

THE MONTANE GRASSLANDS (*PATANAS*) OF CEYLON

AN ECOLOGICAL STUDY WITH REFERENCE TO AFFORESTATION—IV

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PART IV.

PATANA AFFORESTATION AND NATURAL SUCCESSION IN PATANA PLANTATIONS

GENERAL.—The earliest recorded afforestation of the patanas dates from 1890 but actual systematic large-scale afforestation appears to have started in about 1922, and continued fairly regularly up to the present time. The peak development of afforestation was reached in 1939 when, on the instructions of Honourable the Minister for Agriculture and Lands, blocks amounting to 467 acres were taken up in one year for afforestation in Errebedde (or Erabodde) formerly a military reserve. Since 1939, patana afforestation especially of dry patana in Errebedde has been continued but on a gradually decreasing scale. The reason for this curtailment is the unavailability of suitable patana land; most of the land mapped out (5) for the Forest Department has been rocky, steep, inaccessible land.

The total patana afforested in the montane zone is now approximately 3,000 acres, as against a total of approximately 5,000 acres of reforested montane forest felled and planted with exotics. The largest afforestation centre has been in the Errebedde dry patanas where approximately 1,300 acres have been planted to-date. Other afforestation centres are Pattipola-Ambawela, Conical Hill and Ohiya proposed forest reserves in the wet patana zone, Kinigama, Bandarawela and Ella plantations in the dry patana zone.

Species and Planting Technique.—Patana afforestation prior to 1939 was mainly confined to the dry and intermediate patana zone; a great variety of species was used which included a number of the Eucalypts chiefly *Eucalyptus robusta* Smith, *Callitris calcarata* R.Br., *C. glauca* R.Br., in the dry patana, and *Cupressus macrocarpa* Hartweg. in the intermediate patana of Ohiya. Since 1939, *Eucalyptus robusta* has been used also exclusively for wet patana afforestation and with a small proportion of *E. saligna* Smith, *E. microcorys* F.V.M., *E. maculata* Hook. and *E. citriodora* Hook., in the dry patana zone. The technique adopted in afforestation consisted very simply of removal of the grass cover in "clean-weeding" (sometimes accompanied by burning) and holing to a standard depth of two feet (in earlier plantations, an 18-inch

depth was adopted) at a planting distance usually 6 feet by 6 feet. A refinement introduced at a later stage consisted in piling the grasses contourwise to minimize erosion; otherwise the technique has remained little unaltered. The holes are filled in with surface soil free of weeds or gravel and basket plants raised in nurseries were generally used, the planting done with the commencement of the north-east monsoonal rains in October or November. In recent years, the south-west monsoonal planting season has been adopted for the wet patana afforestation. The planted areas are fenced for 3–5 years, for protection chiefly against cattle damage. Prior to 1935, the practice of clean-weeding was carried out continuously and intensively for a period of as much as 8 years, though the average was generally 4 to 5 years. The Kinigama plantation (near Bandarawela) is a glaring example where this practice was carried out to an extreme measure in predominantly *Callitris* plantations and has caused severe erosion resulting in a shallow truncated soil profile with boulders and rock fragments lying thickly strewn on the ground, and deep gully formation. Weeding trials were conducted by the Silviculturist over a period of years, the results of which have been published (35).

RESULTS OF PATANA AFFORESTATION

I. *The Wet Patanas*.—Afforestation of the wet patanas dates only from 1937, so that it is yet too premature to judge the results. However, at elevations between 5,800 and 6,300 feet, in Pattipola-Ambawela and Conical Hill patanas, the condition of the present plantations is not promising. The results of experimental planting are contained in the Administration Report of the Silviculturist for 1942, which suggests *Eucalyptus robusta* exclusively for patana afforestation with a wider espacement of 12 feet by 12 feet. Cypress (*C. macrocarpa*) and the timber gum species *Eucalyptus microcorys*, *E. citriodora* and *E. maculata* have not proved suitable. The choice of site appears to be a very important factor. In sites, especially the crests of hills, highly exposed to the severe south-west monsoonal winds experienced both at Conical Hill and Pattipola-Ambawela, the growth of *E. robusta* has been seriously retarded and the general condition of the plants is unhealthy; furrowed, cracked, prematurely thick bark, the red mottling of the leaves and the severe twisting of the stem with only small undeveloped crowns, all point to the habitat being unsuitable for this species. In a 6-year old plantation at Conical Hill, the average height growth is scarcely 5 feet. The heavy, sodden, deep, peaty humic layer which is as much as 18 inches thick, is also an important factor which contributes to the stunted growth. In actual swamps at Pattipola, *E. robusta* has failed miserably. In sites comparatively sheltered from the south-west winds, e.g., where they are closely surrounded by forest or plantation, more promising results have been obtained. Here, 1937 experimental plantations have shown (in 1945), an average height growth of about 30 feet, in spite of the fact that soil conditions are almost similar to those in exposed sites. The 1938 and 1939 plantations in the same localities also show comparatively good results.

At lower elevations, in the Bopatalawa-Bogowantalawa patanas between 5,100 and 5,300 feet, planting of wind-belts undertaken for the Department of Agriculture has proved to be more successful. Here, plantations of 1942 already show (in 1945) an average height of about 15–18 feet with a correspondingly healthier appearance and better crown development.



Fig. 18.—A distant view of savannah forest near Wellawaya, 2,000 feet. The forest consists of stunted scattered trees of mainly *Careya arborea* and *Phyllanthus emblica* with an understorey of tall grasses, chiefly *mana*.



Fig. 19.—A view of the Errebedde dry patana plantations. In the foreground is part of the 1939 plantation of mainly *Eucalyptus robusta*. In the background are the 1935-36 plantations of *Eucalyptus* and *Callitris* spp.

Poorer growth here seems conditioned more by shallow soils associated with rocky, steep slopes. This is one more proof of the wet patana type occurring here being less moist than at higher elevations and having features in common with the dry patana. This is accounted for by a lower rainfall during the south-west monsoon as compared with the higher elevation wet patanas (*vide* Plate 3, fig 1. Curve 3—Holmwood) and comparatively less severe winds during this monsoon.

Large-scale planting has not been attempted in the wet patana zone, both on account of the difficulty of finding suitable sites and because of the poor results which have been so far experienced. 15 acres has been the maximum planted in any one year.

II. *The Dry Patanas*.—The earlier large-scale plantations in the dry patana zone commencing from about 1917 were situated at Bandarawela and later from 1922 at Ella and from 1923 at Kinigama, all within a 7-mile radius of the town of Bandarawela. It is interesting to record that two indigenous species, *sapu*—*Michelia Champaca* and *lunumidella*—*Melia composita* Willd. were originally suggested for afforestation at Ella but the idea was abandoned as sufficient seed was not available. The earlier plantations at Bandarawela and Ella consisted almost entirely of *Eucalyptus robusta*. Later, *Acacia decurrens* Willd., *E. rostrata* Schlecht. and *Cupressus macrocarpa* were introduced to fill in vacancies in the original planting. At Kinigama, the original planting mixture consisted of approximately 50 per cent. *Cupressus macrocarpa*, 25 per cent. *Callitris calcarata* and 25 per cent. *E. rostrata* and *E. citriodora*. *Cupressus macrocarpa* and *E. rostrata* gave poor results and since 1929 a heterogeneous mixture of species was tried out which included approximately 50 per cent. *Callitris calcarata* and *glauca* and the rest an odd assortment which included *Grevillea robusta* A. Cunn., *C. macrocarpa*, *E. citriodora*, *E. maculata*, *E. tereticornis* Smith, *E. microcorys*, *Widdringtonia Whytii* Rendle, and *Tristania conferta*. Of these, the *Callitris* species now form the stand, the others being mostly suppressed. *Callitris* has proved a not unsuitable species as regards growth and from the point of view of providing a good canopy cover for the soil. However, excessive clean-weeding in these plantations has resulted in such severe erosion that growth has now become relatively stagnant; some of the trees show die-back and the thick root-mat produced by the surface roots of the *Callitris* which is a very shallow rooted species, combined with the thick canopy, have prevented an invasion of herbaceous or shrub growth necessary to cover the soil. Further, the susceptibility of *Callitris* to fire has also resulted in the destruction of fairly extensive areas planted with this species; these earlier burnt plantations now contain only a few isolated *Callitris* trees.

Experimental work at Kinigama and Errebedde, on plantation mixtures has been conducted since 1936. The results which are contained in the Administration Report of the Silviculturist for 1942, indicate that a mixture of *E. robusta* and *Callitris calcarata* in equal proportions is the most suitable, the latter forming a good understorey and permitting the more rapid growth of the former. Since 1939, however, *E. robusta* has been favoured as the chief species in dry patana planting, with small proportions of *E. saligna*, *E. microcorys*, *E. citriodora*, and *E. maculata*, these timber gum species being planted in selected sites. Of these, *E. saligna* and *E. microcorys* have shown

the best results, the former, especially, if limited to the valley bottom sites and lower slopes where moisture conditions are obviously better. Here it overtops the *E. robusta*. Growth in the dry patana plantations is very variable, and a young plantation of 2–6 years usually shows a shading off in growth from an optimum in the lower moist sites to a minimum in the upper rocky sites and sites of poorer soil. This differentiation in growth is seen especially in *E. robusta*. In the 1939 plantations at Errebedde, for example, the maximum height growth (in 1945) is about 50 feet, and the minimum about 5 feet with all degrees of growth between these two limits. A thinnings programme is already current in the better sites of the 1939 plantations at Errebedde, Kinigama and Ella.

III. *The Intermediate Patana*.—Large-scale planting in the intermediate patana zone has been mainly confined to Ohiya proposed forest reserve. Since 1923, fairly extensive tracts of patana, mostly in between forest in the valley of the Ohiya oya were afforested with mainly cypress (*C. macrocarpa*). *Cedrela serrata* Royle and *E. rostrata* were used in small proportions, but these species are practically non-existent to-day. Since 1939, *E. robusta* has been used as the principal species in afforestation with small proportions of *E. saligna*, *E. microcorys* (and *E. citridora* and cypress in the 1939 plantation only). The earlier cypress plantations have been fairly successful and are now practically indistinguishable from the adjoining cypress plantations in reafforested, originally natural forest areas. The Eucalyptus species, especially *E. robusta* and *E. saligna* also hold out good promise of success. As in the dry patanas, the degree of growth is conditioned by the moisture content and the same gradation from good growth on the lower slopes to poor growth on the steep, rocky ridges, is found. The recent Ohiya plantations generally show better average growth and a healthier appearance than those of the corresponding ages in the dry patanas.

The best results in patana afforestation has been obtained at Diyatāwā, which may also be regarded as in the intermediate type of patana but drier than Ohiya, where catchment areas were planted on behalf of the Department of Public Works in 1941 and 1943 with *E. robusta*, *E. saligna* and *E. microcorys*. Here the growth has been spectacular and already in 1945 an average height of about 35–40 feet has been attained in the 1941 plantations which are now being systematically thinned.

SILVICULTURAL RESEARCH IN PATANA PLANTATIONS

Apart from silvicultural research on the ideal plantation mixtures, since 1939, experimental work especially in the dry patanas has been concerned with other important investigations conducted under the direction and initiative of the Silviculturist :—

- (1) the determination of the effect of depth of holding on the growth of *Eucalyptus* spp.,
- (2) the conversion of old *Callitris* stands in Kinigama with control of erosion,
- (3) Silvicultural garden trials with indigenous tree species,
- (4) observations on the growth and regeneration of indigenous tree species under a canopy of *E. robusta* (described under the head "Colonization and Natural Succession in Patana Plantations").



Fig. 20.—A portion of the 1939 Errebedde dry patana plantations showing a patch of the poorest growth of *Eucalyptus robusta*.



Fig. 21.—Another portion of the 1939 Errebedde dry patana plantations showing a patch of the best growth. The tallest trees here are *E. saligna* which show a maximum height growth of about 50 feet. The shrub species to be observed to the right of the figure is *Microglossa zeylanica*.

It is yet premature to draw definite conclusions from these experiments and observations. It is of interest, however, to record the progress made and to surmise the probabilities of the final results.

(1) *Relation of Holing Depth to Growth.*—The standard holing depth now adopted in departmental dry patana afforestation is 2 feet; as the expenditure incurred in holing to this depth is considerable, an experiment was laid out in 1941 with holes of 6, 12, 18 and 24 inches in depth in the standard manner, using basket plants of *E. robusta*, *E. microcorys* and *E. citridora*. Observations were also carried out by the writer on the development of the root system of *E. robusta* by uprooting average plants. Results indicate that although there are yet no salient differences in the height growth, shallower holing appears connected with relative poor development of the tap roots and excessively heavy development of the lateral roots; with the deeper holing, root development was more normal, tap roots being deep and well developed. It is probable that the initial abnormal root development of the plants in shallower holes will correct itself with time. However, so long as growth appears to be unretarded by shallower depth of holes, there would appear to be no silvicultural disadvantage in using shallower holes with consequent saving of expenditure. The experiment is being repeated again in 1944, on a site which gives a wider range of slope and, therefore, soils. In the writer's opinion, so long as the gravelly B horizon is penetrated by holing, it affords the roots greater scope for development. The depth of holing should, therefore, be adapted to the depth and thickness of the B horizon.

(2) *Conversion of Old Callitris Stands and Control of Erosion.*—Reference has already been made to the *Callitris* plantations in Kinigama, dating from 1923 and covering an extent of about 400 acres, in which excessive weeding has caused severe and persistent erosion. These heavily eroded areas present a serious problem as the land is rapidly becoming degraded and useless. The early control of erosion, and, if possible, amelioration of the soil conditions are of urgent consideration. From 1939, various methods on an experimental scale were attempted to control erosion including contour trenching and planting of possible cover crops such as *Centrosema Plumieri* and *pubescens*, *Clitoria cajanifolia* and *Leucaena glauca*, species suggested by the Soil Conservation Officer of the Department of Agriculture in 1938. As these offered little promise of success, on the advice of the Soil Conservation Officer in 1941, *Sansevieria thyrsifolia* with three other species selected by the Silviculturist, viz., *Dodonaea viscosa*, *Tithonia diversifolia* and *Agave americana*, were tried out in contour trenches 2 feet deep with coir dust to provide a manurial base. These experiments have also met with only meagre success.

Apart from the degradation of the soil, the *Callitris* being mostly stunted, heavily branched and showing signs of die-back, also presents a further problem as to whether these stands could be converted into one of a more useful and economic species. This aspect was secondary and subordinate to the question of soil-conservation. Since 1941, a more drastic solution to the problem has been attempted on a small scale, viz., the removal of the *Callitris* stand by clearfelling, and control of erosion by contour brushwood terraces erected, at first, 20 feet apart, later 12 feet apart, the brushwood, branches and logs of the felled *Callitris* being utilized for this purpose;

The plots were originally fenced with wire-netting against damage by hare, and planted with *E. robusta* basket plants in the usual way. The results have been spectacular. The *E. robusta* has shown rapid growth, even more than in the best dry patana plantations of the same years and growth still continues to be vigorous. The bare bouldery soil was rapidly covered with an invasion of pioneer grasses such as *Chrysopogon zeylanicus*, and weeds, chiefly *Gynura* spp. ; later, hardy composite perennials and shrubs such as *Osbeckia octandra* began to appear. With the development of the *E. robusta* and gradual closure of the canopy, the weed growth is now dying out. Another remarkable feature is the appearance of prolific *Callitris* natural regeneration which has now grown rapidly over the plots. The initial results have been so promising in solving both the erosion and conversion problems, that experiments are being continued on a larger scale with modifications. The amazing growth of *E. robusta* can only be explained by (a) the shelter from winds afforded by the surrounding existing plantation, (b) the easily accessible nutrients afforded by decaying *Callitris* roots. Whether the *E. robusta* will continue to grow successfully or reach a stage where rapid die-back will set in, is a question which has to be faced.

(3) *Silvicultural Garden Trials with Indigenous Species*.—Departmental policy aims at the ultimate conversion, as far as possible, of plantations of exotic species to stands of indigenous species. This is in keeping with the Government regulations prohibiting the clearing of natural forest above 5,000 feet elevation. With this end in view, silvicultural research has recently been directed into collecting systematic information on the regeneration and growth of indigenous tree species. Whether it will be possible to eventually convert all patana plantations to natural forest or plantations of indigenous tree species is a moot point. Early (1939) small-scale experimental under-planting of *sapu* (*Michelia Champaca*) and *mahogany* (*Swietenia macrophylla* King) under an *E. robusta* overwood gave encouraging results for *sapu*. *Jak* (*Artocarpus integrifolia*, Linn.) has also been experimentally grown with *E. robusta* and *E. saligna* in two small plots in specially selected sites in the 1939 plantation at Errebedde. This species is suppressed by the Eucalyptus, and, provided early thinnings are undertaken to favour the jak, some measure of success can be achieved. These experimental trials indicate that, jak, although unsuitable as a species for general planting, may be worth considering on a small scale.

Since 1942, a series of silvicultural experimental garden trials have been conducted in the dry patana plantation centre of Errebedde, in which a number of indigenous tree species, especially of local occurrence in the small riparian belts of natural forest or village gardens, are being favoured. Of these may be mentioned, *sapu*—*Michelia Champaca*, *kududaula*—*Neolitsea involucrata*, *diya-damba*—*Syzygium nervosum*, *beriya*—*Litsea* sp., *tel-kekuna*—*Aleurites triloba* Forst., *jak* and *Albizzia moluccana* Miq. (a shade tree locally favoured in tea estates) and among others from the Dry Zone proper, *margosa*—*Azadirachta indica* A. Juss., *mi*—*Madhuca longifolia* Macbr., *suriya-mara*—*Albizzia odoratissima* Benth., and *madan*—*Syzygium cumini* Skeels. The recent experimental work has demonstrated that, especially in the open, species such as *sapu*, *tel-kekuna*, *kududaula* and *Albizzia moluccana* show

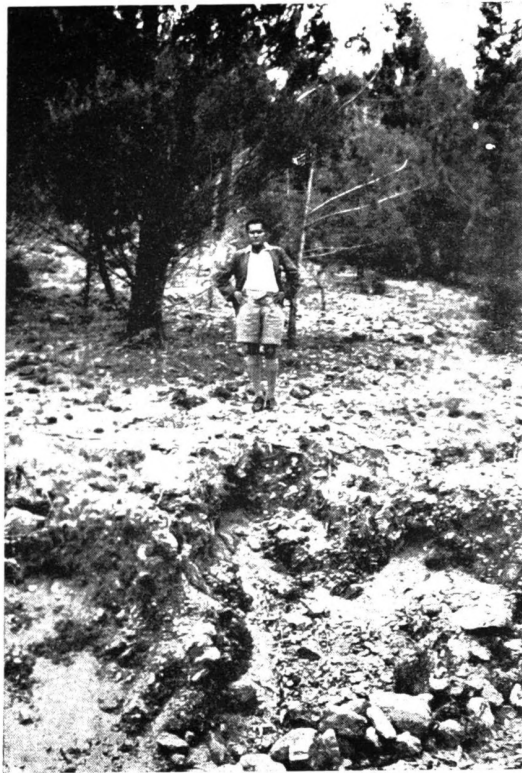


Fig. 22.—A portion of Kinigama dry patana plantations (3,800 feet) of mainly *Callitris* species planted about 1926 showing heavy erosion and absence of soil cover.



Fig. 23.—A similar example of *Callitris* plantation after clearfelling *Callitris*, erecting brushwood terraces and replanting with *Eucalyptus robusta*. This plot of less than one year old already shows promising growth of *Eucalyptus*. Colonization of pioneer grasses and herbs is already to be observed.

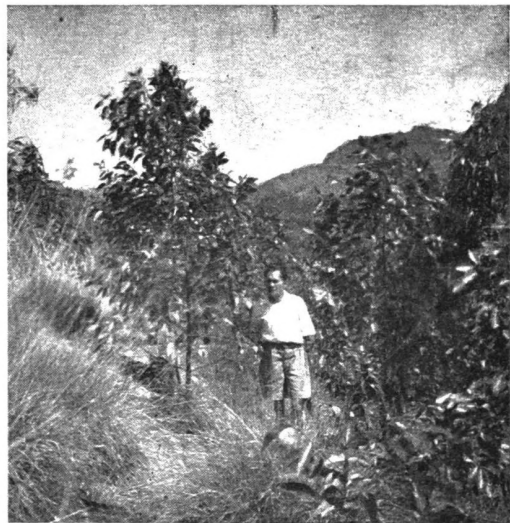


Fig. 24.—A 3-year old stand of *Eucalyptus robusta* planted on a clearfelled *Callitris* area. The growth of the *Eucalyptus* here is phenomenal.

growth and development which compare favourably with exotics. These experiments will be carried a stage further, which includes larger plot trials, before large-scale planting of indigenous tree species can be undertaken.

COLONIZATION AND NATURAL SUCCESSION IN PATANA PLANTATIONS

Some of the earlier dry patana plantations have already provided an opportunity for studying the colonization by indigenous tree species under a plantation canopy. This colonization is not widespread, but so far seems restricted to the better conditions of soil and site normally prevailing within the transition zone of the shrub—*mana*—bracken community and now further improved by the presence of an overhead cover. The progress of colonization, appears, however, to be impeded if the plantation consists of or includes the *Callitris* species or cypress (*Cupressus macrocarpa*) in its composition. This may be attributed to the dense canopy, characteristic of these species, which probably makes light conditions limiting. It is also probable that the acid soil cover of *Callitris* and cypress needles provides unsuitable ground for the establishment of invasive indigenous species. The excessive weeding commonly associated with plantations of these conifers have resulted in badly eroded soils, from their nature unfavourable to the colonization of tree species. The removal of *Callitris*, as described earlier, is, however, followed by the invasion of pioneer grass, herbaceous and shrub species of the original patana flora, which later disappear when the overhead canopy of introduced *Eucalyptus robusta* closes.

The wet patana plantations are comparatively recent (from 1937) and, apart from the reappearance of natural patana species of grasses, herbs and shrubs, it is yet too early to say whether the succession of tree species will follow. This, however, appears unlikely, as the unfavourable soil conditions of excessive humidity, will probably be limiting to the growth of indigenous tree species.

Succession.—In the dry patana plantations, the appearance of indigenous tree species was observed and recorded by the Silviculturist round about 1935–36 in Kinigama under a canopy of *E. robusta* planted in 1928–30. This invasion has now covered, at a rough estimate, about 50 acres of plantation on the lower slopes where growth of *E. robusta* has also been the best in the plantation. These are undoubtedly sites where original moisture and soil conditions were comparatively good. The plantation has contributed to the further improvement of the site conditions by increasing the humus content of the soil by leaf-fall and thereby increasing the moisture-retaining capacity of the soil. The overhead cover also protects the soil from excessive evaporation and also affords protection against the severe south-west monsoonal drying winds. Thus, favourable conditions have been created which cannot exist on bare patana and are naturally predisposing to the growth of tree species.

The earliest pioneer tree colonizer is probably the *beriya*, a large leaved *Litsea* sp. (species unidentified by the Department of Agriculture although flowering specimens were provided) followed by other *Litsea* spp., *kududaula*—*Neolitsea involucrata* and *nikadaula*—*Litsea* sp. and occasionally *Cinnamomum multiflorum* Wight and *C. zeylanicum* Bl. also belonging to the *Lauraceae*, a family almost entirely endemic and characteristic of the montane

zone. Other tree species which are observed are *bombu*—*Symplocos spicata* Roxb. and *lunuwarella*—*Schefflera Wallichiana* Harms. At a later stage, some young regeneration of *sapu*—*Michelia Champaca* has been observed. These are with the exception of *sapu*, all endemic species found in the natural riparian forests of the dry patana at Kinigama. They are also found either cultivated or natural in village gardens. The *sapu* is considered by Trimen (Handbook of the Flora of Ceylon, Vol I. pg. 15) as “an ancient introduction to Ceylon, much cultivated, but nowhere natural”. These tree species except *sapu*, all have berries or drupaceous or other fleshy fruits which are dispersed by birds. The *sapu* has seeds with a thick outer pulp also dispersed by birds. This mode of dispersal appears to be intimately correlated with the colonization of these species. The proximity of the areas where such colonization is observed, to villages, is also a significant fact, as the crow, a bird found in abundance around villages, is also mainly responsible for the dispersal of these tree species, the branches of the *Eucalyptus robusta* providing it with convenient resting places.

The earlier successional stages have also been observed in Errebedde in the 1935 plantation on similar sites. Here invasion of the same species is observed, *kududawla* and *beriya* being the most frequent. This invasion is yet restricted to isolated individuals or groups seldom forming a dense understorey. In Kinigama, succession is so far advanced that the indigenous species have now formed a dense understorey dominated by *beriya* which has (in 1945) reached a height of about 25 feet.

The Control of Kekilla (Gleichenia linearis).—In the same plantations at Kinigama, natural colonization of indigenous species is to a great extent retarded by the spread of the fern, *Gleichenia linearis* (*kekilla*), which is naturally found in ravines where conditions are marshy. From these moister sites, it has gradually invaded the plantation and is very dense on the lower slopes. No successful method had been known of combating this menace. In 1944, it was observed, that following an accidental fire in a typically *kekilla* covered ravine, profuse *Eucalyptus robusta* natural regeneration appeared after the north-east monsoonal rains in November. In February, 1945, this regeneration had completely overtopped the *kekilla*, killing it out and literally forming a thick carpet. This is probably the first recorded instance of natural regeneration of this species in Ceylon. The dense clumps of regeneration have been thinned out as close spacing made the plants weak and spindly. This observation is of importance as suggesting a means for the control of *kekilla*, and which will be tried out experimentally in other *kekilla* infested localities.

Silvicultural Research on Succession.—With the increase in the colonization of indigenous tree species under a plantation canopy of *E. robusta*, the possibility of accelerating succession to a natural forest climax was visualized; research plots with transects were laid out to study colonization and growth of indigenous tree species in the best sites simultaneously with the removal of the *E. robusta* overwood. This removal has been done in steps since 1941, the coppice regrowth of the gums being killed off. Some damage to the understorey was unavoidable in the initial removal of the overwood and, after a period of recovery, the indigenous *Litsea* tree species have shown, fairly rapid growth, but new regeneration has been negligible. The dense



Fig. 25.—Natural succession of indigeneous tree species under a canopy of *Eucalyptus robusta* (1928-30) in Kinigama dry patana plantations. The predominant species here is *beriya*—*Litsea* sp. (Photo. taken in 1943).

Fig. 26.—Six months old natural regeneration of *Eucalyptus robusta* in Kinigama plantations following an accidental burn of *Gleichenia linearis* in a ravine covered with this species.



growth of the *beriya* appears to effectively prevent the invasion of more desirable tree species like *sapu*. Thinnings in the understorey are necessary at this stage accompanied by the complete removal of the remaining overwood.

CONCLUSIONS

The results of patana afforestation, especially in the dry and intermediate patanas, have shown, that given favourable sites, successful patana plantations of exotics can be grown; there is every reason to expect that in the course of time, the growth of indigenous tree species will be obtained by natural regeneration assisted, as necessary, by artificial means, on suitable sites. On poor sites where the plantations of exotics consist of unhealthy, stunted trees, it is unlikely that they will serve any useful purpose except as fuel.

For successful patana afforestation, careful selection of site is necessary. Afforestation has, however, to be confined to blocks mapped out for this purpose (5). In recent mapping out, such blocks are usually the inaccessible crests, ridges and steep rocky slopes of the patanas, the more suitable land being allotted to other purposes such as village expansion and middle-class colonization. While admitting that the needs of the local population are paramount, it must also be realized that successful plantations cannot generally be raised on sites unsuitable for any other purpose.

One of the objects of patana afforestation is to provide wind-belts to afford some means of protection against the severe south-west monsoonal winds which is a factor to be reckoned with in local agriculture and farming. Plantations so far established have fulfilled this object to an appreciable extent, at the same time affording a new and inexhaustible source of supply of fuel and small timber to the surrounding villages. The 1939 plantations at Errebedde have already proved their value in this respect in meeting the demands not only of the surrounding villages but also of important towns such as Welimada and Bandarawela which are also beginning to draw on these sources of supply.

Patana afforestation must therefore be regarded as a scheme which is worth developing in the interests of the country, and also as providing a satisfactory means of economic use of patana. It is unlikely that large extents of land mapped out for middle class colonization and village expansion, particularly the former, will ever be completely and properly utilized. The natural desire to possess land for its own sake has resulted in a scramble for patana land, but such allocation will be of no use to the country unless followed up by intensive development of the land. The writer advises revision of mapping-out to provide suitable land for further large-scale afforestation in conjunction with the needs of the population. The scarcity of fuel which is a factor impeding progress and development in the dry patana zone, can be satisfactorily solved only by the extension of the patana afforestation scheme to areas where this need has to be met.

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