Carpathians. Both spruce ecotypes with a short vegetation rhythm showed no injuries caused by late frosts which are very frequent in the maritime climate of northern France and Belgium.

The pines under maritime climate have a rather longer vegetation rhythm than the ecotypes from the continental climate on a nearly same geographic latitude. The first mentioned pines resemble the ecotypes originating from the more southerly latitudes (Langlet 1938).

THE VERTICAL TRANSFER

Langlet (1948) maintains that the pine and spruce ecotypes of Swedish provenance may be successfully grown in the sites being not more than 200 m higher or lower from the place of their natural occurrence, supposing that the geographic latitude is approximately the same as that of the planting site.

In Central Europe, the transfer of larch (*Larix europaea* DC) ecotypes to the locations situated by 200 m higher or lower than the site of their mother stand did not unfavourably affect their development (Vincent 1953, Vincent, Polák 1962).

On the contrary, the subalpine spruces transferred to the lower situated locations grew distinctly slower both in the medium altitudes of mountain massifs and in the less continuous uplands and they produced also less wood than the ecotypes of the medium and lower altitudes of the same geographic latitudes (Cieslar 1887, Engler 1913, Vincent 1960, Gathy 1960, Bouvarel 1961, Lehotský 1960, Holzer 1967). The slowly developing subalpine spruces from lower situated locations were richly covered with branches, their stems were tapering and they produced sawn timber of bad quality (Vincent 1965).

The Alpine and Carpathian larches originating from the mountain massifs (above 600 m a. s. l.) and transferred to the less continuous uplands and hills (up to 400 m a. s. l.) developed also slower than the autochthonous larches of these sites (Vincent, Polák 1962).

The spruce ecotypes of medium altitudes transferred into the subalpine sites grew in the beginning more rapidly than the subalpine ecotypes, but they were damaged by early frosts, snow and their wind-hardiness was very small.

Both the observations made on trial plots and the practical experiences give evidence that the forest tree species respond to vertical transfer by their growth and wood production much more intensively than to horizontal transfer from north to south or from east to west. The favourable vertical transfer assessed

for the medium altitudes of mountain massifs at plus/minus 200 m a. s. l., narrows for the subalpine sites to plus/minus 100 m a. s. l. (L e h o t s k ý 1960).

This is proved not only by the results of trial plantations, but also by the behaviour of seedlings of individual ecotypes from different height degrees in conditioning chambers. H o l z e r (1966) found that the different lighting period exerts a distinct influence on seedling growth and that the individual ecotypes from sites of different altitudes show their optimum growth in a given day-length. It may be therefore assumed that in individual mountain altitudes the natural selection gave rise to the subpopulations adapted not only to the vegetation period, but also to the day-length.

TRANSFER TO THE SITES OF DIFFERENT GEOGRAPHIC LATITUDE AND ALTITUDE A. S. L.

According to studies made in Sweden (C a r b o n n i e r 1954, L a n g - l e t 1960); many Carpathian and Alpine spruces as well as the spruces originating from the Hercyne mountain massifs grow in southern Sweden more rapidly than the autochthonous Swedish spruces. The favourable experience with planting of Central European spruces requires explanation so much more that planting of Central European pines absolutely failed in southern Sweden.

L a n g l e t (1960) points to the different variability of both species. He maintains that the pine variability is influenced by length of vegetation period and its temperature, as well as by day-length, whereas the spruce variability is determined chiefly by the temperature conditions of site.

It is also possible that the various sibiological qualities of both species become evident by a different reaction to their transfer from south to north. In our opinion, this different reaction is caused, first of all, by the fact that the Scots pine naturally distributed in Central Europe belongs prevailingly to the lowland ecotypes, whereas the Central European spruces belong to the mountain ecotypes.

The pines of Polish provenance from Bolewice (52°21' N. l., alt., 80—100 m a. s. l.) showed excellent growth in the South Bohemian uplands (49°00' N. l.) at the altitude of 430—460 m a. s. l. (P o l á k, V i n c e n t 1965). The Mazurian pines from the surroundings of Olsztyn (53°40' N. l.), altitude 130 m a. s. l. planted out on the trial plot in the forest district Likavka (49°03' N. l.) at the altitude of 590 m a. s. l. overtopped the Central European pines not only in height and d. b. h., but also in slight taper of their stems (Š t a s t n ý 1960).

On the other hand, the Central European spruces from medium altitudes developed favourably on the trial plot Dönjelt (56°56' N. l.) at the altitude of 170 m a. s. l. in the south of Sweden.

It is clear that the vegetation rhythm of pines from Bolewice corresponds approximately to the vegetation period of the South Bohemian uplands and that the similar situation is in the case of Mazurian pines planted out in the Choč highland near Likavka as well as that the vegetation rhythm of spruces from the medium altitudes of the Carpathian, Alpine and Hercyne areas is near to the vegetation period of southern Sweden and that by the mentioned fact the success of above-mentioned plantations was made substantially easier.

The statement of G ü n z l (1969), according to whom some thriving spruce provenances can be successfully transferred by 8 to 12° N. l. to the north, may be explained by the fact that those spruces originated from the higher altitudes of the Alps and were planted out to the lowland sites of southern Sweden.

However, the Central European pines belong prevailingly to the lowland ecotypes and have a relatively long vegetation rhythm, so that their reaction to the transfer to the more northerly latitudes is not favourable.

SUMMARIZING EVALUATION OF THE INVESTIGATION AND MEASUREMENT RESULTS AS A BASIS FOR THE INSTRUCTION ON FOREST SEED TRANSFER

On the basis of the briefly summarized findings mentioned in the first part of this paper, it may be assumed that the growth of ecotypes is to a great degree independent of the environment of their origin. This is also proved by the results of trial plantations mentioned in the second part of this study. The results present evidence that the spruce, pine and larch ecotypes react favourably by their growth to the transfer chiefly in such cases when their vegetation rhythm corresponds approximately to the day-length and to the duration of vegetation period of planting site. However, the term "approximately" may be explained in various ways. Therefore, we must pose a question to what degree the findings mentioned in the first part comply with the planting results.

The provenance trials show that the pine, spruce and larch ecotypes, as well as the ecotypes of common ash do not react unfavourably to the transfer by 2° N. l. to the south or to the north and to the transfer by 200 m a. s. l. upwards or downwards, in the subalpine sites by plus/minus 100 m a. s. l. These results make it possible to assess the allowable difference between the vegetation period of the original site and the vegetation period of planting site to 20—30 days. We believe that the relative independence of the ecotypes of forest tree species on the environment of their origin is approximately expressed even by this difference.

For making easier the transfer of seed corresponding to the genetic qualities of various ecotypes, the forest sites have been classified in different countries by day-length and by the duration of vegetation period. A special attention was paid in Sweden to the different geographic latitudes of forest sites and, in Czechoslovakia or in Austria, to the different altitudinal zones of these sites. It was taken into account that there is a correlation between geographic latitude on the one hand and day-length as well as vegetation period duration on the other hand and that a similar relationship exists also between altitude a. s. l. and day-length as well as vegetation period duration.

The relative independence of ecotypes on the environment allows that the division of forest sites links up to the natural range of major tree species. In Czechoslovakia, it was taken into account that the natural range of Norway spruce is concentrated to the mountain massifs and the sites with vegetation period shorter than 130 days, that the natural range of Scots pine and beech is concentrated mainly to the less continuous highlands with a vegetation period of 130—165 days, whereas the natural range of oak (*Quercus robur* L.) is concentrated to the lowlands and hills with the vegetation period exceeding 165 days.

Instruction for approval of forest stands and plus-trees, issued 1966 by the Ministry of Agriculture and Forestry in Prague permits the transfer of forest seed inside of the following climate zones:

- a) in the subalpine sites with the vegetation period not exceeding 100 days,
- b) in the medium altitudes of mountain massifs, in a cold mountain climate with the vegetation period from 100 to 129 days,
- c) in the less continuous highlands with moderate mountain climate and vegetation period 130—165 days and

d) in the lowlands and hilly regions with the vegetation period longer than 165 days.

The principles for the international transfer of forest seed have not been stipulated as yet. For preventing considerable losses arising from sowing and planting of ecotypes unsuitable for given sites, it is necessary to demand the certification of origin of imported forest seed, as well as the records on the data expressing the day-length and the duration of vegetation period of the mother stand site. These data should at least specify the most important principles governing the international transfer of seeds from the viewpoint of living conditions of the various ecotypes. There is at present the minimum requirement made for certification of forest seeds.

Only in this way can we secure sowing and planting of the ecotypes, which may contribute by their growth to higher production of the coming forest stands and to more economical management of forests.

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Úspěšný přenos lesního osiva v genetickém pojetí

Studie obsahuje výsledky pozorování, která osvětlují vznik subpopulací hospodářsky významných dřevin, jakož i výsledky pokusných výsadeb ekotypů, přenesených z rozdílné zeměpisné šířky, zeměpisné délky nebo nadmořské výšky.

Vznik subpopulací

Lesy v Evropě se staly za jejich migrace v dobách ledových a v dobách mezi jednotlivými dobami ledovými, jakož i v době poledové na druhy chudší, ale byly současně obohaceny o nové subpopulace odolné v podnebí jednotlivých oblastí. Hlavním faktorem procesu, který vedl k těmto změnám a ke vzniku nových subpopulací v odlišných zeměpisných šířkách nebo rozdílných výškových stupních areálu téhož druhu, byl přírodní výběr.

Vyplývá to již z prací Ch. R. Darwina (1859), který na podkladě četných pozorování, konaných v různých světadílech, doložil, že organismy plodí více potomstva, než se může udržet v daném životním prostoru a že tato nadprodukce

organismů se projevuje bojem o život, bojem o „místo na slunci“ u vyšších rostlin.

Předpoklady lamarckistů a neolamarckistů, podle nichž adaptace organismů není vyvolána přírodním výběrem, nýbrž přímo vnějšími podmínkami, nebyly potvrzeny. Naproti tomu Darwinovo pojetí, podle něhož přírodní výběr je hlavním faktorem, hybnou silou evoluce, bylo novými pracemi v oboru molekulární genetiky v zásadě potvrzeno, i když podstata tohoto výběru se dnes hledá ve vzájemném komplexním působení dědičnosti, mutability a boje o život.

Výsledky nových genetických prací vyzdvihují poslání mutací v přírodním výběru. Upozorňují, že mutace, které v daném prostředí vypsely do pohlavní zralosti, se často kříží s jedinci s geny nemutovanými a že potomstvo tohoto křížení může dát základ novým subpopulacím.

Tím však, že při vzniku subpopulací rozhodujícím činitelem byl přírodní výběr, který rozhodl o uplatnění určitých mutačních odchylek nebo jejich kříženců s geny nemutovanými, staly se subpopulace současně relativně nezávislé na prostředí, v němž vznikly. A právě tato okolnost vysvětluje, proč mnohé ekotypy lze s úspěchem pěstovat i ve vzdálenějších oblastech.

Výsledky pokusných výsadeb ekotypů přenesených z rozdílné zeměpisné šířky, délky nebo nadmořské výšky

Podle výsledků provenienčních pokusů lze tvrdit, že v rozdílných oblastech rozlehlých areálů jednotlivých dřevin vznikly subpopulace (ekotypy), jejichž vegetační rytmus (fotoperiodismus) odpovídá délce dne a vegetačnímu období dané polohy, že vegetační rytmus ekotypů je dědičnou vlastností, že ekotypy se vyvíjejí příznivě hlavně v polohách, kde délka dne a vegetační období přibližně odpovídá vegetačnímu rytmu přenesených ekotypů.

Pozorování na pokusných plochách i praktické zkušenosti dokládají též, že lesní dřeviny reagují na vertikální přenos jak svým vzrůstem, tak svou dřevní produkcí daleko citlivěji než na přenos horizontální ve směru sever—jih nebo východ—západ. V horských oblastech se délka dne i délka vegetačního období rychle mění s nadmořskou výškou poloh. S tím souvisí i nápadná reakce jednotlivých ekotypů na vertikální přenos.

Souhrnné zhodnocení výsledků pozorování i měření jako podkladu směrnice k přenosu osiva

Provenienční pokusy poučují, že borové, smrkové a modřínové ekotypy a také ekotypy jasanu ztepilého nereagují nepříznivě na přenos o 2° s. š. k severu nebo k jihu, jakož i na přenos o 200 m nahoru nebo dolů, v subalpinních polohách o ± 100 m n. m. Podle těchto výsledků je možno přípustný rozdíl mezi vegetační dobou místa původu a vegetační dobou místa výsadby odhadnout na 20—30 dnů. Máme za to, že právě tento rozdíl přibližně vyjadřuje relativní neodvislost ekotypů dřevin od prostředí jejich vzniku.

K usnadnění přenosu osiva, který odpovídá genetickým vlastnostem rozdílných ekotypů, byly v četných státech členěny lesní plochy podle délky dne a délky vegetačního období. Přitom se např. ve Švédsku přihlíželo především k rozdílné zeměpisné šířce lesních poloh, kdežto v Československu nebo v Rakousku hlavně k rozdílným výškovým stupňům těchto poloh. Vzala se v úvahu skutečnost, že mezi zeměpisnou šířkou na jedné straně a délkou dne, jakož i délkou vegetačního období na straně druhé je korelativní vztah a že podobný vztah je také mezi nadmořskou výškou a délkou dne, jakož i délkou vegetačního období.

Relativní neodvislost ekotypů od prostředí dovolila, aby členění lesních poloh navázalo na přirozený výskyt hlavních dřevin. V Československu bylo přihlíženo k tomu, že přirozený výskyt smrku se koncentruje v horských masívech v polohách s vegetačním obdobím kratším 130 dnů, že k přirozenému výskytu borovice a buku patří hlavně málo souvislé středohory, jejichž polohy mají vegetační období 130—165 dnů a že přirozený výskyt dubu letního (*Quercus robur* L.) se soustřeďuje v nížinách a pahorkatinách v polohách s vegetačním obdobím delším 165 dnů.

Zásady pro mezistátní přenos lesního osiva zatím formulovány nebyly. Aby se však předcházelo značným hospodářským ztrátám, jež vznikají s jízou výsadbou ekotypů, které jsou pro dané polohy nevhodné, je nutno žádat, aby také u dováženého lesního osiva byl ověřen jeho původ a zjištěna také data, vyjadřující délku dne a délku vegetačního období stanoviště jeho mateřského porostu. Předpokládá to ovšem účinnou kontrolu původu exportovaného i importovaného osiva.

Jediné tak lze zajistit s jízou výsadbu ekotypů, jež svým vzrůstem přispějí k hospodářskému vzestupu lesů a k jejich vyšší a jakostnější dřevní produkci.

Успешный перенос лесного посевного материала в генетическом отношении

Работа содержит результаты наблюдений, которые объясняют возникновение субпопуляций в хозяйственном отношении важных древесных пород, а также результаты экспериментальных посадок экотипов, перенесенных из разных географических широт и долгот или высот над уровнем моря.

Согласно результатам опытов по исследованию влияния происхождения, можно утверждать, что в различных областях обширных ареалов отдельных древесных пород возникли субпопуляции (экотипы), вегетационный ритм которых (фотопериодичность) соответствует длине дня и вегетационному периоду данного местоположения, что вегетационный ритм экотипов является наследственным свойством, что экотипы благоприятно развиваются, главным образом, в местоположениях, где длина дня и вегетационного периода приблизительно соответствуют вегетационному ритму перенесенных экотипов.

Наблюдения на опытных площадях и практический опыт далее доказывают, что лесные древесные породы на вертикальный перенос реагируют как своим ростом, так и своим производством древесины значительно чувствительнее, чем на горизонтальный перенос в направлениях север—юг или восток—запад. В горных областях длина дня и продолжительность вегетационного периода с высотой местоположений над уровнем моря быстро меняются. С этим связана острая реакция отдельных экотипов на вертикальный перенос.

Общая оценка результатов наблюдений и измерений как основы указаний о переносе посевного материала

Опыты с исследованием влияния происхождения показывают, что сосновые, еловые и лиственничные экотипы, а также экотипы ясеня обыкновенного не реагируют отрицательно на перенос на 20° северной широты к северу или к югу, подобно тому, как и на перенос на 200 м вверх или вниз, в субальпийских местоположениях на ± 100 м высоты над уровнем моря. Согласно этим результатам допустимую разницу между вегетационным периодом места происхождения и вегетационным периодом места посадки можно оценить на 20—30 дней. Мы считаем, что именно эта разница приблизительно выражает относительную независимость экотипов древесных пород от среды их возникновения.

Для облегчения переноса посевного материала, который соответствует генетическим свойствам разных экотипов, лесные области во многих государствах были расчленены согласно длине дня и продолжительности вегетационного периода. При этом, например в Швеции, в первую очередь, была учтена разница в географической широте лесных местоположений, тогда как в Чехословакии или в Австрии, главным образом, разница между высотами таких местоположений. Был учтен тот факт, что между географической широтой, с одной стороны, и длиной дня, а также и продолжительностью вегетационного периода, с другой стороны, существует корреляционная зависимость и что подобная зависимость имеется также между высотой над уровнем моря и длиной дня, равно как и продолжительностью вегетационного периода.

Принципы переноса лесного посевного материала между государствами пока не были сформулированы. Однако во избежание значительных хозяйственных потерь, возникших при посеве и посадке экотипов, которые непригодны для данных местоположений, необходимо требовать, чтобы также у ввозимого лесного посевного материала удостоверилось его происхождение и чтобы были также установлены данные, выражающие длину дня и продолжительность вегетационного периода местопроизрастания его материнского насаждения. Конечно, это предполагает действенный контроль происхождения ввозимого и ввозимого посевного материала.

Только так можно обеспечить посев и посадку экотипов, которые своим ростом помогут хозяйственному подъему лесов и повышению их производства в количественном и в качественном отношении.

Standortsgemäße Übertragung des Forstsaatgutes in genetischer Auffassung

Es werden Ergebnisse von jenen Studien und Versuchen zusammengefaßt, welche uns sowohl über die Entstehung der Subpopulationen (Ökotypen) der Hauptbaumarten, als auch über die Reaktion der einzelnen Ökotypen auf die Übertragung in unterschiedliche Standortverhältnisse informieren.

Europäische Wälder sind während ihrer Migration in Eiszeiten um mehrere Baumarten ärmer geworden, aber sie werden gleichzeitig um standortsgemäße Subpopulationen bereichert.

Ch. Darwin (1895) hat die natürliche Auslese für die treibende Kraft des Evolutionsprozesses der Organismen — also auch des Aufkommens von Subpopulationen — gehalten. Er hat bekräftigt, daß die Organismen eine solche Menge von Nachkommenschaft produzieren, daß diese Menge nicht in gegebenem Raum leben kann und daß der entscheidende Einfluß auf die Evolution der Organismen der natürlichen Auslese und nicht den Änderungen der äußeren Faktoren zugeschrieben werden muß. Diese Auffassung hat man durch neue biochemische und genetische Arbeiten im Prinzip bestätigt und dabei die Rolle der Mutationen hervorgehoben.

Da aber die Entstehung der Subpopulationen vor allem durch die natürliche Auslese gegeben wird, sind manche Ökotypen relativ unabhängig vom Milieu ihrer Entstehung geworden. Gerade dies erklärt, warum man mehrere Ökotypen mit Erfolg oft in entfernteren Gebieten anbauen kann.

Die Ergebnisse der Provenienzversuche haben bestätigt, daß die in ausgedehnten Arealen vorkommenden Baumarten Ökotypen von unterschiedlichen morphologischen oder physiologischen Eigenschaften besitzen, daß in einzelnen Gebieten von ungleicher geographischer Breite oder Länge, sowie in einzelnen Seehöhenstufen jene Ökotypen angereichert wurden, deren Vegetationsrhythmus (Fotoperiodismus) der Tageslänge und der Vegetationsperiode des gegebenen Standortes entspricht, daß der Vegetationsrhythmus der Ökotypen der Baumarten zu einer erblichen Eigenschaft gehört und daß die einzelnen Ökotypen sich besonders in solchen Lagen günstig entwickeln können, wo die Tageslänge und die Vegetationsperiode dem Vegetationsrhythmus dieser Ökotypen annähernd entspricht.

Zusammenfassung

der Beobachtungen und Versuchsergebnisse

Die Provenienzversuche belehren uns, daß die Kiefern-, Fichten- und Lärchenökotypen auf die Übertragung nord- oder südwärts um 2° n. B. oder um ± 200 m ü. d. M. (in den subalpinen Lagen um ± 100 m ü. d. M.) nicht ungünstig reagieren. Nach diesen Ergebnissen kann die zulässige Differenz zwischen der Vegetationsperiode des Herkunftsortes des übertragenen Ökotyps und der Vegetationsperiode des Anbauortes auf 20—30 Tage geschätzt werden. Gerade in dieser Differenz spiegelt sich die relative Unabhängigkeit vieler Ökotypen der Baumarten vom Milieu und dies weist darauf hin, daß diese relative Unabhängigkeit nicht überschritten werden darf, wenn wir das Forstsaatgut standortsgemäß übertragen wollen.

Zur Erleichterung der standortsgemäßen Übertragung von Forstsaatgut dienen in vielen Staater Anbaugebiete. Die diesen Gebieten zugeschriebene Aufgabe kann aber nur jene Standortseinteilung erfüllen, bei welcher die Forstlagen nach ihrer Tageslänge und ihrer Vegetationsperiode eingeteilt werden. In Schweden wurden bei der Aufstellung der Anbaugebiete besonders die durch ungleiche geographische Breite gegebenen Unterschiede in der Tageslänge und Vegetationsperiode berücksichtigt. In der Tschechoslowakei hat man die Gliederung der Forstlagen auf Grund der Länge ihrer Vegetationsperiode durchgeführt.

Zur Aufstellung einer Einteilung, die als Grundlage für internationale standortsgemäße Übertragung des Forstsaatgutes dienen könnte, fehlen vorläufig genügend überzeugende, experimentelle Belege und eingehende Erfahrungen. Um so mehr muß aber bei der internationalen Zertifizierung von Forstsaatgut verlangt werden, daß die Angabe von der Länge der Vegetationsperiode in der Charakteristik der Samen- und Pflanzenherkunft angeführt sein soll. Dies könnte als erster Schritt zur Aufstellung der Richtlinien für standortsgemäße internationale Übertragung des Forstsaatgutes betrachtet werden, zur Richtlinien, die zur Gründung von resistenten und wirtschaftlich wertvollen Forstbeständen führen werden.

La conception génétique du transfer des semences forestières

L'article contient les résultats des études et des expériences sur la formation des sous-populations (des écotypes) des essences forestières et sur la réaction des divers écotypes au transfer dans les stations différentes.

Pendant la migration de forêts européennes dans les périodes glaciaires, la représentation des diverses essences forestières dans ces forêts était à vrai dire appauvrie, mais elle était en même temps enrichie par la formation des plusieurs sous-populations.

D'après Ch. Darwin (1859) la sélection naturelle est une force, qu'elle provoque les processus de l'évolution des organismes, c'est à dire une force qu'elle possède une influence décisive aussi sur la formation des sous-populations des essences forestières.

La conception de Darwin était confirmée par les nouveaux travaux biochimiques et génétiques. Ces travaux ont en même temps accentués le rôle des mutations dans les processus de l'évolution des organismes.

Mais, parce que la sélection naturelle est un facteur qui décide sur l'existence de certaines mutations et leur hybrides, les sous-populations sont devenues relativement indépendantes du milieu, dans lequel elles ont pris leur naissance. Cette circonstance explique, pourquoi on peut planter avec succès plusieurs écotypes dans les sites assez éloignés et différents.

Suivant les résultats des expériences sur les provenances on a constaté, que dans les différentes régions climatiques chez les espèces ligneuses, répandues sur des surfaces étendues, des sous-populations (des écotypes) ont pris naissance, dont le rythme de végétation (le photopériodisme) correspond à la durée des jours et à la période de végétation de la site donnée, que le rythme de végétation est une propriété héréditaire des espèces ligneuses et que leurs écotypes se développent favorablement notamment dans les sites, où la durée des jours et la période de végétation ne diffèrent pas beaucoup du rythme de végétation des écotypes transférés.

Les observations effectuées sur les surfaces comparatives montrent que les essences forestières réagissent au transfert vertical tant par leur croissance que par leur production ligneuse de manière beaucoup plus sensible qu'au transfert horizontal dans la direction du sud au nord ou de l'est à l'ouest. Dans les régions montagneuses la durée des jours et la durée de la période de végétation diminue relativement vite avec la hauteur au-dessus de la mer. C'est pourquoi la réaction des écotypes au transfert vertical est plus frappant qu'au transfert horizontal.

Les résultats des expériences sur les provenances et application de ces résultats en pratique forestière

Les différences, qui dans le développement des écotypes transférés ne se reflètent pas défavorablement, sont évaluées — en ce qui concerne la durée des jours et la durée de la période de végétation — 20 à 30 jours, ce qui correspond au transfert au nord ou au sud au maximum de 2° de la latitude boréale, ou au transfert vertical à 200 m — dans les sites subalpine à 100 m — vers le haut ou vers le bas au maximum.

Afin de faciliter le transfert convenable du point de vue des conditions d'existence des divers écotypes — c'est à dire leurs propriétés génétiques —, on a recours dans certains pays à des régions sylvicoles. Les sites forestiers sont divisés suivant leur durée des jours et leur durée de la période de végétation. Lors du choix de ces régions on a tenu compte en Suède des différences données notamment par la latitude boréale, en Tchécoslovaquie par la période de végétation.

Il importe d'élargir les directives actuelles élaborées dans certains pays et de formuler au moins les principes les plus important au transfert international des semences forestières convenable du point de vue de la génétique des divers écotypes. Pour le moment il est nécessaire de demander au moins, que lors de la certification des semences forestières on caractérise l'origine de ces semences par la durée des jours et par la durée de la période de végétation du site de leurs peuplements ou d'arbres-mères.

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■ The author studied the harmfulness of polyporosis due to the fungus *Phellinus pini* found on Scots pine *Pinus silvestris* in the Třeboň region and at the same time devoted his attention to this disease on pine *Pinus uncinata* so frequent there.

Pinus uncinata, a tree form of mountain pine growing on some southern Bohemian peat bogs in the Třeboň basin occurs there individually, in pure and in mixed forest stands with Scots pine. It grows slowly but gives much worse wood quality than Scots pine. Nevertheless, due to rare and interesting occurrence in our conditions, it is worth of interest for forest pathology (A m b r o ž 1927).

Health conditions of *Pinus uncinata* with respect to *Phellinus pini* have not been yet mentioned in our literature, though southern Bohemia indicates many hundreds of hectares of this pine on deep peat bogs. *Pinus uncinata* is reduced by the planned forest management. It is replaced by Scots pine, here and there by Norway spruce as peat bogs are partially utilized. *Pinus uncinata* is an interesting native tree species. Here and there it reaches the age above 100 up to 150 years, exceptionally even more. Its height is about 10–15, scarcely even 20 m. Larger depth of peat bogs reduces the height of the tree. The high age is very suitable for the attack by *Phellinus pini* and for this reason the above-mentioned fungus is relatively common here.

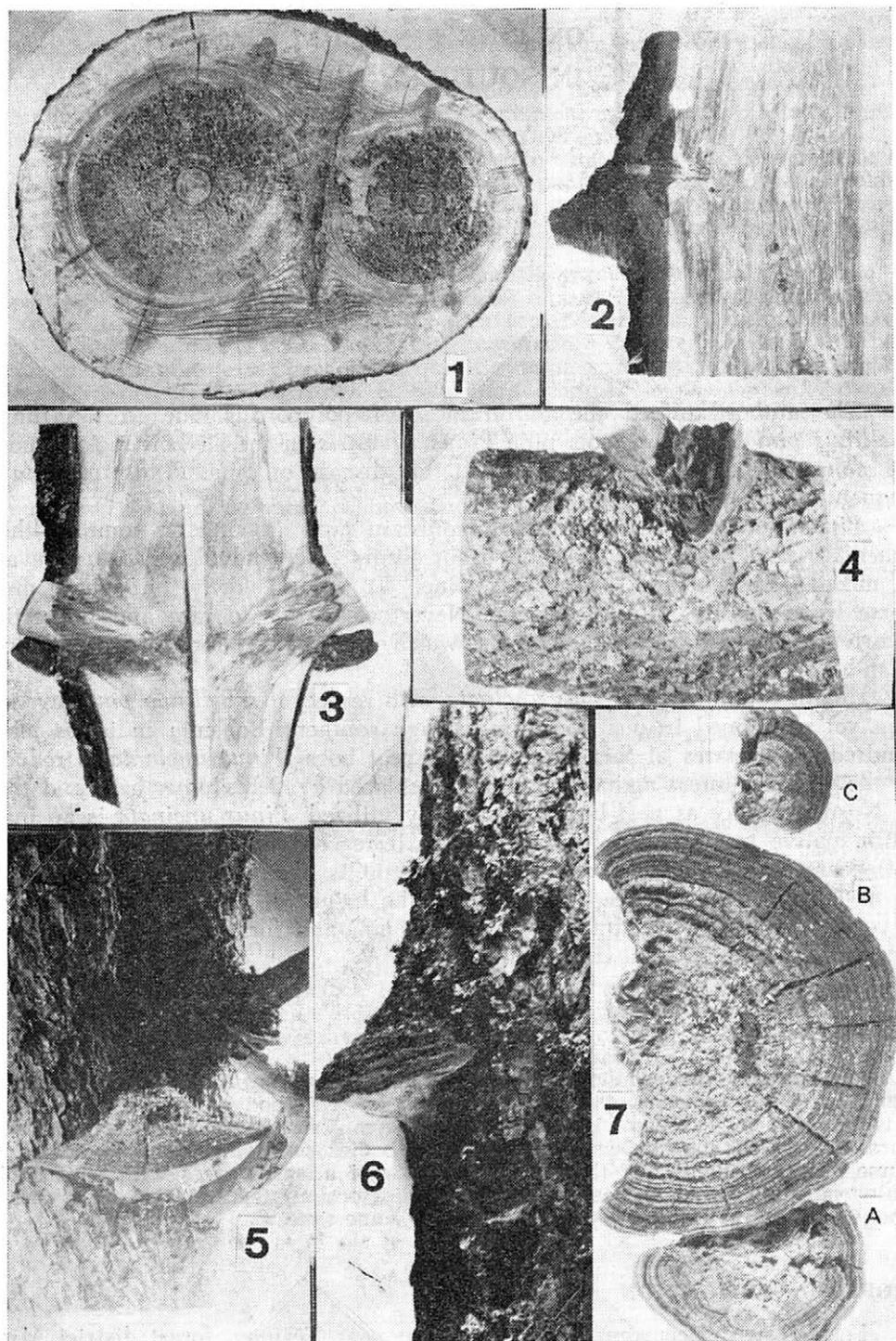
METHODS

The author investigated the attacked pines *Pinus uncinata* on three localities in 1969. This was a personal investigation based on fruit bodies occurrence on stem. It is possible to find attack also by other symptoms, e. g. according to decay character on old stems. Occurrence of fruit bodies on living stems indicates, of course, the true identity of this decay. Quantity of attacked trees with fruit bodies is always smaller than in reality, as fruit bodies occur later and also for a certain time. Overmature fruit bodies fall down after some time.

PROPER INVESTIGATION

Locality with occurrence: Červené blato near Těšínov, forest district Mirochov of the forest enterprise Chlum n. Luž., forest district Borkovice near Veselí n. Luž.

Fruit bodies: Of the similar appearance as *Phellinus pini* on Scots pine stems. Consols were mostly simple, but here and there also complicated (in



1. *Phellinus pini* on *Pinus uncinata* (strongly diminished). Original A. Kalandra, photo B. Urošević: 1 – cross-section of the decayed stem, 2 – longitudinal section of the wood decay with fruit body, 3, 4, 5, 6 – fruit bodies on the stem, 7 (A, B, C) – fruit bodies

rarer cases) from several grown together fruit bodies (2–3, rarely more). They were small, length from 2–5 cm., medium up 10–15 cm., large only in few cases with diameter above 20–22 cm. Widths were small, but also 5–10 cm., height of consols from 1 to 5 cm.

Injuries: Fruit bodies grew at various heights of stem, 2, 4 and 8 m. from rootstock. Here and there they were found also in greater height. The characteristic decay damaged the basal part of stem and often the whole stem up to the tree crown basis. Fruit bodies grew mostly on the western part of stem, often under old knots and dead branches. Localities with inmixed Scots pine indicated the decay of both pine species. Investigation has induced the author to estimate attacked pines by 1–3 % (Borkovice), up to 30 % (Červené blato), or 10–20 % (Mirochov) from forest stands. The higher age indicated increased number of stems with fruit bodies and in this way the increased scope of injuries.

Attacked forest stands: They were, as mentioned before, pure forest stands (Borkovice, Červené blato), but also mixed with Scots pine, here and there with Norway spruce and birch. They were more-storied, of various stocking.

Soil cover: Dense shrubby *Ledum palustre* with *Sphagnum* or here and there with *Rhamnus frangula* (Mirochov), with birch and with *Vaccinium myrtillus* and *Vaccinium vitis-idaea*.

Soils: Deep, plain-land peat bogs (Červené blato, Mirochov, Borkovice) here and there drained by deep trenches.

Conclusion: Carried out investigation indicated that *Phellinus pini* attacks old forest stands of *Pinus uncinata* from the age of 60–100–150 and even more years in the Třeboň region. Higher age shows increased number of stems with fruit bodies from 1 % to some 20–30 % and more.

Phellinus pini attacks not only Scots pine, but considerably also *Pinus uncinata*. This is due to the fact that this pine is not so often felled, occurs in protected areas and reaches high age.

Other localities of *Pinus uncinata* in southern Bohemia in the Třeboň region are under investigation.

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Phellinus pini (Thore) Pilát na blatce *Pinus uncinata* v jižních Čechách

Z šetření vyplynulo, že *Phellinus pini* na Třeboňsku napadá staré porosty blatky od 60 do 100–150 let, a tím spíše i starší. S přibývajícím věkem narůstá i počet plodnicových kmenů od 1 % až do cca 20–30 i více procent.

Phellinus pini napadá mimo borovici lesní značně i blatku, neboť tato borovice není místy tak těžena, zachovává se i v rezervacích a dosahuje vysokého věku.

Další lokality v jižních Čechách na Třeboňsku jsou prošetřovány.

Phellinus pini (Thore) Pilát на сосне *Pinus uncinata* в Южной Чехии

Результаты исследований показали, что *Phellinus pini* в районе Тршебоня поражает старые насаждения сосны *Pinus uncinata* в возрасте 60–100–150 лет, а в еще большей мере и насаждения еще старшего возраста. С возрастом увеличивается и число

стволов, пораженных плодовыми телами гриба. а именно от 1 вплоть до 20—30 и даже больше процентов.

Следовательно, *Phellinus pini* поражает не только сосну обыкновенную, но в значительной мере и *Pinus uncinata*, так как эта сосна в некоторых местах заготавливается в небольшой мере, сохраняется даже и в заповедниках и доживает до высокого возраста.

В районе Тршебоя в Южной Чехии обследуются еще и другие места произрастания.

Phellinus pini (Thore) Pilát an der Kiefer *Pinus uncinata* in Südböhmen

Aus der Untersuchung ging hervor, daß *Phellinus pini* im Gebiet von Třeboň die alten Kiefernbestände von 60—100—150 Jahren und selbstverständlich auch ältere befällt. Mit dem zunehmenden Alter wächst auch die Anzahl der mit Fruchtkörpern von *Phellinus pini* befallenen Stämme an, und zwar von 1 0/0 bis zu cca 20—30 0/0 und mehr.

Phellinus pini befällt also nicht nur die Waldkiefer, aber auch beträchtlich die Kiefer *Pinus uncinata*, da diese Kiefer stellenweise nicht in großem Umfang gefällt wird, sie wird auch in den Reservationen erhalten und erlebt ein hohes Alter.

Die weiteren Lokalitäten in Südböhmen im Gebiet von Třeboň werden überprüft.

Phellinus pini (Thore) Pilát sur le pin *Pinus uncinata* dans la Bohême méridionale

Il ressort de l'enquête le *Phellinus pini* attaque dans la région de Třeboň les vieux peuplements de *Pinus uncinata* à l'âge de 60—100—150 ans et à plus forte raison les peuplements encore plus âgés. A mesure que l'âge avance, c'est aussi le nombre de souches carpophores qui augmente, et cela depuis 1 p. 100 jusqu'à 20—30 p. 100 et même plus.

Phellinus pini attaque par conséquent non seulement le pin sylvestre, mais aussi fortement le *Pinus uncinata*, car ce dernier pin n'est pas tellement exploité dans certaines localités, il se conserve plutôt dans les réserves, où il atteint un âge très élevé.

On est en train d'examiner des localités ultérieures dans la Bohême méridionale, région de Třeboň.

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At present, the mutual relationships of bacteria and fungi are being studied very little. Notably mutual relationship of phytopathogenic bacteria and some wound parasites is up to now unclear, though these microorganisms are found very often together and may be easily isolated from canker diseases of some tree species.

There are now 60 years since Delacroix described bacterial canker of poplar and isolated one gram-negative little mobile bacterium, which he gave the name *Micrococcus populi* Delacroix. One year later Brizi isolated *Bacillus populi* Brizi, also an insufficiently described bacterium.

In the following years new species of the genus *Pseudomonas* Migula were found. 1938, Koning isolated and described *Pseudomonas rimaefaciens* Koning as disease pathogen. Lansade isolated one strain of bacterium *Pseudomonas syringae* van Hall in 1946 and 1952 Sabet et Dowson found *Pseudomonas syringae* van Hall. f. sp. *populea* Sabet et Dowson.

Finally, in 1958, Ridé described one gram-negative, immobile bacterium which he named *Aplanobacterium populi* Ridé. Some years later, in 1963, Ridé mentions rich microflora which takes part in the decomposition of canker tissue: bacteria (*Pseudomonas syringae* f. sp. *populea*, *Pseudomonas fluorescens*, *Aerobacter* sp. and *Erwinia* sp.), fungi (*Aureobasidium pullulans*, *Fusarium divers*, and *Nectria* sp.).

The author of this communication, as mentioned before, could not find *Aplanobacterium populi*. His efforts to isolate *Aplanobacterium populi* from attacked poplars grown in Czechoslovakia were quite unsuccessful.

Even repeated trials succeeded in isolation of bacterium showing fully different morphological and biochemico-physiological properties. Bacterium has been described as *Erwinia cancerogena* n. sp. (Urošević 1966).

Simultaneously, there were isolated more strains of bacterium *Pseudomonas syringae* van Hall., as well as one gram-negative chromogen bacterium which was preliminarily classified into genus *Chromobacterium* Bergonzini emend. Krasilnikov. In canker wounds the author found a larger number of semiparasitic fungi, notably species *Fusarium lateritium* Nees and *Fusarium solani* (Mart.) App. et Wr., further *Phomopsis putator* v. Höhnelt, *Chondroplea populea* (Sacc. et Briard) Klebahn, *Hypoxylon* Bull. sp. etc.

It may be stressed that up to now isolated sufficient number of parasitic and notably epiphytic microorganisms has not been studied as to their mutual relationships. This question of relationships of these microorganisms is of great

importance for knowledge of mechanism governing the development and origin of bacterial canker in poplars. For that reason, the present paper is limited only to this question.

WORKING PROCESS

Mutual relationships of isolated bacteria were studied by means of mixed cultures. Cultures were obtained by water suspension of vegetative cells from one-day pure cultures on yeast agar. Mixing was done in equal ratio.

The author investigated morphological and notable biochemical properties of these mixed cultures. Simultaneously, he tested the pathogenity (virulence) not only of individual isolated bacteria, but also of mixtures of these bacteria, and that by means of artificial infection of poplar plants.

Investigations included details of relationships of isolated phytopathogenic bacteria (*Erwinia cancerogena* and *Pseudomonas syringae*) to isolated wound parasites (*Fusarium solani*, *Chondroplea populea*, *Phomopsis putator*, *Hypoxylon* sp. etc.).

Mutual relationships of these isolated microorganisms were studied by standard growing on solid and liquid nutritive substrates (malt and Czapek-Dox agar, as well as in Fries, Czapek-Dox solutions with added asparagin etc.). We were interested mainly in mycolytic activity of isolated bacteria on the above-mentioned fungi, as well as in other phenomena of antagonism.

Simultaneously we investigated influence of mixed cultures of bacteria and fungi on the host by means of artificial infection. The author used one-year old poplars of common cultivars for infection in laboratory conditions. Infection in field conditions included the most distributed cultivars *P. 'robusta'*, *'marilandica'*, *'serotina'*, *'regenerata'*, *'Virginia de Frignicourt'*, *'brabantica'* etc. Artificial infection was done by injection on the basis of bud or branches by syringe under keeping sterility usual for experiments of this kind.

Simultaneously we studied artificial infection by tangential wounding of bark or of basis of leaf scar and by application of bacterium or mixture of bacteria and fungi by the tip of sterile scalpel.

RESULTS

When growing the bacterium *Erwinia cancerogena* with some isolated fungi (*Fusarium solani*, *Chondroplea populea*, *Phomopsis putator*, *Hypoxylon* sp. etc.) on solid and liquid nutritive substrates certain antagonisms of these microorganisms were observed.

Bacterium attacks mycelium of these fungi, overgrows it and successively brings about a lysis. In contamination of bacterium *Erwinia cancerogena* we found more limited pigment formation and increased formation of chlamydo-spores, for instance of species *Fusarium solani*.

The mycolytic activity of bacterium is changed in dependence on fungus species, nutritive substrate composition, environment moisture etc. There is attacked mainly young mycelium, notably from germinating spores. Mycelium decomposition is never complete, there are always remnants of mycelium. Besides that, bacterium attacks spores of these fungi very little or not at all.

Decomposition of macroconidia and notably of chlamydo-spores of species *Fusarium solani* was not observed though we found bacteria on its surface. In simultaneous inoculation of Czapek-Dox solution by macroconidia of *Fusarium solani* and by young vegetative cells of *Erwinia cancerogena*, a visible growth of colony of fungus is often strongly hindered. In the environment there are formed many chlamydo-spores which germinate later at the increased age of

culture when the activity of bacterial cells is reduced. It is obvious that also in this case the nature maintains an equilibrium.

Mycolytic activity enables in principle that bacterium may contaminate mycelium of these fungi and grow in it. In the re-oculation on malt agar the contaminated fungus grows in total quite normally. Nevertheless, even after some re-oculations, when nothing points to the present of bacterium, the bacterium may be commonly isolated by the use of suitable, sufficiently moist environment. From mycelia, also in pure cultures, bacterium transits into formed clusters of conidia of species *Fusarium* or fruit bodies of species *Hypoxylon*, *Chondroplea*, *Phomopsis* and it may be further distributed by protruding spores.

We succeeded for instance in isolation of mixture of bacteria *Erwinia* and *Pseudomonas* from protruding spores of *Phomopsis* from pure cultures (maintained for a period of two years and in usual intervals re-oculated). We were also successful in isolation of bacterium *Erwinia cancerogena* from pure cultures of fungus *Fusarium solani* obtained from bacterial canker of poplar (cultivar 'I-214' etc.).

It is necessary to point out that the mycolytic activity was exhibited not only by *Erwinia cancerogena* but also by strains of *Pseudomonas syringae* van Hall., though to a lesser extent. It is interesting that mixed cultures of *Erwinia cancerogena* and *Pseudomonas syringae* show considerable mycolytic activity against the above-mentioned wound parasites.

Experiments indicated that bacteria *Erwinia cancerogena*, *Pseudomonas syringae* and mixed cultures of *Erwinia cancerogena* and *Pseudomonas syringae* showed mycolytic activity against some parasites of wounds. This antagonism makes it possible that the above-mentioned bacteria contaminate mycelium of these fungi and are maintained on it. Bacteria pass over from mycelium to clusters of conidia and fruit bodies and may be distributed by ripe spores. It may be said that these contaminated fungi serve in a certain sense also as vectors of these bacteria.

If the above-mentioned phytopathogenic bacteria indicate certain antagonism against some parasites of wounds, their mutual relationship to host plant is considerably different. Artificial infection of poplar by bacteria mixture and fungi indicates their strong virulence. For instance, mixture of bacterium *Pseudomonas syringae* and *Fusarium lateritium* is more pathogenic for infected plants than pure cultures of *Pseudomonas*. Also the infection of mixture of *Erwinia cancerogena* and *Fusarium solani* microorganisms indicates more pronounced symptoms in some cases and somewhat different in comparison with infection by pure bacterium etc. That is simultaneously a matter of a certain kind of synergism.

DISCUSSION

Mutual relationships of bacteria and fungi are up to now little known. Relatively best known is the inhibition effect (antibiotica) of some bacteria, *Actinomyces* and saprophytic fungi (*Penicillium*, *Trichothecium*, *Gliocladium*, *Trichoderma* etc.) on some phytopathogenic bacteria.

In some cases numerous authors observed other kind of antagonistic relationships of bacteria and fungi. So for instance, F. A. Wood and D. W. French observed that perithecia of *Hypoxylon pruinaum* were infected by

bacteria in 72 % which ripened from perithecia after having been stored in moist chambers. Germinating of ascospores was hindered by bacteria up to 94 %, but it is to be regretted that authors have not studied these bacteria in details.

Very often information can be found in the literature on some bacteria and fungi. This phenomenon is usually explained by accidental mixed infection. However, bacteria usually were not studied in detail. No study has been notably done into their relationships to simultaneously isolated fungi. One of exceptions is the work of R i e g g e n b a c h (1956) who studied etiology of ash canker. Besides of bacterium *Pseudomonas savastanoi*, Rieggenschach simultaneously isolated also some fungi, notably *Fusarium lateritium* Nees.

Artificial infection of mixture of *Pseudomonas savastanoi* and *Fusarium lateritium*, may be also of other fungi, was more virulent than infection by bacterium alone. In the study of biochemical properties of mixed cultures, R i e g g e n b a c h found that mixed cultures form one toxin which *Pseudomonas* or *Fusarium* themselves do not form. The author has the same experience. *Pseudomonas savastanoi* isolated from tumor of olive twigs we obtained from Tunis indicated pathogenity also for leaves and stems of our ash. From tumor we obtained also one species of *Fusarium* which, in mixture with *Pseudomonas savastanoi*, showed considerable pathogenity on leaves and stems of ash.

Literature gives very often data on some fungi causing tumor canker in trees. So for instance, B r o w n N. A (1938) isolated not in details determined *Phomopsis* from oak tumor. Artificial infection by cultures of fungi offered in general positive results.

Toole E. R. (1966) isolated a strain of *Fusarium solani* from canker of red oak. Skelly J. M. et Wood F. A. (1965) obtained canker of maple by artificial infection by culture of *Fusarium solani* in September, January, March and October, but not in April, May, June and August. In this direction we may mention other examples. Yet no investigations were done by the above authors into the potential presence of the bacterium.

It is generally very well known that some representatives of genus *Pseudomonas* are strongly mycolytic against some facultative parasites (*Fusarium*, *Verticillium*, *Helminthosporium* etc.). Up to now two mycolytic bacteria *Pseudomonas mycolytica* Chudjakoff and *Pseudomonas mycophaga* Krasilnikov were described.

Frequent hints are also made at the use of mycolytic strains of bacteria as one the methods of biologic control. There are also data on successful trials but the most valuable factor, precise description and taxonomic determination of used bacteria, is lacking. Presently nearly no knowledge on mycolytic activity of phytopathogen bacteria is available. On the basis of some preliminary (up to now not yet closed) investigations, this important feature seems to be much more common, at least in case of some fungi, than may be expected.

CONCLUSION

From the tissues affected by canker a considerable number of parasitic and notably epiphytic microorganisms has been isolated so far, but no study has been done into their mutual relationship. For this reason the investigation was directed to mutual relationships of isolated bacteria and notably to mutual relationships of isolated bacteria and fungi.

We found that bacteria *Erwinia cancerogena*, *Pseudomonas syringae* and their mixed cultures exhibit certain mycolytic activity against some wound parasites: *Fusarium solani*, *Chondroplea populea*, *Phomopsis putator*, *Hypoxylon* sp. etc.

In principle this antagonism enables contamination of mycelium of these fungi and in this way the survival of bacterium. Bacteria pass over to propagation organs of fungi and may be distributed further by spores. It may be said that these contaminated fungi serve in a certain sense as vectors of these bacteria.

Whereas the above-mentioned phytopathogenic bacteria show a certain antagonism against some parasites of wounds, their relationship to host plant is considerably different. By artificial infection of poplars by a mixture of bacteria is considerably different. By artificial infection of poplars by a mixture of bacteria and fungi is it possible to obtain more pronounced or somewhat different symptom of a certain kind of synergism. This circumstance is one of possible reasons of strong variability of symptoms of diseases.

In plant pathology we know today, apart from virus diseases, only pure mycoses and bacterioses. It seems that in future we may meet such terms as "bacteriomycosis" or "mycobacteriosis" as denomination for symptoms of disease caused by the mixture of these microorganisms.

In the problems of mutual relationships of phytopathogen bacteria and fungi many questions remain unclear. Their clarification is to be based on intensive hard research work.

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Vzájemný vztah některých fytopatogenních bakterií a poloparazitických hub

Z pletiv napadených bakteriální rakovinou topolů byl dosud izolován značný počet cizopasných a zejména epifytních mikroorganismů, nebyl však studován jejich vzájemný vztah. Z toho důvodu jsme se zaměřili na studium vzájemných vztahů izolovaných bakterií a zejména vzájemného vztahu izolovaných bakterií a hub.

Zjistili jsme, že bakterie *Erwinia cancerogena*, *Pseudomonas syringae* a jejich smíšené kultury projevují určitou mykolytickou aktivitu vůči některým cizopasníkům ran: *Fusarium solani*, *Chondroplea populea*, *Phomopsis putator*, *Hypoxyylon* sp. aj.

V podstatě tento antagonismus umožňuje kontaminaci mycelia těchto hub, a tím i udržování bakterie. Bakterie přecházejí do rozmnožovacích orgánů hub a sporami mohou být dále rozšiřovány. Je možno říci, že v určitém smyslu kontaminované houby slouží jako nosiči těchto bakterií.

Projevují-li uvedené fytopatogenní bakterie určitý antagonismus vůči některým cizopasníkům ran, jejich vzájemný vztah vůči hostitelské rostlině je však podstatně jiný. Umělo infekci topolů směsí bakterií a hub je možno získat příznaky výraznější anebo poněkud rozdílné než při infekci čistou kulturou. Jde tedy současně o určitý druh synergismu. Tato okolnost je jednou z možných příčin silné variability příznaků chorob.

V rostlinné patologii známe dnes vedle viróz jen čisté mykózy nebo bakteriózy. Zdá se, že si v budoucnosti budeme muset zvykat na termíny „bakteriomykóza“ nebo „mykobakteriíza“ jako označení pro příznaky choroby působené směsí těchto mikroorganismů.

V problematice vzájemných vztahů fytopatogenních bakterií a hub zůstává zatím mnoho věcí nejasných. Na jejich vysvětlení bude nutno vykonat ještě mnoho úmorné práce.

Взаимоотношение некоторых фитопатогенных бактерий и полупаразитных грибов

Из тканей тополей, зараженных бактериальным раком, до настоящего времени было изолировано значительное число паразитных, и в частности эпифитных микроорганизмов, однако их взаимоотношение не изучалось. По этому поводу мы обратили внимание на изучение взаимоотношений изолированных бактерий, и особенно взаимоотношений между бактериями и грибами.

Мы обнаружили, что у бактерий *Erwinia cancerogena*, *Pseudomonas syringae* и их смешанных культур проявляется заметная миколитическая активность по отношению к некоторым паразитным грибам, заражающим раны: *Fusarium solani*, *Chondroplea populea*, *Phomopsis putator*, *Hypoxyylon* spec. и друг.

В сущности этот antagonизм дает возможность загрязнения мицеллия этих грибов, а тем и сохранения бактерий. Бактерии переходят в органы размножения грибов и в дальнейшем могут распространяться спорами. Можно сказать, что в известном смысле такие загрязненные грибы служат в качестве переносчиков этих бактерий.

Если у приведенных фитопатогенных бактерий проявляется известный antagonизм по отношению к некоторым паразитам, заражающим раны, то их взаимоотношение к растению-хозяину в сущности все-же иное. Искусственным заражением тополей смесью бактерий и грибов можно получить более ясно выраженные или несколько различные признаки, чем при заражении чистой культурой. Следовательно, речь одновременно идет об известном виде синергизма. Это обстоятельство является одной из возможных причин сильной изменчивости признаков болезней.

В фитопатологии, наряду с вирусными болезнями, нам известны только чистые микозы и бактериозы. Кажется, что в будущем нам придется привыкать к таким терминам, как «бактериомикоз» или «микозобактериоз» для обозначения признаков болезни, причиняемой смесью этих микроорганизмов.

В проблематике взаимоотношений фитопатогенных бактерий и грибов пока остается много утомительной работы.

Gegenseitige Beziehung einiger phytopathogenen Bakterien und halbparasitischen Pilzen

Aus dem durch den bakteriellen Krebs der Pappeln befallenen Gewebe wurde bisher eine beträchtliche Anzahl von parasitischen und besonders epiphytischen Mikroorganismen isoliert, es wurde jedoch nicht ihre gegenseitige Beziehung studiert. Aus diesem Grunde haben wir uns auf das Studium der gegenseitigen Beziehungen der isolierten Bakterien und besonders der gegenseitigen Beziehung der isolierten Bakterien und Pilze konzentriert.

Wir haben festgestellt, daß die Bakterien *Erwinia cancerogena*, *Pseudomonas syringae* und ihre gemischten Kulturen eine bestimmte mykolytische Aktivität gegenüber einigen Wundparasiten zeigen: *Fusarium solani*, *Chondroplea populea*, *Phomopsis putator*, *Hypoxyylon* sp. u. a.

Wesentlich ermöglicht dieser Antagonismus eine Kontamination des Myzeliums dieser Pilze und dadurch auch die Erhaltung der Bakterien. Die Bakterien übergehen in die Vermehrungsorgane der Pilze und durch die Sporen können sie weiter verbreitet werden. Es kann gesagt werden, daß in bestimmtem Sinne diese kontaminierten Pilze als Träger dieser Bakterien dienen.

Falls die angeführten phytopathogenen Bakterien ein bestimmtes Antagonismus gegenüber einigen Wundparasiten aufweisen, ist jedoch ihre gegenseitige Beziehung gegenüber der Wirtspflanze wesentlich eine ganz andere. Durch eine künstliche Infektion der Pappeln mittels eines Gemisches von Bakterien und Pilzen können ausdrucksvollere oder etwas unterschiedlichere Symptome als bei der Infektion mittels Reinkultur gewonnen werden. Es handelt sich also gleichzeitig um eine bestimmte Art von Synergismus. Dieser Umstand ist eine der möglichen Ursachen der starken Variabilität der Krankheitssymptome.

In der pflanzlichen Pathologie kennen wir heute neben den Virose nur reine Mykosen oder Bakteriosen. Es scheint, daß wir uns in Zukunft an solche Termine wie zum Beispiel „Bakteriomykose“ oder „Mykobakteriose“ als Bezeichnung für die Krankheitssymptome des wirkenden Gemisches dieser Mikroorganismen gewöhnen müssen.

In der Problematik der gegenseitigen Beziehungen der phytopathogenen Bakterien und Pilze bleiben einstweilen viele Sachen unklar. Zu ihrer Erklärung wird es notwendig sein noch viele anstrengende Arbeiten durchzuführen.

Rapport mutuel entre certaines bactéries phytopathogéniques et champignons semi-parasitiques

Jusqu'à présent on a isolé à partir des tissus attaqués par le chancre bactérien des peupliers un nombre considérable de microorganismes parasitiques et notamment épiphytiques, on n'a pas cependant étudié leur rapport réciproque. C'est pour cette raison que nous nous sommes orientés sur l'étude des rapports réciproques des bactéries isolées et surtout du rapport réciproque des bactéries et champignons isolés.

Nous avons constaté que les bactéries *Erwinia cancerogena* et *Pseudomonas syringae* et leurs cultures mélangées manifestent une certaine activité mycolytique à l'égard de certains parasites des plaies: *Fusarium solani*, *Chondroplea populea*, *Phomopsis putator*, *Hypoxyylon* sp. et autres.

En substance, cet antagonisme permet la contamination du mycélium de ces champignons et de ce fait également la conservation de la bactérie. Les bactéries passent dans les organes de reproduction des champignons et peuvent être propagées par les spores. On peut dire que ces champignons contaminés servent dans un certain sens comme vecteurs des bactéries en question.

Or, si les bactéries phytopathogènes mentionnées manifestent à l'égard de certains parasites des plaies un certain antagonisme, leur rapport mutuel à l'égard de la plante hôte est cependant tout à fait différent. Grâce à une infection artificielle des peupliers, réalisée par un mélange de bactéries et de champignons, on peut obtenir des symptômes plus marqués ou quelque peu différents que ceux obtenus lors de l'infection par la culture pure. Il s'agit par conséquent simultanément d'un certain mode de synergisme. Cette circonstance constitue une des causes possibles d'une forte variabilité des symptômes des maladies.

Dans la pathologie végétale nous ne connaissons à l'heure actuelle, à côté des viroses, que des mycoses pures ou bactérioses. Il paraît qu'à l'avenir il faudra se familiariser avec les termes comme „bactériomycose“ ou mycobactériose“ en tant que désignation des symptômes de la maladie due au mélange de ces microorganismes.

En attendant, il reste dans la problématique, relative aux rapports mutuels entre les bactéries et champignons phytopathogènes, beaucoup de choses qui ne sont pas claires. Pour les expliquer, il faudra effectuer encore beaucoup de travail fatigant.

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■ The effort of determining in detail the quality of growing stock and volume production of the stands of major tree species and especially of expressing this quality financially is recently apparent not only in special theoretical studies of several authors, but it begins successively to be applied even in forest management works as a part of the detailed investigation of forest and its production possibilities. However, the practical foresters are interested not only in the determination of the value of proper stand volume production; the main goal consists, first of all, in the financial evaluation of growing stock, as yet mostly in connection with the estimate of destroyed or damaged stands or forest units and with setting up the indemnities. The data for a detailed financial evaluation of growing stock and volume production must be therefore reliable and theoretically fully satisfactory and, at the same time, as simple as possible, lest their practical use should meet with difficulties and that they may be applied even to other fields of forestry activity.

METHODOLOGY OF FINANCIAL EVALUATION OF VOLUME PRODUCTION BY FORESTRY AND GAME RESEARCH INSTITUTE

In determining the economic effects of growing stock and volume production of stands, an important role is attributed, first of all, to the studies on diameter and volume structures of stands, especially to the direct analysis of assortment structure enabling a proper financial evaluation. Not many research scientists have dealt with the studies concerning this matter, especially in connection with the evaluation of thinning trials, and it was namely *Wiedemann* (1932, 1937) who contributed very much to the solution of this problem by simplifying substantially the method of financial evaluation of growing stock of stands and volume production of beech and spruce stands on thinning trial plots. For determining the financial value of volume production he used the average prices of 1 cu. m of "derbholz" for 10 cm diameter classes. The market prices achieved in the sale of beech and spruce timber within a longer time period formed a basis for the calculation of the mentioned "derbholz" price. As a shortcoming of *Wiedemann's* method must be considered the fact that he did not use in evaluating the volume production the proper assortment structure of mentioned 10 cm diameter classes, but only its final economic expression in selling price. Whenever greater changes arise in mutual price relations between individual assortments or in assortment standards, it is necessary to redetermine the average

price of "derbholz" in the mentioned diameter classes and to evaluate at the same time mostly a very comprehensive material.

The research workers in the Forestry and Game Research Institute worked out a new project of the financial evaluation of growing stock and total volume production of spruce stands; analogously to Wiedemann's method, there were applied the average prices of "derbholz", however not in diameter classes, but in more detailed (2 cm) diameter degrees. This is very advantageous because the "derbholz" price may be calculated — contrary to Wiedemann's method — directly by assortment tables constructed on the basis of a detailed sorting of stem profiles and selling price of relevant assortments. It is therefore possible to calculate without difficulties the "derbholz" price in diameter degree, whenever the assortment prices or standards are changed.

The average "derbholz" price in diameter degrees presents at the same time a reliable basis for the construction of proper stand value tables. The basic mensurational data of valid yield tables (first of all the mean stand diameters of "derbholz" volume of primary and secondary stands) and further very close relations of "derbholz" volume distribution in diameter degrees and thereof also resulting close relations of average (stand) "derbholz" price of mean stand diameter were applied for the construction of mentioned tables. Therefore, the average "derbholz" prices in diameter degrees have a much broader applicability if compared with the Wiedemann's prices of "derbholz" in diameter classes and they may be consequently applied even for further special studies directly connected with forest valuation.

DETERMINATION OF AVERAGE PRICE OF "DERBHOLZ" U. B. IN DIAMETER DEGREE

The calculation of average price of 1 cu. m of "derbholz" u. b. in diameter degrees may be practically best made by using the assortment tables constructed on the basis of stem profiles, where the volume of individual assortments is not expressed absolutely, but in per cents of stem volume. These so-called percentage assortment tables showed clearly that the size of assortment sections for differently high trees changes very little within a diameter degree (e. g. 2 cm), of course disregarding the extreme heights. It is therefore possible to utilize this knowledge immediately in the construction of percentage assortment tables and to elaborate them only on the basis of "mean" stem profile; its relevant diameter degree equals roughly its mean height (Pařez 1966, 1969). D. b. h. becomes therefore the main criterion for the determination of assortment structure. This essential simplification of the assortment tables construction exerts no unfavourable effect on the accuracy of the determination of assortment sections in the stand, if compared with sorting made according to the basic "volume" assortment tables: the average error % in the assessment of assortments by the simplified percentage assortment tables in the comparison with the results of sorting made by the common "volume" assortment tables varies within a very close range from $-0,77$ to $+0,55$ %.

The financial evaluation of spruce stand production was based on the percentage assortment tables. Their construction was made by using the "mean" stem profiles (K o r s u ň 1959), which were divided into assortments according to the then valid assortment standards for sawn timber (ČSN 48 00 61) pulpwood (ČSN 48 00 89) and fuelwood (ČSN 48 00 92).

The percentage assortment tables (Pařez 1964, 1967, 1968) are intended for the assessment of assortment structure of spruce stands and for their financial evaluation, having regard namely to the healthy, undamaged trees with normal growth, and under condition that the "derbholz" volume distribution in 2 cm diameter degrees for the subject of sorting work, i. e. as a rule for the standing trees population is known.

For considering the height of financial effect of individual spruce stands the state wholesale prices (SVC) of individual timber assortments (table 1) may be used. The evaluation of production by means of SVC is disadvantageous to some degree, because these prices include besides the "pure" income component also the cost components and, moreover, they lack a sufficient differentiation of price relations between some assortments.

Trials were therefore made for finding some other price expression, which would make it possible to estimate the timber assortments in such a way that the price relations between individual assortments may be preserved, but, that their mutual evaluation may be more distinctly distinguished and, moreover, that these price units may be applied in stand evaluation even in such a case, where particularly the "pure" income component plays a decisive role in the assortment price. For this reason the new price units were derived on the basis of standard calculation by individual phases of logging activity. These price units were calculated as a difference between the state wholesale prices of individual assortments and full total costs of logging, wood processing, skidding, transport, loading on waggons (part of timber transported by railway in the total volume of deliveries), skidding line and road building. The average nationwide costs of timber production in 1966¹⁾ were a comparison basis in the construction of above-mentioned prices, where by the changed method applied in cost formation, after the introduction of new management system in the state forests, was taken into consideration. The new prices represent to some degree stumpage assortment prices (CSP), they fully respect the different height of net income component involved in the state wholesale prices of individual assortments of spruce timber and have an advantage that they represent to some degree the financial utility of the production of individual assortments from the viewpoint of forestry as a special branch (Table I).

By means of percentage assortment tables for undamaged healthy spruce stems and appropriate stumpage assortment prices is it relatively easy to calculate the average prices of "derbholz" in diameter degrees (see Table IV, column 2).

The knowledge of average price of "derbholz" u. b. in diameter degrees makes it possible to evaluate the growing stock and the proper volume production for spruce stands — as it was already mentioned — on the basis of a concrete distribution of "derbholz" volume u. b. in 2 cm diameter degrees. From the economic point of view, it is very interesting and instructive to follow the development of price relations between individual diameter degrees and to get an insight into the size of gross income (from the viewpoint of forestry forestry as a branch) for a concrete diameter degree. The percentage assortment tables and the corresponding average prices of "derbholz" u. b. in diameter degrees provide us with a very good basis for various further economic considerations and price calculations.

¹⁾ In calculating the prices for 1968, the average costs from 1966 were at disposal.

I.

	Price of 1 cu. m of "derbholz" u. b.								
	classes of saw timber bolts						poles ¹⁾	pulp-wood ²⁾	fuel-wood ³⁾
	1	2	3	4	5	6			
	Kčs								
State wholesale prices (1. 1. 69)	265	365	401	395	385	377	249	273	94
Stumpage assortment prices	136	241	298	296	294	286	94	84	(-70)
Full prime costs of logging, processing, skidding etc.	129	124	103	99	91	91	155	189	164

Note:

1) Price of poles in 2. class u. b.

2) Price of brown-peeled pulpwood

3) Price of 1 cu. m of fuelwood is by V. Václav 5,54 times higher than the price of 1 q of fuelwood (1 q = 16,50 Kčs)

II. Survey of bark portions and reductions in spruce stands with mean d.b.h. (\bar{d}_k) 5-49 cm for sound stands

\bar{d}_k	Bark %	Bark reduction	\bar{d}_k	Bark %	Bark reduction	\bar{d}_k	Bark %	Bark reduction
5	14,0	0,860	20	10,5	0,895	35	9,1	0,909
6	13,4	866	21	10,4	896	36	9,0	910
7	13,1	869	22	10,2	898	37	8,9	911
8	12,9	781	23	10,1	899	38	8,9	911
9	12,7	873	24	10,0	900	39	8,8	912
10	12,5	875	25	9,9	901	40	8,8	912
11	12,3	877	26	9,7	903	41	8,7	913
12	12,1	879	27	9,6	904	42	8,7	913
13	11,9	881	28	9,5	905	43	8,6	914
14	11,7	883	29	9,4	906	44	8,6	914
15	11,5	885	30	9,3	907	45	8,6	914
16	11,3	887	31	9,3	907	46	8,5	915
17	11,1	889	32	9,2	908	47	8,5	915
18	10,9	891	33	9,2	908	48	8,5	915
19	10,7	893	34	9,1	909	49	8,5	915

THE USE OF AVERAGE PRICE OF "DERBHOLZ" U. B. IN THE STANDS WITH A GIVEN MEAN DIAMETER d_k FOR THE COMPILING OF STAND VALUE TABLES

The present method of fixing the value of stands, where the "derbholz" volume distribution in diameter degrees is known, brings about no special difficulties if the percentage assortment tables are applied. It is, however, necessary to fix often this value even in the uncalipered stands. In such cases the stand value may be found, analogously as in yield tables, only on the basis of stand values tables. The stand value tables link up usually with the yield tables, they utilize their basic dendrometric data concerning namely the mean stand diameter and height, growing stock of main stand per 1 ha and the individual thinnings. The mean stand diameter d_k and the corresponding average price of "derbholz" u. b. are of decisive importance for the connection of yield tables and stand value tables. For the determination of the relationship between average price of "derbholz" u. b. and mean stand diameter, the commonly known experience

III. Stand value tables for Norway spruce (in stumpage assortment prices, basis: Schwappach's yield tables — 1902)

Age	Mean stand		Value			Mean value increment	
	height \bar{v}_k cm	diameter \bar{d}_k cm	growing stock of main stand	thinning	total volume production	main stand	volume production
			stumpage assortment price in Kčs				
1	2	3	4	5	6	7	8
Ist Class quality							
20	6,8	5,8	1814	—	1814	91	91
25	9,2	7,6	5116	76	5192	205	208
30	11,6	9,6	9173	580	9829	306	328
35	14,1	11,7	15760	1049	17465	450	499
40	16,6	13,8	25212	1760	28677	630	717
45	19,0	16,0	37175	2599	43239	826	961
50	21,2	18,2	52238	3382	61684	1045	1234
55	23,1	20,4	70567	4288	84301	1283	1533
60	24,7	22,6	88517	5344	107595	1475	1793
65	26,1	24,9	105509	6716	131303	1623	2020
70	27,4	27,2	121308	8217	155319	1733	2219
75	28,6	29,4	135093	9588	178692	1801	2383
80	29,7	31,5	146942	10686	201227	1837	2515
85	30,7	33,6	157201	11610	223096	1849	2625
90	31,6	35,6	166229	12026	244150	1847	2713
95	32,5	37,6	173870	12250	264041	1830	2779
100	33,3	39,6	180069	12387	282627	1801	2826
105	34,1	41,5	184253	12514	299325	1755	2850
110	34,8	43,3	187770	12462	315304	1707	2866
115	35,4	44,9	189634	12358	329526	1649	2865
120	35,9	44,6	190513	11957	342362	1588	2853

Table III — continued

Age	Mean stand		Value			Mean value increment	
	height \bar{v}_k cm	diameter \bar{d}_k cm	growing stock of main stand	thinning	total volume production	main stand	volume product- ion
			stumpage assortment price in Kčs				
1	2	3	4	5	6	7	8
IIInd Class quality							
25	6,2	6,2	1747	—	1747	70	70
30	8,3	8,0	5191	218	5409	173	180
35	10,6	9,9	9107	437	9762	260	279
40	12,8	11,9	14765	806	16226	369	406
45	14,9	14,1	23139	1356	25956	514	577
50	16,9	16,0	32451	2095	37363	649	747
55	18,8	18,1	45231	2772	52915	822	962
60	20,5	20,1	59381	3904	70969	990	1183
65	22,0	22,0	73305	5152	90045	1128	1385
70	23,3	23,8	86083	5968	108891	1230	1556
75	24,5	25,5	97365	6937	127010	1298	1693
80	25,6	27,2	108394	7711	145750	1355	1822
85	26,6	28,8	117944	8342	163542	1388	1924
90	27,6	30,4	125854	8836	180388	1398	2004
95	28,5	31,9	132053	9500	196094	1390	2064
100	29,3	33,4	137550	9710	211300	1376	2113
105	30,1	34,8	142874	9855	226479	1361	2157
110	30,8	36,2	146692	9931	240228	1334	2184
115	31,5	37,6	150084	9586	253206	1305	2202
120	32,1	39,0	153242	9194	265558	1277	2213
IIIrd Class quality							
30	5,7	6,3	1672	143	1815	56	60
35	7,4	8,2	4612	437	5192	132	148
40	9,3	10,2	8065	731	9376	202	234
45	11,3	12,1	13269	1025	15605	295	347
50	13,1	13,9	19525	1386	23247	390	465
55	14,7	15,6	26378	1813	31914	480	580
60	16,2	17,3	34857	2314	42706	581	712
65	17,6	18,9	43956	2753	54558	676	839
70	18,9	20,4	53485	3350	67437	764	963
75	20,1	21,8	62686	3781	80419	836	1072
80	21,2	23,1	71060	4698	93491	888	1169
85	22,2	24,3	78840	5166	106437	928	1252
90	23,2	25,5	85654	5613	118864	952	1321
95	24,1	26,7	92203	6089	131502	971	1384
100	25,0	27,8	97306	6636	143241	973	1432
105	25,9	28,8	101269	6984	154188	964	1468
110	26,7	29,7	104434	7164	164517	949	1496
115	27,5	30,6	106427	6961	173471	925	1508
120	28,2	31,5	108548	6877	182469	905	1521

Table III — continued

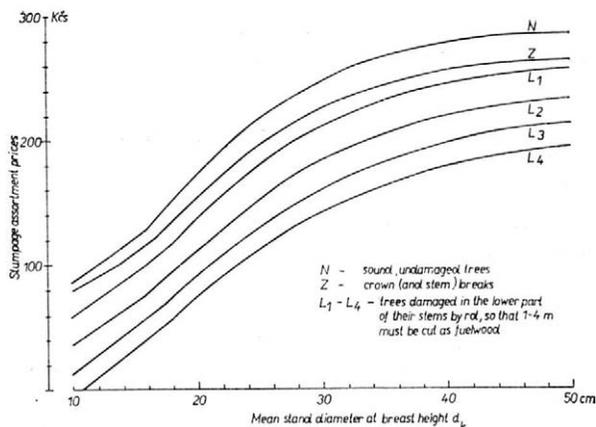
Age	Mean stand		Value			Mean value increment	
	height \bar{v}_k cm	diameter \bar{d}_k cm	growing stock of main stand	thinning	total volume production	main stand	volume production
			stumpage assortment price in Kčs				
1	2	3	4	5	6	7	8
IVth Class quality							
35	5,5	6,5	1596	—	1596	46	46
40	6,9	8,2	3948	—	3948	99	99
45	8,3	10,0	6846	218	7064	152	157
50	9,8	11,7	10773	512	11503	215	230
55	11,3	13,3	15593	806	17129	284	311
60	12,7	14,7	20845	1267	23648	347	394
65	14,0	15,9	25742	1848	30393	396	468
70	15,2	17,1	31088	2301	38040	444	543
75	16,3	18,1	36179	2705	45836	482	611
80	17,3	19,2	41811	3019	54487	523	681
85	18,3	20,1	46830	3387	62893	551	740
80	19,2	21,0	51634	3596	71293	574	792
95	20,1	21,8	55938	3751	79348	589	835
100	21,0	22,6	60190	3961	87561	602	876
105	21,8	23,3	63514	4259	95144	605	906
110	22,6	23,9	66133	4287	102050	601	928
115	23,3	24,5	68256	4446	108619	594	945
120	24,0	25,0	68900	4563	113826	574	948
Vth Class quality							
40	4,5	6,7	1243	—	1243	31	31
45	5,6	7,9	2856	—	2856	63	63
50	6,8	9,2	4696	—	4696	94	94
55	8,0	10,5	7013	294	7307	128	133
60	9,3	11,6	9766	664	10724	163	179
65	10,5	12,6	12898	892	14748	198	227
70	11,7	13,6	16211	1218	19279	232	275
75	12,8	14,5	19412	1500	23980	259	320
80	13,8	15,3	21908	1733	28209	274	353
85	14,6	16,0	24304	1966	32571	286	383
90	15,7	16,6	26497	2142	36906	294	410
95	16,5	17,1	28475	2450	41334	300	435
100	17,2	17,5	29866	2510	45235	299	452

may be applied that the distribution of "derbholz" volume in diameter degrees is subject to characteristic changes dependent on mean stand diameter. This means that without respect to their age and site quality, the stands of equal mean diameter at breast height \bar{d}_k show an equal "derbholz" volume distribution in the diameter degrees (Pařez 1965) and, consequently, the same average price of 1 cu. m of "derbholz" u. b.

IV. Average price of 1 cu. m of "derbholz" u.b. in diameter degrees for sound and differently thinned spruce stems, expressed in "stumpage assortment prices" (CSP)

Diameter degree	Average price (CSP) of "derbholz" u. b.					
	sound stems <i>N</i>	stems damaged by crownbreaks <i>Z</i>	stems damaged in their lower part by rot, so that it is necessary to cut fuelwood from below			
			1 m <i>L₁</i>	2 m <i>L₂</i>	3 m <i>L₃</i>	4 m <i>L₄</i>
1	2	3	4	5	6	7
8	84	84	28	-70	-70	-70
10	84	84	52	20	-6	-32
12	84	84	58	32	12	9
14	84	71	63	42	24	6
16	84	72	65	47	31	15
18	100	89	68	56	39	25
20	114	104	93	70	58	41
22	154	146	126	82	67	51
24	188	180	160	133	103	80
26	204	196	179	154	131	110
28	212	205	187	162	141	128
30	214	206	193	168	147	135
32	214	207	197	172	151	138
34	250	239	221	173	153	140
36	266	252	234	203	176	153
38	272	259	244	217	194	171
40	277	260	249	222	200	177
42	280	262	252	226	202	182
44	282	263	255	230	208	187
46	283	266	256	233	212	191
48	285	270	260	234	215	195
50	287	270	263	237	219	199
52	288	270	265	240	221	202
54	288	270	266	243	224	205
56	288	269	266	244	224	205
58	288	269	265	244	224	205
60	288	269	265	243	224	205
62	288	269	265	243	224	205
64	286	270	265	243	224	205
66	286	270	265	243	224	205
68	285	270	263	242	224	205
70	284	270	262	240	222	204
72	284	270	261	240	221	203
74	283	269	261	238	220	201
76	283	269	260	238	219	200
78	283	269	260	238	218	199
80	283	269	260	238	218	199

1. Average price of 1 cu. m of "derbholz" u. b. in spruce stands both sound and damaged by various injurious agents



For the calculation of average price of 1 cu. m of "derbholz" u. b. in the stands of a given mean stand diameter it is advantageous to use the average "derbholz" prices in diameter degrees together with the distribution of "derbholz" volume in diameter degrees, as they were constructed e. g. for individual mean stand diameters for spruce by H a l a j (1957) on the basis of materials from Slovakia. The appropriate average prices of stand "derbholz" for individual mean stand diameters will be calculated by multiplying the per cent parts of "derbholz" volume in diameter degrees by the corresponding average price of 1 cu.m of "derbholz". The price of 1 cu.m of "derbholz" in the stand may stand may be determined by the direct application of per cent distribution of assortments (found for individual stands with different mean d. b. h. by means of the percentage assortment tables and the appropriate "derbholz" volume distribution in diameter degrees), which will be multiplied by the stumpage assortment price. The resulting values of average "derbholz" prices in the stands with a given mean stand diameter — calculated by the two mentioned methods — are roughly equal (graph 1).

The dependence of the average price of "derbholz" u. b. on the mean stand diameter \bar{d}_k may be further utilized also for the compiling of stand value tables. Taking as a basis for the compiling of these tables the S c h w a p p a c h yield tables (1902), commonly applied in Czechoslovakia, it will be possible to read for individual site qualities and age the average prices of "derbholz" u. b. of individual mean stand diameter directly from the graph 1. After multiplying by the corresponding growing stock values of primary and secondary stands (of course after bark reduction²) the price of both growing stocks (here in stumpage assortment prices) is determined and, analogically to the procedure applied in the yield tables, the financial value of total volume production and all increments may be calculated. An example of stand value tables is given in table IV.

The stand value tables make it possible to find the growing stock price of main stand (or volume production), in our case in "stumpage assortment prices" in the stands of different age and site quality. As already emphasized,

²) Schwappach yield tables contain the data on „derbholz“ volume in cu. m o. b.; these data are to be converted to the data u. b. by means of bark reduction determined also in the dependence on mean stand diameter \bar{d}_k in table IV (Pařez 1969).

this price represents in fact the "gross income" which forestry (as a branch) may obtain at a given age and in a given site quality from each hectare of fully stocked spruce stand formed by healthy and undamaged stems.

THE INFLUENCE OF A CHANGED SANITARY STATE OF TREES ON THE HEIGHT OF THE PRICE OF "DERBHOLZ" U. B. IN DIAMETER CLASSES AND IN STAND

Nearly all spruce stands suffer during their life time to a different degree from various injurious agents unfavourably influencing the development of trees and whole stands. The chief unfavourable influences afflicting Norway spruce especially in its young pure and even-aged stands are represented namely by wind, snow, hail and deer; but other injuries caused e. g. by fungi achieve sometimes in spruce stands a great extent. Of course, each unfavourable change in sanitary state of trees results in unfavourable composition of stem assortments and affects, consequently, the average price of timber in diameter degrees.

The method of the construction of percentage assortment tables on the basis of mean stem profiles makes it possible to construct the special percentage assortment tables even for the populations of damaged trees; of course, some generalization of stem defects arisen as a result of tree damage caused by one of various injurious agents is supposed (P a ř e z 1969). There are mainly two types of damages of decisive nature to the spruce stands: the crown (and stem) breaks caused by wind, hail and snow damaging the stem in the bottom part of crown immediately under crown (on average at $\frac{2}{3}$ of tree height) and, further, the damages to stem in its lower part by rot (caused by peeling or browsing by deer, or by occurrence of honey fungus, red rot etc.), where it is necessary to take into consideration that one or more metres must be cut from the basal part of the stem as fuelwood. The special percentage assortment tables make it possible to determine even for damaged trees the size of average price of 1 cu. m of "derbholz" in diameter degrees (table IV, columns 3-7). The comparison with the prices of "derbholz" in diameter degrees of sound trees makes it possible to determine the losses per 1 cu. m of "derbholz", directly in individual diameter degrees of damaged trees (P a ř e z 1969).

The average "derbholz" prices in diameter degrees of variously damaged trees form even in this case a basis for the determination of average price of 1 cu. m of "derbholz" in the stand. The calculation of this price is analogous as in sound stands, i. e. by using Halaj's distribution of "derbholz" volume in diameter degrees in the stands with different mean diameters at breast height on the one hand and the relevant average "derbholz" prices in diameter degrees of variously damaged trees on the other hand, supposing, of course, that the stand is fully damaged by an injurious agent (graph 1). The relation between the average "derbholz" prices of sound stands and the prices of "derbholz" of damaged stands makes it possible to derive for the stands with different diameters at breast height the size of loss as result of stand damage caused by this or another injurious agent, and to use this loss size, expressed in % (Table V), for the modification of the basic price of stands given in the stand value tables by age, site quality and for full density. The application of the mentioned per cent losses in stand value requires that the per cent rate of trees damaged by individual injurious agents be estimated for each individual stand. For the trees damaged in the lower part of their stems is it moreover necessary to assess — as a rule on the basis of experience gained in previous loggings in a given stand or in neighbouring stands — the average

V. Percentage of losses of the basic financial value of spruce stand as a result of damage caused by crown and stem breaks Z , or by peeling and browsing by deer, or by fungal infection L , when it is necessary to use the lower 1—4 m of the basal part of the stem L_1 — L_4 as fuelwood

Kind of damage	Mean stand diameter \bar{d}_k	Percentage of damaged trees									
		10	20	30	40	50	60	70	80	90	100
		loss percentage of the basic financial stand value									
Z	10—18	0,007	0,014	0,022	0,029	0,036	0,043	0,050	0,058	0,065	0,072
	20+	0,005	0,011	0,016	0,022	0,027	0,032	0,038	0,043	0,049	0,054
L_1	10—18	0,024	0,047	0,071	0,094	0,118	0,141	0,165	0,188	0,212	0,235
	20—28	0,013	0,026	0,039	0,053	0,066	0,079	0,093	0,105	0,119	0,132
	30—38	0,010	0,020	0,031	0,041	0,051	0,062	0,072	0,082	0,092	0,103
	40—48	0,009	0,018	0,027	0,036	0,045	0,054	0,063	0,072	0,081	0,090
L_2	10—18	0,045	0,090	0,135	0,180	0,225	0,270	0,316	0,361	0,406	0,451
	20—28	0,026	0,055	0,082	0,110	0,137	0,165	0,193	0,220	0,248	0,275
	30—38	0,021	0,042	0,064	0,085	0,106	0,127	0,149	0,170	0,191	0,212
	40—48	0,018	0,036	0,054	0,072	0,091	0,109	0,127	0,145	0,163	0,181
L_3	10—18	0,064	0,128	0,192	0,257	0,321	0,385	0,449	0,513	0,578	0,642
	20—28	0,039	0,077	0,115	0,154	0,192	0,230	0,269	0,307	0,346	0,384
	30—38	0,030	0,059	0,090	0,120	0,149	0,179	0,209	0,239	0,268	0,298
	40—48	0,026	0,051	0,077	0,102	0,128	0,153	0,179	0,204	0,230	0,256
L_4	12—18	0,074	0,148	0,221	0,295	0,369	0,443	0,516	0,590	0,664	0,738
	20—28	0,047	0,095	0,142	0,189	0,236	0,284	0,331	0,378	0,425	0,473
	30—38	0,037	0,075	0,112	0,149	0,186	0,224	0,261	0,298	0,336	0,373
	40—48	0,032	0,065	0,098	0,131	0,163	0,196	0,228	0,261	0,294	0,326

length (in m) of the basal stem part, which must be usually in primary wood procession cut as fuelwood, this being in spruce stands 2—3 m. The proper loss percentage may be found by kind of injury, percentage of damaged trees and mean stem diameter in table V.

The determination of financial stand value by means of stand value tables and making this value more accurate by means of loss percentage, corresponding to the sanitary state of stands at a given time, means therefore a further step to a more objective evaluation of the growing stock.

AN EXAMPLE OF THE DETERMINATION OF FINANCIAL VALUE OF SPRUCE STAND

The determination of the basic financial value of spruce stand is always based on the following chief dendrometric characteristics of the stand: stand height, age, site quality and mean stand diameter. The basic financial value

of stand corresponds to the value of a sound, undamaged stand of full density. In the stands damaged by one of the mentioned injurious agents it is necessary to subtract the loss corresponding to the extent and intensity of stand damage from the basic financial value of the stand. The determination of the value, which is only part of the actual stand value, is made by formula (1), if we wish to know the size of loss caused by stand injury, or by formula (2), if we wish to determine the actual stand value directly.

$$W_{sk} = [W - W(Z + L_x)] R, \quad (1)$$

$$W_{sk} = W \cdot R [1 - (Z + L_x)], \quad (2)$$

where W_{sk} — actual financial value of growing stock,
 W — basic financial value of growing stock according to the stand value tables for a given age and site quality in full density (table III),
 R — estimated stand density in tenths,
 Z — percentage of loss in financial stand value W corresponding to a given share of trees damaged in the stand by crown and stem breaks (Table V),
 L_x — percentage of loss in financial stand value W corresponding to a given share of trees damaged in the stand by peeling, browsing, red rot, honey fungus, i. e. of the trees infected with rot in their lower part of the stem. Index x corresponds to the estimated length in metres, which must be cut (because of rot) from all damaged trees as fuelwood (Table V).

The application of the mentioned formula for the assessment of the financial growing stock value of a stand may be clearer from the following example. There is to be determined the financial value of a 60-year-old spruce stand on IIInd quality class with density 0.9 and mean stand diameter $d_k = 20.1$. The stand includes about 20 % of trees with damaged crown and stem snow-breaks and about 50 % of all trees with lesions caused by peeling and browning, mostly with rotted basal stem part; it will be necessary to use, on the average, 2 m-sections, as fuelwood.

Example of calculation:

$$W_{sk} = [59\,381 - 59\,381(0.011 + 0.137)] \cdot 0.9 = 45\,533 \text{ Kčs/ha} \quad (1)$$

$$W_{sk} = 59\,381 \cdot 0.9 [1 - (0.011 + 0.137)] = 45\,533 \text{ Kčs/ha} \quad (2)$$

The proper loss caused to the stand by snow and deer peeling makes 8788 Kčs/ha, i. e. 14.8 % of the original basic stand value W .

CONCLUSION

A brief analysis of the problem concerning the construction of "derbholz" prices by diameter degrees and their application to the determination of individual stand values and to the construction of stand value tables shows that the chosen method is relatively simple and presents necessary data for a concrete financial evaluation of spruce stands. It may be applied not only for the evaluation of sound stands, but also, this being very important, it makes it possible to follow from the financial viewpoint even various unfavourable effects manifesting themselves in the damages of trees and stands caused by different biotic and abiotic injurious agents. The average price of "derbholz" u. b. in diameter degree, dependent on the structure of assortments of a "mean" stem profile, becomes in this way a basis for all other further price calculations

connected not only with the proper financial evaluation of spruce stands or with the indemnity for destroyed or damaged stands but, last not least, it may play an important role e. g. in checking up the work and skills of responsible workers at all levels of forestry.

SUMMARY

The analysis of assortment structure of growing stock and volume production of stands and their financial evaluation may be safely made by means of so-called "percentage" assortment tables (Table II) constructed on the basis of stem profiles in individual diameter degrees. Because it was found that within one diameter degree (here 2 cm) the proper tree height, disregarding the extremely big or low heights, exerts only a very small influence on the size of assortment portions of the stem, the assortment tables were practically constructed only on the basis of stem diameter at breast height; as appropriate height in a diameter degree was chosen the height corresponding to the so-called "mean" stem profile. The construction of percentage assortment tables on the basis of "mean" stem profiles makes it possible to construct the assortment tables not only for sound trees, but also for differently damaged trees (snow, peeling, browsing etc.). In applying these special assortment tables, it is necessary to know the repartition of "derbholz" volume in the diameter degrees separately for the sound trees and the trees damaged in various way.

The percentage assortment tables may be advantageously applied also for the determination of the average price of "derbholz" u. b. by diameter degrees, and it becomes then a starting basis for all further financial calculations. As the suitable price units for this average price of "derbholz" may be used the state wholesale prices or, yet better, the newly derived so-called "stumpage assortment prices" (Table I), calculated as a difference between state wholesale prices and full total costs of logging, processing, skidding, transport, loading etc. (Table I) directly for individual assortments. The newly-derived prices show to some degree the financial advantage of individual assortment production from the point of view of forestry as a branch.

The construction of special percentage assortment tables, giving the structure of assortments for differently damaged trees, with relevant price units (here e. g. stumpage assortment prices) makes it possible to determine also the height of possible loss, in which the different kinds of injurious agents share in the concrete diameter degrees.

The financial values of uncalipered stands will be determined by the use of stand value tables. For their construction the close relationship between the average price of "derbholz" in the stand and the mean stand diameter d_k was used. The data on mean stand diameter, stand height and "derbholz" volume of the main and secondary stand formed a basis for the construction of stand value tables.

In determining the proper basic financial value of spruce stand the value tables will be applied (Table IV). In case that the stands is damaged, the loss arisen as a result of stand damage by some of injurious agents will be subtracted from the mentioned basic financial stand value W modified by actual density R . This loss is given directly in % of the basic financial stand value W for the stands with a certain mean d. b. h. for individual kinds of injurious agents (Table V), for crown and stem breaks Z and for not in the lower part of the stem L_x . The calculation of the actual financial stand value W_{sk} will be made

by the formulae (1) or (2), this being dependent on the fact whether we wish to know the size of loss caused by injurious agents (1), or if we satisfy ourselves with a direct calculation of W_{sk} value (2).

$$W_{sk} = [W - W(Z + L_x)] R, \quad (1)$$

$$W_{sk} = W \cdot R [1 - (Z + L_x)]. \quad (2)$$

The average price of "derbholz" u. b. in a diameter degree dependent on the assortment structure of "mean" stem profile becomes in this way a basis for all further price calculations connected not only with the proper financial evaluation of spruce stands or with the indemnities for destroyed or damaged stands, but, last not least, it may play an important role in checking up the right professional work of responsible workers at all levels of forest management.

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Finanční hodnocení hmotové produkce smrkových porostů

Pro rozbor sortimentní struktury porostních zásob a hmotové produkce, pro ev. jejich finanční ocenění, se dá spolehlivě použít tak zvaných procentuálních sortimentačních tabulek sestavených na podkladě středních kmenových profilů v jednotlivých tloušťkových stupních. Poněvadž bylo zjištěno, že v rámci jednoho tloušťkového stupně (zde dvoucentimetrového) má samotná výška stromu, pokud nepřihlížíme k extrémně vysokým nebo nízkým výškám, jen velmi malý vliv na velikost podílů sortimentů na kmeni, byly proto procentuální sortimentační tabulky sestaveny prakticky jen na podkladě výčetní tloušťky kmene; za odpovídající výšku byla v tloušťkovém stupni zvolena ta, která odpovídala tzv. střednímu kmenovému profilu. Konstrukce procentuálních sortimentačních tabulek na podkladě středních kmenových profilů umožňuje sestavit sortimentační tabulky nejen pro stromy zdravé, ale i pro stromy různé poškozené (sníh, loupání vysokou apod.). Předpokladem pro použití těchto speciálních sortimentačních tabulek je znalost rozložení hmoty hroubí v tloušťkových stupních odděleně pro stromy zdravé a stromy různým způsobem poškozené.

Procentuálních sortimentačních tabulek lze s velkou výhodou využít i ke stanovení průměrné ceny hroubí b. k. v tloušťkových stupních a ta se pak stává východním podkladem pro všechny další finanční kalkulace. Za vhodné cenové jed-

motky pro tuto průměrnou cenu hroubí lze použít státních velkoobchodních cen nebo ještě lépe nově odvozených tzv. cen sortimentů na pni (tabulka I), vypočítaných jako rozdíl mezi státními velkoobchodními cenami a úplnými vlastními náklady na těžbu, manipulaci, přibližování, odvoz, vagónování atd. (tabulka I) přímo u jednotlivých sortimentů. Nově odvozené ceny prozrazují do určité míry finanční výhodnost výroby jednotlivých sortimentů z hlediska lesního hospodářství jako odvětví.

Sklobením speciálních procentuálních sortimentačních tabulek, jež udávají skladbu sortimentů u různě poškozených stromů a příslušných cenových jednotek (zde např. cen sortimentů na pni) lze určit i výši ev. ztráty, na niž se v konkrétním tloušťkovém stupni podílí různý druh škodlivého činitele.

Ke stanovení finanční hodnoty neprůměrkovaných porostů se použije porostních hodnotových tabulek. K jejich sestavení jsme využili těsného vztahu mezi průměrnou cenou hroubí v porostě a střední porostní tloušťkou d_k . Podklad pro konstrukci porostních hodnotových tabulek (tabulka IV) tvořily údaje střední porostní tloušťky, porostní výšky, hmoty hroubí hlavního a podružného porostu.

Při určování vlastní základní finanční hodnoty smrkového porostu se použije hodnotových tabulek (tabulka IV). V případě, že je porost poškozen, odečte se od této základní finanční hodnoty porostu W , upravené podle skutečného zakmenění R , ztráta, jež vznikla v důsledku poškození porostu některým ze škodlivých činitelů. Tato ztráta je uvedena přímo v procentech ze základní finanční hodnoty porostu W pro porosty o určité střední výčetní tloušťce pro jednotlivé druhy škodlivých činitelů (tabulka V), pro korunové a kmenové zlomy Z a pro hnilobu v dolní části kmene L_x . Výpočet skutečné finanční hodnoty porostu W_{sk} se uskuteční podle vzorce (1) nebo (2), podle toho, chceme-li znát výši ztráty škodlivými činiteli (1) nebo zda se spokojíme jen s výpočtem W_{sk} přímo (2):

$$W_{sk} = [W - W(Z + L_x)] R \quad (1)$$

$$W_{sk} = W \cdot R [1 - (Z + L_x)] \quad (2)$$

Průměrná cena hroubí b. k. v tloušťkovém stupni, závislá na struktuře sortimentů středního kmenového profilu, se tak stává základem všech dalších cenových kalkulací, souvisejících nejen s vlastním finančním hodnocením smrkových porostů, popř. s náhradou za zničené nebo poškozené porosty, ale v neposlední řadě může sehrát důležitou roli např. při kontrole správné odborné práce odpovědných pracovníků na všech stupních lesního hospodářství.

Финансовая оценка производства древесины в еловых насаждениях

Для анализа сортиментной структуры запасов насаждений и производства древесины, в частности для их финансовой оценки, с надежностью можно применить так наз. «процентные» сортиментные таблицы, составленные на основе «средних» стволовых профилей в отдельных ступенях толщины. Так как было установлено, что в рамках одной ступени толщины (здесь двухсантиметровой) сама высота дерева (не учитывая крайние величины, т. е. высоты самых высоких и самых низких деревьев) оказывает лишь очень слабое влияние на размер долей сортиментов на стволе, поэтому процентные сортиментные таблицы были составлены практически только на основе толщины (диаметра) на высоте груди; в качестве соответствующей высоты в ступени толщины принята была та высота, которая соответствовала так наз. среднему стволу профилю. Построение процентных сортиментных таблиц на основе средних стволовых профилей дает возможность составить сортиментные таблицы не только для здоровых деревьев, но и для деревьев с разными повреждениями (снегом, обдиранисом коры охотничьими зверями и т. п.). Предположением для применения этих специальных сортиментных таблиц является знание распределения массы крупной древесины по ступеням толщины в отдельности у здоровых деревьев и с разными видами повреждений.

Процентные сортиментные таблицы можно очень выгодно использовать и для установления средней цены крупной древесины без коры по ступеням толщины, а эта цена потом становится исходным основанием для всех дальнейших финансовых вычислений. В качестве подходящих единиц цены для этой средней цены крупной древесины можно использовать государственные оптовые цены, или, еще лучше, выведенные новые так наз. цены сортиментов на корню (таблица I), вычисленные по разнице между государственными оптовыми ценами и общими собственными издержками на лесозаготовку, сортировку, трелевку, вывоз, погрузку в вагоны и т. д. (таблица I) прямо у отдельных сортиментов. Выведенные

новые цены до известной степени открывают финансовую выгодность производства отдельных сортиментов с точки зрения лесного хозяйства как отрасли.

Сочленением специальных процентных сортиментных таблиц, которые показывают состав сортиментов у деревьев с разными повреждениями и соответствующих единиц цены (здесь напр. цен сортиментов на корню) можно определить и размер возможных потерь, приходящейся в конкретной ступени толщины на долю разных видов вредных факторов.

Для установления финансовой стоимости необмеренных насаждений применяются таблицы стоимости насаждений. Для их составления использовано тесное соотношение средней цены крупной древесины в насаждении со средним диаметром насаждения d_k . Основание для построения таблиц стоимости насаждений (таблица IV) составляли данные среднего диаметра насаждения, средней высоты насаждения, массы крупной древесины главного и подчиненного яруса насаждения.

При определении собственной основной финансовой стоимости елового насаждения используются таблицы стоимости (таблица IV). В случае, когда насаждение повреждено, от этой основной финансовой стоимости насаждения W , установленной согласно действительной плотности насаждения R , вычитывается потеря, возникшая вследствие повреждения некоторым из вредных факторов. Эта потеря приведена прямо в процентах основной финансовой стоимости насаждения W для насаждений с известным средним диаметром на высоте груди для отдельных видов вредных факторов (таблица V), для изломов крон и стволов Z и для гнили в нижней части ствола L_x . Вычисление действительной финансовой стоимости насаждения W_{sk} осуществится по формуле (1) или (2), согласно тому, если мы хотим знать размер потерь от вредных факторов (1), или если мы удовлетворимся только непосредственным вычислением W_{sk} (2);

$$W_{sk} = [W - W(Z + L_x)] R \quad (1)$$

$$W_{sk} = W \cdot R [1 - (Z + L_x)] \quad (2)$$

Средняя цена крупной древесины без коры в ступени толщины, зависящая от структуры сортиментов «среднего» стволового профиля, становится, таким образом, основой всех дальнейших вычислений цен, связанных не только с непосредственной финансовой оценкой еловых насаждений или с возмещением за уничтоженные или поврежденные насаждения, но в случае надобности может сыграть важную роль, напр., при контроле правильности специальной деятельности ответственных работников на всех ступенях лесного хозяйства.

Finanzielle Bewertung der Massenproduktion der Fichtenbestände

Zur Analyse der Sortimentenstruktur der Bestandesvorräte und Massenproduktion für ihre eventuelle finanzielle Abschätzung können verlässlich die sogenannten „prozentuellen“ Sortentafeln angewandt werden, die auf Grund der mittleren Stammprofile in den einzelnen Durchmesserstufen zusammengestellt werden. Da festgestellt wurde, daß im Rahmen einer Durchmesserstufe (hier zweizentimtrige) hat alleinige Baumhöhe, sofern wir nicht die extrem hohen oder niedrigen Höhen berücksichtigen, nur einen geringen Einfluß auf die Größe des Sortimentanteils am Stamm; deshalb wurden die prozentuellen Sortentafeln praktisch nur auf Grund des Brusthöhendurchmessers zusammengestellt; für die entsprechende Höhe wurde in der Durchmesserstufe nur die gewählt, die dem sogenannten mittleren Stammprofil entsprach. Die Konstruktion der prozentuellen Sortentafeln und Grund der mittleren Stammprofile ermöglicht Sortentafeln zusammenzustellen, und zwar nicht nur für gesunde Bäume, sondern auch für unterschiedlich beschädigte Bäume (Schnee, Schälens vom Hochwild u. a.). Die Voraussetzung für die Anwendung dieser speziellen Sortentafeln ist die Kenntnis der Derbholzmassenverteilung in den Durchmesserstufen, und zwar getrennt für die gesunden und die auf verschiedene Art beschädigten Bäume.

Die prozentuellen Sortentafeln können mit großem Vorteil auch zur Bestimmung des durchschnittlichen Preises des Derbholzes ohne Rinde in den Durchmesserstufen ausgenützt werden und dieser wird dann zu einer Ausgangsunterlage für sämtliche weiteren finanziellen Kalkulationen. Für geeignete Preiseinheiten für diesen durchschnittlichen Derbholzpreis können die Großhandelspreise oder noch besser die neu abgeleiteten sogenannten „Preise der Sortimenten am stehenden Stamm“ angewendet werden (Tabelle I), die als Unterschied zwischen den Großhandelspreisen und gänzlichen Selbstkosten auf die Nutzung, Manipulation, Rückung, Abfuhr, Einwaggonieren usw. (Tabelle I) direkt bei den einzelnen Sortimenten berechnet wurden. Die neu abgeleiteten Preise verraten in einem bestimmten Maße den finanziellen Vorteil der

Produktion der einzelnen Sortimente vom Gesichtspunkt der Forstwirtschaft als Abzweig.

Durch das Zusammenfügen der speziellen prozentualen Sortimentstabellen, die die Aufstellung der Sortimente bei verschiedenen beschädigten Bäumen und der zugehörigen Preiseinheiten angeben (hier zum Beispiel der Sortimentpreise am Stamm), kann auch die Höhe des eventuellen Verlustes, an dem sich in der konkreten Durchmesserstufe verschiedene schädliche Faktoren beteiligen, bestimmt werden.

Zur Festsetzung des Finanzwertes der unkluppierten Bestände werden Bestandeswerttabellen angewendet. Zu ihrer Aufstellung wurde die enge Beziehung zwischen dem durchschnittlichen Derbholzpreis im Bestand und dem mittleren Bestandesdurchmesser d_k ausgenützt. Die Unterlage für die Konstruktion der Bestandeswerttabellen (Tabelle IV) bildeten die Angaben des mittleren Bestandesdurchmessers, der Bestandeshöhe, der Derbholzmasse des Haupt- und Nebenbestandes.

Bei der Bestimmung des eigenen grundlegenden Finanzwertes des Fichtenbestandes werden Werttabellen (Tabelle IV) angewendet. Falls der Bestand beschädigt ist, wird von diesem grundlegenden Finanzwert des Bestandes W , der laut tatsächlicher Bestockung R geregelt wird, der Verlust abgerechnet, der infolge der Bestandesbeschädigung durch einen der schädlichen Faktoren entstand. Dieser Verlust wird direkt in Prozenten aus dem grundlegenden Finanzwert des W Bestandes für Bestände in einem bestimmten mittleren Brusthöhendurchmesser für die einzelnen Arten von schädlichen Faktoren (Tabelle V), für die Kronen- und Stammbrüche Z und für die Holzfäulnis im unteren Teil des Stammes L_x angeführt. Die Berechnung des tatsächlichen Finanzwertes des Bestandes W_{sk} wird laut Formel (1) oder (2) verwirklicht, je nachdem, ob wir die Höhe des Verlustes durch schädliche Faktoren (1) kennen wollen, oder ob wir uns nur mit der direkten Berechnung W_{sk} (2) zufriedengeben:

$$W_{sk} = [W - W(Z + L_x)] R \quad (1)$$

$$W_{sk} = W \cdot R [1 - (Z + L_x)] \quad (2)$$

Der durchschnittliche Preis des Derbholzes ohne Rinde in der Durchmesserstufe, der von der Sortimentenstruktur des mittleren Stammprofils abhängig ist, wird so zur Grundlage sämtlicher weiteren Preiskalkulationen, die nicht nur mit der eigenen finanziellen Bewertung der Fichtenbestände zusammenhängen, z. B. mit dem Ersatz für die vernichteten oder beschädigten Bestände, sondern kann nicht zuletzt eine wichtige Rolle spielen, und zwar z. B. bei der Kontrolle der richtigen fachlichen Arbeit der verantwortlichen Mitarbeiter auf sämtlichen Stufen der Forstwirtschaft.

Evaluation financière de la production du volume des peuplements d'épicéa

Pour l'analyse de la structure d'assortiment des volumes sur pied et de la production de volume et pour leur évaluation financière éventuelle, on peut utiliser avec confiance les soi-disant tables d'assortiment en pour-cent, établies sur la base des profils médians de la tige dans classes d'épaisseur particulières. Comme il a été vérifié que dans le cadre d'une même classe d'épaisseur (qui dans notre cas est de deux centimètres) la seule hauteur de l'arbre, tant qu'on ne tient pas compte des hauteurs extrêmement élevées ou basses, n'a qu'une très faible influence sur l'importance de la proportion des assortiments de la tige. On n'a par conséquent établi pratiquement les tables d'assortiment en pour-cent que sur la base du diamètre (de l'épaisseur) de la tige à hauteur de poitrine. Comme hauteur correspondante dans la classe d'épaisseur on a choisi celle qui répondait au profil médian de la tige. La construction des tables d'assortiment en pour-cent sur la base des profils médians de la tige permet d'établir les tables d'assortiment non seulement pour les arbres sains, mais aussi pour les arbres différemment endommagés (neige, décortication due au gros gibier, etc.) La condition d'emploi de ces tables d'assortiment spéciales est la connaissance de la répartition du volume du bois fort dans les classes d'épaisseur et cela séparément pour les arbres sains et les arbres qui ont subi des dommages variés.

Les tables d'assortiment en pour-cent peuvent être utilisées, avec un grand avantage, également à la détermination du prix moyen du bois fort sans écorce dans les classes d'épaisseur, ce prix devenant le point de départ pour tous les calculs

financiers ultérieurs. Comme unité de prix convenable pour ce prix moyen du bois fort on peut utiliser les prix de gros d'Etat, ou encore mieux, les prix des assortiments de la tige (tableau I), nouvellement dérivés et calculés en tant que différence entre les prix de gros d'Etat et les frais de revient coplets d'exploitation, de manipulation, de débardage, de transport, de chargement des wagons, etc. (tableau I) et cela directement pour les assortiments particuliers. Les prix nouvellement dérivés font entrevoir, dans une certaine mesure, l'avantage pécuniaire de la production des sortiments individuels sur le plan de l'économie forestière en tant que branche.

En combinant les tables spéciales d'assortiment en pour-cent qui indiquent la structure des assortiments pour les arbres différemment endommagés, et les unités de prix correspondantes (dans notre cas, par exemple, les prix des assortiments de la tige), on peut déterminer également le volume des pertes éventuelles, auxquelles participent, dans la classe d'épaisseur concrète, les différents facteurs nocifs.

Pour déterminer la valeur pécuniaire des peuplements non pointés, on aura recours aux tables d'estimation du matériel sur pied. Pour établir ces dernières, on a utilisé le rapport étroit, existant entre le prix moyen du bois fort dans le peuplement et l'épaisseur moyenne du peuplement d_k . La base utilisée à la construction des tables d'estimation du peuplement sur pied a été formée par les données de l'épaisseur moyenne du peuplement, de la hauteur du peuplement, du volume du bois fort du peuplement principal et du peuplement secondaire.

En déterminant les valeurs financières fondamentales propres du peuplement d'épicéa, on utilisera des tables d'estimation (tableau IV). Au cas où le peuplement est endommagé, on retranche de cette valeur financière fondamentale du peuplement W , ajustée selon la densité réelle du peuplement R , la perte qui a eu lieu par suite de l'endommagement du peuplement par un quelconque des facteurs nocifs. Cette perte est indiquée directement en pourcentage sur la valeur financière fondamentale du peuplement W , et cela pour les peuplements d'un diamètre à hauteur de poitrine moyen déterminé, pour les espèces particulières de facteurs nocifs (tableau IV), pour les bris de cime et de tige Z et pour la pourriture dans la partie inférieure de la tige L_r . Le calcul de la valeur financière réelle du peuplement s'effectue d'après la formule (1) ou (2), selon que nous désirons de connaître le volume de la perte, due aux facteurs nocifs (1) ou si nous nous contentons du calcul direct de W_{sk} (2):

$$W_{sk} = [W - W(Z + L_r)] R \quad (1)$$

$$W_{sk} = W \cdot R [1 - (Z + L_r)] \quad (2)$$

Le prix moyen du bois fort sans écorce dans la classe d'épaisseur, dépendant de la structure des assortiments du profil médian de la tige, devient ainsi la base de tous les autres calculs de prix qui sont non seulement en rapport avec l'estimation financière propre des peuplements d'épicéa, le cas échéant avec le remboursement des peuplements détruits ou endommagés, mais qui peut aussi, et non en dernier lieu, jouer un rôle important, par exemple, lors du contrôle du travail professionnel des travailleurs responsables, et cela sur tous les échelons de l'économie forestière.

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■ Debarking of felled timber is one of the most laborious and exacting operations of tree logging, and this is why there is an incessant search for better, faster and cheaper methods of how to remove tree bark without a greater labour input. In most cases the problem of debarking has been solved by way of mechanization, i. e. by barking machines of different design and output, based on a number of mechanical engineering principles.

As a rule, mechanical removal of tree bark becomes easier with decreasing cohesion of bark and wood, their cohesion varying throughout the year even in standing timber. In felled timber in bark the cohesion of bark and wood layers increases in the process of air-drying and thus the bark "stick-dries" easily to the wood. Newly felled (green) timber can be most easily debarked, particularly in spring during the sap flow time and then in summer. Outside the growing period the peeling of tree bark becomes more difficult to become almost impossible during the period of frosts. Partly dried or dry timber can necessarily be barked only with greater effort, by means of specially designed barking machines, etc., and de-barking methods of this type involve as a rule — if perfect removal of tree bark is desired — also a certain loss of wood.

To facilitate the barking procedure, timber is sometimes treated in a particular way to reduce (or to eliminate completely) the effect of bark-wood cohesion forces. Similar methods of timber pre-treatment prior to barking are fairly costly in general, and must be thus chosen very carefully to suit the projected barking method and to be economically feasible. These are e. g. treatments by cold or hot water, wood steaming, treatment by chemicals, artificial inducement of the cambial activity, etc.

It is thus obvious that the problem of debarking cannot be considered as completely and satisfactorily resolved, and the search for new barking methods and principles facilitating this difficult and time-consuming logging operation seems to be fully justified.

As already indicated, it is the cohesion of tree bark and wood that exercises a very strong effect on a number of bark removing methods, and certain artificial measures seem thus to be very promising, enabling inducement of some changes in the outer wood layers reducing or disrupting the cohesion of bark and wood, and facilitating the process of bark removal.

This artificial reduction of bark-wood cohesion can be best attained as long as the timber in question is fresh and moist, the wood cells in the outer wood layers remaining alive (surviving) for some time after tree felling as well as

moist over a relatively long period under favourable conditions. This phenomenon can be utilized for inducement of changes in the outer wood year rings, changes aimed at a reduction of the bark-wood cohesion. The "bark" includes in this case all the tissues lying outside the cambium, which is fully in line with the meaning of this term in forestry and timber trade practice.

The new method of timber pre-treatment or debarking is based on the effect of electric current on the peripheral wood layers, this resulting in a decrease or disruption of cohesion between tree bark and wood. During the laboratory experiments attention was paid particularly to Norway Spruce wood since this is the major commercial and on an extensive scale "debarked" species. Orientation tests have shown, however, that the same applies to other species as well. During our research we used newly felled timber, moist timber, and various stages of air-dried timber.

In the following a new method of timber treatment and debarking by means of electricity will be described, based on the fact that both the cambium zone and the adjacent tissues are always moister than any other tissue layers inside and outside the cambium, be it in a newly felled tree, or in partly air-dried log, some weeks or months after felling, this depending on the site and storage method and treatment.

The finest cells with thin cell walls, and rich in saps are found in the cambial layer, this being obviously (most likely) the place of highest conductance. A fairly good conductance exhibit also the tissues closely adjacent to the cambium (outer wood layers and particularly the bast). The conductance of all these layers depends obviously on their moisture content, best conductance being in newly felled timber, and — when dry — acting as an excellent insulant.

The flow of electricity in plant tissues is affected both by their micro-structure (arrangement, condition, size and shape of cells, etc.), composition of the cell-wall, chemical composition and the cell content. The cell wall of a plant cell is of a complicated structure, consisting of several layers differing in their structure and chemical composition. All this makes the wood tissues offer resistance to the electric current as well as reactance (the cell-walls functioning in this case as a capacitor (condenser)). The plant saps contained in the tissues act as an electrolyte, and at the same time, i. e. as a result of the passing electric current, electrolysis and polarization of the electrodes take place. When measuring the values of electric resistance offered by the wood tissues underlying the tree bark, we find that a simultaneous effect of resistance, reactance, of electrolysis and polarization of electrodes presents certain difficulties. This combined impact of resistance and reactance depends necessarily on the type of electric current applied (passing through the wood tissues), the above factors being queued in various ways. The recorded resistance is not, for the above reasons, a simple "ohmic" resistance, but an impedance consisting of resistances, reactances, etc. connected at a time in the circuit in a variety of ways.

The fact that there is not only a pure resistance can be seen from the results of the laboratory measurements, e. g. from the difference in resistance values for passing either the AC or DC currents (the above difference being always greater for the DC) and from the difference in resistance values for varying electrode clearance (distance of electrodes). A change in the conductor length (electrode clearance) does not bring about a change in resistance of such a magnitude that would take place in case of a simple (pure) "ohmic" resistance. Also a change in the length of the electrodes (change in cross-section

of the conductor carrying the electric current) does not result in resistance changes corresponding (as to their magnitude) to those due solely to the "ohmic" resistance. The resistance of wood tissues under bark is greatly affected by moisture, a fact that comes very distinctly to light particularly at lower moisture contents when a great increase in resistance takes place. If the electric current flows perpendicularly to the wood fibers, the resistance encountered is always greater than if it flows parallel to them, this being due both to the structure and anatomical pattern of the tissues involved. The resistance decreases with rising temperature, and also the bark thickness exercises a negative effect on the value of resistance, of decisive importance being particularly the inner, moist, and pulpy parts (layers) of the bark. The effect of the seasons of the year on the magnitude of resistance offered by the wood tissues adjacent to bark has not been proved by our laboratory tests.

The measurement of impedance under different conditions has revealed that its magnitude is mostly of the order enabling a smooth flow of the electric current through the subcortical wood layers (year-rings), a phenomenon which constitutes the basis of a new method of timber de-barking by electric current the description of which follows.

The effects of the electric current flowing through the subcortical (under bark) wood layers are in the first place of heating (thermal) and chemical nature, of which the thermal effects are most important with regard to the possibilities of timber treatment since it is they that result in a substantial decrease in the cohesion of bark and wood.

The subcortical wood layers offer resistance to the flow of electric current the result of which is that the temperature of them is rising. It should be also pointed out, in this connection, that the so called conductors of the first class (metals) are heated on carrying the electric current while the second class conductors (electrolytes) are not only heated but show also chemical changes due to the dissociation of the electrolyte (electrolysis). The electrolysis takes place as a result of the flow of DC in electrolyte, yet there are also certain chemical changes caused by the AC when passing through.

In addition to the chemical changes due to electric current (electrolysis) also the polarisation of the electrodes takes place, resulting from an accumulation of the electrolysis products on the electrodes or from a change in the concentration of the ion determining the potential in the course of electrolysis. This way a galvanic cell originates, with electromotive force headed against the external voltage. At increasing frequency of AC the polarisation diminishes, this drop being more apparent not earlier than at a fairly high frequency. The flow of electric current through liquids is governed by fairly complex laws, and in addition to the purely physical phenomena there are also certain chemical reactions. The resistance of electrolyte depends both on the solids dissolved, on the solvent, and on the concentration and temperature. The resistance decreases with increasing temperature.

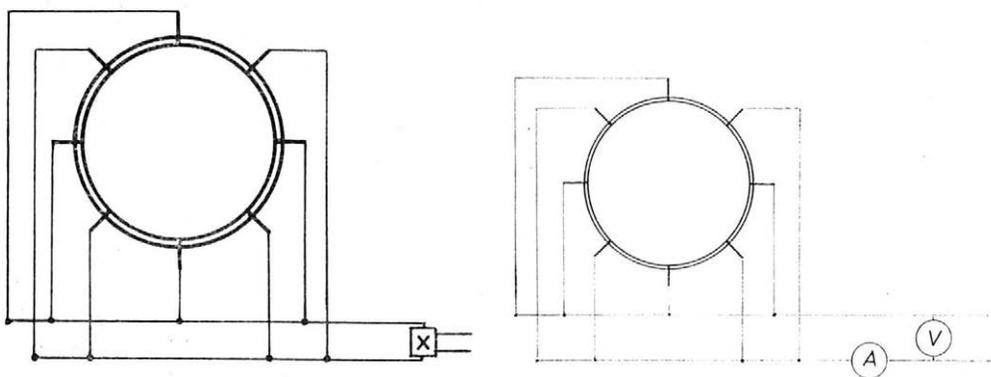
The thermal (heating) effects of the electric current take place during the flow of both DC and AC in the subcortical wood layers, this being due to the (ohmic) resistance. The "ohmic" resistance does not result in a phase-shift in case of AC, and thus the power is equal to that of DC. If there was only the resistance, then the total energy input within the circuit would be converted into heat. The conversion of the electric energy into heat energy in the process of resistance flow is very economical since this is done without any losses. It should be noted, however, that the flow of electric current through the under-

bark wood layers is hindered both by the beginning polarisation and by re-actance, this resulting in the electric energy being only partly converted to heat.

If the heating of the under-bark wood layers is to be sufficient (with regard to the desired reduction and disruption of cohesion of bark and wood) it must be complete and also rapid to make the method economical and feasible. The subcortical wood layers, strictly speaking the cambium and its adjacent layers, which form a relatively narrow zone, can be heated perfectly within a very short time, provided there is an adequate distance of electrodes inserted in the bark as well as a properly chosen voltage and type of current. The effectiveness and feasibility of such heating depend particularly on its speed, the main objective being a fast conversion into vapor of all the saps present in the tissues under treatment.

Rising temperature of the above tissues contributes to a softening of the cell-walls within the heated zone, which in itself brings about a reduction in the bark-wood cohesion. The volume of plant (wood) saps increases due to rising temperature, yet it is particularly the pressure of the produced vapor that breaks (disintegrates) the thinnest, softest and least resistant cell walls, and when the pressure of the generating vapor exceeds the strength limit of those walls they break down and thus the cohesion of tree bark and wood is severed. The vapor pressure falls off, the bark gets loose and the steam escapes out of the wood. At the same time the resistance of the layers in question increases sharply, since the flow of the electric current through wood layers of highest conductivity (i. e. through the cambium) gets interrupted suddenly by the breakage of the radial and transversal cambium cell-walls, and as a result of the vapor leakage a sharp drop in the moisture of the above tissues takes place.

The effect of electric current on unpeeled timber and on the lowering of wood-bark cohesion was studied in a number of experiments, to find the impact of different voltages and frequencies. More extensive tests and measurements were made with the AC, the voltage of which was 220 V, and the frequency 50 Hz. The above voltage and frequency were used mainly because it was possible to draw the necessary current (after voltage stabilisation) from the network without any additional treatment. For the recording of changes in electric current taking place throughout the timber treatment a portable self-recording V-A meter Varg and the SM measuring transformer were used. Initial



1. Connection scheme: x — RLC bridge

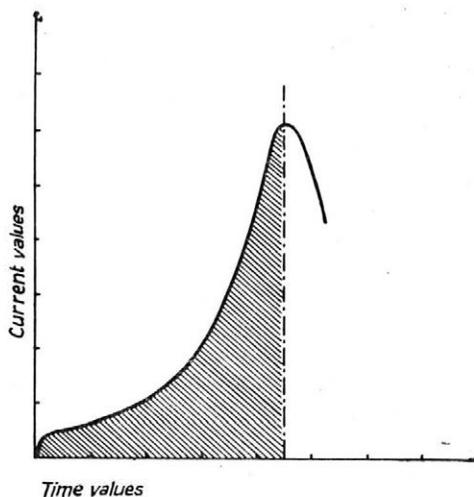
2. Connection scheme: A — ampermeter, V — voltmeter

resistances were measured by a RCL bridge Tesla TM 393, the timber samples were being taken from felled timber (in bark) as short billets throughout the year. The samples under study were either fresh (newly felled trees) or stored for a longer time; their moisture content was determined by the oven-dry method, and small wood samples for moisture determination (bark and adjacent wood layers) were taken from the logs (close to the point of measurement) immediately. The measurements were made in laboratory at 20°C, and the wood samples were stored for 12 hours in the lab prior to testing at a constant temperature of 20°C. Steel knife electrodes served as a measuring device, which were inserted into the bark. The connection used can be seen from Figures 1, 2.

After switching on, the current begins to flow through the moist wood sample (particularly through the sub-cortical tissues), raising the temperature of the tissues involved. This rise in temperature necessarily results in a lower resistance offered by the transit tissues and in higher current values. The above changes are slow at the beginning, they proceed until the water in the subcortical tissues begins to steam and the cohesion of bark and wood is impaired.

The electric current, when passing through the subcortical layers of wood, produces power that is equivalent to the product of voltage, current (in amperes), time, and $\cos \varphi$. A part of the electrical energy consumption goes to the active power, i. e. it represents the necessary energy input for wood treatment to heat the subcortical tissues and to disrupt the wood-bark cohesion, as well as to heat additional wood layers (which is however of no use from our point of view), to electrolysis and de-polarisation of electrodes, another part of it going to reactive power as a result of the capacitance.

The consumption (input) of electric energy necessary for timber treatment was determined from the area limited by the current change curve recorded by the V-A meter, by the zero line, and by a perpendicular from the curve top to zero line (see Figure 3). The voltage drop and consumption of electric energy by the measuring apparatus and the connecting line were not considered (taken into account), and the same applied to the $\cos \varphi$ the value of which was always taken as equal to unity. Thus, the maximum $\cos \varphi$ value was taken as a basis for all calculations, as if the phase-shift was 0°, as if the current was in phase, and as if it was fully utilized for active power. It goes without saying, however, that as a result of capacitance the $\cos \varphi$ value is in fact always less than 1. The above allowances lead inevitably to certain inaccuracies of calculations and the computed consumption of electric energy is thus higher than the actual one, representing the upper limit of input necessary for the treatment of timber by electric current. This is of course quite sufficient for a reliable estimate of



3. The course of electric current changes during wood treatment

the feasibility and suitability of timber treatment by electric current, and provides at the same time also a guarantee that the actual consumption of electric energy will not exceed the computed value.

In all the measurements taken in the process of timber treatment by electric current also the effects of the procedure on the decrease in wood-bark cohesion were studied, and the cohesion changes due to electric current were assessed by means of a measuring method based on a sample bark strip to be separated from wood by a blunt wedge driven under specified pressure and angle in between the bark and wood. It is a method used for the first time by H u b e r, later on by Z i e g e r and G l ä s e r. In our experiments the test strip of bark was 100 mm wide, sometimes of other width e. g. in comparative measurements. The bark test strip must be perfectly separated from the adjacent wood layers (by a sharp knife, etc.) yet the cohesion of bark and wood must not be impaired prior to measurement. The inclination angle of the wedge was 30° , and the force necessary (required) to drive the wedge under the bark strip and to separate it from the underlying wood was determined by a spring type gauge. Reading was made only of the value (force) at the moment of the beginning separation of bark from wood.

The bark test strip being 10 mm wide, the steel wedge used had the following dimensions: width 10 mm, length 35 mm, thick end 3 mm, thin end 0.5 mm (measured at a distance of 1 mm from the thin edge). The face of the wedge, perpendicular to its longitudinal axis, was 0.25 mm wide and rounded so that the front end of the wedge was blunted.

According to our experiments, there is a close relationship between the resistance values (found by the above described method) and barkability of Norway Spruce timber: if the force necessary for the separation of the bark test strip does not exceed 400 pounds, tree bark may be peeled easily. At higher values (400—600 pounds) bark can be peeled away only with difficulty, and at the values ranging from 600 to 700 pounds removal of tree bark is impossible (peeling limit). At the values exceeding 700 pounds bark can be only scraped off by special tools, and hand-scraping is understandably getting more difficult with increasing force required for the separation of the bark test strip from wood.

The method applied to a strip width of 10 mm gives fairly reliable (satisfactory) results up to the value of 1.400—1.500 pounds; the measurement is less accurate with higher resistances, being difficult and less accurate also at very low values (less than 200—150 pounds).

Without any exception, the cohesion of bark and wood after treatment by the electric current was found to be lower than that prior to treatment, ranging in general from 0 to some 200—300 pounds. This means however that it was not higher than it is in springtime during the sap flow (when tree bark can be peeled easily) and that in most cases it was even less or approaching zero.

The results of our measurement testify to the fact that as long as felled timber is sufficiently moist, through application of electric current a considerable reduction in the bark-wood cohesion can be attained, yet if electric current is applied to fairly air-dried timber (or to timber with little moisture in the sub-cortical tissues — less than 70 per cent moisture), then the process becomes too extended, till non-feasible. In addition, also the decline in cohesion is likely to be unsatisfactory in such cases. The best way is thus to treat green timber, immediately after felling. The breakdown of cohesion between wood and bark occurs in sufficiently moist timber in the cambial tissues, and this is why bark becomes separated (peeled off) from wood in the very cambium layer, a phe-

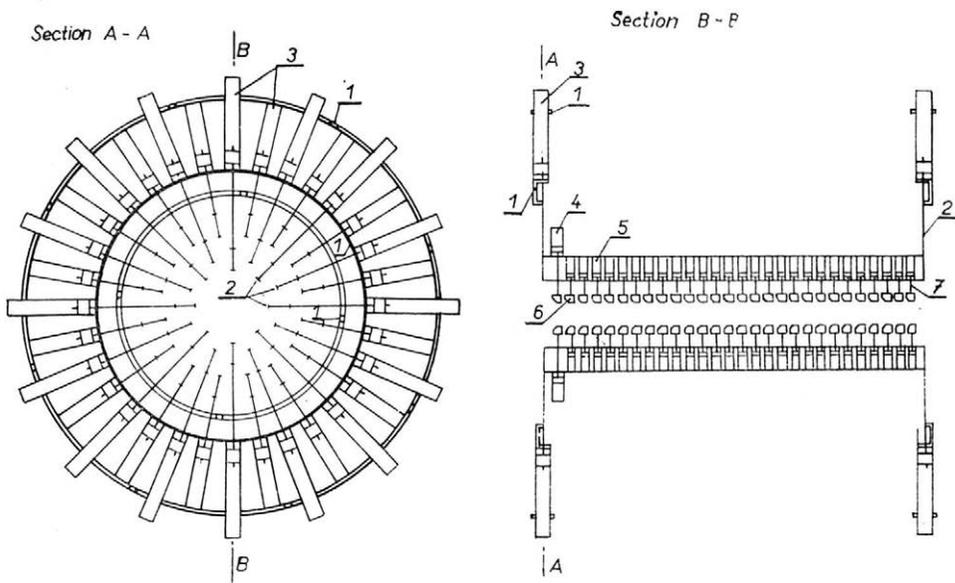
nomenon resembling to springtime peeling of bark. It should be pointed out that bark removal by the above described method is perfect and that there is no loss of wood.

The distance (clearance) of electrodes driven through bark into the sub-cortical layers (outer year-rings) must be adequate so as to allow a quick and intensive heating of the rings in question. The greater the distance of electrodes, the longer is the necessary time of treatment, and when determining the optimum electrode clearance, particularly the moisture and temperature of the youngest rings, bark thickness, and voltage of the electric current must be taken into account.

When treating timber having thicker bark (innermost moist pulpy part) the consumption of electric energy increases, yet according to our experiments even logs of greater diameters and with thick bark can be treated with full success.

During the procedure, there must be uniform spacing of all the electrodes; the necessary input of electric energy depends in the first place on the volume of treated and heated wood, on its moisture and initial temperature. The amount of heated tissues is determined largely by the bark thickness (its innermost moist and pulpy part) and by the surface area of timber under treatment from which tree bark is to be removed; a certain part of heat goes however also to the outer layers.

The number of electrodes does not affect the consumption of electrical energy, provided that other factors have remained unchanged. The number of electrodes used affects, however, the duration of treatment (in case of a lower number of electrodes their spacing increases and the heating time gets prolonged too) and the top (maximum) current values (with less electrodes their clearance grows and the maximum current values decrease). The consumption of electric energy remains on the same level for various voltages.



4. Head with electrodes
5. Head with electrodes

As a result of timber treatment by electric current, the cohesion of bark and wood will be completely broken over the whole circumference of the log under treatment (in a strip the depth of which depends on the length of the electrodes used).

Our experiments and measurements have demonstrated that under certain conditions the electrical current can be utilized for timber treatment aimed at a reduction and breaking of the bark-wood cohesion forces. It has been also demonstrated that the method is operational with almost the same effect throughout the year, also in wintertime and during frosts.

The installation for electrical tree bark removal will consist of a log feeding conveyor, a head with electrodes, a device for mechanical removal of "electrically freed" bark strips, and of a finished logs conveyor.

A head with mounted electrodes represents the major part of the barking installation, other parts being similar to those of other makes of barking machines. The head with electrodes (Figs. 4,5) consists of a metal frame 1 with mounted electrodes 2 operated by push and shift buttons 3. The elements of the electrodes 7 are cushioned to surmount (adjust to) the uneven surface of the logs being barked. The electrodes and their elements are pressed against the timber surface by push and spring devices (Figs. 3, 4, 5) that cut the bark through and keep the respective electrode part in the cut-out notch. The Figs. 4 and 5 show a model design of the barking installation, yet there are many alternative solutions to this problem.

The electrode cutting edges 6 are parallel and their arrangement on the head is regular (symmetric); their basic position is in concentric circles, and they are adjustable to bigger diameters of the logs undergoing barking. The number of concentric circles with mounted electrodes depends on the minimum and maximum diameters of logs for which the installation is designed: the bigger is the diameter of trees to be peeled off, the more electrodes are put step by step to work. The number of electrodes working simultaneously depends on the diameter of the processed logs, and the connection (switching on) of the electric current is changed successively so that always a pair of the neighbouring electrodes functions as a "working unit" and, this way the flow of the electric current between the electrodes and the cambial and adjacent tissues is ensured. The clearance of the electrodes increases necessarily in relation to diameter of the logs to be peeled until yet another electrodes are put to work which are mounted on the head in basic position on another concentric circle. The diameters of the above concentric circles (carrying uniformly arranged electrodes in basic position) were chosen so as to keep at a minimum the differences in the distance of the electrodes.

Short and long logs to be barked are fed to the machine continuously, the logs being moved in the direction of their longitudinal axis. If the electrodes in the head are arranged obliquely and if the head or the logs themselves rotate along their longitudinal axis when passing through the stationary head, then the strips of bark peeled off take the form of a spiral.

As for the shape of the electrodes, use can be also made of the needle-shaped electrodes that could be designed as endless conveyor belts lead over guide pulleys and provided with rows of sharp steel needles. It is most likely, however, that the effectiveness of such needle electrodes will be a little bit lower than that of the knife electrodes of the same length.

Should the above described barking installation be feasible and of practical use, it must be efficient enough, its effect depending particularly on the time

which is necessary for perfect heating of the subcortical wood layers. Other parts of the installation, e. g. the log feeding conveyor, the device for removal of peeled bark strips, the finished logs conveyor, and the bark removal device can be designed easily in a way corresponding in performance (output) to that of the major part of the installation, i. e. to the log-output of the head with electrodes.

The time necessary for bark treatment depends particularly on the distance of electrodes, on the voltage of electric current used and on the moisture of timber undergoing treatment. When e. g. the moisture content of the sample was 40–50 per cent, this time was 12–70 seconds (this depending on the distance of electrodes ranging from (between) 1–3 cm, the current being 220 V and 50 Hz). For a voltage of 800 V and frequency of 50 Hz the treatment time was only some 1.2–8 sec. The installation should be designed in a way enabling adjustments both of the electrode clearance and of the voltage or the length of electrodes. With longer electrodes much faster log feeding to the machine can be used (for the same electrode clearance and the same voltage) so that the optimum desired time for unit-log treatment will be attained.

The experimental calculations (estimate) have shown that the log flow velocity could be quite satisfactory (up to 30 m/min.) and that the installation could compare favorably in performance with other modern barking machines.

Mean consumption of electric energy per one ccm of treated bark varied, according to moisture (120–170 per cent) and temperature (+30°C till –5°C) from 145.6–235.15 Ws/ccm. When assuming that the log length is 1 m, log diameter 10–20 cm, bark thickness 2–5 mm, that the outer part of bark is thin and smooth, then the consumption of electrical energy per one cu. m. of wood is some 3.18–6.90 kWh provided the treatment would be done under the same conditions as our laboratory tests on which the above estimate is based.

The above consumption of electric energy per 1 cu. m. represents however only the maximum electric input required for the treatment of timber (removal of bark). There will be necessarily another consumption required for driving the whole installation (log feeding and log removal conveyors).

If there is a steady power input of some 150 kWA (for timber treatment), a theoretical output per shift could be, when working to a 75 per cent capacity of the installation, some 60–80 cu. m. for small logs of some 10 cm in diameter, and some 120–180 cu. m. for large logs over 15 cm in diameter.

It goes without saying that provision of adequate safety devices on the installation is a must. Log feeding and removal to and from the head with electrodes must necessarily be fully automated to prevent the operators from being hurt by the electric current; and the installation itself must be housed in a perfectly dry roofed shelter (building). It is thus obvious that it is not an easy task to design a well functioning barking installation of the type described, particularly with regard to the safety measures to be taken.

It has not been the main objective of this research project and experiments preceding elaboration of this new method of timber treatment and de-barking to design an installation serving this purpose but, the major aim of the author of this paper was to do investigations into this problem and to verify that timber treatment by electric current, resulting in a reduction and disruption of cohesion between bark and wood, is possible, and to propose the method enabling practical application of the above theoretical finding.

A design of such electrical barking installation and its putting into operation is another problem the solution of which was not attempted — without any doubt this is to be a difficult and taxing task yet very promising and feasible, at least in the opinion of the author of this paper.

The above described method of timber treatment and barking was patented in Czechoslovakia in 1968 (Patent No. 130 192, registered September 21, 1968).

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Nový způsob ošetřování a odkorňování dřeva

Nový způsob ošetřování a odkorňování dřeva byl vypracován na základě výsledků základních studií rostlinných pletiv nacházejících se v podkorních vrstvách dřeva. Byly sledovány změny v těchto vrstvách způsobené průchodem elektrického proudu. Tím se porušuje nebo snižuje soudržnost mezi dřevem a kůrou (tj. souborem všech pletiv ležících vně kambia). Využívá se přitom té skutečnosti, že kambialní vrstva a vrstvy pletiv přilehlé ke kambiu jsou vlhké (u stromu čerstvě pokáceného nebo u dřeva částečně vyschlého několik týdnů i měsíců po kácení podle místa uložení a způsobu uskladnění a ošetření) a jsou složeny — zvláště kambium — z jemných buněk. Obsahují vodu a v ní rozpuštěné látky a pro elektrický proud jsou vodivější než další vrstvy pletiv vně i dovnitř kmene od kambialní vrstvy.

Při zavedení elektrického proudu do podkorních vrstev pomocí elektrod (např. nožových) zaražených do kůry se působením elektrického proudu teplota kambialních vrstev a vrstev přilehlých ke kambiu rychle zvyšuje. Tlakem rychle se vyvíjející páry spolu s účinky vyšší teploty a dalšími pochody fyzikálními a chemickými se porušuje soudržnost mezi dřevem a kůrou. Kůra se dá ze dřeva buď velmi snadno odstranit, nebo se sama od dřeva odchlípí. Oddělení kůry od dřeva nastane vždy na rozhraní mezi dřevem a lýkovými vrstvami, ve vrstvách kambia. Takto lze oddělovat kůru stromů od dřeva během celého roku, v době vegetačního klidu i za mrazu. Odkornění je dokonalé a nevznikají ztráty na dřevě. Podmínkou ovšem je, aby ošetřované dřevo (jeho podkorní vrstvy) bylo ještě vlhké.

Výsledků získaných při experimentální práci bylo použito k vypracování návrhu na nový způsob odkorňování dřeva, popř. ošetřování dřeva pomocí elektrického proudu. Bylo navrženo zařízení k využití tohoto způsobu a stanoveny základní parametry navrhovaného zařízení. Nový navrhovaný způsob odkorňování dřeva a zařízení k využití tohoto způsobu byly patentovány.

Новый способ обработки и окорки древесины

Новый способ обработки и окорки древесины был разработан на базе результатов основного исследования, касающегося растительных тканей, находящихся в подкормных слоях древесины. Проводились исследования изменений в этих слоях, вызванные прохождением электрического тока. Таким образом вызывается нарушение или снижение прочности связи между древесиной и коровой (подразумевая под понятием кора совокупность всех тканей, находящихся вне камбия). При этом используется тот факт, что камбиальный слой и слои тканей, примыкающие к камбию, влажны (у свежесрубленного дерева или у частично высушенной древесины, спустя несколько недель и месяцев после валки, в зависимости от места хранения и обработки) и состоят — в особенности камбий — из мелких клеток. Они содержат воду и растворимые в ней вещества и для электрического тока они более проводимы, чем дальнейшие слои тканей по направлению наружу и внутрь ствола от камбиального слоя.

При введении электрического тока в подкормные слои с помощью электрод (напр. ножевых), вбитых в кору, под действием электрического тока температура камбиальных и примыкающих слоев быстро повышается. Под давлением быстро образующегося пара, вместе с действием повышенной температуры и дальнейшими физическими и химическими процессами происходит нарушение прочности связи между древесиной и корой. Кору можно со ствола или весьма легко удалить, или она сама от него отпадает. Отделение коры от древесины происходит всегда на пределе между древесиной и лубяными слоями, в слоях камбия. Таким образом можно отделять кору деревьев от древесины в течение всего года, даже в период вегетационного покоя, и в мороз. При этом происходит полная окорка

и потери древесины не возникают. Однако условие заключается в том, чтобы обрабатываемая древесина (ее подкорные слои) была еще влажной.

Результаты, полученные при проведенной экспериментальной работе, были применены в разработке проекта нового способа окорки древесины, или обработки древесины с помощью электрического тока, и было предложено оборудование для использования этого способа; были также определены основные параметры предлагаемого устройства. Новый предлагаемый способ окорки древесины и устройство для использования этого способа были запатентованы.

Die neue Art der Holzpflege und Entrindung

Die neue Art der Pflege und Entrindung des Holzes wurde auf Grund der Ergebnisse der Grundstudien betreffs der in den Schichten unter der Rinde des Holzes sich befindenden Pflanzengewebe ausgearbeitet. In diesen Schichten wurden Veränderungen verfolgt, die durch den Durchgang des elektrischen Stroms verursacht wurden. Dadurch wird eine Zerstörung oder Herabsetzung der Kohäsion zwischen dem Holz und der Rinde erreicht (wenn wir unter der Auffassung Rinde den Komplex sämtlicher außerhalb des Kambiums liegenden Gewebe erwägen). Dabei wird diejenige Tatsache ausgenützt, daß die an das Kambium anliegende kambiale Schicht und die Gewebeschichten feucht sind (beim frisch gefällten Baum, oder bei teilweise ausgetrocknetem Holz, einige Wochen und auch Monate nach dem Fällen, laut Ort der Aufbewahrung und Art der Lagerung und Pflege) und aus feinen Zellen — besonders Kambium — zusammengesetzt sind. Sie enthalten Wasser und in ihm aufgelöste Stoffe und sie sind für den elektrischen Strom leitfähiger als die weiteren Gewebeschichten außerhalb und auch innerhalb des Stammes von der kambialen Schicht.

Bei der Einführung des elektrischen Stroms in die Schichten unter der Rinde mittels der Elektroden (zum Beispiel Messerelektroden), die in die Rinde eingeschlagen werden, erhöht sich rascher durch die Wirkung des elektrischen Stroms die Temperatur der kambialen und der an das Kambium anliegenden Schichten. Durch den Druck der sich rasch entwickelnden Dämpfe, gemeinsam mit den Wirkungen einer höheren Temperatur und weiterer physikalischer und chemischer Prozesse kommt es zu Störungen der Kohäsion zwischen dem Holz und der Rinde. Die Rinde kann vom Holz entweder sehr leicht beseitigt werden, oder sie stülpt selbst vom Holz ab. Die Abtrennung der Rinde vom Holz entsteht stets im Grenzpunkt zwischen dem Holz und den Bast-schichten, in den Kambiumschichten. So kann die Baumrinde während des ganzen Jahres, auch in der Zeit der Vegetationsruhe und auch während der Frostzeit vom Holz getrennt werden. Dabei kommt es zu einer vollständigen Entrindung und es entstehen keine Holzverluste. Die Bedingung ist jedoch, daß das gepflegte Holz (seine Schichten unter der Rinde) noch feucht ist.

Die bei der durchgeführten experimentellen Arbeit gewonnenen Ergebnisse wurden zur Ausarbeitung des Vorschlags auf eine neue Art der Holzentrindung, eventuell Holzpflege mittels elektrischen Stroms angewandt und es wurden auch Einrichtungen für die Ausnützung dieser Art vorgeschlagen und grundlegende Parameter der vorgeschlagenen Vorrichtungen bestimmt. Die neue vorgeschlagene Art der Holzentrindung und Vorrichtung für die Ausnützung dieser Art wurde patentiert.

Mode nouveau de traitement et d'écorçage du bois

Un mode nouveau de traitement et d'écorçage du bois fut élaboré sur la base des résultats des études fondamentales, concernant les tissus végétaux que l'on trouve dans les couches sous-corticales du bois. On suivait les modifications ayant lieu dans ces couches et qui sont dues au passage du courant électrique. On parvient ainsi à altérer ou à abaisser la cohérence entre le bois et l'écorce (on comprend sous la notion d'écorce l'ensemble de tous les tissus situés à l'extérieur du cambium). Ici on utilise le fait que l'assise de cambium et les assises de tissus, adhérentes au cambium, sont humides (s'il s'agit d'un arbre récemment abattu, ou du bois partiellement desséché, abattu depuis plusieurs semaines ou mois, selon l'endroit de conservation et le mode de stockage et de traitement), étant composées — notamment le cambium — de cellules fines. Elles comprennent de l'eau

et des substances dissoutes en elle, étant par conséquent plus conductives pour le courant électrique que les autres couches de tissus de la tige, situées à l'intérieur et à l'extérieur de l'assise de cambium.

En faisant entrer le courant électrique dans les couches sous-corticales à l'aide des électrodes (par exemple des électrodes à couteaux) enfoncées dans l'écorce, la température des assises de cambium et des couches adhérentes au cambium augmente rapidement, justement par suite de l'action du courant électrique. C'est sous pression que se développent rapidement les vapeurs, de sorte que, encore sous l'influence d'une température supérieure et de procédés physiques et chimiques ultérieurs, il se produit une altération de la cohérence entre le bois et l'écorce. L'écorce peut être soit très facilement enlevée du bois, soit elle se détache de ce dernier elle-même. La séparation de l'écorce du bois a lieu toujours au point de séparation entre le bois et les couches de liber, dans les assises de cambium. C'est ainsi qu'on peut séparer l'écorce des arbres du bois pendant l'année entière, même à l'époque du repos végétatif ou pendant les gelées. On constate que le décorçage est parfait et que les pertes en bois n'ont pas lieu. Ce qui est cependant nécessaire, c'est que le bois traité (ses couches sous-corticales) soit encore humide.

Les résultats obtenus au cours des travaux d'expérimentation étaient utilisés à l'élaboration du projet introduisant le nouveau mode d'écorticage du bois ou bien de traitement du bois à l'aide du courant électrique et simultanément on a aussi proposé le dispositif capable d'exploiter le mode en question, tout en déterminant les paramètres principaux du dispositif projeté. Le mode nouveau d'écorticage du bois proposé, aussi bien que le dispositif destiné à l'exploitation du mode mentionné, ont été garantis par un brevet.

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TOPICAL NEWS

DOLEŽAL B. ET AL.: HOSPODÁŘSKÁ ÚPRAVA LESŮ (FOREST MANAGEMENT). 1969, PRAGUE

The book represents a university textbook comprising the subject-matter of forest management pursuant to the syllabus approved by the Ministry of Education.

The lay-out of the book is as follows: Part I. Theory of Forest Management; Part II. Forest Management Plan — this part represents the practical portion of forest management. The book is concluded by the chapter entitled "Further Development of Forest Management", compiled by Prof. Doležal.

The introductory chapter (by Prof. Priesol) gives an insight into the historical development of forest management in Europe, including Czechoslovakia. There is a from-past-to-date analysis of Czechoslovak legal regulations and accomplishments of forest management achieved in accordance with the rules. Furthermore, the economic principles of socialist forest management and forestry in general are analysed.

Prof. Korf compiled the part concerning the production of wood species. There is a particularly detailed consideration on the art of the production of even-aged pure forest stands as well as of all-age stands. Some attention is paid to the yield factors growth and production of wood species, including an evaluation of recent scientific findings (analysis of the tree count, basal area, mean DBH, height and stand volume, both main and thinned). A similar methodology is employed in the consideration of the growth and production of the main types of mixed stands. Special attention is paid to the analysis of the production of thinned stands, to the effect of thinning on the production of wood and on the growth in height and thickness. There is also an evaluation of the contemporary scientific findings obtained by Assman and

other authors. The problem of increments, their utilization and methods of determination in forest management, is being treated in detail.

Space arrangement of forest was a problem elaborated by Prof. Priesol. There is a survey of the historical development in Europe as well as in this country, and an analysis of the units of space arrangement in Czechoslovak forest management. These are: working plan unit, working circle, and other (subordinated) units: permanent subcompartment, compartment, stand. In this relation, the textbook deals with the problem of one-, two-, and three-degree division of forest in Czechoslovakia pursuant to the existing valid regulations.

The time arrangement of forest is described by Prof. Doležal, based mostly on the results of his own research studies. First, the components of time arrangement (age and thickness) are being treated, followed by the problem of maturity for felling. Here, the concepts and definitions of maturity are presented, and the different main kinds of the maturity of trees and stands are analyzed (natural maturity for felling, the maturity of the maximum volume production, and economic maturity). A detailed consideration is also devoted to the problem of rotation. There are definitions explaining the importance of rotation for the time arrangement of forest and the determination of rotation under Czechoslovak conditions based on the technological procedures of forest management. The author gives an explanation of his own conception of the determination of the rotation of a working circle based on the differentiation of current stand groups. The questions of the forest reproduction time are contained in a special chapter giving also the respective definitions and

methodical procedures of the derivation of the duration of forest reproduction. These definitions are also based on the differentiation of current stand groups.

The articles on the models of silvicultural systems of clear-cutting, selection and shelterwood forests are compiled by Prof. Priesol. First, there is a consideration on the theory of normal clear-cutting forest belonging to the group based on age (age classes), and on the theory of model (balanced) selection forest based on an even curve of diameter frequencies which is treated in detail both from mathematic and survey aspects. A scheme of the model of a normal shelterwood working circle is drawn up according to the model of Prof. Korf. As a conclusion, this part includes a discussion on the importance of such models of working circles in modern forest management.

Another part, dealing with the methods of forest management, was compiled by Prof. Doležal. In a development line, all methods are described in this chapter (from the area regulation to small-area shelterwood forest method). The systems of the classification of forest management methods were chosen on the basis of various economic principles behind the respective methods. The oldest methods (area regulation and formula methods as well as the pure method of age classes) were based on the principle of yield balance which was of crucial importance to this conception. There is also a treatise on the methods following the principle of the highest net yield from land (pure-stand management method) and on methods based on more economic principles, including the Judéich method of Saxony stand management (bearing on the highest yield from land and on balanced yield), the age class method, represented in Czechoslovakia by the "Suggestion of Instructions for the Incorporation of Forests in the Enterprise of State Forest" of 1929 and by the Gov. Reg. No. 35-1944 Coll. of Laws. This class of methods also includes the technique of "intensive small-area forest management" — a title assigned by the author to a forest management method which is now being developed in Czechoslovakia. Pursuant to the Forest Act No. 166/1960 Coll. of Laws, the method is designed for the management of small-area cutting forests, or for the conversion of a forest from the even-age class to the shelterwood class. As to the economic principles underlying the method, the most important principle is that of extended re-

production and balanced yield. The method is characterized by: the introduction of a permanent unit of the division of forests; the use of the typification of forest stands; the introduction of current stand groups and of the index of cutting regulations based on the principle of extended reproduction. The conclusion of the chapter on forest management methods deals with control methods.

There is also a chapter concerning the management of selection forest (by Prof. Priesol) and chapters by Prof. Doležal on small-area cutting (shelterwood) forest management, on the management of conversions, changes and special-purpose forests.

The treatise of the management of selection forests deals with the principles of selection methods, space and time arrangement, as well as the methods of cutting regulation. Dealing with the management of shelterwood forest, Prof. Doležal, basing on the results of his research, gives a detailed analysis of the scheme of a shelterwood forest working circle model, and the importance of rotation and cutting cycles. There is a very close and detailed description of cutting regulation, and an analysis of presumed and proposed indices; the author also describes the method of the derivation of his proposal of a cutting index for shelterwood forests. The chapter on the management of conversions concerns primarily the problems of the conversions of coppices and elaborates on the most important principles of forest management, particularly cutting regulation.

This chapter is followed by a treatise by Prof. Doležal on "The Cutting Regulation of Forests", analysing in detail the methods of the derivation of the allowable cut (inductive, deductive), and — particularly — the cutting regulation indices for allowable cut. The systems of the cutting regulation indices are based on the main economic principles underlying the indices. There is an analysis of all known formula methods (particularly methods of time periods) and of the average cutting increment as a cutting regulation index. This index is particularly thoroughly analysed as to the conditions of its applicability, advantages, and shortcomings. Some consideration is also given to the indices of the orientation to extended reproduction (the Mélard method, and the index of 1/20 of stand reserves of the last age class, now broadly used in Czechoslovakia).

The last part of the theoretical part of "Forest Management" is devoted to the economic and management planning of forests (by Prof. Doležal). The chapter presents a scheme of management planning, divided to basic planning (for a working plan unit or for a working circle), planning within permanent forest division units (permanent subcompartment), and detailed planning for decades. These three kinds of planning are described in detail. In relation to planning, there is a treatise on the typification of forest stands, both biocenological and economic. The problems of the use of forest typology for the establishing of economic groups of forest types and current economic stand groups are also analysed as to their utilization within the framework of forest management. There is also a detailed consideration of the methods of the differentiation of current stand groups, defined as sets of stands characterized by equal operational and production conditions, by equal stand structure, equal condition of stands, attainable goals, and method of operation. Some special typifications of forest stands are also described (in forest protection, in the concentration of wood, transport typification).

The practical portion of forest management (the elaboration of a forest management plan) is worked out by Prof. Priesol, and the chapter on forest management based on approved forest management plans is prepared by Prof. Doležal. The components and all things pertinent to plans as well as the individual procedures of the elaboration of a forest management plan are described. First, there is a consideration of survey and measurement procedures (the division of forest, measuring and mapping work, the description of stands with detailed operational planning, and the determination of the volumes of stands). The description of this work and these procedures is based on the up-to-date development and on the present state

of Czechoslovak forest management practice. The chapter on the measuring methods includes a detailed description of modern photogrammetric techniques of mapping introduced and used by Czechoslovak institutes for forest management. These techniques are treated also in a chapter on forest-survey evaluation of air survey photographs used for various inventory purposes. Then there is a consideration of the work involved in the elaboration of the parts of forest management plan: the drawing-up of various kinds of forest maps, areal tables, management registers, methods of the derivation of allowable cut both for harvest and intermediate cutting, general description of natural and economic conditions, principles of future ways of forest management, and the drawing up of concluding tables, of numeric surveys, and of the graphs of the forest management plans.

The subject-matter of forest management is treated in the book in a manner corresponding to the present level of scientific knowledge and with the development of modern forest management practices. In an exhaustive manner, the book describes and evaluates the results of Czechoslovak and foreign research made in recent years. Czechoslovak forest management of post-war years has reached a good international level, which is the merit of scientific and research workers as well as of practical forest management workers. The new textbook is a good example and evidence of the level of Czechoslovak forest management.

Although the main purpose of the book is to serve as a textbook for students, it is also a valuable aid for the workers of forestry practice (both in forest management and in forest operations). The subject-matter of forest management is treated with respect to the present state of management practice involving all present Czechoslovak technological procedures of the work of forest management institutes.

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EINE NEUERSCHEINUNG

GRUNDZÜGE DER WALDHYGIENE WEGE ZUR ÖKOLOGISCHEN REGELUNG

Ein Leitfaden von Dipl. — Ing. Dr. ERWIN SCHIMITSCHEK, o. Professor em. der Universität Göttingen

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Aufgabe der Waldhygiene ist es, Erkrankungen des Waldes, vor allem Massenauf-treten schädlicher Insekten, vorzubeugen sowie die Gesundheit und Intaktheit der Lebensgemeinschaft Wald zu fördern und zu sichern. Es ist das besondere Charakteristikum dieses Buches, daß im Mittelpunkt der Erörterung nicht der Erreger, der Schädling, steht, sondern der Patient: der Wald. Weshalb konnte er erkranken, wodurch wurde die Befallsbereitschaft ausgelöst und wie kann sie ausgeschaltet werden? Das ist die Kernfrage von Schimitscheks Buch, die noch nie so ausschließ-lich und umfassend behandelt worden ist wie hier. An Hand einer Fülle von Beispielen werden besonders falsche Einstellungen des Menschen zur Bewirt-schaftung des Waldes als die entscheidende Ursache schädigender Kulturmaßnahmen nachgewiesen. Zugleich werden die Mittel und Wege aufgezeigt, die geeignet sind, diese Schäden zu verhindern oder zu mildern.

Ein wesentlicher Teil von Schimitscheks Forschungen im In- und Ausland galt Ur-sachen der Befallsbereitschaft, so z. B. standortsfremden Monokulturen, Brandwirt-schaft, Weide, Grundwassersenkung, Bodenverdichtung. Ihnen ist der Hauptteil des Buches gewidmet. Kartierungen des Massenauftritts einiger forstlicher Haupt-schädlinge tragen zur Beurteilung der Befallsbereitschaft standortsfremder Nadel-holzbestände bei. Desgleichen die Ergebnisse langjähriger anatomischer und physio-logischer Untersuchungen an gesunden und an befallsbereiten Nadelbäumen. Auch die durch Großkahlschlagwirtschaft, durch Veränderung des Bestandsklimas, durch Maßnahmen der chemischen Lässerung sowie durch unpflegliche Ernte bedingte Befallsbereitschaft und Befallsförderung sowie die Möglichkeiten, sie zu vermeiden, werden dargelegt. Schließlich wird als wichtiger Teil der Waldhygiene auch die biologische Regelung durch Erhaltung der Schlupfwespen und Raupenfliegen in einer den örtlichen Gegebenheiten entsprechenden Artzusammensetzung und Menge be-handelt, wobei besonderes Augenmerk den hierbei zu beachtenden ökologischen Voraussetzungen gilt.

Erfahrung und Forschung des Verfassers aus mehr als 40 Jahren sowie das ein-schlägige Schrifttum bis in die jüngste Zeit werden in diesem Buch verarbeitet und ausgewertet. Als ökologische Gesamtschau von allgemeiner Gültigkeit spricht es heute, wo der Blick der Öffentlichkeit sich in wachsendem Maße auf die Erhaltung der Reste der natürlichen Landschaft und besonders auch des Waldes richtet, weite Kreise von Interessenten an, und zwar nicht nur Forstwirte und Waldbesitzer, Bio-logen, Ökologen, Zoologen und Pflanzenschützer, sondern auch Vertreter der Raum- und Landesplanung, Wirtschaftswissenschaftler und Studierende aller biologischen Richtungen.

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LESNICTVÍ č. 1/1970

je tematicky zaměřeno na problematiku ekonomiky lesního hospodářství, která v podstatě souvisí se všemi úseky lesnické činnosti. Aktuálnost ekonomické tematiky vyplývá z potřeby zpřesnit vývojové tendence lesnického odvětví, obhájit společenské postavení lesů mezi ostatními odvětvími národního hospodářství, zajistit komplexní rozvoj lesnictví.

Toto tematické číslo Lesnictví je důkazem o připravenosti ekonomů řešit všechny důležité problémy, je výsledkem snahy co nejhluběji vyjádřit současné i perspektivní potřeby odvětví. V jednotlivých příspěvcích je zachycena námětová šíře, v níž se pohybuje současná tematika lesnické ekonomiky: problematika pracovních sil, optimalizace technologických postupů aplikací matematicko-statistických metod, komplexní zhodnocení vývoje odvětví.

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Lesnictví č. 1/1970 bude zajímat nejen ekonomy na vědeckých pracovištích, ale i ekonomické pracovníky v provozní praxi.

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