

FOREST POCKET BOOK

FOR THE

CENTRAL PROVINCES

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CENTRAL PROVINCES



NAGPUR :
PRINTED AT THE GOVERNMENT PRESS
1926

FOREWORD.

This pocket book was compiled to meet the demand for a small compendium of useful forest information applicable to the Central Provinces.

I wish to thank the compilers of the U. P. Forest Pocket Book for permission to reproduce some of their tables and the various forest officers of this and other provinces who supplied figures and information, particularly Mr. D. O. Witt, I.F.S., Mr. C. A. Malcolm, I.F.S. and Mr. C. M. Harlow, I.F.S.

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Sylviculturist, C. P.

October 1925.

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CHAPTER I.

SYLVICULTURAL NOTES ON SPECIES OF IMPORTANCE.

Tectona grandis (teak, sagun, sagwan, sag).

Nat. order—*Verbenacæ*.

Sapwood whitish, heartwood yellow to dark brown. Wood does not warp. Crushed leaf gives red stain (useful in seedling identification). Average bark thickness $\frac{1}{4}$ ". Maximum height at maturity varies from about 30' to 120' in Central Provinces according to quality of locality, etc. Rainfall requirements not exacting but where rainfall is less than 50" per annum it begins to suffer markedly. Withstands slight frost only, seedlings and coppice shoots being sensitive. Demands good drainage and soil aeration—hence found mainly on slopes and in pure patches on old cultivation. Optimum soil a well drained alluvium. Essentially a light demander and fire resister, it must have a free overhead space to produce straight stems at maturity. Responds rapidly

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to thinning if not left too long. Closes up after heavy thinning in five years. Height growth immediately affected by hard subsoil and incomplete disintegration of rock e.g., metamorphosed sandstone and quartzite. Trap soil is most favourable to teak but is rarely deep enough to give it full expression while laterite is unfavourable and hard quartzite inimical. Poorness of C. P. teak due to past mutilation as well as to drought and other adverse conditions. Very good coppice known to coppice for at least three generations vigorously. Root system of coppice shoots eventually becomes independent. Leaves fall November-February in Central Provinces. New leaves appear in June. Drought delays new leaf-flush. Flowers about July-September. Fruits mature December-January and fall gradually. Fruit 0.4" to 0.6" diam. containing 1 to 3 seeds. Seeds for storage should be winnowed free of husks by rubbing. Seed fertile from trees more than 20 years old. Seed may remain dormant for years. Seedling very sensitive to drought, any shade, whip, and drip. Established teak withstands grazing better than most of its associates. Defoliation common in C. P. (*Pyrausta Machaeralis* also skeletonizes the leaves). A mildew (*Uncinula tectonae* Salmon) causes leaves to go bluish. For best coppice results cut just before leaves appear. If felling later than this cut higher to allow for dying back.

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Shorea robusta (sal, sarai, rinjal).

Nat. order—*Dipterocarpaceae*.

Sapwood small and pale, heartwood brown, hard, cross-grained, durable and very slow to season. The resin is white. Bark thickness of mature trees 1" to 2". Seedlings of first year have opposite leaves. Maximum height at maturity in Central Provinces varies from 30' to 130' according to locality-quality. Main requirement is sufficient moisture (survival of the seedling through one hot weather being the critical factor). Minimum rainfall about 40". No maximum in Central Provinces and distribution localised. The tree is frost tender but is even more susceptible to drought. Sal avoids swamps as soil aeration is essential. The optimum soil is a well drained loam, moist and sandy, with good subsoil drainage. Physical properties of soil of more importance than chemical for sal. Sal avoids "trap" soil (cf. teak), except where broken up and mixed with decomposed laterite. Can stand a high proportion of iron in the soil. Sal is essentially gregarious on account largely of the definiteness of its requirements and is eminently suitable for high forest treatment. Even aged stands appear to be due to the successive occurrence of years with suitable conditions. It is associated usually with grass lands as small blanks or large savannahs. Leaf fall begins about February in Central Provinces. New leaves then

appear (turn shining red to green). Early defoliation induces earlier appearance of new leaves. Flowers appear February—whitish blossom. Fruit falls in June. Drought, e.g., late rains, is the chief cause of seedling mortality. "Dying back" is a familiar phenomenon. Food is stored in the thick tap root. The last seeds to fall are the biggest and have the best chance of germination under ordinary conditions. The size of the parent, and whether of seedling or coppice origin, has but little effect on the quality of seeds produced. Can stand moderate shade but responds at once to admission of light. Best development of sal necessitates full overhead light. Coppices well (from trees up to 3' in girth). Dying back of stools in dry localities must be remembered when cutting for coppice. Annual frosting of leading shoots induces rotteness of the stem in the shape, roughly, of an inverted cone. A valuable protection is afforded by a drought-hardy undergrowth and a frost-hardy over-wood. The latter is of little use in a very severe frost. The ideal combination for regeneration is early rains and a good seed year. Burning of the leaf layer is valuable—early burning should wait till this is possible. The new leading shoot of the hot weather must not be sacrificed in a later fire. Soil indicators of sal are *Indigofera* spp. and *Woodfordia floribunda*. Dominant sal reaches about 6' girth in 170 years

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in C. P. quality II to I locality-without thinnings.

Terminalia tomentosa (laurel-wood, saj, saja, ain, sain, sadra).

Nat. order—*Combretaceae*.

Wood dark brown, streaked, hard, strong. Size varies in Central Provinces from 120' maximum height and 8'-9' girth to 30' maximum height according to locality. A very good "locality-quality" indicator on account of its universal distribution and adaptability. Grows best on deep alluvium or well drained clayey soil. Remains stunted on black cotton soil where, however, it is common. Saj is a typical teak and sal associate. Bad drainage and heavy grazing affect it at once. It seeds well most years, and at first maintains a bushy straggling habit. This continues for several years till a strong leader is produced. Leaves have whitish sheen in some localities. Mortality from grazing heavy in early stages. At first a moderate shade bearer it develops into a decided light demander. Coppice shoots are of very rapid growth. Saj is frequently pollarded for tassar silk production. The bark is used for tanning and the wood makes good charcoal and fuel. Leaves fall about February, new leaves May-June. Flowers May-July. Fruits fall March-May. Fairly low percentage of fertility in seeds.

Anogeissus latifolia (dhawa, dhaora, dhamora, dhaunda).

Nat. order.—*Combretaceae*.

Wood yellowish-white, hard, strong and tough (stands bending). Common in all divisions, typical teak and sal associate. Coppices freely. Seldom sound when large in Central Provinces. Mainly wanted as thin poles. Chief requirement good drainage, accommodating as regards soil but grows best on sandstone or alluvium. The crooked habit of the tree in Central Provinces is due to fire, maltreatment and drought. A marked light demander, not relished by browsing animals. Produces root suckers. It is comparatively frost hardy and is a valuable species for the re-clothing of dry hill sides. Flowers May-July. Fruits November-January. Leaves fall January-February. New leaves May-June. Seedlings cannot compete with weed-growth and spring up after a fire. After establishment (of seedlings) rigid fire protection is required as this is a thin-barked species peculiarly liable to be killed outright by a fire.

Pterocarpus marsupium (kino, bija, bija-sal, bibla).

Nat. order—*Leguminosae*.

Sub. order—*Papilionaceae*.

Heartwood yellowish brown, hard and close grained. Stains yellow when damp. Bark

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gives red gum ("kino" of commerce). Average bark thickness $\frac{1}{2}$ ". Blaze and wrinkled leaf edges useful for identification. Maximum height at maturity varies from 40' to over 110', in Central Provinces. Best development in South Chanda and Bhandara. Prefers well drained moist soil. Far more common in the Central Provinces mixture than usually supposed.

Occurs mainly on hilly and sloping ground. Prefers north aspect. Extensively damaged by lopping and browsing. Seedlings can stand shade but tree requires full light for best development later on. A moderate light demander. Responds rapidly to thinnings even if late.

Common as saplings in all divisions. Should always be encouraged. Comparatively poor coppicer. Leafless only for a short time (April-May). Flowers June-September. Pod ripens December-March (flat with stiff wing and 1 to 2 seeds in centre). Pods fall during hot weather. Seed years frequent but seed fertility percentage fairly low.

Seedlings very frost-tender.

Ougenia dalbergiodes (tinsa, tinas, tiwas, ruthu).

Nat. order—*Leguminosae*.

Sub. order—*Papilionaceae*.

Wood whitish, hard, tough and durable;

close grained and strong, in great request for agricultural purposes. Cut bark gives a red gum used locally as an astringent, fish poison, etc. Grows up to maximum girth of about 5' in Central Provinces and maximum height 70' (Balaghat). Usually present as small crooked tree or coppice shoot (result of merciless maltreatment in the past). A valuable tree and a typical teak associate. Common in all divisions, not exacting. Thrives best on red clayey or alluvial loam. In early stages it can stand shade and is then frost tender and susceptible to drought. Becomes hardier with age and requires free overhead light for best development. Good coppicer, produces root suckers. Requires fire protection and suffers much from grazing and browsing.

Flowers February-April. Fruits April-June. Leaves fall January-February. New leaves April. Good seed years occur at intervals with great mortality among seedlings on the bare ground without protection from the sun. Seedlings readily respond to weeding.

Lagerstroemia parviflora (Iendia, seja, chakrey), senha.

Nat. order—*Lythraceae*.

Wood reddish, hard, tough and elastic. Useful for poles and agricultural implements. Liable to split at centre in large trees and

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often hollow. Fibre sometimes twisted. Typical associate of sal and teak. Excellent coppicer. Maximum height in Central Provinces up to 90' and girth 6'. (A girth of 15' was once recorded in Bori range). Usually present as a small coppice pole in most areas. Leaves and bark rich in tannin. Found in all divisions and on almost all soils commonly. Best development on deep well-drained loam. Avoids water-logged localities. Established trees and coppice shoots are fairly frost-hardy but seedlings are frost-tender. It largely escapes grazing damage; is a light demander, and rapidly recovers from fire and mutilation. The fertility of the seed varies from year to year. Flowers April-June. Fruit ripens December-January, and remains for some time on the tree. Leaves fall February-March. New leaves May-June.

Chloroxylon Swietenia (satin-wood, bhirra, ghiriya).

Nat. order—*Meliaceae*.

Wood hard, yellow, with "satin" lustre. Durable and in demand for agricultural uses. Suitable for cabinet-making, etc. Very thick corky bark frequently damaged by rubbing of deer. Occurs in all divisions (locally). Generally small and crooked but can grow up to height of 60' and girth of 6' in Central Provinces. Has been badly treated in the past in this province (a sapling makes an ideal

cart-axle). Rapidly responds to thinnings. Thrives best on sandy loam with a sandstone sub-soil. A markedly xerophytic type not found where the annual rainfall exceeds 65". Can live on bare, shallow, or rocky soil, avoids stiff or clayey soils. Good drainage essential. It escapes much damage by grazing on account of its unpalatable acid leaf juice. Very frost-tender at all stages. Quickly recovers from fire damage. A strong light demander but seedlings at first require a little protection from the sun. Coppices freely and seeds abundantly every year. The seed soon loses its vitality. Flowers March-April. Fruits May-June. Leaves fall January-February. New leaves in May.

Dalbergia latifolia (blackwood, rosewood, shisham, jitengi).

Nat. order—*Leguminosae*.

Sapwood narrow and yellowish. Heartwood dark purple with black streaks. A valuable wood, very hard, durable, and close grained. Maximum height in Central Provinces is about 70'—80' and girth 6', but sound trees of over 4' girth are rare. Main soil requirement is good drainage. Best growth occurs on deep soil near permanently flowing water. Accommodating as regards rainfall and soil requirements. Sometimes found almost pure on light sandy soil with perfectly drained sub-soil. Root-sucker reproduction good. Frost-tender (more so than *D. sissoo*).

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A moderate light demander which can stand a fair amount of shade when young and responds rapidly to thinnings. Seedlings are affected by drought but mature trees are drought resistant. Less fire resistant than teak and heavy crown fires kill it outright. Produces root suckers and is practically evergreen. Chief cause of death of seedlings is direct sun and drought. Large percentage of seedlings lose their vitality if kept for one year. Moderate grass growth favourable, heavy grass growth harmful to seedlings. Occurs in all divisions. Leaves shed February-March. New leaves April-May. Flowers September. Pods ripen December-April and contain 1 to 3 or even 4 seeds.

Acacia arabica [babul (var. *telia*), bamara].

Nat. order—*Leguminosae*.

Sapwood very large and whitish. Heartwood pink to dark-brown. Hard and durable. A valuable wood for most agricultural purposes. Bark and pods rich in tannin and used as fodder. Gum from bark of local use. Tree of hot dry localities in Central Provinces. Grows up to about 60' in height and 5' in girth in Berar in very good localities. Occurs in all divisions. Three varieties—

- (a) *Telia*.—Bark blackish-brown and slightly cracked, short thorns.
- (b) *Kaoria*.—Bark grey-brown and deeply cracked, long thorns.

(c) *Ramkanta*.—Branches grow out at an acute angle like those of a cypress, stem tall and branches thin.

The wood of *telia* is much superior to that of *kaoria*.

Babul is gregarious in habit and a typical xerophyte of open lands and grazing grounds outside actual forest areas. Thrives on black cotton and alluvial soil, especially near water (e.g., bunds of tanks, etc). Soil for babul must be retentive of water though a very low annual rainfall (20") can be endured. The *telia* variety requires more water than the *kaoria*, and is of faster growth. Annual inundations are favourable to babul growth. Babul is frost-hardy and can grow on saline soils which exclude most other species. Lime in the soil appears harmful. An essentially light demanding species which responds rapidly to thinnings. The tree is never quite leafless. Flowers August-December. Fruit ripens April-May. New leaves appear February-April. In Central Provinces it is a very poor coppicer, sometimes giving a few feathery shoots which die after one season. The annual seeding is fairly regular and the pods are eaten by cattle, goats, etc. Goat-ejected seeds are used in artificial regeneration. The seedlings are frost-tender, strong light demanders, and very liable to damage by fire. The optimum conditions for develop-

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ment are—ample moisture, loose soil, and absence of grass and weeds. In Berar a fungus (*Fomes pappianus*) attacks and renders this species liable to windbreak.

***Hardwickia binata* (anjan).**

Nat. order—*Leguminosae*.

Sub. order—*Caesalpinaceae*.

The hardest and heaviest of Indian timbers. Sapwood narrow and white; heartwood dark brown with purple streaks, close grained, very hard and durable. It is in demand for building, agricultural, and household purposes. Anjan is extensively lopped for cattle fodder. Grows best on granite and limestone formations. Gregarious but stunted in the poor trap areas of Nimar. The tap-root is able to work its way deep into rocky soil. Mature trees are hardy against drought and heat. Seedlings are sensitive to drought. The tree is in leaf in the hot weather when most others are leafless. Small branches and twigs are shed with the leaves. Flowers July-September. Seeds fall May. New leaves April. Good seed years occur every 3 to 5 years. The seed may remain fertile at least 2 years and fresh seed has a high percentage of fertility. Stands shade in early youth, but later becomes a moderate light demander. Suffers much from grazing and fire but possesses great powers of recovery. Whether the value of grass in protecting seedlings from

drought outweighs the harm done by smothering is still a vexed question.

Soymida febrifuga (rohan, soimi).

Nat. order—*Meliaceae*.

Wood dark reddish-brown, durable and useful for building, agricultural, and household purposes. The bark is of medicinal value and ropes are made from the bast fibre. Grows up to maximum height of about of 70' and girth of 5' in the Central Provinces. Common in all divisions in mixed deciduous forest. Adapted to withstand fire and drought but not frost. Rate of growth slow. Becomes almost gregarious by elimination of other species on poor, denuded, calcareous or quartzite soils where even grass is absent. The felty covering of the seeds protects them and functions as a sponge in retaining water after rain. Seedlings cannot compete with weeds. Rohan coppices and produces root-suckers. Pure rohan is the typical remnant of over-grazed forest or otherwise bare and denuded, eroded hill sides. Flowers March-May. Fruits May-June. Leaves fall February-March. New leaves April-May.

Diospyros melanoxylon (tendu, temru, tumri).

Nat. order—*Ebenaceae*.

Wood hard, sapwood white, heartwood irregular and black ("ebony") strong, and durable. Grows up to about 90' in height

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and 6' in girth in Central Provinces. Much maltreated in the past and usually present as small poles. Great power of survival and spreading (especially on old cultivation) by root-suckers. Accommodating as regards soil, best development on metamorphic rock. Can live in dry localities where sal has disappeared. Frost-hardy at all stages, shade bearer till fair height growth is attained when it benefits by more light. Can stand fair amount of drought and escapes grazing and browsing damage. Seedlings are able to struggle through grass. Flowers April-June. Fruit ripens following April-May. Leaves fall April-May. New leaves May-June (coppice shoots and root suckers have deep red new leaves in April-May). Hence never quite leafless. Fertility percentage of fresh seeds very high.

Gmelina arborea (kumher, khamer, sewan, shewan, khursi.

Nat. order—*Verbenaceae*.

Wood greyish or yellowish, close grained, soft and light, durable and strong. Seasons well and is valuable for household and ornamental purposes. Root is medicinal, fruit edible. Responds well to heavy thinning and should always be favoured. Grows up to about 80' in height and 5' in girth in Central Provinces (Bhandara), but is usually

found small or medium sized. Found scattered in all divisions in moister and cooler areas (e.g., northern slopes of hills, etc). Chief requirements are moisture and good drainage. Very susceptible to drought but fairly frost-hardy, especially as a seedling. After the sapling stage it is a marked light demander but is not so intolerant as teak. Fresh seed has a high percentage of fertility, but this is much lowered after one year. The seed rarely germinates, unless covered, for want of sufficient moisture. Flowers February-April. Fruits May-July. Leaves fall February-March. New leaves April-May.

Adina cordifolia (haldu, kaim, kem).

Nat. order—*Rubiaceae*.

Distinguished from *Stephegyne parvifolia* by the heart-shaped leaf. Wood yellow, fairly hard, even-grained and in demand for building, agricultural and household purposes. Grows up to 80' in height and 7' in girth in Central Provinces (e.g., Melghat and Chanda). Bole frequently buttressed and fluted at base. Found rather scattered in all divisions. Favours hill localities with good depth of soil and attains its best development on well-drained ground. Stunted on stiff soil. A typical teak associate. In seedling and early stages it stands moderate shade and requires protection, but after the early sapling stage it becomes a strong light demander. The

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leading shoot of haldu frequently dies as a result of rubbing against an overhead tree. Seedlings are frost-tender—in all other stages the tree is frost-hardy. Suffers excessively from grazing and browsing in spite of good powers of recovery. Impossible to combine grazing with natural regeneration of haldu. Coppices well. Seeds are minute and very few survive. Seedlings frequently spring up on the sides of streams where they have been washed down in the rains. They are very hard to recognise, being small. Later terminal stipules enclosing the bud are reddish. Flowers June-August. Fruits February-May. Leaves fall March-April. New leaves May-June. Only partly deciduous March-April.

Bambusa arundinacea, **thorny bamboo**,
(katang bans).

Nat. order—*Graminae*.

Tribe—*Bambusae*.

“A large densely tufted bamboo, culms 30' to 50', bearing on the lower nodes horizontal almost leafless branches armed with stout recurved spines.” (Witt: Descriptive Botanical List, Northern and Berar Circles.) Not common indigenously in the province but widely planted. Requires moist fertile locality, e.g., alluvial loam. Good drainage essential. Flowers gregariously at intervals of about 32 to 34 years.

This bamboo should not be thinned too heavily on account of the danger of subsequent breaking or bending over of the remaining stems. Should be cut at 1' to 2' from the base. The danger of cutting too high is that the base of the clump becomes a congested mass of rotting stems. The danger of cutting too low lies in the exposure of the base of the clump.

Dendrocalamus strictus (male bamboo, bans, uhadur, waddur).

Nat. order—*Graminae*.

Tribe—*Bambusae*.

“A middle sized tufted bamboo” (Witt). Flowers sporadically and gregariously December-February. Fruits April-May. Leaves fall January-February. New leaves June. Indigenous and common in all divisions, mainly on hilly ground and in valleys in better localities. In dry localities solid stems are in larger proportion. The main requirement is a loose well-drained moist soil.

Young bamboo seedlings should be protected with the utmost rigidity from any grazing.

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List of commoner trees, forest shrubs and climbers
of the Central Provinces.

NOTE.—Trees described as "Timber trees" have useful wood.

Latin names.	Vernacular names.				Natural order.	Remarks.
	Hindi.	Marathi.	Gondi.	Telgu. Korku.		
Saccopetalum tomentosum. (H.F. & Th.)	Kari ...	Homba ...	...	...	Anonaceae.	Common on sandstone. Large tree.
Cochlospermum gossypium. (D. C.)	Gabdi, Ganiar, Galgal.	Gongal, Ganer.	...	Phangra.	Bixaceae	Wood use- less, small tree, com- mon in dry areas.

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.				Natural order.	Remarks.
	Hindi.	Marathi.	Gondi.	Telgu. Korku.		
Flacourtia Ramonichi (L'Herit.)	Kanker ...	K a k a i, Gorghoti, Parekal, Par be- kal.	...	...	Bixaceae	Small tree with thorn- y branch- es.
Shorea ro- busta. (Gaertn.)	Sal, ...	...	Sarei Rin- jal.	...	Dipter o- carpeae.	Large tim- ber tree.
Kydia caly- cina. (Roxb.)	Barga Ba- ranga.	B h o t i, S u f e d - D h a - man.	...	Arang	Malvaceae	Small tree in hilly ground.
Bombax malabar i- cum. (D. C.)	Semal, Semur.	Khatsa- war, Khatsa- weri.	Bargu	...	„	Tall straight tree with prickles.

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Sterculia urens. (Roxb.)	Kulu, Ka- rai, Kur- lu and Karlu.	Karai, Guru, Kuru.	Hu- tum.	...	Tiklai, Tar- kle.	Large tree on any rocky hills. Exudes gum "Ka- tila".
Helicteres Isora. (Linn.)	Maror- phai, Maror- seng.	Murad- sheng.	Aithi, Aith- ni.	...	Karai- bothi.	Large shrub of under- growth on rocky hill sides.
Grewia Ro- thii. (D. C.)	Ghatyari	Gengurua, Kharota, Atariya.	Ban- silli, Kursi, Bar- sala.	...	...	Shrub of under- growth es- pecially in sal forest. Medium sized tim- ber tree.
Grewiatiliac- folia. (Vahl.)	Dhaman	...	...	Bar- ringa.	...	Medium sized tim- ber tree.
Grewia hir- sutia. (Vahl.)	Gengurua	Kharota, Kareta.	Gur- sakri.	...	...	Small shrub of under- growth.

Latin names.	Vernacular names.				Natural order.	Remarks.
	Hindi.	Marathi.	Gondi.	Korku or Telgu.		
Ægle Marmelos. (Correa.)	Bel	...	Maha- ka.	...	Rutaceae	Small thorny greyish tree.
Balanites Rox- burghii. (Planch.)	Hingua n, Hingota.	Hingan ...	...	...	Simarub- aceae.	Small shrubby tree with thorns.
Ailanthus ex- celsa. (Roxb.)	M a h a r u k h, M a h a nim.	Aral ...	...	M a r u k h a.	„	Large tree- wood of little use.
Boswellia serrata. (Roxb.)	S a l a i, Saleh.	Burser- aceae.	Large tree with green flaky bark. Nurse for teak.

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Garuga pinnata. (Roxb.)	Kenkar, Kakar, Ghogar.	Bania, Kakar, Kekda, Kahud, Kekad.	Gur- gu, Ghar- ri.	...	Medium sized tree on hills.
Azadirachta in- dica (A. Juss) or Melia aza- dirachta.	Nim ...	...	...	L i m- bosi.	Large tree not truly indi- genous or wild.
Soymida febrifuga. (A. Juss.)	Rohan, Rohni, Rohani.	Ragat-ro- hoda.	Soi- mi.	...	Medium sized timber tree- especially found in dry localities.
Chloroxylon swietenia. (D. C.)	Bhirra ...	Chiriya, Halad- bera.	...	...	Medium sized timber tree found especi- ally in dry localities.
Celastrus panicu- lata. (Willd.)	Kakun- dan, Mankangni.	Warangul	War- angar.	Pinguel	Large clim- bing shrub.
				C e l a s- traceae.	

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.			Natural order.	Remarks.
	Hindi.	Marathi.	Korku or Telgu.		
Gymnosporia montana. (Beath.)	Fharati, Yekal.	Baikal, Bharati.	...	Celastraceæ.	Tall shrub with thorns.
Elæodendron glaucum. (Pers.)	Jamrassi, Bhutekassi.	Aran, Mimri.	...	"	Small tree.
Zizyphus jujuba. (Lam.)	Ber, Bor	...	Rengâ	Rhamnaceæ.	Small tree or shrub with spines.
Zizyphus Oenoplia. (Mill.)	Makor, Makoya.	Irun, Iruni.	...	"	Common thorny climber.

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Zizyphus xylopyra. (Willd.)	Ghont ..	G h o t i, Ghatbor.	Ghat-tol.	Ghota...	"	Small sbruby tree. A lac tree.
Vitis latifolia. (Roxb.)	Popasvel, R a n d-rakshi.	N a r d e l, Khandvel, Dokarbel. Totam ...	Doto, Im-lora.	...	Vitaceæ (ampelideæ.)	Common climber.
Vitis auriculata. (Roxb.)	Ambatvel	Totam ...	Khatua.	Kumbe-la.	"	Common climber with corky bark.
Schleichera trijuga. (Willd.)	Kusam ...	Kusumb...	...	Baru ...	"	Large timber tree, lactree.
Mangifera indica. (Lim.)	Am ...	Amba ...	Marka	...	Anacardiaceæ.	Large timber tree usually cultivated.
Buchanania latifolia. (Roxb.)	Achar, Char.	...	Sareka.	Tarop...	"	Medium sized tree—fruit is chironji.
Odina Wodier. (Roxb.)	Mohi, Moyen.	Mohin, Mohni, Gunja.	Gunja, Jhingan.	...	"	Medium sized to large tree. Wood of little use.

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.				Natural order.	Remarks.
	Hindi.	Marathi.	Gondi	Korku or Telgu.		
<i>Semecarpus anacardium.</i> (Linn.)	Bhila wa, Bhilwan.	Biba ...	Koha-ka.	Choso...	Anacardiaceae.	"Marking Nut" tree, Small tree.
<i>Indigofera pulchella.</i> (Roxb.)	Birhol, Bholi-bhuli.	Kondka, Junglil-nil.	Jira, Jirola, Bilod.	Bholori	Leguminosae. (papilionaceae.)	Tall brushy shrub.
<i>Millettia auriculata.</i> (Baker.)	Gauj, Guhalar, Nasbel, Gonja, Agri.	Gorari ...	Gurari	...	" "	Large woody climber.

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Ougenia bergiodes. (Benth.)	Tina, Tinsa.	Tiwas, tewas.	Sar	Ruthu...	,,	Small to large timber tree.
Desmodium Gan- geticum (D. C.) and D. lati- folium. (D. C.)	Chirpat ...	...	...	Poti ...	,,	Small shrubs of under- growth in moist forest.
Mucunapuriens. (D. C.)	Kiwanch, Karench.	Kanch- kuri.	Ma- how- janta.	...	,,	Twinning plant ("Cow- itch.")
Erythrina sube- rosa (Roxb.)	Haruwa, Harwa, Gadhapa- las.	Pangra ...	...	Nag- thada, Gada- phad.	,,	Small to me- dium sized tree. Very corky bark.
Butea frondosa. (Roxb.)	Pallas, Cheola, makra.	...	Mur	Pharsa	,,	Small to me- dium sized tree.
Butea superba. (Roxb.)	Bel-Palas, Palas- vel, Ba- dori-Bel Budna- Bel.	Bhador, Chiola, Bhad- rosa, Bhonria- chiola.	...	Tunang	,,	Large climber. Very com- mon.

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.				Natural order.	Remarks.
	Hindi.	Marathi.	Gondi.	Korku or Telgu.		
<i>Dalbergia latifolia.</i> (Roxb.)	Shisham	Botbiola, Bodbera, Biola.	Siris, Sison, Siase.	...	Leguminosae. (papilionaceae.)	Medium sized timber tree.
<i>Dalbergia paniculata.</i> (Roxb.)	Dhoben, Dhobni.	Phansi ...	Padri	Passi ...	...	Medium to large tree, wood useless.
<i>Pterocarpus marsupium.</i> (Roxb.)	Bija, Bijasal.	Ragatbera, Dhorbola.	...	...	...	Medium to large timber tree.
<i>Pongamia glabra.</i> (Vent.)	Karani, Kanji.	Karani ...	Gan-gaji.	...	Leguminosae (papilionaceae.)	Medium sized tree.

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Cassia fistula. (Linn.)	Amaltas	Bahawa ...	Jagaruwa, Relabhungru, Kerawara, Dhanbahar.	Bhanna bhungru.	Leguminosae. (Caesalpiniae.)	Small to medium sized timber tree.
Cassia tora. (Linn.)	Chakaora, Tarota.	Puar ...	...	...	...	Small herb—gregarious and characteristic of overgrazed areas.
Hardwickia binata. (Roxb.)	Anjan ...	...	...	...	...	Large timber tree, wood very hard, much lopped for fodder.
Tamarindus indica. (Linn.)	Imli ...	Chinch ...	Chita	Chicha	...	Large timber tree, not indigenous or a forest type.

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.			Natural order.	Remarks.
	Hindi.	Marathi.	Gondi or Telgu.		
Bauhinia craccinosa (Lam.)	A s h t o, M o h a l a, D a u r e r a, K a t e r i.	B h o s a, A p t a, A b e t a.	D h o n- d e r a, D h o n- d r i.	Leg u m i- n o s a e. (C a s e l- p i n e a s).	Small crooked tree.
Bauhinia vahlii (W. and A.)	M a h u l, M o h l e i n, M o h a- l a i n.	...	P a u r- b e l a.	...	Large com- mon climber in better forests.
Bauhinia varie- gata. (Linn.)	K a c h n a r...	K a n c h a n, K a c h- n a g.	M o h a- l a, B e j o- l a m a r	Ch a m p a	Small tree.

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Acacia arabica. (Willd.)	Babul	Bam- ra.	...	Leg u m i- n o s a e. (M i m o- s e a e.)	Medium sized timber tree- 3 varieties— Telia, Kao- ria, Ram- kanta. Medium to large timber tree. Small timber tree. Largescrabl- ing climber.
Acacia leucoph- loea. (Willd.)	R e u n g, Reunjha.	Hiwar ...	...	Rinjara	..	..
Acacia Catechu. (Willd.)	Khair ...	...	...	...	..	..
Acacia pennata. (Willd.)	Raona ...	A r Chilati, Chou- daria, Araih.	...	...	..	..
Albizzia lebbek. (Benth.)	Siris ...	Chichola, Kinhi.	...	...	..	Large timber tree pro- bably not indigenous. Small to me- dium sized timber tree in hilly tracts.
Albizzia odora- tissima. (Benth.)	S i r i s, K a l a- s i r i s, E r m a Bansa.	Chichwa, Sirsas, Chichal- da, Chi- chonda.	...	...	..	..

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.			Natural order.	Remarks.
	Hindi.	Marathi.	Korku or Telgu.		
<i>Albizia procera</i> . (Benth.)	S u f e d- s i r i s, Gurat.	Kinhi ...	Kiran- ji.	Leg u m i- n o s a. (Mimo- seae.)	Large timber tree, found along naldas.
<i>Terminalia bele- rica</i> . (Roxb.)	B a h e r a, Behera.	Boheda ...	Taha- ka.	Com b r e- taceae.	Medium to large tree.
<i>Terminalia che- bula</i> . (Retz.)	H a r r a ...	H i l d a, Hirda.	Maho- ka.	"	Medium sized tree, yields myrabolams of com- merce.
<i>Terminalia Ar- juna</i> . (Bedd.)	K o h a, Kahu.	A r j a n, Anjan.	Mangi	"	Large tree flut- ed or buttres- sed at base of bole. Found along naldas.

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<i>Terminalia mentosa.</i> (W. et. Arn.)	Saj, Saja	Ain, Sadorra, Sadra, Sadar, Athna.	Mard	"	Medium to large timber tree. Very common.
<i>Anogeissus latifolia.</i> (Wall.)	Dhaura, Dhawa.	Dhaura, Dhamora, Dhaura, Dhaundha.	Arma	Dhaoda	Medium sized timber tree. Very common.
<i>Anogeissus pendula.</i> (Edgew.)	Kardhami, Kalaria, Dhaura.	...	...	...	Medium sized tree.
<i>Eugenia jambolana.</i> (Lam.)	Jamun ...	Jambhul	Lendi	...	Large tree, commonly found in moist localities.
<i>Lagerstroemia parviflora.</i> (Roxb.)	Lendia, Seja, Karia-seja.	Lendi, Laraiya, Seina.	Senha, Seina.	Chakrey, Chakrej.	Medium size to large timber tree.

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.			Natural order.	Remarks.
	Hindi.	Marathi.	Korku or Telgu.		
Woodfordia floribunda. (Salisb.)	Dhawaj, Dhawai, Sona-dhaura.	Dhawati, Dhayri.	Sur-teli.	Lythra- cea.	Bushy shrub.
Casearia graveolens. (Dalz.)	Haldu ...	Hardu ...	Girchi Kaim, Kem, Kam- ram.	Samy- daceae.	Small tree.
Adina cordifolia. (Hook f.)		Kalamb ...	Mun- di.	Rubiaceae	Large timber tree.
Stephegyne parvifolia. (Korth.)	Kalam, Kalm, Kalmi.		Kurum, Kurum- rum- bo.	"	Medium to large timber tree.

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Gardenia lucida. (Roxb.)	Dikamali. Mali.	Small timber tree.
Gardenia gum- mifera. (Linn. f.)	Bandar- Aledu.	Large shrub.
Gardenia latifo- lia. (Ait.)	Papar, papra.	Ghogar, Gogari, Pani- abilo, Pip- har.	Gugal	...	Small timber tree.
Gardenia turgi- da. (Roxb.)	Kahar, Chamar- Karhar.	Phendra, Phetra, Pendra, Temria.	...	...	Small tree with spines.
Randia uligino- sa. (D. C.)	Bhirara, Pindalu, Katul, Kadla- Phetra.	Tirkha, Tupke- la, Kala, Phendra- ra.	Ghan- gra, Pur- put.	...	Small tree swamp indicator.
Bassia latifolia. (Roxb.)	Mahua ...	Mohwa, Moh, Moho.	Mu, Mohu.	Sapotaceae.	Large timber tree. Very common.

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.			Natural order.	Remarks.
	Hindi.	Marathi.	Korku or Telugu.		
Diospyros melanoxylon. (Roxb.)	Tendu ...	Tembhur- ni, Tem- ru,	Tum- ri.	Ebenaceæ.	Medium to large timber tree. Very common.
Nyctanthes arbor-tristis. (Linn.)	Sihau, Siharu.	Kharbadi, Khan- chari- Kharas- si, Pari- jatak.	Khir- saru.	Oleaceæ	Large gregarious shrub.
Schrebera swietenoides. (Roxb.)	Mokha, Chato, Chanta.	...	Choti- Karan- di.	"	Medium sized timber tree.

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Carissaspinarum. (D. C.)	Kar a u n - da, Ka- ronda.	Kari	Ap o c y - nacæ.	Thorny shrub.
Holarrhena anti- dysenterica. (Wall.)	Kura, Du- dhi, Ku- raiyâ, K a l i - Dudhi.	Kuda, In- drajau, Moka.	...	Samo- ka.	..	Small tree or shrub.
Cryptolepis buchanani. (Roem & Sch.)	Dudhi, K a l i - Dudhi, Nagbel.	Ka u w a - rori, Ba- disar, Iukur- Dudh- Mogri.	...	Kao- vel, Kawa- vel.	Ascle- piadaceæ.	Large twin- ing shrub.
Gordia Macleo- dil. (H. F. & Th.)	Dhengan, Dahgan, Daiyar, Deyar, D e h - wan.	Da i w a s, Dahipa- las, Te- liasag.	...	...	Bot o g i - naceæ.	Small to me- dium sized tree.

List of commoner trees, etc.—contd.

Latin names.	Vernacular names.		Natural order.	Remarks.
	Hindi.	Marathi. Gondji.			Korku or Telugu.
<i>Stereospermum suaveolens</i> , (D. C.)	Padar, Pandri, Jaiman-gal.	Paral, Padal, Paarkar-mul.	...	Medium to large timber tree.
<i>Lantana Camara</i> , (Linn.)	...	...	Padar... Raimuniya.	Scrambling shrub.
<i>Tectona grandis</i> , (Linn. f.)	Sagon	Sag Sag-wan, Teka	Sipna...	Large timber tree.
<i>Gmelina arborea</i> , (Roxb.)	Kumher, Khamer.	Shewan, Sewan, Chiman-sag.	Kassimar.	Medium sized to large timber tree.

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Vitex Negundo. (Linn.)	N e g u r Nirgur, Ningori, Nirgur.	Nirguri, Nirgudi, Nirgud.	...	Samalu	Verbenacæ.	B r a n c h y shrub.
Litsæa sebifera. (Pers.)	M a i d a, lakri.	...	Lenjo	Lenja...	Lauracæ	Small to me- dium sized tree.
Loranthus longi- florus. (Desr.)	Banda ...	Kowvel, Kawara- rak.	...	Kawar- ka.	Loranthacæ.	Semi-Parasitic and epi- phytic shrub.
Euphorbia Nivul- lia. (Ham.)	Thuar, Thuar.	Niwarang	...	...	Euphorbiacæ.	Small useless tree.
Bridelia retusa. (Spreng.)	K a s a i, Kassi.	Katia in, Katiyen.	San- kana, Biula.	Karkha, Khad- ka.	,, ,,	Small to me- dium sized timber tree.
Cleistanthus col- linus. (Benth.)	Garar ...	Garari, Garadi.	Rari	...	,, ,,	Small to me- dium sized timber tree.
Phyllanthus em- blica. (Linn.)	A o n l a, Aonra, Aonri.	Aonli, Awala, Aola.	Nalli, Lalli.	...	,, ,,	Small to me- dium sized trees.

List of commoner trees, etc.—concl'd.

Latin names.	Vernacular names.			Natural order.	Remarks.
	Hindi.	Marathi.	Korku or Telgu.		
<i>Trema politoria.</i> (Planch.)	A n d i s, J i l m i l i, M a j n i, D a n d a n - n i.	...	...	Urticaceae.	Small tree.
<i>Ficus religiosa.</i>	P i p a l ...	P i m p a l ...	P i p r i ...	"	Large tree.
<i>Dioscorea dæmona.</i> (Roxb.)	B a i c h a n - d i, C h a n.	B h u i k a n d	K u l u ...	Dioscoreaceae.	Climbing herb.
<i>Dioscorea bulbifera.</i> (Linn.)	A g i t h a, K a r u - k a n d, G a t h a l u, C h a r i - a l u.	G o g d u, M a t a r u.	B a y a l ...	"	"

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Smilax macrophylla (Roxb.)	Ramdatun, Pothur.	...	Liliaceæ	Large prickly climber.
Phoenix sylvestris (Roxb.)	Khajur, Khajuri.	...	Palmæ ...	(Tody palm.) Tall tree. Not a forest tree but indigenous.
Phoenix acaulis (Buch.)	Kuchachind, Chotisingi.	...	"	Dwarf palm Common in sal arcas as undergrowth and in grass.
Bambusa arundinacea (Willd.)	Katang, Bans.	...	Graminæ. (tribe. Bambuseæ.)	Large tufted thorny bamboo.
Dendrocalamus strictus, Nees.	Bans	Uhadur, Wad-dur.	...	Medium sized tufted smooth bamboo. (Male bamboo.)

The majority of the common tree species coppice extremely well, of the remainder—

Moderate coppicers are

Pterocarpus marsupium.

Adina cordifolia.

Stephegyne parvifolia.

Ougenia dalbergioides.

Ægle marmelos.

Soymida febrifuga.

Bad coppicers are—

Acacia arabica.

Odinä wodier.

Terminalia belerica.

Cochlospermum gossypium.

Bombax malabaricum.

Sterculia urens.

For further information with regard to silvicultural and ecological characters, *vide* pp. 243 to 247 of Witt's Descriptive Botanical List, Northern and Berar Circles (1916), also the pertinent portions of Troup's Sylviculture of Indian Trees (1921).

Note on girdling of commoner species.

In girdling trees about $1\frac{1}{2}$ ' of the bark should be removed all round and the tree then ringed by a deep cut extending to the heartwood. There is danger of the tree recovering by rapid callus growth if the bark only is removed. In rains girdling however, bark removal alone usually kills most trees.

SYLVICULTURAL NOTES ON SPECIES

The following common trees (in addition to all small trees from which coppice reproduction is required) should not be girdled (for the reasons given) :—

Species.	Reason.
<i>Dalbergia paniculata</i> (Dhobain).	No heartwood. Concentric bands of hard and soft tissue alternate and there is internal cambium. Hence the tree can only be killed by cutting right through.
<i>Cochlospermum gossypium</i> (Gongal).	Gossy- Extremely easy to cut.
<i>Odina Wodier</i> (mohin, guinja).	Thick sap wood, more practical to fell.
<i>Boswellia serrata</i> (salai)...	Soft-wooded—also there is danger of the tree (some months after being girdled) falling uncontrolled and damaging the young growth for whose benefit it was originally removed.
<i>Ficus</i> species	Aerial roots developing into new trees are formed. A large fierce fire of several days duration round the base of the stem will kill.
<i>Garuga pinnata</i> (kakar)...	Soft wooded.
<i>Saccopetalum tomentosum</i> (kari).	Soft wooded.
<i>Kydia calycina</i> (baranga).	Soft wooded.

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Species.	Reason.
<i>Sterculia urens</i> (kulü)	Soft wooded; also for same reason as salai.
<i>Bombax malarbaricum</i> (semal).	Soft wooded.
<i>Ailanthus excelsa</i> (mahanim).	Soft wooded.
<i>Ougenia dalbergiodes</i> (tinsa).	Possesses power of rapid occlusion aided by copious exudation of gum.
<i>Butea frondosa</i> (palas).	Soft wooded and sends up shoots from adventitious buds near lower cut surface.
<i>Euphorbia Nivulia</i> (thur).	Should be burnt. Otherwise this tree is remarkably difficult to destroy. Cutting only stimulates further extension.

All *Terminalia* spp. and *Bassia latifolia* should be girdled especially thoroughly as their callus growth is very rapid and vigorous.

General note on Central Provinces.

For general notes on topography, geological formations, etc., vide "Descriptive List of Trees, Shrubs, and Economic Herbs of the Southern Circle, Central Provinces" (Haines), Intro., pp. iii to xvii, and "Descriptive List of Trees, Shrubs, Climbers and Economic Herbs of the Northern and Berar Circles, Central Provinces" (Witt), Intro., pp. vii to xiii. Troup ("Silviculture of Indian Trees,"

SYLVICULTURAL NOTES ON SPECIES

Vol. I, pp. xxii to xxiii) classifies the main Central Provinces types as follows:—

(a) Mixed deciduous forest.

Prevailing trees.—*Tectona grandis*, *Terminalia tomentosa*, *Terminalia belerica*, *Terminalia chebula*, *Anogeissus latifolia*, *Lagerstroemia parviflora*, *Pterocarpus marsupium*, *Dalbergia latifolia*, *Ougenia dalbergioides*, *Cassia fistula*, *Acacia catechu*, *Butea frondosa*, *Adina cordifolia*, *Stephegyne parvifolia*, *Bridelia retusa*, *Phyllanthus emblica*, *Cleistanthus collinus*, *Grewia* spp. *Diospyros melanoxylon*, *Bassia latifolia*, *Soymida febrifuga*, *Schrebera swietenioides*, *Chloroxylon Swietenia Odina Wodier*, *Buchanania latifolia*. *Schleichera trijuga*, *Dendrocalamus strictus*. On dry ridges, etc.—*Boswellia serrata*, *Sterculia urens*, *Cochlospermum gossypium*, etc. A special sub-type is anjan forest (*Hardwickia binata*).

(b) Sal forest.

Either pure or with the Central Provinces mixture of the first list above.

Characteristic and special sal associates (Witt) are—

Dillenia aurea, *Dillenia pentagyna*, *Sterculia villosa* (undergrowth), *Phoenix acaulis*, *Grewia Rothii*, *Strobilanthes auriculatus*, *Ochna pumila*, *Careya herbacea*, *Combretum nanum*.

(c) **Thorn forests.**

Characteristic species are—

Acacia arabica, *Acacia leucophloea*, *Acacia catechu*, *Diostrachys cinerea*, *Balanites Roxburghii*, *Butea frondosa*, *Phyllanthus emblica*, *Zizyphus xylopyra*, *Zizyphus cænoplia*.

These forests occur in the drier open tracts.

The standardised C. P. quality classes.

Average maximum height at maturity (e.g., *Terminola tomentosa* is generally a convenient criterion)—

Quality I	Over 90'
Quality II	Over 70' to 90'
Quality III	Over 50' to 70'
Quality IV (a)	Over 40' to 50'
Quality IV (b)	Under 40'

SYLVICULTURAL NOTES ON SPECIES

Recorded seed years of forest species,
Central Provinces.

Species.	Year.	Division.
<i>Dendrocalamus strictus.</i>	1876	... Hoshangabad.
Do.	... 1885-87	... North and South Mandla, Hoshangabad, Jubbulpore-Narsinghpur.
Do.	... 1890-91	... Betul.
Do.	... 1893-94	... Jubbulpore - Narsinghpur.
Do.	... 1895-96	... North and South Raipur.
Do.	... 1901	... Hoshangabad.
Do.	... 1907-08	... Nimar.
Do.	... 1917-19	... Hoshangabad, North and South Mandla.
Do.	... 1921-23	... Saugor, Seoni, Bilaspur, Balaghat.
<i>Bambusa arundinacea</i>	1839	... Jubbulpore, North Mandla.
Do.	... 1870	... Chanda.
Do.	... 1889-90	... Bhandara, Saugor.
Do.	... 1915-16	... Jubbulpore.
Do.	... 1918-19	... Jubbulpore.
Do.	... 1919-21	... Balaghat.
<i>Hardwickia binata,</i>	1910-11	... Buldana.
<i>Acacia arabica</i> <i>Ougenia dalbergiodes.</i>	1913-14	... All Divisions of Berar Circle.

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Species.	Year.	Division.
Pterocarpus Marsupium, Eugenia dalbergioides, Terminalia tomentosa, Tectona grandis	1915-16	... Chhindwara.
Terminalia tomentosa.	1916-17	... South Chanda.
Diospyros Melanoxylon, Eugenia jambolana, Anogeissus latifolia, Pterocarpus marsupium.	1918	... South Raipur, Chhindwara, South Chanda, Bhandara.
Tectona grandis	1919	... Seoni.
Xyl o c a r p a Pterocarpus marsupium, Diospyros melanoxylon.	1922	... South Chanda.
Terminalia tomentosa T e c t o n a grandis Anogeissus latifolia.	1922	... Chhindwara.
Tectona grandis, Terminalia tomentosa, Acacia arabica.	1923-24	... Akola and Yeotmal.
Shorea robusta	1924	... All sal-divisions.
Hardwickia binata	1925	... Hoshangabad.

CHAPTER II.

ARTIFICIAL REGENERATION—GENERAL

PLANTING NOTES.

GENERAL.

In planting work the selection of species must be made to suit the locality and to give the best financial results.

Tending and supervision of the seedlings for the first few years is of vital importance. Where requirements of seedlings are small the encouragement of private nurserymen is recommended.

NURSERY WORK.

The long dry season of the Central Provinces renders the proximity of a good water-supply essential to a nursery. The nursery should be on good, well drained soil, which must be worked well as a preparatory measure and then properly fenced. The beds should run from east to west in flat country and should follow the contours in hilly country. In Bengal the unit of area for nursery work is a "kamra" of 12 running feet of bed 6' wide. Two kamras in most cases suffice (for 6' by 6' planting) for each acre of

planting area, or 1 acre of nursery for 200 acres of planting area.

Beds should be hoed to 1' deep and all roots, etc., removed. After levelling they should be covered with leaf mould in January-March and made up before the rains break. Bamboo matting and thatch grass are usually used for shading seed beds and pricking out beds (for slow-growing species) but must be carefully watched. The objects are to protect from the hot weather sun and the monsoon.

Shades should slope from 6' to 3', the 6' side being to the north in flat country and towards the hills in hilly country.

Weeding is allowed for either by leaving the beds narrow enough to be reached across from central paths or (better) by fixing planks across them resting by their ends on poles lashed to the shade uprights. Seeds are sown broadcast on the beds and covered lightly with earth to a depth roughly equal to the diameter of the seed (for large seeds especially).

Seedlings may be planted out direct or else first pricked out to another seed-bed. The latter requires a planting board 6' long and 3" wide on the edge of which are notches 3" apart. The notched edge of the board is laid across the bed and along the edge of a small furrow, slightly deeper than the length of the

ARTIFICIAL REGENERATION

seedlings' roots. Each seedling is held upright against the notch and loose earth thrown in round it and firmly pressed round. Pricking out gives the seedlings a better root system and a greater chance of survival eventually. First weeding is necessary in seed-beds just after germination is over, and in pricking out beds a fortnight after pricking out. After this weed every fortnight.

Planting out is best done from the middle of June to the middle of August. Plant out in prepared pits, usually 6' by 6'. Preparation of pits consist in digging (about 12" to 18" deep) in the cold weather and filling in with the loosened earth before heavy rain falls. In planting, roots must be kept straight and a stake driven in firmly near each seedling to show its position. Seedlings are planted with a handful of soil adhering to the root. If roots can be kept shaded and moist the excess earth is better gently shaken or washed off. *Avoid*—insufficient pricking out beds for seed-beds maintained, too narrow beds, too many and too narrow paths, too low shades, excess of watering, too little weeding, planting out with plant too large, doubling up and bending of roots, incomplete filling up of pits [NOTE.—The tops should be above the surrounding level and form a small mound], too small pits, and failure to press earth firmly round each pricked-out seedling.

Water heavily 2 or 3 days before transplanting to effect easy loosening. The more attention afterwards in the way of weeding and tending the better for the development of seedlings. Sal especially should always be weeded till well established. A rough rule for thinnings in later stages is, for light demanders, thin to a distance equal to their height up to 5'. For shade bearers half this. After 5' thin as conditions demand.

Thin plantations every 5 years where possible. This is essential for best development of fast-growing species.

SOWING IN SITU.

This has been proved suitable in many localities in the Central Provinces (North Raipur, Damoh, etc.), and is at present more within our scope in the Central Provinces than nursery work. Essentials are—Preparation of ground, selection of good seed, preparation of seed, subsequent weeding and tending (e.g., shading, etc.), and fencing (for most species).

Regeneration areas must have constant attention to be successful.

Tectona grandis (teak).

For teak and similar seeds [e.g., ghont (*Zizyphus xylopyra*)] with a hard shell prepa-

ARTIFICIAL REGENERATION

ration is essential. Various methods are advocated, *e.g.*—

- (1) Scorching in a light running fire of dry leaves.
- (2) Soaking of seed in water from a few hours to several days.
- (3) As in (2) but after soaking, drying in the sun and then again soaking, etc.
- (4) Burying in the ground or in a mixture of cowdung and water.
- (5) Alternately soaking and drying in straw, etc.

The best preparation is to approximate to natural conditions and to "weather" the seed for a year. Spread it out in a well drained open place, *e.g.*, a sloping slab of rock. Occasionally stir up the bottom layers, bringing them to the surface. After the rains, when all are quite dry, store in gunny bags or dry hay bundles and keep in a cool, dry, airy, shady place. Sow in April-May. The above method has been proved successful in Kanara. For direct teak sowings first burn over the area, then peg out spacings required (*e.g.*, 6' to 8'). Break soil with pickaxes deeply into pits at the requisite spacing and put in 2 or 3 seeds into each pit-mound. Cover and trample down. After germination, choose a cloudy, moist, not actually rainy day and transplant excess seedlings from successful to

blank mounds. For nursery work with teak sow very early *i.e.*, March-April.

Large nurseries, if established properly, may also be independent of water and shade attention, and seedlings can be transplanted direct into the forest the following rains. Seedlings from such nurseries are best subjected to root and shoot pruning (leave up to 9" of stem and as much root as convenient).

There are 1,600 to 1,800 teak weathered seeds per 1 lb., *i.e.*, 1 lb. per acre is required at 6' by 6'. In the weathering, teak seeds lose 1/4th of their weight.

Zizyphus xylopyra (ghont) seed responds to the same treatment as teak seed.

***Shorea robusta* (sal).**

Sal must be sown when the monsoon has begun and "when rain is actually falling" (United Provinces). If rain fails for a serious period between the sowing and the monsoon, watering is essential. The area to be sown must be cleared of all grass and hoed up early in the season. Before sowing level over. Forest seedlings cannot be transplanted as a practical measure and nursery seedlings only with difficulty and exercise of great caution.

Hence for practical purposes sow *in situ*. The more soil preparation the better. A good method is to dig trenches to a depth of

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about 12". Remove the earth and break up the floor of the trench deeply with a pickaxe. Then throw back the soil and sow sal seed. Seed should be pressed into the soil so that the wings only are seen. Lines should be about 6' apart. Weeding is essential, hence sal sowing in conjunction with field crops is the best for work on a large scale. Where frost damage is severe a helpful measure is to cut off the first pair of normal leaves (not cotyledonous). A great danger lies in the depredations of pig, deer, etc.

General figures of cost per acre first year (U. P. Forest Pocket Book) are—

	Rs.
Soil preparation : burning, hoeing and levelling.	20
Collecting and sowing	5
Tending (1st year)	12

NOTE.—Cost per acre with proper taunyga should be *nil*.

Pinus longifolia (chir pine).

This is a possible nurse for sal in frosty grassy places when it has attained its main height growth. It should be sown in furrowed lines as ploughing up the whole area is wasteful and the crop comes up too thick. Weeding is unnecessary and grass protects from drought.

The first 5-6 years growth produces a bushy little plant which then throws up a strong leader and forges ahead. In obtaining seed, care should be taken to ensure that it is obtained from stock not affected by twisted fibre. Also when ordering state the elevation at which it is to be sown.

Seed ripens March-April. Seed can be shaken out when cones open in dry weather.

One maund of cones gives $2\frac{1}{2}$ to 4 seers of seed. One maund of seed will suffice for 10 acres.

Acacia arabica (babul).

Break up the soil thoroughly before and after sowing and germination. Distance between lines in Berar sowings is now 12'. Use seed from sheep and goat pens if possible. Weed for at least 2 years and thin annually for 5 years after which thin every 5 years. Admit light grazing of cattle *only* to keep down the grass which shelters rats, hares, insects, etc. The babul seeds at 5 to 7 years. Cost per acre of thinning at age 15 is about 11 annas in Buldana. The seed ripens in May. Pods weigh twice as much as seeds (volume for volume). Direct sowings only are suitable, and this should be done after the rains have started.

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STORING OF SEEDS:

Seeds which cannot be stored for any practical period generally fall in the rains, e.g., of *Shorea robusta* and *Garuga pinnata*.

Seeds which cannot be stored for more than a year are usually of the light, winged, wind-borne type, e.g., of *Adina cordifolia* and *Cedrela toona*.

Seeds which can be kept for more than a year are characterised by hard protective cases, e.g., of *Tectona grandis*, *Gmelina arborea*; *Zizyphus xylopra*, etc.

The largest seed is usually the best. Only the best available seed should be sown.

1812	8	8	111	1	2	1	1
1813	8	3	355	8	3	7	1
1822	10	1	330	2	3	2	1
1810	13	3	378	10	3	9	1
898	13	3	1812	13	3	10	1
1810	6	6	1742	2	2	4	4
895	6	6	1425	6	6	2	4
896	6	6	1342	6	6	6	4
858	10	6	1082	3	3	3	4
862	13	6	871	10	3	10	4
484	18	6	752	13	6	13	4
300	11	11	242	2	2	7	4
230	13	11	184	18	9	8	4
305	13	13	103	13	2	10	4
313	13	13	220	10	10	13	4
333	14	14	203	13	10	6	8
182	13	13	280	13	10	2	8
103	30	30	218	30	10	10	2
48	30	30					

C. P. FOREST POCKET BOOK

TABLE OF SPACING PER ACRE.

[From U. P. Forest Pocket Book.]

One acre—4,840 sq. yds. 43,560 sq. ft.

5 chains × 2 chains = 10 sq. chains.

70 yds. × 70 yds. nearly.

Spacing.	Number per acre.	Spacing.	Number per acre.	Spacing.	Number per acre.
1' × 1'	43,560	2' × 2'	10,890	3' × 3'	4,840
1' × 2'	21,780	2' × 3'	7,260	3' × 4'	3,630
1' × 3'	14,520	2' × 4'	5,445	3' × 5'	2,904
1' × 4'	10,890	2' × 5'	4,356	3' × 6'	2,420
1' × 5'	8,712	2' × 6'	3,630	3' × 7'	2,074
1' × 6'	7,260	2' × 7'	3,111	3' × 8'	1,815
1' × 7'	6,223	2' × 8'	2,722	3' × 9'	1,613
1' × 8'	5,445	2' × 9'	2,420	3' × 10'	1,452
1' × 9'	4,840	2' × 10'	2,178	3' × 12'	1,210
1' × 10'	4,356	2' × 12'	1,815	3' × 15'	968
4' × 4'	2,722	5' × 5'	1,742	6' × 6'	1,210
4' × 5'	2,178	5' × 6'	1,452	6' × 8'	907
4' × 6'	1,815	5' × 7'	1,245	6' × 9'	806
4' × 8'	1,361	5' × 8'	1,089	6' × 10'	726
4' × 10'	1,089	5' × 10'	871	6' × 12'	605
4' × 12'	907	5' × 12'	726	6' × 18'	484
7' × 7'	889	9' × 9'	538	11' × 11'	360
7' × 8'	778	9' × 10'	484	11' × 12'	330
7' × 10'	622	9' × 12'	403	12' × 15'	302
7' × 12'	519	10' × 10'	436	12' × 13'	242
8' × 8'	680	10' × 12'	363	14' × 14'	222
8' × 9'	605	10' × 15'	290	15' × 15'	193
8' × 10'	544	10' × 20'	218	20' × 20'	109
				30' × 30'	48

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TABLE OF SOIL-WORKING PER ACRE.

(Applied to some of the commoner forms of soil preparation.)

(Calculated for 1 acre of flat ground.)

1. Complete ploughing or digging—
 - (a) To a depth of 1' = 43,560 c. ft.
 - (b) To a depth of 1½' = 65,340 c. ft.
2. Digging in patches, to a depth of 1 foot.

Size of patch.	At centre to centre distance of—	Number of patches.	Amount of earth work.
			C. ft.
1' x 1'	5'	1,742	1,742
1' x 1'	10'	436	436
2' x 2'	10'	436	1,744
2' x 2'	15'	193	772
3' x 3'	10'	436	3,924
3' x 3'	15'	193	1,737

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3. Digging in lines or strips, to a depth of 1 foot.

Width of strips.	At a distance of—	Length of strips per acre.	Amount of earth work.
		Chain.	C. ft.
1'	4'	165	10,890
1'	5'	132	8,712
1'	6'	110	7,260
1'	8'	82½	5,445
1'	10'	66	4,356
2'	12'	110	14,520
2'	8'	82½	10,890
2'	10'	66	8,712
2'	12'	55	7,260
3'	10'	66	13,068
3'	15'	44	8,712
5'	20'	33	10,890
5'	30'	22	7,260
10'	50'	13½	8,712
20'	60'	11	14,520
20'	100'	6½	8,712

4. Making mounds 2' mean diameter and 1' high.

Spacing centre to centre.		Number of mounds per acre.	Amount of earth work.
5' x 5'	...	1,742	C. ft. 4,472
5' x 8'	...	1,089	3,421
5' x 10'	...	871	2,736
8' x 8'	...	680	2,136
10' x 10'	...	436	1,370
12' x 12'	...	302	949

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List of main *C. P.* species showing number of seeds per ounce (Howard).

Species.	No. of seeds per oz.	Remarks.
<i>Acacia arabica</i> ...	220	Seeds.
<i>Acacia catechu</i>	1,100	Do.
<i>Acacia leucophloea</i> ...	1,400	Do.
<i>Adina cordifolia</i>	315,000	Do.
<i>Aegle Marmelos</i>	150	Do.
<i>Albizzia Lebbeck</i>	210	Do.
<i>Albizzia odoratissima</i> ...	320	Do.
<i>Albizzia procera</i>	670	Do.
<i>Anogeissus latifolia</i> ...	3,400	Do.
<i>Anogeissus pendula</i> ...	4,300	Do.
<i>Bassia latifolia</i>	12	Do.
<i>Bauhinia malabarica</i> ...	320	Do.
<i>Bauhinia purpurea</i> ...	140	Do.
<i>Bauhinia racemosa</i> ...	220	Do.
<i>Bauhinia variegata</i> ...	90	Do.
<i>Bombax malabaricum</i> ...	780	Do.
<i>Bridelia retusa</i>	480	Do.
<i>Buchanania latifolia</i> ...	110	Do.
<i>Butea frondosa</i>	35	Do.
<i>Cassia fistula</i>	160	Do.
<i>Cedrela toona</i>	7,150	Do.
<i>Chloroxylon Swietenia</i> ...	1,650	Do.
<i>Dalbergia latifolia</i> ...	660	Dry pods.
<i>Dalbergia paniculata</i> ...	180	Seeds.
<i>Dalbergia sissoo</i>	500	Pods.
<i>Dendrocalamus strictus</i> ...	850	Seeds.
<i>Diospyros melanoxylon</i> ...	30	Do.
<i>Diospyros montana</i> ...	37	Do.
<i>Eugenia jambolana</i> ...	50	Do.

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List of main C. P. species showing number of seeds per ounce (Howard)—concl'd.

Subject.	No. of seeds per oz.	Remarks.
Garuga pinnata	120	Seeds.
Gmelina arborea	40	Do.
Hardwickia binata	110	Pods.
Holarrhena antidysenterica	1,150	Seeds.
Holoptelea integrifolia	750	Do.
Hymenodictyon excelsum	4,800	Do.
Kydia calycina	910	Do.
Lagerstrœmia parviflora	800	Do.
Melia azadarach	40	Do.
Ougenia dalbergioides	350	Pods.
Phyllanthus emblica	1,840	Seeds.
Pinus longifolia	300	Seeds with wings.
Pongamia glabra	12	Pods.
Pterocarpus marsupium	45	Seeds.
Santalum album	110	Do.
Schleichera trijuga	45	Do.
Shorea robusta	25	Dry.
Soymida febrifuga	320	Seeds.
Spondias mangifera	6	Do.
Stephegyne parvifolia	2,83,500	Do.
Stereospermum suaveolens	810	Do.
Tectona grandis	50	Variable.
Terminalia arjuna	5	Seeds.
Terminalia chebula	4	Do.
Terminalia tomentosa	14	Do.
Xylia xylocarpa	90	Do.
Zizyphus jujuba	50	Do.
Zizyphus xylopyra	6	Do.

CHAPTER III.

NOTES ON FOREST ROADS AND BUILDINGS.

NOTES ON FOREST SURFACE ROADS.

Five convenient divisions of road work are—

- (1) General scheme and office work.
- (2) Alignment and survey on the ground.
- (3) Estimate (including measurement of work).
- (4) Construction.
- (5) Repairs and maintenance.

(1) General scheme.

A proposed forest road must always be considered in relation to, and as a part of, an existing general road scheme for the particular locality. Roads may be classified as main roads, permanent feeder roads (regularly repaired) and temporary feeder roads (repaired only when required). Variations in the terrain demand that roads be considered under the two categories—(i) hill roads, (ii) flat roads. The former should generally be aligned as near as possible to the bottoms of valleys to follow the river system. The two advantages of this are, that the surface at the bottoms of valleys is flatter and hence easier for construction, and that timber is more

easily extracted down hill. The latter should follow watersheds, descending only where main nalas are to be crossed, to avoid large detours, or for some specific purpose as water-supply for transport animals, etc. A road may fall into the first or the second category in different portions of its length.

The general road scheme is laid out in the office with 4" maps and is conveniently shown on a 1" trace. Main roads will carry heavy traffic, must provide easy access to markets at one end and must never be allowed to end "in the air" at the forest boundary. Sections across private land, linking with Public Works Department roads should be constructed first. The other end must approach and enter the forest with regard to the feeder road system.

Water-supply and halting places.—The supply of permanent water is essential during most of the carting season and regular halting places, preferably not in the middle of dense jungle, must be provided. Water permanent till May in normal years should occur every 5 miles. Surface water is preferable, but wells with masonry troughs may serve occasionally.

Gradients.—The ruling gradient for main roads is 1 in 20 both ways. At nala crossings where square cutting has to be made, 1 in 15 is admissible for 150'. The ruling gradient of permanent feeder roads is 1 in 20 except for

NOTES ON FOREST ROADS AND BUILDINGS

nala crossings (1 in 15 for 150') and for short distances (1 in 15 up to 500' with the load only) to reduce construction work or to shorten the road. It is unnecessary to fix any ruling gradient for temporary feeder roads but gradients of more than 1 in 15 are inadvisable. Short lengths of 1 in 10 and very short lengths even steeper are admissible, provided they involve no danger to carts.

Width.—The width of main roads where no earthwork is required is 25' between drains. In side cutting it is usually 20', reducible to 16' where cutting exceeds 4' in depth. Where square cutting is necessary there should be 16' of roadway with 2' each side for drains, making 20' over all.

The width of permanent feeder roads where no earthwork is required is 25' between drains and in side cutting 16' reducible to 12' where the depth of cutting exceeds 4'. Where square cutting is necessary, and the depth of cutting exceeds 4' the width is 16' (plus 4' for drains) reducible to 12' (plus 4' with drains) for distances up to 100'.

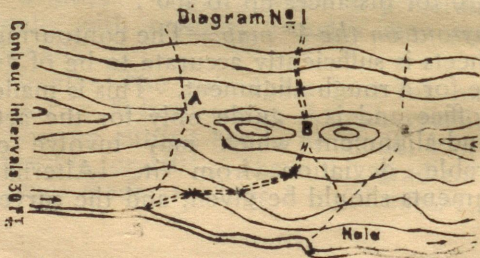
Lay-out on the 4" map.—The contouring of 4" sheets is sufficiently accurate to be of great value for a rough alignment. This is made in the office and is a guide only for the actual ground-alignment which may involve considerable deviation from it. Alternative alignments should be given, and the surveyor

ordered to make a choice after investigation on the ground.

Obligatory points.—The term “Obligatory point”, as used in road survey, means points or short stretches of road requiring special care in selection. They are, hence, not necessarily obligatory, and may be changed to the most suitable found.

The general line is first decided on the map and obligatory points selected. The usual types are narrow watersheds, saddles (one of the lowest will usually be selected), large nala crossings (the surveyor must be given the greatest latitude here to select the easiest, narrowest and most direct route), and water-supply and halting places (these can seldom be selected definitely on the map).

Having selected obligatory points it must be seen whether they can be suitably linked up without exceeding ruling gradients or introducing zig-zags. The following examples illustrate what is meant (diagram No. 1)—



NOTES ON FOREST ROADS AND BUILDINGS

For crossing the ridge (diagram No. 1), A appears to be the most suitable saddle. Of the others, B is higher than C. D is the best nala crossing. From A to D on the map scale is 1,320'. This gives, with a gradient of 1 in 20, a rise of $\frac{1320}{20} = 66'$. As there are 3 contours (90') between A and D it is impossible to go from D to A without zig-zagging. Hence one must try joining B to D although B is one contour higher than A and not so desirable a saddle. B to D. is 3,300', and it is possible to rise 165'. There are 4 contours involved and the rise is about 120' to 150. It should hence be possible to get a direct alignment from D to B without zig-zagging. It may not be necessary to go on to C. To facilitate this kind of work use a pair of spring dividers, and set them on the map scale at the distance necessary to pass from one contour to another (in this case 600'). Starting at B step down with the dividers from contour to contour towards D, obtaining a series of points as shown in the diagram. These can be joined to show the general line of the road. In this way the whole general line, probable obligatory points, alternative routes, and notes on the line can be prepared in the office for the surveyor.

(2) Alignment and survey on the ground.

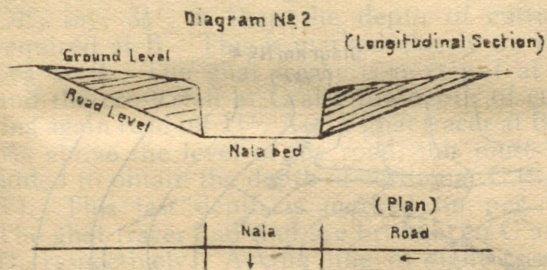
The surveyor should be given with his orders a trace of the suggested lines showing

alternative roads, etc., as described, a specification as to gradients and widths, special notes (*e.g.*, permission to adopt bridges, banks and murraming, etc. at certain points), and the necessary instruments (*e.g.*, ghat-tracer and staff, 50' tape, and compass).

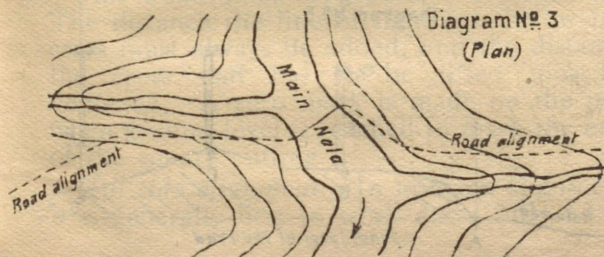
The line is first walked over and the probable route that the road will follow, decided. Notes are made of all the difficult and all the easy places. Then a provisional selection of the obligatory points (especially the large nala crossings) is made. Nala crossings must always be square across the nala and should be selected to give a short crossing, easy approaches from both sides, and a convenient situation to link up with the general line of the road. The crossing is marked by pegs driven in on both sides of the nala and by blazing trees. Obligatory points are similarly marked. Having obtained an apparently suitable series of obligatory points, the road sections on either side of each point are aligned until easy ground is reached. It is then seen if they appear likely to join up. The obligatory points can still be changed if the alignments from them do not link up satisfactorily. The alignments lying over easy ground are next linked up. The whole line should then be gone over and improvements looked for. It is usually easier to work down hill with the ghat tracer.

NOTES ON FOREST ROADS AND BUILDINGS

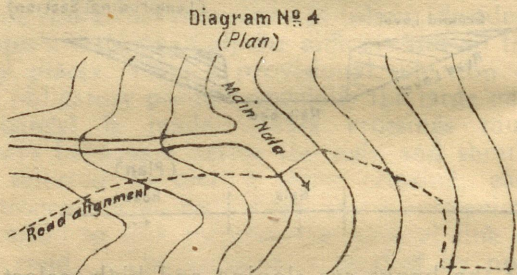
Large nala crossings.—Where in large nala crossings the banks are low and roughly vertical it is best to make the approaches in square cutting (diagram No. 2)—



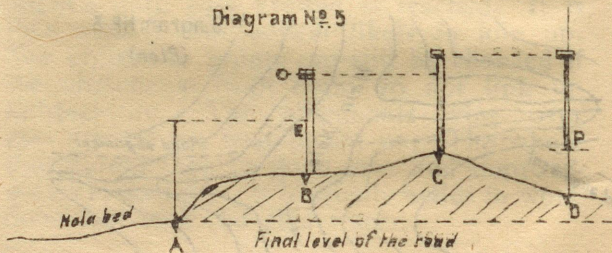
If the banks are sloping and high, select a crossing point near where side nalas join the main nala so that the road may follow the side valleys in side cutting (diagram No. 3)—



Side nalas are not always found so conveniently. One can usually be found, and it is then necessary to align on the other side along the bank of the main nala. Work downstream as shown (diagram No. 4)—



The difficulty in square cutting is that the surveyor cannot place his instruments on the actual road level. The following example is given (diagram No. 5)—



A peg is put in at A at the edge of the nala, and others, B, C, and D, at intervals of 10' along the proposed line. The ghat tracer is set up at A with the required gradient, and the staff at B. The assistant moves his finger up and down the staff until it coincides with the observer's line of sight (E). The distance OE, say, $3\frac{1}{2}'$, is then the depth of cutting required at B. This is marked clearly on the peg at B. The ghat tracer is next put at B and the cross staff at C and the depth of cutting again read off $1\frac{1}{2}'$. As the ghat tracer at B is $3\frac{1}{2}'$ above the level of the road, this must be added to obtain the depth of cutting at C (*i.e.*, 5'). This last depth is marked on peg C. The ghat tracer and staff are brought to C and D, respectively. As the line of sight passes right above the cross staff, a bamboo is placed by its side and the staff lifted till the line of sight cuts the cross. The distance PD (bottom of staff to ground, say, 3'), is deducted from the level of C to get the depth of cutting at D. (*i.e.*, $5' - 3' = 2'$).

This is continued till ground level is reached. The distance the line of sight cuts below the cross must always be added, and the distance the cross staff has to be lifted must be deducted. A zero mark is made on the peg when ground level is reached to mark the end of the square cutting.

Hill side alignment.—In hill side alignment it is generally best to work down hill and at

fixed distances of, say, 50'. A peg is put in at the highest point and the ghat tracer erected at 1 in 20 down. Fifty feet are measured off in the approximate direction required and the cross-staff moved up or down hill till the line of sight cuts the cross. A level peg (about 4" long) is driven in flush with the ground with a position peg (about 2' long) by its side. The nearest tree, if any, is blazed. The ghat tracer is brought along from peg to peg. Should an obstruction like a large rock or precipice be met unexpectedly, a suitable line above the obstruction is selected and a peg driven in. Alignment is carried backwards at level until the old alignment is crossed. Then by returning to the peg above the obstruction the new alignment is carried on at 1 in 20 down.

Nala crossing in side cutting.—A road should go flush across small nalas in side cutting, though it is sometimes possible to make culverts. In either cases the road must be carefully graded down to the nala on both sides of it (diagrams Nos. 6 and 7).

Diagram No 6
(Longitudinal Section)

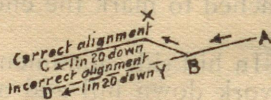


Diagram No 7
(Plan)



NOTES ON FOREST ROADS AND BUILDINGS

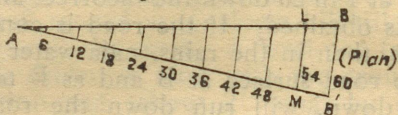
The road is aligned at 1 in 20 down from A to B where a small nala has to be crossed. If the nala is crossed and the alignment continued at 1 in 20 down the incorrect alignment BYD is obtained. If the road is constructed on this, then in the rains, nala water will fall on the road surface at B and as B to Y is 1 in 20 down, will run down the road until deflected by chance as long as the down gradient continues. To avoid this, the correct road alignment is BXC. From B to X the gradient is 1 in 20 up and from X onwards it is 1 in 20 down. Nala water now must cross the road and continue in the old bed.

Linking up in dense jungle.—The linking up of sections through dense forest can be achieved without excessive labour and felling by the method of offsets (diagram No. 8). The two points A and B are marked on the map as accurately as possible and joined by a pencil line representing the line to be laid out on the ground. The magnetic bearing of this is found and laid out from A (the more westerly point) with pegs and ranging rods at 200' intervals. The final error, if the line does not pass through B, is corrected by offsets.

If BB' is 60' and there are 10 pegs (200' apart) from A to B, then the error at B' is 60' and the difference in at successive pegs is $\frac{60}{10} = 6'$, i.e., L.M. = 54', etc. The new line

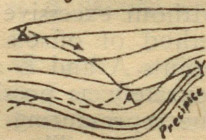
of pegs is thus laid out and straightened perfectly with a little clearing of the forest—

Diagram No. 8



Zig-zags and turns.—Zig-zag turns should only be used when an impassable obstruction is met and all alternative routes fail. Such turns are costly and the choosing of their site requires care. The flattest place is selected (diagram No. 9).

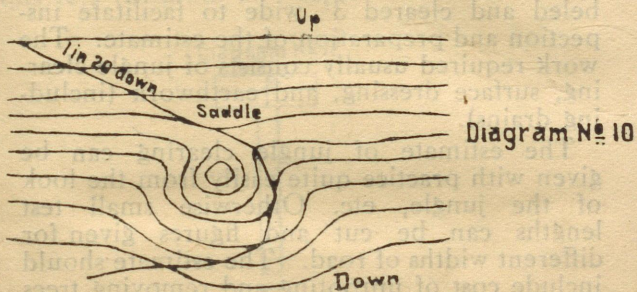
Diagram No. 9



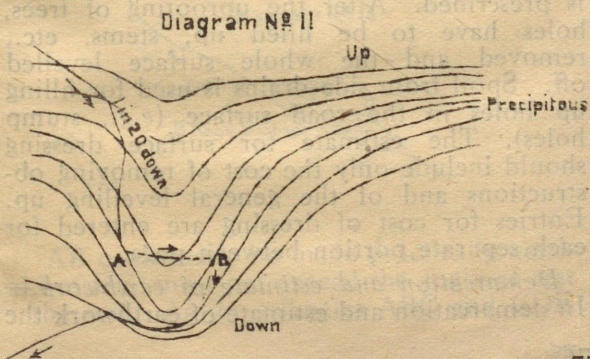
If in making the alignment down from X to Y an impassable precipice is met at Y, return along the alignment and select A, the flattest part of the hill slope in the alignment. Making a turn here continue down from A to Z. [For further details of the proper survey of the turn, *vide* pages 86 and 87 (estimates).] Small saddles and spurs found near where the turning is required should be used. The

NOTES ON FOREST ROADS AND BUILDINGS

alignment is carried through the saddle and round the front of the spur (diagram No. 10)—



When a flattish spur with no saddle is met, an artificial saddle is sometimes made in square cutting (diagram No. 11). Square cutting is from A to B (*vide* below). Sharp corners at A and B can be subsequently rounded off—



(3) Demarcation and Estimate of Work.

On completion of alignment the line is daggled and cleared 3' wide to facilitate inspection and preparation of the estimate. The work required usually consists of jungle clearing, surface dressing, and earthwork (including drains).

The estimate of jungle clearing can be given with practice quite easily from the look of the jungle, etc. Otherwise small test lengths can be cut and figures given for different widths of road. The estimate should include cost of uprooting and removing trees from the roadway. Double rates should be allowed for dense bamboo forest. An arbitrary estimate as an average for the whole jungle line leads to great inaccuracy.

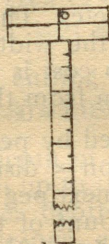
Surface dressing.—Allowance for surface dressing is only necessary where no earthwork is prescribed. After the uprooting of trees, holes have to be filled up, stems, etc., removed and the whole surface levelled off. Spoil from side drains is used for filling up holes in the road surface (e.g., stump holes). The estimate for surface dressing should include only the cost of removing obstructions and of the general levelling up. Entries for cost of dressing are entered for each separate portion between pegs.

Demarcation and estimate of earthwork.—In demarcation and estimate of earthwork the

NOTES ON FOREST ROADS AND BUILDINGS

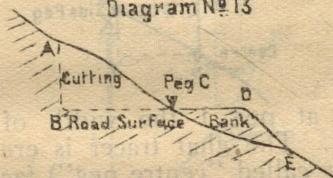
ghat tracer is used as a level together with a tape and two 16' bamboos marked in feet and quarters (diagram No. 12)—

Diagram No. 12



Earthwork in side-cutting.—The earthwork in side-cutting consists partly of cutting and partly of embankment as shown (diagram No. 13)—

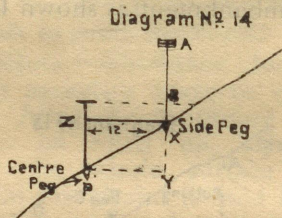
Diagram No. 13



AB can usually be made practically vertical but DE must not exceed the angle of rest of the soil. As the triangles ABC and CDE

are equal in area the width of the cut BC must be greater than that of the cover CD. For a 20' road—cut : cover :: 12 : 8 or 13 : 7 or 14 : 6, etc. (depending on the slope of the ground and the type of soil); while for a 16' road, 9 : 7 or 10 : 6 or 11 : 5, etc. The surveyor makes an eye estimate of the width of road to be made in cutting—no cost is usually necessary for bank construction from the cutting spoil.

Sections are marked by pegs at intervals of 50'. The cross-section \times distance from beginning of work to the next peg gives an estimated figure of the amount of the earthwork to be done. Thus (diagram No. 14)—



Starting at peg 1 the width of cutting is, *e.g.*, 12'. The ghat tracer is erected at the peg (now called "centre peg") facing the hill side. A graduated bamboo is laid horizontally with one end on the ground at 12' from the ghat tracer and a peg "side peg" driven in. The cross staff is placed at the side peg and with the ghat tracer at level, the length

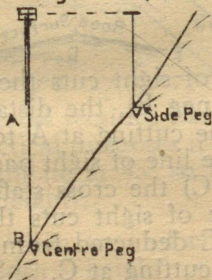
NOTES ON FOREST ROADS AND BUILDINGS

AB (=XY, the depth of cutting) is read off direct from the cross staff. The surveyor notes—(a) the width of cutting ZX, (b) the depth of cutting (XY=AB), (c) the type of soil. He proceeds from peg to peg in the same way. The area of cross-section PXY, if $XY=3\frac{1}{2}'$, is $\frac{3\frac{1}{2}' \times 12'}{2} = 21$ square feet.

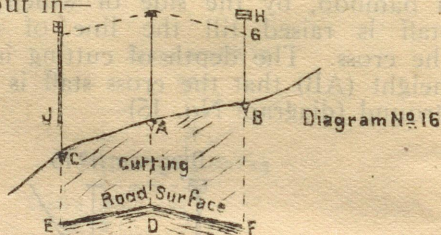
The volume of cutting from this peg to the next is $\frac{3\frac{1}{2}' \times 12'}{2} \times 50 = 1,050$ cubic feet.

Readings for depth of side-cutting as above can only be taken up to the length of the cross staff. For greater depths the ghat tracer is placed at the side peg, and at the centre peg a bamboo, by the side of which the cross staff is raised till the line of sight cuts the cross. The depth of cutting is then the height (AB) that the cross staff is above the ground (diagram No. 15)—

Diagram No. 15.



Earthwork in square cutting.—For earthwork in square cutting centre pegs should usually be at intervals of 10' and cross sections taken at each peg. The volume is obtained by multiplying by the length to the next peg. Square cutting roads must be provided with good drainage by having a camber or crown of 1 in 15 to 1 in 20. This is done by setting the ghat tracer at 1 in 20 down when measuring the depth of cutting at side pegs from the centre peg (diagram No. 16). The depth of cutting at A the centre peg, (AD), has been found during alignment. 10 feet on either side (or 8 feet if the road is to be 16' wide including drains) is measured, and side pegs B and C put in—



If the line of sight cuts the cross staff (as at G for side peg B), the distance HG must be added to the cutting at A to give the cutting at B. If the line of sight passes over the cross staff (as at C) the cross staff should be lifted till the line of sight cuts the cross, and the elevation JC deducted from the cutting at A to give the cutting at C.

NOTES ON FOREST ROADS AND BUILDINGS

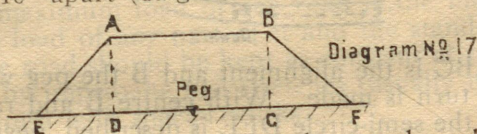
The area of cross section is obtained by—

$$\frac{\text{Depth at A} + \text{depth at B} + \text{depth at C}}{3} \times \text{the width of road}$$
 and the volume by multiplying the result by the length to the next peg.

A more correct formula is—

$$\frac{2 \times \text{depth at A} + \text{depth at B} + \text{depth at C}}{4} \times \text{the width of road}$$
 and this should be used if the depth of the cutting at the three pegs varies much. The surveyor notes the depths of cuttings at the three points, putting the centre peg first, then the width and type of soil, cost of jungle clearing, etc.

In the case of the usual lengthy bank over low-lying, swampy ground the height of the bank is measured by using the ghat tracer as a level and noting the height to which the cross staff has to be raised at a series of centre pegs 10' apart (daigram No. 17)—



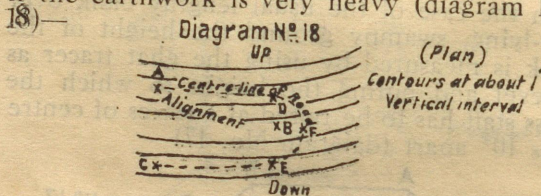
The areas of cross sections have to be calculated. For practical purposes it can be assumed that earth will lie at 45° so that $AD = DE = BC = CF = h$ (height).

If W = width, then area of cross section = $(h + W)h$ or $(\text{width} + \text{height}) \times \text{height}$

The surveyor roughly locates necessary borrow pits which must not be less than 15' from the foot of the bank to arrive at estimate for cost of transport.

Another type of bank is characteristic of side-cutting along a hill side when a small nala is crossed. Such nalas can sometimes be filled with the spoil of adjacent side-cuttings and no allowance is necessary. Otherwise the height can be measured with the ghat tracer and width estimated or measured.

Layout of zig-zags.—In laying out zig-zag turns they must be given a radius of at least 20' to the centre of the road, reducible to 15' if the earthwork is very heavy (diagram No. 18)—



ABC is the alignment and B the peg where the turn is made. With centre B and radius 20' the semi-circle DFE is described, pegs put in, and the straight lines AD and CE dashed. ADFEC is the centre line of the road. Square cutting will have to be made from A to D and on approximately to F. The spoil can be used to make a bank from C to E and on approximately to F. The gradient

NOTES ON FOREST ROADS AND BUILDINGS

from A to D and from E to C will be about 1 in 20 down; from D to F and D to E will be about level. A beginning is made from A at 1 in 20 down, pegs being put every 10'. The square cutting to D and on (at level) to about F (where cutting finishes) is estimated. Then a fresh beginning is made at C and the bank laid out to E at 1 in 20 up and on to F at level where it joins up to the cutting.

Murraming and metalling.—The material for murraming and metalling is obtained from quarries located by the surveyor, the work consisting of quarrying, breaking up to gauge, carting from quarry to site, and spreading out and consolidating. Local rates are applied.

Other special works.—For all special works (as simple bridges, causeways, culverts, etc.) the surveyor takes special orders but must submit measurements of the necessary work. The maximum load of any road is the maximum load of any part of it and the standard of the road should be kept as constant as possible by improving bad stretches (usually nala crossings) with special works.

Submerged nala crossings.—Sandy nala crossings are very difficult for carts. A cheap form is shown below (diagram No. 19)—

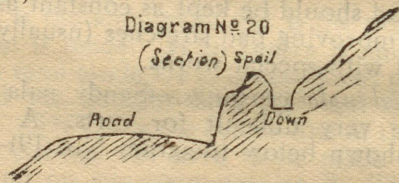
Diagram No. 19



Sand to a depth of $3\frac{1}{2}$ ' is excavated and filled up as shown in section with $1\frac{3}{4}$ ' of boulders, 6" metal, and 3" murrum. The whole should be well consolidated. The surface of the road will then lie 1' below the level of the sand. The first rains will cover the road with sand which will protect the surface and can be raked away again afterwards. Such crossings 10' wide can be constructed at about Rs. 3 per running foot and last well.

Drains.—The provision of proper drains for forest roads is very important and reduces the cost of maintenance. Surface roads can usually be closed to cart traffic in the rains and on ghat section cross drains can be laid down just before them. The necessity of having catchwater drains usually arises on ghat sections.

The following type keep water from above the road from falling on to it (diagram No. 20)—



Catchwater drains are usually unnecessary where the slope above the road is short or undulating and much intersected by nalas.

NOTES ON FOREST ROADS AND BUILDINGS

Where the slope is long and even they should be included in the estimate and specification. They should be 2' wide at the top, not less than 1' deep, and 1' wide at the bottom. The spoil is heaped on the lower side. Such drains should be graded with a ghat tracer at about 1 in 30 and diverted into nalas wherever possible. They do not replace cross drains but assist them in preserving the road surface.

On fairly level ground a drain on each side is usually required; if the ground slopes sharply away to one side, the drain on that side can be omitted. The function of drains (*i.e.*, to lead water away from the road and not to accumulate it on the surface) must be realised. They should be continuous for short distances only, properly graded, and diverted into nalas, etc., wherever possible. This is often a matter of skill on the upper side of a road. Here such drains should be 2' wide at the top, 6" deep and 1' wide at the bottom. The lay-out of drains is made at the time of construction and the surveyor only notes the number of drains required.

Two drains are always required in square cutting—one on each side of the road and should be 2' wide at the top, 1' deep and 1' wide at the bottom. They are diverted from the ground at every opportunity even if special cuttings are necessary.

Forms.—The following forms are suitable for the surveyor's note-book and estimate, respectively:—

Surveyor's Note-book Form.

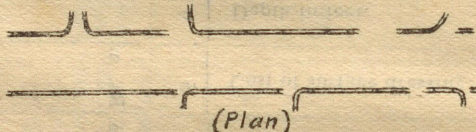
Peg No.	Distance to next peg in feet.	Gradient to next peg + = up — = down = level.	Cost of jungle clearing.	Cost of surface dressing.	Cutting in feet.			Remarks.	
					Depth.	Width.	Soil.		
1	2	3	4	5	5	7	8	9	10
			Rs. a-	Rs. a.					

(4) Construction.

The officer in charge of road construction must have a copy of the estimate, specification, sanction, and orders thereon. Labour and a sufficient number of supervisors (forest guards, etc.) are arranged. The first work (lay-out on the ground) requires a ghat tracer, graduated bamboos, tape, pegs, coal tar, 200 yards of strong string, and a few coolies with picks, etc.

Lay-out in flat country.—In flat country the side limits of the work are first dagbeled. With a road 25' wide, 4' for drains are added, *i.e.*, 14½' on each side of the centre peg. This width is cleared of jungle and side drains dagbeled. These are diverted at every opportunity and gentle curves are always used (see below, diagram No. 21)—

Diagram No. 21

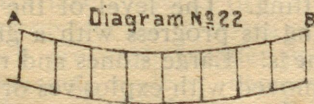


All obstructions (rocks, white-ant hills, etc.) are removed and surplus earth used to fill up holes and make the camber.

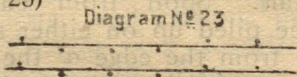
Lay-out in side cutting.—In side cutting, trees may be easily removed (from the cutting portion) after the earth round them has been

NOTES ON FOREST ROADS AND BUILDINGS

cut away. The gradient (usually 1 in 20) between successive (50') pegs must be maintained evenly and undulations avoided. The ghat tracer is set at the higher peg at 1 in 20 down and the staff erected about 5' away. A point here at the right grade is found and marked with a peg. The staff is moved another 5' away and a further point found. Thus, similarly pegs are driven in at 15, 20, 25, 30, 35 and 40 feet to give a series between the main pegs. The series is not necessarily on the centre line of the road as it serves only to indicate the correct level of the road surface. The intermediate pegs will indicate whether a saving of earthwork can be made by the introduction of a slight curve (diagram No. 22)—



In this case a dagbel is laid out from A to B and a parallel one between the side pegs. A side peg is put in on the second dagbel opposite each intermediate level peg (the ghat tracer being put actually on the level peg). The cutting work is now fully laid out (diagram No. 23)—



Should the lay-out be as shown above (diagram No. 23) the centre line and then the side-peg line should be dagbeled straight to avoid a number of small curves. In calculating cutting at the side pegs the ghat tracer is put on the centre level pegs and not on the centre dagbel. The actual construction is then carried out, the level pegs giving the correct level of the road surface and the side pegs the depth of cutting at each peg.

When the main cutting is laid out the bank portion is begun. The toe of the bank is judged by eye and a line of stones well bedded in the ground is first made. Where stones are plentiful a regular sloping wall of them is built up. The top is made a little too high to allow for settling. The level of the work is checked during its progress with a graduated stick at side pegs. Large stones and rocks are dug up or removed with explosives or cracked by burning a fire on them for several hours and then suddenly drenching with cold water.

Square cutting.—In square cutting level pegs must not be put in till the work is nearly finished. Additional centre and side pegs can be put in until the work is nearly finished, at 5' intervals. Spoil from cuttings has usually to be piled up on either side at not less than 5' from the edge of the cutting (a 5' dagbel is required).

NOTES ON FOREST ROADS AND BUILDINGS

The depth of cutting is frequently checked and the earth round centre and side pegs left till the work is finished and passed by the inspecting officer.

The ends of the cutting require special attention. Drains should be dug and every opportunity taken to divert them out of the cutting.

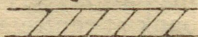
Banks.—Banks should be made of the hardest material available and with stone toes or retaining walls if possible. A 6" or 1' layer of murrum on top is very desirable. The height of the bank at centre and sides is shown by long pegs each projecting above the ground as far as the correct height of the bank. They can be put in by using the ghat tracer as a level. Banks of earth several feet high are constructed in layers—the first being 6"—which are each trodden well down. A bank crossing a deep narrow nala should always have a simple culvert or else large stones at the bottom to allow passage of water.

(5) *Repairs and maintenance.*—Proper repair and maintenance of forest roads is essential. Repairs following the first rains after construction are especially important. The drainage system is tested and obvious improvements made. Surface dressing is again carried out over the entire length. Cart ruts are the main

source of trouble, especially on long gradients. Roads can be closed to cart traffic during the rains and raised cross drains made. These should be made in May at 20' to 30' intervals on all except flat sections. A pole (of at least 18" girth) is laid across the road and backed up with earth on its lower side. Cart tracks are filled with stones.

The lay-out of cross drains varies somewhat. If the road is in side cutting they must all slope one way (diagram No. 24)—

Diagram No. 24



If the road is in square cutting or no cutting at all they usually slope alternately one way and the other (diagram No. 25)—

Diagram No. 25



At the time of construction of cross drains all side drains are cleaned out and repaired. Care is taken that the outflow is clear—this is ensured several times during the rains. Regular annual repairs are carried out immediately after the rains, cross drains are removed (the pole being placed at one side of the road for possible use next year), banks are repaired, ruts filled up, nala crossings re-made, etc. All sections which have worn badly and require special repairs, are reported

NOTES ON FOREST ROADS AND BUILDINGS

in detail for orders. If roads are repaired properly and drains kept clear and in order, it will soon be found that the standard of the road is improved and that the cost of annual repairs decreases. The cost of construction of forest roads varies enormously (e.g., from Rs. 200 to Rs. 1,000 per mile). Hill roads with heavy cuttings and blasting may cost up to Rs. 1,865 per mile in Nimar, while ordinary hill roads in the same division cost only Rs. 119 per mile.

Maintenance charges vary from Rs. 5 to Rs. 30. Tools purchased are pickaxes, phoras, crow-bars, hammers and baskets. Current prices of pickaxes and phoras, respectively, are Rs. 2-8-0 and Re. 1-3-0.

Gradients.

1 in—	Per cent.	Angle.	
1	100	45°	0'
1½	67	33°	41'
2	50	26°	34'
3	33	18°	26'
10	10	5°	43'
12	8·3	4°	46'
15	6·7	3°	49'
18	5·6	3°	11'
20	5·0	2°	52'
25	4·0	2°	18'

Gradients.

Kind of road.	Average gradient.	Ruling gradient.
Foot roads for laden coolies.	1 in $7\frac{1}{2}$	1 in 5
Bridle roads for laden ponies.	1 in 10	1 in $7\frac{1}{2}$
Bridle roads for pack animals.	1 in 15	1 in 10
Roads for camels ...	1 in 20	1 in 15
Roads for wheeled traffic.	1 in 50	1 in 20

BUILDINGS.

Repairs to forest rest-houses.

Thatched roofs should be renewed every 3 years and grass blown away replaced annually. If the junction line of walls and ceiling is filled up with thorns, bats can be kept out. All woodwork of doors, windows, furniture, etc., should be treated by rubbing with half-boiled linseed oil every year. All furniture should be varnished every 5 years in addition.

NOTES ON FOREST ROADS AND BUILDINGS

Broken panes of glass should be quickly replaced and fresh putty put in where necessary. Putty consists of—

Chalk	...	10 parts
White lead	...	1 part

Linseed oil (boiled) is mixed with the above to the requisite consistency.

Cracks in the walls and floor should receive immediate attention. Extravagance in white washing charges is common. The charge should not exceed annas 4 to annas 5 per 100 square feet (exclusive of carriage charges to distant places). "Fat" lime should be used.

Melghat figures for cost of thatching are—

	Rs.
Thatch 9" thick	... 7½ per 100 sq. ft.
Do. 6" do.	... 5½ do.
Do. 3" do.	... 3 do.

In Yeotmal thatching of 1" thick costs per 100 sq. feet Rs. 2-4-0.

Mud plastering of outhouse walls, clearing of regrowth in the compound, maintenance of rest-house approaches are points to be watched..

General.

In constructing quarters select a suitable site, paying special attention to the following

points. The village must be well chosen, preferably in a central position. Proximity—roads, medical attendance, post office, social amenities should be remembered. Give preference to a site near houses of villagers of good standing, and accessible to a good water-supply. Bear in mind the possibility of sinking a well near by. Good drainage on the site is essential—avoid a water-logged position. As regards soil, avoid necessity of deep foundations. Acquire a good lease (land acquisition), remembering the size of compound required.

Building materials.

Bricks.—Size of standard table moulded bricks is $9'' \times 4\frac{3}{8}'' \times 2\frac{3}{4}''$.

Size of table moulded bazar bricks is $8\frac{1}{2}'' \times 4'' \times 3\frac{1}{2}''$.

Size of sundried and kumbar bricks is $9'' \times 4\frac{1}{2}'' \times 1\frac{3}{4}''$ or $8'' \times 4'' \times 2''$.

1,400 standard table moulded bricks of $9'' \times 4\frac{3}{8}'' \times 2\frac{3}{4}''$ are required for 100 c.ft. of brick in line or brick in clay masonry. For the same amount of masonry 1,600 table moulded bazar bricks of $8\frac{1}{2}'' \times 4'' \times 2\frac{1}{2}''$ or 1,700 to 1,800 sundried and kumbar bricks of $9'' \times 4\frac{1}{2}'' \times 1\frac{3}{4}''$ (or $8'' \times 4'' \times 2''$) are necessary.

Lime mortar consists of 1 part of lime to 2 parts of sand.

NOTES ON FOREST ROADS AND BUILDINGS

24 c.ft. of lime mortar are required for 100 c.ft. of wall (brick in lime). — 25

25 c.ft. of lime mortar are required for 100 c.ft. of wall (stone in lime).

30 c.ft. of lime mortar are required for 100 c.ft. of wall (kumbar brick in lime).

Mortar should not be more than $\frac{3}{8}$ " thick between bricks.

A mason should lay 300 to 350 bricks in lime or clay masonry per day, *i.e.*, 25 c.ft. of masonry

Weight of material—

	Lb. per c.ft.
Clay	... 130
Loam	... 110
Sand	... 125
Rammed earth	... 100
Brick work (burnt brick)	... 120
Brick work (sundried brick)	... 100
Stone masonry	... 156
Lime concrete	... 115
Cement concrete	130 to 150
Reinforced concrete	... 150
Lime plaster	... 106
Lime mortar	... 109
Shingle	... 90

In earthwork a man can dig and fill in baskets in one day—

	C. ft.
(1) Soft earth	120 to 125
(2) Hard murrum	55 to 60
(3) Boulders and clay	40

The proportions of lime concrete used in foundations are 100 c.ft. gitti to 33 c.ft. mortar (*i.e.*, 22 c.ft. sand and 11 c.ft. lime).

The number of headers that should be allowed in stone-in-lime plinths is roughly one quarter the amount of masonry, *i.e.*, 25 per 100 c.ft. (of all courses).

CHAPTER IV.

UTILIZATION: FUEL, POLES, BAMBOOS,
SLEEPERS, SEASONING OF TIMBER, ETC.

NOTE ON FUEL.

Mainly from figures collected at the Dhamtari Depôt, South Raipur division.

Size of fuel stacks (mainly *satkatha spp.*).—
8' × 5' × 4'

Billets—4'—10' in length; 4"—12" in girth.

Weight of stacks and loss of weight in drying.—Weight of stack 8' × 5' × 4' (or 160 c.ft.)—(green weight), 30—40 mds. (dry weight) 18 mds.

Dry weight per stacked c.ft.—4.55 seers.

Most of the loss in weight occurs in the first 6 months after felling. After about 10 months the loss is negligible and the weight of the stack remains almost constant till white ants attack it.

Cost of cutting and stacking.—per stack, annas 8; per stack (if fuel has many thorny climbers, etc., or if density of crops is poor), annas 9.

Cost of carting to depôt.—Varies with proportion of katcha and pucca road, number of sandy nala crossings, etc.

C. P. FOREST POCKET BOOK

Examples—

South Raipur.	Length of forest road lead.	Length of P. W. D. road lead.	Cost per stack.
	Miles.	Miles.	Rs. a. p.
Gurur range ...	2-3	10-14	2 2 0
Dhamtari range...	1-2	7-9	1 8 0

An average South Raipur bullock or buffalo cart carries 15 maunds fuel (green).

Cost of weighing fuel on receipt in depôt.—
Per cart-load of 15 maunds (average),
Re. 0-3-6.

NOTE.—Fuel stacks at the railway depôts should be of such a size that wagon loads can be made up without a second weighing.

Railway carriage of fuel (South Raipur narrow gauge).

Open trucks design.	Dimensions.	Carrying capacity.	Cost of loading.	Remarks.
S. O. C.	Feet.	Tons.	Rs. a.	Length of chains supplied for fuel transport is 20'.
(i) Single chain fitted open trucks.	16 x 6	4½	1 0	
O. B. R.				
(ii) Open bogie chain fitted trucks.	27 x 6	11	2 0	

With loading to a height of $9\frac{1}{2}'$ this gives for (i), 912 c.ft. or 105 to 108 maunds and for (ii) 1,539 c.ft. or 185 to 190 maunds.

In Nimar, Melghat and Yeotmal the average volume of a cart-load of fuel is 15 to 20 c.ft. only. Carting rate is annas 2 to 3 per mile. Berar carting rates are higher (*e.g.*, Rs. 4 in Akola for distance up to 20 miles).

POLES, BAMBOOS, CAPACITY OF CARTS,
WAGONS, ETC.

Northern Circle average figures are—

Number of poles (12"—18") per cart—

(a) On pucca roads	... 25 (dry)
(b) On kutchra roads	... 18 (dry)
(c) On pucca roads	... 15 (green)
(d) On kutchra roads	... 10 (green)

Number of bamboos to a cart on both pucca and kutchra roads—

(a) Green bamboos (thick)	... 50
(b) Green bamboos (thin)	... 75—100
(c) Dry bamboos	... Up to 200

Cost of cutting bamboos (Balaghat) varies from Re. 0-12-0 to Re. 1 per 100.

Number of bamboos to a wagon-load (narrow gauge)—

(a) Bamboos up to 4" girth	... 3,700
(b) Bamboos above 4" to 6" girth	3,000
(c) Bamboos above 6" to 8" girth	2,500

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SAL SLEEPERS.

Sal sleepers.—(Average figures from Balaghat, South Raipur and South Mandla).

Dimensions.	B. G.	M. G.	N. G.	Remarks.
	9½' x 10" x 5" or 3·3 c.ft.	6' x 8" x 4½" or 1·5 c.ft.	5' x 7" x 4" or 1·1 c.ft.	
	M. S.	M. S.	M. S.	
Weight freshly converted.	2 30	1 15	1 0	
Weight seasoned (<i>i.e.</i> , over 2 years old).	2 0	1 0	0 30	
Weight of sleepers sawn October—December and weighed following March.	2 19	1 5	0 32	Average weight per c.ft. 31 seers.

Carting of sleepers.—Figures per cart are—

Division.	B. G.	M. G.	N. G.	Remarks.
	Number of sleepers.			
Balaghat and Mandla.	3—6 usually 4—	5—10 usually 9—	12—0	
South Raipur	8—10	12—16	15—20	

Average cost of carting sleepers.—South Raipur per mile per sleeper—

B. G.	M. G.	N. G.
Pies. 5½	Pies. 2¾	Pies. 2

Cost of sawing sleepers (per sleeper)—

B. G.	M. G.	N. G.
Rs. a. p. 0 14 0 to 1 0 0	Rs. a. p. 0 7 0 to 0 8 0	Rs. a. p. 0 5 0

Number of sleepers to a wagon—

Kind of sleeper.	Number.	Remarks.
B. G.	150	Covered bogie wagon 33' x 7' (height 7'), capacity 16 tons.
M. G.	400	
N. G.	450	
B. G.	62	Covered single wagon 16' x 16' (height 7'), capacity 5 tons.
B. G.	62	
M. G. or N. G....	100	

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Number of sleepers to a wagon—concl'd.

Kind of sleeper.	Number.	Remarks.
B. G. ...	50	Open single truck 16' x 16' (height 7'), capacity 4½ tons.
M. G. or N. G....	100	

Number of sleepers that go to a ton (sawn) October to November and converted following March—

B. G.	M. G.	N. G.
11	25	34

C. P. Sleeper outturn from sal trees (in c.ft. of sleepers).

Girth class. (in feet).	Quality I.	Quality II.	Quality III.
Over 3—4 ...	8·6	5·6	3·0
Over 4—5 ...	14·0	9·8	6·0
Over 5—6 ...	20·0	14·5	9·8
Over 6—7 ...	27·0	20·2	14·5
Over 7—8 ...	36·4	26·9	19·8
Over 8—9 ...	47·7	35·4	26·2

C. P. Sleeper outturn from sal trees (approximate—by sleepers).

Girth class (in feet.)	Quality I.			Quality II.			Quality III.		
	B. G.	M. G.	N. G.	B. G.	M. G.	N. G.	B. G.	M. G.	N. G.
Over 4-5	2	4	2	1	2	2	0	4	0
Over 5-6	3	4	2	2	4	2	2	2	1
Over 6-7	5	3	1	4	3	1	3	3	0
Over 7-8	9	3	1	7	2	1	5	2	0
Over 8-9	13	3	1	10	2	1	7	2	0

UTILIZATION

NOTES ON CHARCOAL MANUFACTURE.

The Sambalpur method described below is a useful model.

The type of kiln used in "paraboloidal" of a capacity of 600 c.ft.

Preparation of site.—The site should be as level as possible and should be cleaned of stones and brushwood. Alongside this another clearing is made for spreading the charcoal to cool when the kiln is opened. A heap of loose earth should be placed near the kiln for use in covering and controlling the kiln. Water must be near the site.

The kiln.—Billets used are of uniform length 2'. The central flue (of bamboos) is 6' high and 1' diameter. Billets are stacked on and round the flue in three tiers as closely as possible and interstices are filled with small billets and sticks.

The kiln is given—(a) an inner covering of green bamboos and twigs; (b) an outer covering of earth.

Burning.—After sunset a few dry twigs, etc., are dropped down the flue followed by a few glowing embers. Once the fire is well started the flue is completely filled first by small and finally by large billets. These are well rammed down and the flue covered over. The whole kiln now has an earth covering

which is usually so porous that there is no difficulty in lighting the kiln. Should more draught be necessary, air can be admitted by opening a small hole in the covering close to the ground. This is closed up as soon as the fire has caught. Kilns require constant attention for the first day or two after lighting and burners should be on duty day and night as burning progresses, beating in the covering and applying more earth whenever combustion is seen to be too rapid.

Burning should be complete in about 3 days but the exact time varies with the species burnt. Sal billets in a 600 c.ft. kiln are converted to well burnt charcoal in 48 hours. In cases of over-burning, the charcoal in the top and centre of the kiln suffers. Billets round the outside of the bottom tiers may be incompletely burnt and the collection and reburning of these should be included in the burner's contract.

The weak point of burning with dry covering is uneven burning.

Opening the kiln.—This is done at night on the leeward side, very gradually. The charcoal is raked into small baskets and spread over the ground already prepared for it to cool. A supply of loose earth is kept near at hand wherewith to close up the kiln in case of danger of its catching fire. When the spread charcoal is "dead" it is sorted, stacked

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and weighed. Half burnt pieces are collected for reburning.

Suitable species—

Shorea robusta, sal (probably the best).

Tectona grandis, teak.

Terminalia tomentosa, saja.

Pterocarpus marsupium, bija.

Dalbergia latifolia, shisham.

Cleistanthus collinus, garari.

Lagerstroemia parviflora, lendia.

Anogeissus latifolia, dhaura.

Acacia catechu, khair.

Acacia arabica, babul.

Zizyphus Juiuba, ber.

Odina Wodier, moiën.

Mixing of species in one kiln gives rise to uneven burning and waste and should be avoided.

Labour, cost and outturn.—The manufacture is usually done on contract and average figures for a gang of 3 to 4 coolies per kiln of 600 c.ft. are—

	Rs.	a.	p.
(i) Billetting	...	6	0 0
(ii) Building kiln	...	1	8 0
(iii) Covering	...	1	4 0
(iv) Burning and watching	...	2	0 0
(v) Opening kiln and stacking charcoal.	...	2	8 0

Average outturn per kiln is 45 maunds.

In Sambalpur the total cost per maund of production, including the above plus carriage to rail at 5 annas per maund, and contingencies at 4 annas per maund, is Re. 0-13-9.

General.—Felling refuse or small material unwanted by timber contractors is best suited for charcoal manufacture. Large godowns at the despatching stations are essential.

For comparative costs of other methods, *vide also Ind. For.*, April 1925.

C. P. Railway Rates for sawn timber and firewood, 1925.

(i) *G. I. P. Railway.*—Firewood and timber at 1st class rate, *i.e.*, 0.57 pie per maund per mile with usual terminals. For special rates for certain stations, *vide p.* 184, *G. I. P. Goods Tariff, Part I-B, of 1924.*

(ii) *E. I. Railway.*—Firewood is chargeable at 1st class rates, *i.e.*, 0.38 pie per maund per mile with usual terminals on actual weights, and at c/Q schedule rate at owner's risk in minimum loads of 300 maunds, owners to load and unload. Basis of c/Q schedule rates charges is—

	Per md. per mile Pies.
For the first and up to 100 miles	2.000
For extra distances above 100 miles but not exceeding 200 miles to be added to the charge for 100 miles.	0.170

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	Per md. per mile Pies.
For extra distance above 200 miles but not exceeding 500 miles to be added to the charge for 200 miles.	0.140
For extra distances above 500 miles to be added to the charge for 500 miles.	0.100

Sawn timber is chargeable at 1st class rates, *i.e.*, 0.38 pie per maund per mile with usual terminals. For types dimensions and details of wagons, *vide* p. 633, E. I. R. Goods pamphlet No. 1.

(iii) *B. B. & C. I. Railway* (metre gauge).—From M. G. Section to M. G. Section.—(a) For one 4-wheeled wagon up to the carrying capacity of 245 maunds a charge per truck per mile of Re. 0-3-0, plus terminal charge of Rs. 2-0-0.

(b) Minimum charge Rs. 10-0-0 per 4-wheeled wagon.

(iv) *B.-N. Railway*.—*Vide* B.-N. Railway Goods Tariff, pp. 5—15, 76—80 and 132.

NOTES ON SEASONING.

Artificial seasoning follows the lines of, and is merely accelerated, natural seasoning. Humidity is maintained during the process to avoid unequal drying and case hardening.

Most Indian species should be seasoned either by girdling or by the conversion of green logs with or without subsequent immersion of converted material in water. Protection against sun and rain must be given to prevent cracking and decay. Removal of bark reduces insect damage but increases danger of splitting. Log seasoning is very slow and there is more damage by cracking, insects and fungi. Squared timber is less liable to crack than round, split timber less liable than sawn. Sweet considers (*Ind. For. Records*, Vol IX, Part V) that if the log can be converted soon after felling, the time of felling is of little importance as regards seasoning.

Conversion notes on Central Provinces species.—Vide also *Ind. For. Records*, Vol. VII, Part I.

Adina cordifolia.—The timber is more suitable for conversion to planks, boards and rafters than into beams.

Anogeissus latifolia requires care in stacking.

Bassia latifolia.—Best to convert green logs, and then stack in the shade for 12—18 months. Immerse planks at once for 4 weeks, then season on land for about 18 months.

In stacking this timber, wedges must be kept between the planks to prevent discolouration. This applies to several other spp. also, e.g.,

salai *B. serrata*). The stack should be periodically broken.

Chloroxylon swietenia.—Season in the log. Keep well covered when seasoning after conversion to avoid change of colour.

Cleistanthus collinus.—Season in the log.

Dalbergia latifolia.—Season in rough hewn squares for 18—24 months. Green conversion is useless as it involves loss of much of the valuable colour.

Dalbergia sissoo.—Season for 6—12 months in the plank.

Diospyros melanoxylon.—Season for 6 months in the plank.

Hardwickia binata.—Seasoning in the log must be avoided on account of borers. Convert immediately after felling. Avoid rapid drying of stacked converted material.

Lagerstroemia parviflora.—Season in the plank for 6—12 months. More suitable for rafters and scantlings than planks.

Odina Wodier.—Convert green immediately after felling. Stack carefully.

Ougenia dalbergioides.—Fell either in January or August, season in the log for 12 months then season in the plank for 6—12 months. Before seasoning in the log this timber must be barked on account of insect damage.

Phyllanthus emblica.—Water seasoning or green conversion.

Pinus longifolia.—Convert green and season under cover for 6–12 months.

Pterocarpus marsupium.—Convert green to planks and scantlings, then immerse in running water for 6 weeks or stagnant water for 4 months. Finally season on land for 12 months under cover.

Shorea robusta.—Best method not yet known. A good method (the only drawback being borer damage) is seasoning in the log in the shade for 20 months followed by conversion and seasoning for 12 months.

Soymida febrifuga.—Convert green. Minimises insect damage.

Stephegyne parvifolia.—Season for 6 months in the plank.

Tectona grandis.—(a) Timber from the log.—Convert and season in the plank for 15 months.

(b) Pole wood.—Fell in August, immersing poles at once in water for 2–3 months, then season on land for 9 months.

Terminalia arjuna.—Season in the plank for 12 months.

Terminalia belerica.—Convert and season for a short period under cover.

Terminalia tomentosa.—Convert timber from green logs with or without subsequent

immersion in water, then season in the shade for 12—18 months.

Xylia xylocarpa.—Convert as soon after felling as possible and season for short period under cover.

General note.—Girdling in the Central Provinces as a preliminary seasoning measure has been proved a failure on account of the dryness of the climate.

Stacking of converted timber.—Vide also *Ind. For. Records*, Vol. IX, Part V.

Stack so that every board is flat and not subjected to bending. Piling sticks should be in line one above the other. The weight of the pile should thus keep everything flat (otherwise boards dry out curved). Avoid overhanging board ends (causing warping and bending) by putting the longest boards at the bottom and the shortest at the top.

A stack in the open should be protected with a thatch on top and given side protection from wind. (In the case of woods which season slowly.)

Avoid facing ends of planks to the prevailing wind as this causes their overdrying together with stagnation in the centre of the stack. Ventilation across and through is wanted.

CHAPTER V.

MINOR FOREST PRODUCTS: HARRA, LAC, GRASS, MEDICINAL USES OF FOREST PRO- DUCTS.

NOTE ON HARRA (*Terminalia chebula*) FRUIT.

Fruits of the harra (*Terminalia chebula*) which occurs scattered in open mixed forests on higher plateau constitute the Myrabolams of the dyeing industry. The fruit is 1" to 1½" long, ribbed and yellowish when dry and ripe. Collection commences about the middle of November. The fruit is shaken or beaten from trees. Unripe fruit (much of which is usually also collected) gets discoloured in drying and is of inferior quality. It is dried in the sun (night dew during drying does not discolour) and then stored. Moisture then discolours it. In the store room harra should be kept (either in heaps or filled in gunny bags) on low *machans* 2' to 3' high, plastered with mud to avoid possible damping. Un-crushed harra is less liable to discolour in wet weather though crushing is carried out at time of export (mainly to reduce freight charges). The rind is separated from the seed and sometimes sold to brick and tile-makers as fuel.

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NOTE ON LAC.

General.—In former years lac was in demand for the dye produced. Substitutes for this supplanted it, but later the value of the resinous product made its cultivation profitable. Fluctuations in price were so great as to make cultivation speculative but recently stabilisation of prices due to steadier and increased demand now make regular production feasible. The industry represents practically a world's monopoly for India and no satisfactory substitute has been produced.

The lac insect.—*Tachardia lacca* belongs to the Coccidæ of Scale insects. The scale here is lac, a protective excretion and secretion of an amber-coloured resinous substance. The insects suck its food solutions from the host plant by means of a hairlike proboscis. The life of the female insect is about 6 months, and there are two broods per year. The summer brood swarms at the end of the hot weather or early rains (South Raipur, 25th June to 15th July) and the winter brood about January (South Raipur 8th to 20th January). A mass of minutes larvæ emerge from lac crust of the dead mother and seek small shoots of the host of sufficient tenderness for them to pierce. Failing finding a suitable host-twig within [it is said], a day, the larvæ perish. The majority of the insects emerge in the first few days but swarming goes on for about a month. [Note.—Swarming period

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of kusum lac is about a month after that for other species.] The mortality during swarming is enormous and continues great (up to 25 per cent) for the first month after settling down. Insect, etc., enemies of lac, hot dry winds, frost, dust, hail and heavy rain all destroy moving and recently-settled larvæ and largely affect the future lac crop. The female larvæ begin to produce lac after settling and excrete "honey dew". After the first moult legs, etc., are lost and the insect consists of a sac with probosis at one end and breathing holes at the other. The holes at the latter end are not closed up by lac but from them protrude waxy white filaments, the amount of which in a crop is an indication of its general vitality. The male insects develop differently and produce only a small amount of lac, but after about seven weeks from swarming again emerge and appear with legs and wings to fertilise the stationary females. Without fertilisation the full lac crop is not produced and the male swarming period is hence also a critical time. After the fertilisation the female produces lac rapidly and then dies. The young emerge from the body and swarm when ready.

Main lac hosts.—

Kusum (*Schleichera trijuga*).

Ber (*Zizyphus Jujuba*).

Ghont (*Zizyphus xylopyra*).

Palas (*Butea frondosa*).

Pipal (*Ficus religiosa*).

Babul (*Acacia arabica*).

NOTE.—Lac from kusum can be transferred to ber from ber to ghont, etc., and not in the reverse order. Only kusum lac (it is said) can be transferred to babul.

The above are of major importance. Of the many other trees on which lac will grow the following common species of the Central Provinces also may be mentioned:—*Ficus*, *Shorea*, *Albizzia*, *Acacia* and *Dalbergia species*, *Mangifera indica*, *Ougenia dalbergioides*, *Tamarix gallica* and *Spatholobus Roxburghii*.

Names of crops and swarming dates.—*Ku-Sum*.—Summer crop (*jewthi*) swarms July-August giving winter crop (*kusmi*), which swarms December-January to give summer crop (*jewthi*) again.

Other species.—Summer crop (*baisakhi*) swarms June-July giving winter crop (*katki*), which swarms October-December to give summer crop (*baisakhi*) again.

In the case of kusum the winter crop is better than the summer crop; with other species the reverse is the case except in Damoh division (ghont lac), Bhandara and neighbouring divisions.

Exact dates of swarming vary with each locality. An exact record of local observations should be kept in this book. A further differentiation in lac is—

Ari lac from which the insect has not swarmed.

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Phunki—lac from which the insect has swarmed.

Phunki is the better lac. It is less coloured, is lighter and contains more resin.

Methods of cultivation.—(1) *Common and old C. P. method.*—The upper $\frac{1}{3}$ to $\frac{1}{6}$ of the host tree is left untouched when the crop is collected. Brood hence on swarming finds the lower branches broken or bare of young shoots and suffers heavily.

(2) *The new methods.*—Just before swarming all lac-bearing branches are cut off and placed either in bundles or by sticks on other trees to be infected. After swarming the new *phunki* lac is collected.

This latter method involves less waste of the swarming insects but demands rigid supervision and discipline amongst the staff.

A drawback is the fact that many insects settle on the ends of the parent branch after swarming and so get destroyed in collection. The ideal is to break off "*phunki*," the lac from the twig or branch. This requires great care.

General notes on kusum lac cultivation.—The optimum locality for kusum (*Schleichera trijuga*) appears to be the alluvial soil along nala banks. Individuals are usually well grown trees up to 80' in height and large girth. The ideal tree for lac cultivation is the

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tree grown in the open and not the typical forest tree, *i.e.*, crown should be bushy and round and not too high. Kusum rate of growth is slow and it coppices poorly but pollards fairly well. Leaves are shed in February; new leaves and flowers March-April.

Cultivation should be kept as concentrated as possible and confined to areas with not less than about 10 trees to every 2 or 3 hundred yards (*e.g.*, along a river bank). Trees should be enumerated, numbered and registered in compartment histories or forest journals. Surrounding trees should be felled to favour kusum crown production, and the kusum heavily pollarded; every branch being cut back to a point where it is of about 2" diameter. Cut the underside of the branch first to avoid stripping bark. The cut ends may be painted with coal tar. An average figure for cost of this in South Raipur is 4 annas per tree. Pruning should be done in December-February or July-August.

When swarming is expected a close watch must be kept. It begins slowly and reaches its maximum in 7 to 10 days, lasting in the summer only 15 to 20 days, and in the winter more than a month. A few trees should be kept under close observation daily till the first insects appear. As soon as this occurs cut the brood lac and transfer it to the new trees

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which should have been pruned up to 3 years previously, *i.e.*, which bear a mass of young twigs. Only use the best lac for brood purposes. Brood should be kept as long as possible, but all wood not bearing lac trimmed carefully off. Part of each brood stick should touch a new twig to provide an easy path for the wingless, non-jumping, insects. It is better to infect a few trees thoroughly than many trees partially. Lac must be watched all the time, especially at night from the time it is put on the trees till it is collected. After that, *i.e.*, when it is developing, it need not be watched until about 15 days after the male insect has swarmed when it begins to grow rapidly.

Insect enemies.—These are mainly the larvæ of moths of the genera *Eublemma*, *Hypatina*, and *Holococera*. *Eublemma amabilis*, a small white moth, is the commonest.

E. amabilis is said to lay its eggs direct in the young lac. The young larvæ develops in the lac and at first is about $\frac{1}{4}$ " to $\frac{3}{8}$ " long, reddish and very active. It makes a burrow, eating both lac and lac insect. It pupates when about $\frac{1}{2}$ " long, having then grown white in colour. It is as a cocoon easily visible in affected lac. The moth emerges at about the swarming time of the lac. Hence check of the pest can be effected by rejecting as brood all affected lac. From the latter the

moth emerges in the lac godown where it can be collected and destroyed.

Collection.—Good climbers are sent up the tree to cut off all lac-bearing twigs. These are thrown on to the ground where women and children break off leaves, etc., and then thrown on to tarpaulins. [NOTE.—Without tarpaulins much lac gets lost.] In the evening all lac is taken to the depôt or godown and weighed. The best lac is carefully selected as brood and the rest scraped off the twigs, dried and cleaned ready for sale. Drying is difficult in the rains.

Storage.—The lac is spread out to a depth of about 4" on the floor of the godown (which should have a good roof). Doors are opened and the lac is raked over three times daily till it is quite dry and crumbly. If it tends to form solid lumps these should be immediately broken up. The dried lac is then carefully weighed into gunny bags previously carefully examined and repaired. The great danger lies in lac getting wet. This causes it to become blocky and lose value.

Disposal and rates.—Usually by auction at a fixed rate per maund at a lac bazar. Such bazars are held in the Central Provinces at Pendra, Rajim, Dhamtari, Gondia, Damoh, Katni, Bankheri and Itarsi. As a rough guide the rates for phunki lac are $\frac{2}{3}$ (kusum) and $\frac{1}{2}$ (palas, etc.) the rates for Calcutta

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T. N. shellac. The latter should be wired for 3 days before the day fixed for sale. Sales are best held in the afternoon as the T. N. rates usually issue at noon. Lac should be turned out of the bags and graded in heaps before the sale. After sale it should be weighed out in the presence of the purchaser or his agent in his own bags and delivery made at once. Departmental bags must then be repaired and stored for future use.

Lac staff.—Extra lac staff should be amalgamated with the regular cadre and as many as possible of the total staff turned on to lac work during the busy periods.

Glossary of English technical terms (Lindsay and Harlow, Vol. VIII, Part I, Ind. Forest Records).

Brood lac.—Lac containing live lac insects about to swarm. Used for infection of fresh trees.

Button lac.—Refined lac made up in button shape.

Fine lac.—The better qualities of lac.

Garnet lac.—Inferior refined lac of dark colour. Made up into thick slabs or lumps.

Grain lac.—Lac crushed to about the size of peas and washed free from dye.

Seed lac.—(a) Grain lac or (b) Brood lac.

Shellac.—Refined lac stretched into thin sheets and broken up into small fragments. Also all forms of refined lac.

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Standard I.—A grade of shellac just superior to T. N.

Stick lac.—All forms of crude lac.

Superfine.—The highest grades of shellac.

T. N.—Usually surrounded by a diamond; a non-proprietary mark of low grade shellac.

TYPICAL COSTS.

Kusum lac.—Cost of collection.—

(a) Hoshangabad, Rs. 13-9-0 per maund.

(b) Seoni, Rs. 5 to Rs. 19 per maund.

Cost of propagation.—

(a) Hoshangabad, Rs. 2 to Rs. 3 per 100 trees.

(b) Seoni, Rs. 2-2-5 to Rs. 6-11-4 per 100 trees.

Ghont lac.—Cost of propagation varies between Re. 0-12-0 and Re. 0-8-0 per 100 trees, and cost of collection between Rs. 10 to 15 per maund.

NOTES ON THE MAIN CENTRAL PROVINCES AND BERAR FODDER GRASSES.

[From *Forest Flora of the Berar Circle*,
Part II, Witt.]

Tribe Paniceae.

Paspalum sanguinale (Lamk); Vern. safed-rai, rai, sika, etc.—An extremely variable species. Stem 2' to 3' erect from a branching

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base. Leaves long, narrow, glabrous. Spikes 2 to 6 in number and 4" to 5" long, at the end of a long peduncle, erect when young, finally horizontal, forming a star-shaped inflorescence. The small oblong spikelets lying flat against the spikes vary greatly in their degree of hairiness. Common, chiefly on poor soil. Never in large masses. An excellent fodder for horses and cattle and makes good silage.

Panicum colonum (Linn.); Vern. sawan, saonria, etc.—Stem 1' to 2'. Leaves long and narrow, dark green. Spikes less than 1" long, rather far apart, along a stout erect rachis. Inflorescence pale green turning yellowish when ripe. Common in fields and a good fodder grass, especially for cattle.

Pollinea argentea (Trin.); Vern. marwel, belia marwel.—A tufted, rather slender, erect grass. Stems 2' to 4' high, smooth, shining, leafy chiefly at the base. Leaves 6" to 18" long, very narrow, often filiform, smooth. Inflorescence of 6 to 12 slightly spreading, flexuous, silky-hairy, spike-like racemes 2" to 6" long, golden brown when immature, becoming whiter and more hairy as they ripen. Awns the lower half dark-brown, the upper half straw coloured. A late grass, ripening usually not before December. Found commonly on black cotton soil in all divisions. A good grass for grazing when young.

Ischaemum sulcatum (Hack.); Vern. pawana, paonia, sainar.—A rather short (1' to 2'), slender, weak, much branched grass with numerous solitary, terminal, pale-green or white racemes with long awns, the lower half brown or twisted, the upper half almost white. Leaves 4" to 8" long, narrow, glabrous, with pointed tips. Fairly common on good soil, in considerable masses. A very valuable fodder grass.

Ischaemum laxum (Br.); Vern. shahada, sairi.—A perennial grass, very hard to distinguish from the preceding. Usually taller, longer leaved (leaves with long terminal capillary tips), and the exterior (lower involucral) glume of the sessile spikelet is 6 nerved instead of 2 nerved. One of the best fodder grasses of the province.

Apluda varia (Linn.); Vern. polki, phota, etc.—A tall slender perennial leafy grass. Stems densely tufted, much branched, usually rambling amongst bushes. Leaves long, narrowed from middle to a filiform tip. Inflorescence pale green or purplish. Essentially forest grass found amongst bushes on poor soil. Fairly good fodder.

Andropogon pertusus (Willd.); Vern. malher, makhel, etc.—A sparingly branched, generally sweet grass 1'-2' high. Nodes bearded with spreading hairs. Leaves moderately long and narrowly linear, usually hairy spike-like

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racemes 1"-2" long. Awns the lower half brown, the upper half yellowish-white. Common on all classes of soil. Known in Northern India as one of the species of "Janewah". Excellent fodder and silage.

Andropogon annulatus (Forsk.) Vern. belia marwel, kail, etc.—A perennial densely tufted grass, stems bent at base and then erect, up to 3', nodes usually bearded. Leaves moderately long and narrow running to a fine point, glabrous. Sheaths bearded at the tip. Inflorescence of 2 to 6 terminal, pinkish or nearly white. Spike-like racemes; awns light brown. Excellent fodder and silage grass (one of the "Janewah" species).

Andropogon contortus (Linn.); Vern. kusal, ponijara, butoojara, sookal, etc.—The perennial well-known spear-grass. The long awns of the ripe grass twist together and with attached spikelets form conspicuous branches entangled in the grass stems. Responds markedly to cultivation. A good fodder grass if cut before the seed has ripened. It should be shaken out before feeding to cattle and horses, otherwise sore mouths may result.

Anthistiria ciliata (Linn.); Vern. ghonad, goniari, etc.—A tall annual grass. Stems up to 5' or more on rich soil. Leaves 6" to 10" long, narrow, smooth or sparingly ciliate near the base. The tubercle-based hairs on the

spathes and spikelets are a characteristic distinguishing mark. A common grass occurring in large masses. Valuable as fodder when young and green.

Iseilma laxum (Hack.); Vern. gondal, musar, etc.—A slender usually erect, comparatively short, tufted perennial grass seldom over 2' high. Stems frequently red. Leaves 3" to 6" long, narrow, smooth, but often ciliate near the base, the margins rough. Inflorescence a flexuous panicle usually occupying half the stem. Found on all but the poorest soils and in moist water-logged places (borrow pits, etc.).

Iseilma Wightii (Anders); Vern. mushad, mushan, shania.—Very like the preceding species and hard to distinguish from it. Distinguishing marks are that it is usually taller, panicle is longer, more spreading and with longer branches, spathes are narrower and green and keels and margins of the spathes and floral leaves are distinctly tubercled. (Seen with a lens.)

Abundant in heavy and light soils. This is an exceedingly good fodder and silage grass and is (probably) the "unscented" species (*I laxum* being "scented"). The two species are generally known as musel.

The typical musel grass of the native is the third *Iseilma* species which is taller, more slender, longer and narrower leaved, never with

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red stems, and narrower, longer inflorescence and spathes. The inflorescence is erect. One of the best fodder grasses, always found on heavy black, water-logged soil.

Cynodon dactylon (Pers.); Vern. hariali, dub.—A prostrate widely creeping grass with short ascending branches. Leaves short, glaucous. Inflorescence of 2 to 5 terminal green or purplish radiating spikes, 1" to 2" long. Along nalas and in moist places on sandy loam. A excellent fodder. Commonly used as turf.

Eleusine oegyptiaca (Desf.); Vern. kakkdel, mandi, kandi, etc.—A small annual grass 6" to 18" high, stems at first prostrate then erect, much branched and rooting from the nodes. Leaves 1" to 5" long, narrow, glabrous or hairy. Inflorescence of 2 to 5 terminal almost erect, digitate spikes 1" to 1½" long; spikelets 2-3 seriate, second, spreading at right angles to the rachis, long. Common on low dry stoney hills and generally on shallow soil. Said to be among the best of the annual grasses. Best used when green and succulent. Makes good silage but inferior hay.

Chloris virgata (Sw.); Vern. pandhad, phundna, etc.—A not very tall grass, the stems flattened, decumbent and much branched below. Leaves rather long and narrow with ciliate margins.

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Inflorescence of 6 to 15 pale coloured feathery spikes 1" to 2" long, rising nearly erect from the apex of the flowering stem. The minute spikelets which readily fall away when ripe are 2 awned.

Common on black cotton soil. A good fodder for horses and cattle.

Notes on grass.—Kusal in open jungle yields up to 800 lbs. per acre: Shahada is cleared yields 1,800 lbs. per acre: (In military grass birs in Saugor, after clearing up trees and stones, it yields up to 1½ tons per acre). The best time for cutting is October to December. In fairly dense jungle kusal remains green till April and still makes fairly good cattle fodder.

The quality depends largely on proper care. The pulas should be turned over and stood on end and when fairly dry, stacked in cocks of 1,000 to 1,500 pulas until they can be carted to a main depôt and stacked. Slight discoloration from rain spoils the appearance but not the quality of the grass, in fact cattle prefer discolored grass. Exposure to a hot sun causes deterioration.

With a good growth of approved grass a fair average for an 8 hours day for 1 man is 200 pulas of 1 lb. each. (This allows 2 hours for rest and food.) Cutting of grass is mainly done by women and piece work gives the best results. Avoid large pulas, they take longer to dry. 1 lb. is a convenient weight.

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Average weight of a cart-load of grass—
Baled, 9—12 maunds; loose, 6—9 maunds.

Baling.—For transport by rail and even long distances by cart, baling is advisable as it not only increases the density but preserves the colour and quality of the grass. Unbaled grass in stacks 8' to 10' high weighs about 1 ton for every 700 cubic feet and its density referred to as 700.

Irani presses condense to 300 to 400.
Each bale weighs 200 lbs.

Robertson presses condense to 300 to 400.
Each bale weighs 60—70 lbs.

Howard's bullock presses condense to 140 to 170. Each bale weighs 80 lbs.

Steam presses condense to 100 to 120.
Each bale weighs 80 lbs.

Baling wire for Irani Robertson and Howard presses can be of 16" gauge (but 14 or 12 gauge is preferable).

Baling wire for steam presses must be of 14 gauge.

Bales.—Size of bale 22" × 20" × 18", weight 80 lbs. (Howard steam press and hydraulic presses).

Weight of baling wire required per bale (annealed black 12 gauge B wire)—12 ozs., cost Re. 0-1-1.

Cost of wire, Rs. 16 per cwt.

Cost of baling.—Dreadnought Perpetual Press, Re. 0-1-6 per bale; Howard's steam press, Re. 0-2-0 per bale.

The capacity of a (23 tons) railway wagon for grass baled by Howard steam press or hydraulic presses is 150 to 180 bales of 80 lbs. each. (Metre gauge railway trucks about 90 bales.)

LIST OF USES (MEDICINAL, ETC.) COMMONER SPECIES.

Acacia arabica.—Bark and pods used for dyeing and tanning. Gum astringent used in Berar after childbirth.

Acacia catechu.—Extract (katha) from heartwood (by boiling) used for tanning fishermen's nets. Locally used for chewing.

Aegle marmelos.—Fruit medicinal for dysentery, etc.

Ailanthus excelsa.—Leaves and bark used as tonic.

Andropogon Martini.—Oil from this grass fragrant and valuable. Said to cure rheumatism.

Anogeissus latifolia.—Bark and leaves used for tanning.

Azadirachta indica.—Bark used as febrifuge, leaves as poultice for ulcers seeds as vermicide.

Balanites Roxburghii.—Seeds, bark and leaves used as purgative.

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Bamboos.—Young shoots powdered give *banslochan* (a tonic). Cooked as a vegetable, etc. Leaves are used as a vermicide for horses (internal).

Bassia latifolia.—Oil from seeds used in cooking and burning. Flowers have edible fleshy corolla and from them a spirit is distilled.

Bauhinia racemosa.—Fibre from bark.

Bauhinia vahlii.—Leaves used as plates; rope from bark; seeds edible.

Bauhinia variegata.—Yields gum (sembla). Bark used for dyeing and tanning.

Bombax malabaricum.—Gum used as poison.

Bridelia retusa.—Edible fruit.

Buchanania latifolia.—Kernel of fruit extensively used as sweetmeat (*chironji*).

Butea frondosa.—Fibre from root. Yellow dye from flowers. Gum from bark. Vermifuge from seeds. (Especially useful for horses). Bark counteracts irritation caused by *Mucuna pruriens* (cow itch).

Carissa spinarum.—Fruit edible.

Careya arborea.—Bark used for ropes.

Casearia graveolens.—Fruit used for poisoning fish.

Cassia Fistula.—Pulp of pods is purgative. Bark used for tanning. Flowers are cooked as a vegetable.

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Cassia tora.—Leaves edible and with seeds are used in skin diseases.

Celastrus paniculata.—Yellow oil from seeds used for gout and paralysis.

Cleistanthus collinus.—Leaves and bark contain poisonous juice. Used in fishing, etc. Crushed leaves said to prevent coppice shoots from stumps of cut climbers.

Cochlospermum gossypium.—Gum used medicinally and burnt for clearing the air. Floss used for stuffing pillows, etc.

Dioscorea daemonia.—Root edible after soaking in running water.

Diospyros melanoxydon.—Fruit edible. Gum said to cure cataract in eyes.

Eugenia jambolana.—Bark used for dyeing and tanning. Fruit edible.

Euphorbia nivulia.—Milky juice a purgative and antidote for snake-bite.

Gardenia lucida.—Resin from bark used as dressing for wounds, etc. Also used internally.

Gardenia gummifera.—As above.

Gardenia turgida.—Gum used medicinally.

Gmelina arborea.—Root medicinal.

Grewia spp.—Fibre from bark.

Hardwickia binata.—Leaves edible.

Helicteres isora.—Medicine from bark used colic, etc. Fibre from bark.

Holarrhenum antidysenterica.—Bark leaves, fruit and seeds are a remedy for dysentery.

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Kydia calycina.—Coarse fibre from bark.

Lagerstroemia parviflora.—Leaves and bark used in tanning.

Litsaea sebifera.—Bark mucilaginous, used as astringent. Extract used for incense.

Mucuna pruriens.—Hairs of the pod are a vermifuge.

Nyctanthes arbortristis.—Leaves are a substitute for sand paper.

Odina wodier.—Bark used for tanning.

Ougenia dalbergiodes.—Bark is pounded and used to intoxicate fish. Gum used as astringent.

Phoenix acaulis.—Used as brush.

Phoenix sylvestris.—Toddy made from juice. Fruit edible.

Phyllanthus emblica.—Edible fruits also used medicinally and for dyeing and tanning.

Pongamia glabra.—Oil from seeds used in burning, also medicinally in skin diseases.

Pterocarpus marsupium.—Red gum from bark is an astringent.

Randia uliginosa.—Fruit edible and astringent. Used for dysentery.

Schleichera trijuga.—Oil expressed from seeds.

Semecarpus anacardium.—Juice of pericarp is a powerful vesicant (all skin diseases); yields a black marking ink.

Shorea robusta.—Resin from bark used for incense. Bark used in tanning.

Smilax macrophylla.—Stems used as tooth-brushes. Berries edible.

Soyimida febrifuga.—Febrifuge from bark. Also yields fibre.

Sterculia urens.—Yields the gum "karaya" of commerce. Fibre from bark.

Tamarindus indica.—Pulp of pod is laxative. Poultices from leaves.

Terminalia arjuna.—Bark used for tanning.

Terminalia belerica.—Seeds of medicinal use.

Terminalia chebula.—Fruit (harra) used for dyeing and medicinally (purgative).

Terminalia tomentosa.—Bark used for tanning. Tassar silk worm feeds on leaves.

Trema politoria.—Leaves are a substitute for sand paper.

Vitex negundo.—Leaves medicinal, aromatic when bruised).

Vitis latifolia.—Edible berry, decoction of root used for mixing with lime to increase its cohesiveness.

Woodfordia floribunda.—Flowers give red dye.

Zizyphus jujuba.—Fruit eaten.

Zizyphus xylopyra.—Fruit used for tanning.

CHAPTER VI.

THE WILD BIRDS AND ANIMALS PROTECTION ACT No. VIII OF 1912, WITH RULES ISSUED UNDER IT; SHOOTING RULES FOR C. P.

Whereas it is expedient to make better provision for the protection and preservation of certain wild birds and animals, it is hereby enacted as follows:—

1. (1) This Act may be called the Wild Birds and Animals Protection Act, 1912, and

(2) It extends to the whole of British India, including British Baluchistan, the Sonthal Parganas and the Parganas of Spite.

2. (1) This Act applies, in the first instance, to the birds and animals specified in the schedule, when in their wild state.

(2) The Local Government may, by notification in the local official gazette, apply the provisions of this Act to any kind of wild bird or animal, other than those specified in the schedule, which, in its opinion, it is desirable to protect or preserve.

(3) The Local Government may, by notification in the local official Gazette, declare the whole

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year or any part thereof to be a close time throughout the whole or any part of its territories for any kind of wild bird or animal to which this Act applies or for female or immature wild birds or animals of such kind, and subject to the provisions hereinafter contained, during such close time, and within the areas specified in such notification: it shall be unlawful—

- (a) to capture any such bird or animal, or to kill any such bird or animal which has not been captured before the commencement of such close time;
- (b) to sell or buy, or offer to sell or buy, or to possess, any such bird or animal which has not been captured or killed before the commencement of such close time, or the flesh thereof;
- (c) if any plumage has been taken from any such bird captured or killed during such close time, to sell or buy, or to offer to sell or buy, or to possess such plumage.

4. (1) Whoever does, or attempts to do,

Penalties.

any act in contravention of section 3, shall be punishable with fine which may extend to fifty rupees:

(2) Whoever, having already been convicted of an offence under this section, is again convicted thereunder shall, on every subsequent conviction be punishable with imprisonment for a term which may extend to one

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month, or with fine which may extend to one hundred rupees, or with both.

5. (1) When any person is convicted of an offence punishable under this Act, the convicting magistrate

Confiscation.

may direct that any bird or animal in respect of which such offence has been committed, the flesh or any other part of such bird or animal shall be confiscated.

(2) Such confiscation may be in addition to the other punishment provided by section 4 for such offence.

6. No court inferior to that of a Presidency Magistrate or a magistrate of the second class shall try any offence against this Act.

Cognizance of offence.

7. Where the Local Government is of opinion that, in the interests of scientific research, such a course is desirable, it may

Power to grant exemption.

grant to any person a license, subject to such restrictions and conditions as it may impose entitling the holder thereof to do any act which is by section 3 declared to be unlawful.

8. Nothing in this Act shall be deemed to apply to the capture or

Savings.

killing of a wild animal by any person in defence of himself or any other person, or to the capture or

killing of any wild animal in *bona fide* defence of property.

9. The Wild Birds Protection Act, 1887,
Repeal is hereby repealed.

SHOOTING RULES.

(Applied to the Central Provinces by Notification No. 1263, dated the 28th October 1907, as amended by Notifications No. 472, dated the 13th July 1912, and No. 888, dated the 27th September 1913, and to the A Class Forests of Berar by Notification No. 1119, dated the 22nd November 1911, as amended by Notifications No. 473, dated the 13th July 1912, No. 1124, dated the 28th November 1913, and No. 13, dated the 3rd January 1914.)

Under sections 25 (i) and 75 (a) of the Indian Forest Act, 1878 (VII of 1878).

1. The poisoning or dynamiting of rivers, streams or tanks is prohibited.

2. The Conservator of Forests of the Circle shall prepare in October of each year a list of forests which shall be closed to the public generally for hunting, shooting, fishing, netting, or setting traps and snares. The list shall specify those forests which are closed—

(a) absolutely for purposes of forest management or as sanctuaries for the

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protection of game, other than carnivora;

(b) conditionally, subject to the issue of a permit in accordance with the rules hereinafter following.

The list shall be published in the *Central Provinces Gazette* and a copy shall be hung up for information in the offices of the Deputy Commissioner and Forest Divisional Officer. No permit shall ordinarily be granted for forests under complete systematic fire-protection between the 15th February and the 30th June, except to approved sportsmen for the hunting and killing of carnivorous animals and of such other animals as may be expressly mentioned in the permit.

3. As soon as the list is published under rule 2, the forests of each division shall be divided off into convenient shooting blocks by the Deputy Commissioner and Divisional Forest Officer in consultation, with the approval of the Conservator of the Circle.

4. Permits under rule 2 shall be of two kinds, *i.e.*, *District* and *Block* permits, and shall, subject to the control of the Conservator, be issued by the Divisional Forest Officer on behalf of the Deputy Commissioner. The former shall be valid for any forest in the district or division for which they are issued, subject to the conditions of rule 2 and to the reservation in respect of occupied blocks as

set forth in rule 5. Block permits shall ordinarily be valid for one block only, but may cover two blocks when there are no applicants for the surplus blocks.

Provided that wounded game may be pursued into an adjoining district or block.

5. The following classes of officers, when travelling on duty, are exempted from taking out a permit:—

All Heads of Departments;

Officers of the Central Provinces Commission;

Gazetted Forest Officers;

Gazetted Officers of the Central Provinces Police;

Superintending Engineers, Irrigation Circle;

Other officers whose duties require them to travel over the whole province.

Officers exempted from taking out a permit, as also district permit-holders, may stalk or track in any forest open for shooting, but they shall not tie up, beat or drive in any block for which a block permit has been issued provided the holder of such permit is himself present in the area covered by his permit. If such exempted officers or district permit-holders wish to reserve entirely any given block for their own sport, they must take out a block permit for the same.

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6. Except carnivora, only a limited head of game shall be allowed to be killed in any shooting block in any one year. On this limit being reached the block shall, subject to the exception in favour of block permit-holders permitted under rule 11, be closed for the remainder of the season as a matter of course. It shall also be within the discretion of the Conservator to prohibit the driving of any animals other than carnivora in any specified block.

7. The Deputy Commissioner and Divisional Forest Officer, subject to the approval of the Conservator, shall fix the limit of game which may be allowed to be killed in each block under the above rule. They shall, at the same time, subject to similar approval, fix for each block the number of head of specified game to be shot by any one person under a permit. The number so fixed shall be on a sliding scale based on the duration of the permit, according as it is for fifteen days, one month or over one month.

The aggregate of game of each species allowed to be killed by any one person, whether holding a permit or not, during the season (1st November to the 31st October) in each Forest Division shall be similarly fixed. Provided that, except with the special permission of the Conservator, the aggregate of game of the following species allowed to

be killed by any one person in the forests of the Provinces during the year from the 1st November to the 30th October, shall not exceed the following:—

- (1) Two buffaloes.
- (2) Two bison.
- (3) Three barasingha.
- (4) Four cheetal.
- (5) Four sambhar.

8. When any officer exempted under rule 5, or any holder of a district permit, shoots an animal of any of the five kinds mentioned in rule 7, he shall at once inform the Forest Divisional Officer what he has shot and in which block he has shot it.

9. Game books shall be kept up in the Divisional and the Range offices in the appended form showing the number of heads of protected animals permitted to be shot and the number shot up to date.

NOTE.—After the end of each year the Chief Conservator will compile, from an annual statement to be submitted to him by each Conservator, a statement showing the number and kind of protected game shot by each officer and sportsman.

10. Exempted officers and holders of district permits shall be required, before shooting in any block, to make themselves acquainted with the number of head available for shooting, and this number may not be exceeded.

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11. Block permit-holders may exceed this limit so long as they do not shoot in excess of the number entered in their permits; but any excess over the block limit caused by such permit-holders shooting up to the full number of game allowed by their permits will be considered by the Forest Divisional Officer when fixing the block limits for the succeeding year.

12. Every permit shall specify the number of sportsmen who authorized by it to shoot, and may limit the number of retainers and of dogs and other animals that may be taken into the forest.

13. The permit shall have entered upon it the number and kind of game which may be killed. As soon as the permit-holder leaves the shooting block or district, the permit-holder shall return his permit to the Divisional Forest Officer, endorsing upon it the number and kind of game killed.

14. No application should be made for a block permit more than three months, or less than one month before the date on which it is desired to make use of it: provided that in the case of a resident of the district, a notice of fifteen days shall be considered sufficient and that permits for short periods, not exceeding ten days, may be granted on application.

14-A. No person shall hold more than one block at the same time except as provided in rule 4; provided that two sportsmen shooting together may take two blocks in the same district for the same period.

The following certificate to be signed by the permit-holder shall be printed in red ink on a detachable slip added to the permit:—

“I certify that I have read the rules printed on the back of my shooting permit and that I will comply with the same; also that I will not transfer my permit to any other person and that I will return it at the earliest possible moment should I find that I am unable to utilize it.”

The certificate shall be returned to the Forest Divisional Officer when the permit-holder receives the license.

15. The duration of a permit shall be determined by the demand for shooting blocks. In no case shall it exceed three months. Provided that Gazetted officers of the District staff, other than those exempted under rule 5, and, when the district forms part of their charge, Executive Engineers, Assistant Engineers and Inspectors of Schools may be given a permit to cover the whole year (1st November to 31st October).

16. Permits are not transferable.

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17. Sportsmen shall not sit up for the purpose of shooting any animals other than carnivora over water or over salt-licks or over paths leading directly to water or to salt-licks.

18. The holder of the permit shall camp only on such regular camping-grounds as may have been set apart by the Forest authorities, or in places specially pointed out to him by a Forest Officer.

19. A permit may be cancelled at any time by the officer granting it, or by the Conservator of Forests. Any breach of the Forest Act or of any rule made under the Act, if committed by the holder of the permit or any of his retainers or followers shall render the permit liable to cancellation. Permits are liable to be declared invalid in regard to any particular forest in case of fire breaking out in any part of the forest, or in case of unwarrantable interference with forest work.

20. The holder of a permit is not exempted from liability under the Forest Act, or any other law, for anything done in contravention of such Act or law, or for any damage caused by him, his retainers or followers.

NOTE.—Section 25 of the Forest Act prescribes penalties for breach of these rules, and section 67 of the Act empowers the Divisional Forest Officer to compound any such breach on payment of a sum of money.

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21. Permit-holders may not enter any forest without previously giving 24 hours' notice to the local forest official.

22. Every permit-holder must pay for a forest guard to accompany him and his camp during the time he is within Government forest limits, whose sole duty it will be to see that none of the Forest rules are infringed by he permit-holder or his followers :

Provided that in exceptional cases in which permit rights are exercised only at irregular intervals and for short periods, the Conservator of Forests or the Deputy Commissioner of the district may exempt permit-holders from this payment.

23. A permit issued under these rules does not authorize the destruction of any kind of bird other than the game and edible birds included in the list appended (Appendix A) and birds of prey. Provided that the shooting or snaring of any kind of bird may be permitted to *bonâ fide* naturalists for the purpose of scientific collection, in limited numbers to be regulated by the Divisional Forest Officer.

24. A close season is fixed for the birds and animals entered in Appendix B. The destruction of any bird or animal during the close season fixed on such bird or animal is

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prohibited. Any animal of the species mentioned in rule 7 shot contrary to the provisions of this rule shall be counted in the permit-holder's aggregate provided for in rule 7.

25. Nothing in these rules shall prevent the disposal by auction sale, contract, or otherwise of the shooting or fishing within any forest or part of a forest, but no such disposal shall be made without the special sanction of the Chief Commissioner previously obtained in each case.

NOTE.—Shooting in the C Class forest of Berar is also regulated by the notification applying to the A Class forests, as further amended by Notification No. 184, dated the 5th March 1914, as follows :—

Subject to the provisions of Act XI of 1878 (an Act to consolidate and amend the law relating to arms, ammunition and military stores) as applied to Berar, any person may hunt, shoot, fish or set traps, subject to the following conditions :—

- (1) The poisoning and dynamiting of rivers and other waters is prohibited.
- (2) The hunting, shooting or trapping of the animals and birds during the closed or breeding season entered in Appendix B is prohibited.

APPENDIX A.

List of game and edible birds.

Name.	Systematic name.	Vernacular name.
Sand-grouse ...	Pterocles fasciatus ...	Bhat titar, Don garkouri.
	Do. exustus ...	Do.
Pea-fowl ...	Pavo cristatus ...	Mor manzur,
Jungle-fowl ...	Gallus ferrugineus ...	Jungli murgi.
	Do. sonneratii ...	Do.
Spur-fowl ...	Galloperdix spadiceus.	Choti jungli murgi.
	Do. lunulatus ...	Do.
Partridge ...	Francolinus vulgaris ...	Kala titar.
	Do. pictus ...	Do.
Quail ...	Ortygornis pondiceriana	Gora titar.
Bush-quail ...	Coturnix Coromandelica	Chinuk.
	Perdica argoonda ...	Lawa.
	Do. Asiatica ...	Do.
Bustard-quail ...	Microperdix Blewitti ...	Sirsi lawa.
	Turnix pugnax ...	Gundru.
	Do. joudera ...	Do.
Bustard ...	Do. dussumieri ...	Tura dabki.
Bustard ...	Eupoditis Edwardsii ...	Hom tokdur.
Lik-florikan ...	Sypheotides aurita ...	Tun mor.
Spurred-goose...	Sarkidiornis melanonotus.	Nukta.
Goose-teal ...	Nettapus Coromandeli-anus.	Girga.
Whistling-teal	Dendrocygna arcuata ...	Silli.
Grey-duck ...	Anas pœkilorhyncha ...	Grampai.

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List of game and edible birds—concl.

Name.	Systematic name.	Vernacular name.
Green-pigeon ...	{ Corcopus phornicop-terus.	Harrial.
	{ Corcopus chlorigaster...	Do.
Blue rock-pigeon.	Columba intermedia ...	Kabutar.
Doves	{ Turtur meena	... Kalla facta.
	| Do. cambayensis	... Tortru facta.
	| Do. suratensis	... Chitrokafachta
	| Do. risorius	... Dhor facta.
	| Do. senegalensis	... Seroti facta.

Migratory, marsh and water-birds, such as duck, teal, snipe, etc., which do not breed in these Provinces and visit them in the cold season only.

APPENDIX B.

Close seasons for birds and animals.

Names.	Close time.
1. Sand-grouse	... 1st January to 30th June.
2. Painted partridge	... 1st June to 30th November.
3. Grey partridge	... 1st March to 30th September.
4. Pea-hen	... 1st May to 30th November.
5. Jungle-hen	... 1st March to 30th September.
6. Spur-fowl	... 1st March to 30th September.
7. Rain-fowl	... 1st May to 30th November.
8. Bush-quail	... 1st April to 31st October.
9. Bustard-quail	... }
10. Bustard	... } 1st May to 30th November.
11. Lik-florikan	... }
12. Comb-duck	... }
13. Cotton-teal	... } 1st June to 30th November.
14. Whistling-teal	... } ber.
15. Spotted billed duck	... }
16. Painted snipe	... 1st April to 31st October.
17. Herons	... }
18. Egrets	... }
19. King-fishers	... } Whole year.
20. Rollers	... }

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Deer and Antelope other than Nilgai.

- | | |
|--------------------------------|---------------|
| 1. Does*, hinds and fawns. | } Whole year. |
| 2. Immature stags and bucks. | |
| 3. Hornless stags | |
| 4. Stags with horns in velvet. | |

Bison and Buffalo.

Cows and calves ... Whole year.

*(a) Does of antelope in Berar may be shot with the permission, in writing, of Conservator of Forests, Berar Circle.

The above close time will not apply in respect to chital hinds in the following areas of Berar for such periods, in favour of such persons, and in respect of such number of animals as the Commissioner, in consultation with the Conservator of Forests, may decide:—

- | |
|---|
| (1) Bhongaon Reserve in the Buldana district. |
| (2) Tipeswar " " Yeotmal " |
| (3) Tiwsala " " " " |
| (4) Gondwakri " " " " |
| (5) Pathroat " " " " |

(b) The above close time will not apply:—

- (i) In the Jubbulpore, Saugor and Damoh districts so far as it relates to does of black buck until further orders.
- (ii) In respect of barasingha hinds in the Banjar Reserve of the Mandla district for such periods in favour of such persons and in respect of such number of animals as the Commissioner of the Division, in consultation with the Conservator of Forests, may decide.

Until further notice throughout the Chanda district and throughout the Baloda Bazar tahsil of the Raipur district close time for wild buffaloes will be observed for the whole year.

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Form of Game Book prescribed by rule 9.
Block _____

Kind of game.	Number of head allowed to be shot.	Date of shooting.	Name of sportsman with number shot.	Balance of game available for shooting.
Buffalo	1st head.		
	...	2nd ..		
	...	3rd ..		
	...	etc.		
Bison ...				
Barasingha...				
Cheetal ...				
Sambhar ...				

CHAPTER VII.

GENERAL.

NOTE ON SAMPLE PLOTS.

These are of three kinds :—

(a) *Permanent*.—These plots have been laid out in accordance with Howard's "Code for the collection and tabulation of statistical data". In them all trees are marked with a white cross in paint at the point of diameter measurement and all carry above the white paint cross a number also in white paint. Tin number tickets are now also affixed. Teak plots are painted in black. Permanent plots are mainly intended for the collection of increment data in even-aged thinned woods of pure crops. They are thinned and measured every 5 years by the silviculturist.

(b) *Temporary*.—A temporary plot, strictly speaking, is not demarcated permanently. There exist, however, a number of plots in the Central Provinces which have been demarcated but in which all trees have not been numbered. In many cases such plots are intended to be permanent. They are for the present included under this head and may later be converted. The classification is one of convenience and does not indicate that the plot is on the verge of abandonment.

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(c) *Experimental*.—These plots are usually of small area and their general lay-out varies with the object of the particular experiment.

Plots are numbered by divisions, e.g.—

Seoni 1—Seoni Permanent Plot 1.

Seoni T2—Seoni Temporary Plot 2.

Seoni E2—Seoni Experimental Plot 2.

All that is required of the Divisional Forest Officer with regard to sample plots is to see that the Rangers' return is sent in regularly and is conscientiously filled. The Range officer must personally see to the following work:—

(a) *Permanent plots*.—Boundary ditch and posts maintained. Painted crosses, numbers and tickets in good order. Care must be taken in the case of painted crosses that the same exact point is painted over.

(b) *Temporary plots*.—Ditches and posts maintained, also numbers where these exist.

(c) *Experimental plots*.—Maintained according to detail of the plot.

One copy of each plot record is with the silviculturist and a duplicate copy of each of the essential forms of each record is with the Divisional Forest Officer.

The annual Ranger's certificate should reach the Silviculturist's office by December 10th each year. In this certificate such statements as "Ditch will be repaired shortly" are quite useless. The work should be definitely stated to have been done. White zinc paint should

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be used, except in the case of numbers on teak trees which should be in black paint.

ANNUAL SAMPLE AND EXPERIMENTAL PLOT.
RETURN, C. P.

Division _____ * Permanent Sample Plot No. _____
Temporary Sample Plot No. _____
Experimental Plot No. _____

Range _____ Felling Series _____
Coupe _____ Near _____

Certified that I have personally inspected the above ^{* sample} experimental plot on the _____ (date) and found the following _____ :—

State of ditch and boundary posts and whether any damage has been repaired.	Condition of white paint numbers and whether re-painted, if necessary.	Trees damaged, dying, felled or removed. Give tree numbers in permanent plots.	Other damage and remarks.

Signed _____
Range Officer,
Range.

*Strike out whichever does not apply.

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Forwarded to the Sylviculturist, Central Provinces, through the Divisional Forest Officer, _____, date _____

STOCK-MAPPING.

For the present no standardised conventional signs exist. It is considered that as these depend largely on exactly what local types it is desired to show, the stock-mapping officer should choose his own signs to suit his own conditions. As an example of signs used, the following for the South Raipur (a) Sal Working Plan stock map and (b) Mixed Forests Working Plan stock map, may be given as examples of signs found successful in practice. The map is based on locality qualities, the criterion of quality being the average maximum height at maturity of type-trees :—

Class.	Maximum height growth of mature trees.	Conventional signs on 4" map.
	Feet.	
Sal 1	... Over 90 ...	Single green vertical lines.
Do. 2	... Do. 70 to 90...	Double green horizontal lines.
Do. 3	... Do. 50 to 70...	Treble green diagonal lines.

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Class.	Maximum height growth of mature trees.	Conventional signs on 4" map.
	Feet.	
Sal 4	... Under 50 ...	Green wash.
Teak 1	... Over 90 ...	Single blue vertical lines.
Do. 2	... Do. 70 to 90..	Double blue horizontal lines.
Do. 3	... Do. 50 to 70...	Treble blue diagonal lines
Do. 4	... Under 50 ...	Does not exist.
Mixed 1	.. Over 90 ...	Single red vertical lines.
Do. 2	... Do. 70 to 90...	Double red horizontal lines.
Do. 3 & 4	... Under 70 ...	Pink wash.
Bamboos	... ..	Vertical black lines (superimposed over the conventional sign of the forest type).
Forest villages	Light brown wash; dark brown boundary lines with pillars indicated.
Blanks	Blank.

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Class.	Maximum height growth of mature trees.	Conventional signs on 4" map.
	Feet.	
Teak 1	... Over 90 ...	Single blue vertical lines.
Do. 2	... Do. 70 to 90...	Double blue horizontal lines.
Do. 3	... Do. 50 to 70...	Treble blue diagonal lines.
Do. 4	... Under 50 ...	Blue wash ...
Sal 1	... Over 90 ...	Single green vertical lines.
Do. 2	... Do. 70 to 90...	Double green horizontal lines.
Do. 3	... Do. 50 to 70 ...	Treble green diagonal lines.
Do. 4	... Under 50 ...	Green wash.
Mixed 1	... Over 90 ...	Single red vertical lines.
Do. 2	... Do. 70 to 90...	Double red horizontal lines.
Do. 3	... Do. 50 to 70...	Treble red diagonal lines.
Do. 4-a	... Do. 40 to 50 ...	Hatching red vertical and horizontal lines.
Do. 4-b	... Under 40 ...	Pink wash.

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Class.	Maximum height growth of mature trees.	Conventional signs on 4" map.
	Feet.	
Bamboos	...	Vertical black lines (superimposed over the conventional sign of the forest type).
Poor unworkable forest.	...	Chrome orange wash.
Forest villages	...	Light brown wash, dark brown boundary lines with pillars.
Blanks	...	Blank.

To illustrate the possible variation in stock mapping signs we may take the case of teak mixed forest of a given quality containing only 15 per cent teak and 10 per cent first class species. Here the respective percentages of teak and first class species might have to be indicated on the map by writing them in *e.g.*, red and black ink, respectively, thus—

15 per cent (red ink).

10 per cent (black ink).

The best inks to use are Watson's Waterproof British Drawing inks from Government

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Mathematical and Survey Instrument Office,
Calcutta, under the following names:—

Blue	...	Cobalt
Red and pink	...	Carmine
Green	...	Green

NOTE ON CONTROL FORMS, COMPARTMENT
HISTORIES, AND DIVISIONAL NOTE-BOOK
FOR NEW WORKING PLANS.

In view of the antiquated state of the majority of Central Provinces Working Plans, and of the fact that in many divisions a start is being made to assist future Working Plans Officers by collecting local compartment history and other information now, concurrently with the working of coupes, the following notes are included to indicate the lines on which any such work should proceed to render its results of use. The prescribed forms in which control forms, compartment histories and divisional note-book are to be kept up have been standardised in recent Government orders (Secretariat letter No. 509-183-XV, dated the 25th June 1924, to Chief Conservator of Forests. The first essential is subdivision of the forest into permanent compartments or units of management.

(1) *Control book*.—This will consist of a loose leaf file containing a series of simple

forms each consisting of two main headings:—

- (a) Provisions of the plan.
- (b) Result of operations.

One form is provided for each important prescription of the plan and an entry will be made in each form in each year detailing (against the work laid down to be done) the actual work done (*e.g.*, area against area prescribed).

[*N. B.*—Details of outturn will not be included, these find their proper place in compartment histories.]

(2) *Compartment history*.—This will be maintained by the smallest permanent division of the forest.

[*NOTE.*—In less valuable forests compartments will be larger and may conveniently coincide with blocks or even felling series.] It will consist of—

- (a) Map (trace of 4" or larger scale map to elaborate existing stock map and to record operations cartographically). It will be filled in as a stock map yearly as coupes are marked and worked.
- (b) Description and history of the area and stock. This will be filled in at the same time as (a).
- (c) Details of silvicultural operations and of outturn. This will be filled in with summaries of marking and outturn in tabular statement whenever possible;

creeper cutting statement will also be entered.

(d) Diary remarks or comments; notes on condition of the crop and on results of silvicultural operations. This form is intended to contain a running commentary on the changing condition of the crop; its value will depend largely on the discretion of the Divisional Forest Officer.

(3) *Divisional Note-book*.—This is a general “dump” of records of all miscellaneous information which cannot find a place elsewhere. Suggested sheets are, e.g.—

Black list of contractors.

Black list of shikaris.

List of prescribed Government servants.

Details of seed years.

Details of insect, etc., attacks.

Lac notes, etc., etc.

General note.—Eventually all new Working Plans will contain these records in the form indicated above. Details of forms already in use may be obtained from the Provincial Working Plans Officer.

Upkeep of records.—The above records will be prepared in triplicate. One copy will be maintained in the Conservator’s office, one in the divisional office and the third will be a flying copy which in the case of the compartment history may be lent to Range officers when not required by the Divisional Forest

Officer. When control books are submitted to Conservator the Divisional Forest officer will at the same time prepare draft entries for all compartment histories in which work of any kind has taken place during the past year and he will submit them in the flying copy to the Conservator. The Superintendent of Working Plans should be asked by the Conservator to examine and report to him on all the entries proposed each year for compartment histories before the latter passes orders on them. On approval the Conservator will make the entries on his compartment histories and return the flying copy to the Divisional Forest Officer who will then enter up his office copy.

These records must be on good paper in loose leaves and typed. As regards the Divisional Note-book only the record of works section need be submitted annually to Conservator. The other information in the note-book can be examined at the annual office inspection.

NOTES ON DEMARCATION OF COUPES, FOREST BOUNDARIES, ETC.

Demarcation of coupes.—This is done annually before marking, each coupe being demarcated on the ground by the Range Officer and his staff according to the boundaries shown on the map. Boundary lines are 10'—15' wide and cleared of all scrub and

undergrowth. Pillars are erected at prominent places where natural boundaries do not exist. One trace is pasted into the marking register and one given to the purchaser. Each pillar should be seen from the next and numbers should face inwards.

Maintenance of forest boundaries.—The total width varies from 80' to 100'; of this 20' is generally malguzari. The malguzari portion is kept clear by malguzars and the remainder by Government. Where Government forest adjoins ryotwari, the whole width of the line is Government forest. A five-year scheme is followed whereby regrowth on 1/5th of the entire length is cut every year without reference to fire protection. Existing pillars must be repaired and numbers kept clear. Pillars should be numbered from trijunction point to trijunction point. Trijunction pillars should bear both a forward and a backward number. Numbers must face outwards. Each pillar must be visible from the next. Stone cairns should be built up properly. The numbering should be clockwise. Pillars are checked with 4" survey sheet.

To ensure proper check of line burning and demarcation work it is necessary to prepare maps showing in different colours the portion to be done in any year in the scheme. When pillars are checked the distance between them should also be checked.

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The cost of clearing regrowth exclusive of line burning under the five-year scheme is usually Rs. 1 to Rs. 2 per mile.

STANDING ORDERS FOR FOREST VILLAGES.

Standing orders to be printed and pasted in every forest village mukkadam's note-book (*vide* C. P. Forest Manual, paragraph 80, and Resolution No. 4, Conservators' Conference 1922).

Mukadam's note-book.

Name
Forest village
Range
Division

1. (a) The Forest Department and forest contractors have the first claim to forest villagers on payment.

(b) Forest villagers will not accept employment from any other department, company or any other person without the Divisional Forest Officer's or Range Officer's sanction.

(c) Forest villagers will obey the orders of the Divisional Forest Officer. Non-compliance with orders; bad character, or disobedience will result in removal from the village.

2. The mukaddam will be held responsible for the characters of forest villagers. He will be given commission for recovering land rent and for this will be held responsible.

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3. If any forest villager is given taccavi the mukaddam and the residents of the village will be considered as jointly and severally liable for the recovery of the amount with interest.

4. The forest villagers will be responsible for clearing and burning fire lines round the village as well as for clearing internal lines. No tree may be cut without the Divisional Forest Officer's sanction.

5. No forest subordinates or any individual can take any kind of work from forest villagers without writing the detail and necessity of work in the mukaddam's note-book. Whatever the necessity may be it must be written in the mukaddam's note-book. The wages paid should also be noted.

If written orders are not given to the mukaddam for the supply of labour he will not be held responsible except on the occasion of forest fires, when all must turn out at once without question.

6. The mukaddam should show his note-book to all gazetted officers and to the Range Officer when they visit the forest village. He should then make any complaint he may wish on behalf of the village. If the mukaddam makes any complaint the Range Officer should write it in his (mukaddam's) note-book as also the action taken on the complaint, and report to the Divisional Forest Officer.

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7. No outsider can settle in a forest village without the Divisional Forest Officer's written permission, which must be quoted in the book.

8. Rates at so much per plough for black cotton soil and so much per plough for ordinary land will be charged.

9. Every year details showing the following against each man must be entered in the book :—

Land revenue, number of ploughs, number of cattle owned, number of cattle allowed free, free grants, grants and recoveries of taccavi, warnings or praise.

10. All pages in this book must be numbered in ink.

SPECIMEN VILLAGE NOTE-BOOK.

(General responsibilities.)

Names of villagers.

Name.	No. of ploughs.	No. on payment.	Land revenue.	No. of cattle free.	No. of cattle on payment.	Payment for cattle.	Taccavi outstanding.
Total ...							

Divisional Forest Officer.

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Example.—11-10-14. Two coolies required to carry my saman to Shivtarai. Payment of 8 annas made.

(Sd.) RAM BUX,
Ranger.

Example.—12-10-14. One cart required to carry furniture to Chappara. One rupee paid.

(Sd.) LAL SING,
Forester.

NOTES ON ANIMAL MANAGEMENT.

Treatment of elephants.—The advice given in "Elephants and their diseases" (Evans) cannot be followed too closely. The following general remarks are offered:—

The grain ration should always be fed before dark in front of the senior officer or subordinate present, with plenty of grass, or plantain leaves and stems, etc., to make bulk. A good supply of salt is of first importance.

The fullest possible supply of fodder must be arranged for at all times and if possible it should be varied, 2 or 3 different kinds being given daily. The animals should never be kept standing about with no fodder in front of them but whenever grass or bamboos are

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available in the forest near by must be shackled and let loose to graze. A daily bath and at least 3 thorough rubbings weekly with a brick are conducive to health.

After the end of February marches should commence before day-break and not last more than 3 hours.

Dragging elephants must be examined on return from work and taken off work at once if there are any indications of sores or bruises. Constant care is needed to see that elephants are not taxed beyond their powers on dragging work. Excreta should be occasionally examined for worms.

Treatment of dragging buffaloes.—As with elephants the main points to watch are feeding, salt ration, watching for and prompt treatment of sores.

The officer in charge of the dragging camp must personally inspect sick animals and must see that they are properly fed and attended to.

CHAPTER VIII.

GENERAL STATISTICS WITH SPECIAL REFERENCE TO TEAK AND SAL.

TABLE OF DIAMETERS FOR GIRTHS.

For teak and sal $\frac{\text{girth.}}{\text{diameter.}} = 0.3119$ instead of π .

INCHES.							
Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.
2.0	0.6	3.0	0.9	4.0	1.2	5.0	1.6
2.1	0.7	3.1	1.0	4.1	1.3	5.1	1.6
2.2	0.7	3.2	1.0	4.2	1.3	5.2	1.6
2.3	0.7	3.3	1.0	4.3	1.3	5.3	1.7
2.4	0.7	3.4	1.1	4.4	1.4	5.4	1.7
2.5	0.8	3.5	1.1	4.5	1.4	5.5	1.7
2.6	0.8	3.6	1.1	4.6	1.4	5.6	1.7
2.7	0.8	3.7	1.1	4.7	1.5	5.7	1.8
2.8	0.9	3.8	1.2	4.8	1.5	5.8	1.8
2.9	0.9	3.9	1.2	4.9	1.5	5.9	1.8
6.0	1.9	7.0	2.2	8.0	2.5	9.0	2.8
6.1	1.9	7.1	2.2	8.1	2.5	9.1	2.8
6.2	1.9	7.2	2.2	8.2	2.6	9.2	2.9
6.3	2.0	7.3	2.3	8.3	2.6	9.3	2.9
6.4	2.0	7.4	2.3	8.4	2.6	9.4	2.9
6.5	2.0	7.5	2.3	8.5	2.7	9.5	3.0
6.6	2.1	7.6	2.4	8.6	2.7	9.6	3.0
6.7	2.1	7.7	2.4	8.7	2.7	9.7	3.0
6.8	2.1	7.8	2.4	8.8	2.7	9.8	3.1
6.9	2.2	7.9	2.5	8.9	2.8	9.9	3.1

GENERAL STATISTICS REGARDING TEAK AND SAL

INCHES.

Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.
10-0	3-1	11-0	3-4	12-0	3-7	13-0	4-1
10-1	3-2	11-1	3-5	12-1	3-8	13-1	4-1
10-2	3-2	11-2	3-5	12-2	3-8	13-2	4-1
10-3	3-2	11-3	3-5	12-3	3-8	13-3	4-1
10-4	3-2	11-4	3-6	12-4	3-9	13-4	4-2
10-5	3-3	11-5	3-6	12-5	3-9	13-5	4-2
10-6	3-3	11-6	3-6	12-6	3-9	13-6	4-2
10-7	3-3	11-7	3-6	12-7	4-0	13-7	4-3
10-8	3-4	11-8	3-7	12-8	4-0	13-8	4-3
10-9	3-4	11-9	3-7	12-9	4-0	13-9	4-3
14-0	4-4	15-0	4-7	16-0	5-0	17-0	5-3
14-1	4-4	15-1	4-7	16-1	5-0	17-1	5-3
14-2	4-4	15-2	4-7	16-2	5-1	17-2	5-4
14-3	4-5	15-3	4-8	16-3	5-1	17-3	5-4
14-4	4-5	15-4	4-8	16-4	5-1	17-4	5-4
14-5	4-5	15-5	4-8	16-5	5-1	17-5	5-5
14-6	4-6	15-6	4-9	16-6	5-2	17-6	5-5
14-7	4-6	15-7	4-9	16-7	5-2	17-7	5-5
14-8	4-6	15-8	4-9	16-8	5-2	17-8	5-6
14-9	4-6	15-9	5-0	16-9	5-3	17-9	5-6
18-0	5-6	19-0	5-9	20-0	6-2	21-0	6-5
18-1	5-6	19-1	6-0	20-1	6-3	21-1	6-6
18-2	5-7	19-2	6-0	20-2	6-3	21-2	6-6
18-3	5-7	19-3	6-0	20-3	6-3	21-3	6-6
18-4	5-7	19-4	6-1	20-4	6-4	21-4	6-7
18-5	5-8	19-5	6-1	20-5	6-4	21-5	6-7
18-6	5-8	19-6	6-1	20-6	6-4	21-6	6-7
18-7	5-8	19-7	6-1	20-7	6-5	21-7	6-8
18-8	5-9	19-8	6-2	20-8	6-5	21-8	6-8
18-9	5-9	19-9	6-2	20-9	6-5	21-9	6-8

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INCHES.

Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.
22.0	6.9	23.0	7.2	24.0	7.5	25.0	7.8
22.1	6.9	23.1	7.2	24.1	7.5	25.1	7.8
22.2	6.9	23.2	7.2	24.2	7.5	25.2	7.9
22.3	7.0	23.3	7.3	24.3	7.6	25.3	7.9
22.4	7.0	23.4	7.3	24.4	7.6	25.4	7.9
22.5	7.0	23.5	7.3	24.5	7.6	25.5	8.0
22.6	7.0	23.6	7.4	24.6	7.7	25.6	8.0
22.7	7.1	23.7	7.4	24.7	7.7	25.7	8.0
22.8	7.1	23.8	7.4	24.8	7.7	25.8	8.0
22.9	7.1	23.9	7.5	24.9	7.8	25.9	8.1
26.0	8.1	27.0	8.4	28.0	8.7	29.0	9.0
26.1	8.1	27.1	8.5	28.1	8.8	29.1	9.1
26.2	8.2	27.2	8.5	28.2	8.8	29.2	9.1
26.3	8.2	27.3	8.5	28.3	8.8	29.3	9.1
26.4	8.2	27.4	8.5	28.4	8.9	29.4	9.2
26.5	8.3	27.5	8.6	28.5	8.9	29.5	9.2
26.6	8.3	27.6	8.6	28.6	8.9	29.6	9.2
26.7	8.3	27.7	8.6	28.7	9.0	29.7	9.3
26.8	8.4	27.8	8.7	28.8	9.0	29.8	9.3
26.9	8.4	27.9	8.7	28.9	9.0	29.9	9.3
30.0	9.4	31.0	9.7	32.0	10.0	33.0	10.3
30.1	9.4	31.1	9.7	32.1	10.0	33.1	10.3
30.2	9.4	31.2	9.7	32.2	10.0	33.2	10.4
30.3	9.5	31.3	9.8	32.3	10.1	33.3	10.4
30.4	9.5	31.4	9.8	32.4	10.1	33.4	10.4
30.5	9.5	31.5	9.8	32.5	10.1	33.5	10.4
30.6	9.5	31.6	9.9	32.6	10.2	33.6	10.5
30.7	9.6	31.7	9.9	32.7	10.2	33.7	10.5
30.8	9.6	31.8	9.9	32.8	10.2	33.8	10.5
30.9	9.6	31.9	9.9	32.9	10.3	33.9	10.6

GENERAL STATISTICS REGARDING TEAK AND SAL

INCHES.

Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.
34.0	10.6	35.0	10.9	36.0	11.2	37.0	11.5
34.1	10.6	35.1	10.9	36.1	11.3	37.1	11.6
34.2	10.7	35.2	11.0	36.2	11.3	37.2	11.6
34.3	10.7	35.3	11.0	36.3	11.3	37.3	11.6
34.4	10.7	35.4	11.0	36.4	11.4	37.4	11.7
34.5	10.8	35.5	11.1	36.5	11.4	37.5	11.7
34.6	10.8	35.6	11.1	36.6	11.4	37.6	11.7
34.7	10.8	35.7	11.1	36.7	11.4	37.7	11.8
34.8	10.9	35.8	11.2	36.8	11.5	37.8	11.8
34.9	10.9	35.9	11.2	36.9	11.5	37.9	11.8
38.0	11.9	39.0	12.2	40.0	12.5	41.0	12.8
38.1	11.9	39.1	12.2	40.1	12.5	41.1	12.8
38.2	11.9	39.2	12.2	40.2	12.5	41.2	12.8
38.3	11.9	39.3	12.3	40.3	12.6	41.3	12.9
38.4	12.0	39.4	12.3	40.4	12.6	41.4	12.9
38.5	12.0	39.5	12.3	40.5	12.6	41.5	12.9
38.6	12.0	39.6	12.4	40.6	12.7	41.6	13.0
38.7	12.1	39.7	12.4	40.7	12.7	41.7	13.0
38.8	12.1	39.8	12.4	40.8	12.7	41.8	13.0
38.9	12.1	39.9	12.4	40.9	12.8	41.9	13.1
42.0	13.1	43.0	13.4	44.0	13.7	45.0	14.0
42.1	13.1	43.1	13.4	44.1	13.7	45.1	14.0
42.2	13.2	43.2	13.5	44.2	13.8	45.2	14.1
42.3	13.2	43.3	13.5	44.3	13.8	45.3	14.1
42.4	13.2	43.4	13.5	44.4	13.8	45.4	14.1
42.5	13.3	43.5	13.6	44.5	13.9	45.5	14.2
42.6	13.3	43.6	13.6	44.6	13.9	45.6	14.2
42.7	13.3	43.7	13.6	44.7	13.9	45.7	14.2
42.8	13.3	43.8	13.7	44.8	13.9	45.8	14.3
42.9	13.4	43.9	13.7	44.9	14.0	45.8	14.3

C. P. FOREST POCKET BOOK

INCHES.

Girth.	Dia. meter.	Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- me'ter.
46·0	14·3	47·0	14·7	48·0	15·0	49·0	15·3
46·1	14·4	47·1	14·7	48·1	15·0	49·1	15·3
46·2	14·4	47·2	14·7	48·2	15·0	49·2	15·3
46·3	14·4	47·3	14·8	48·3	15·1	49·3	15·4
46·4	14·5	47·4	14·8	48·4	15·1	49·4	15·4
46·5	14·5	47·5	14·8	48·5	15·1	49·5	15·4
46·6	14·5	47·6	14·8	48·6	15·1	49·6	15·5
46·7	14·6	47·7	14·9	48·7	15·2	49·7	15·5
46·8	14·6	47·8	14·9	48·8	15·2	49·8	15·5
46·9	14·6	47·9	14·9	48·9	15·2	49·9	15·6
50·0	15·6	51·0	15·9	52·0	16·2	53·0	16·5
50·1	15·6	51·1	15·9	52·1	16·3	53·1	16·6
50·2	15·7	51·2	16·0	52·2	16·3	53·2	16·6
50·3	15·7	51·3	16·0	52·3	16·3	53·3	16·6
50·4	15·7	51·4	16·0	52·4	16·3	53·4	16·7
50·5	15·8	51·5	16·1	52·5	16·4	53·5	16·7
50·6	15·8	51·6	16·1	52·6	16·4	53·6	16·7
50·7	15·8	51·7	16·1	52·7	16·4	53·7	16·8
50·8	15·8	51·8	16·2	52·8	16·5	53·8	16·8
50·9	15·9	51·9	16·2	52·9	16·5	53·9	16·8
54·0	16·8	55·0	17·2	56·0	17·5	57·0	17·8
54·1	16·9	55·1	17·2	56·1	17·5	57·1	17·8
54·2	16·9	55·2	17·2	56·2	17·5	57·2	17·8
54·3	16·9	55·3	17·3	56·3	17·6	57·3	17·9
54·4	17·0	55·4	17·3	56·4	17·6	57·4	17·9
54·5	17·0	55·5	17·3	56·5	17·6	57·5	17·9
54·6	17·0	55·6	17·3	56·6	17·7	57·6	18·0
54·7	17·1	55·7	17·4	56·7	17·7	57·7	18·0
54·8	17·1	55·8	17·4	56·8	17·7	57·8	18·0
54·9	17·1	55·9	17·4	56·9	17·8	57·9	18·1

GENERAL STATISTICS REGARDING TEAK AND SAL

INCHES.

Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.	Girth.	Dia- meter.
58-0	18-1	59-0	18-4	60-0	18-7		
58-1	18-1	59-1	18-4	60-1	18-7		
58-2	18-1	59-2	18-4	60-2	18-7		
58-3	18-2	59-3	18-5	60-3	18-8		
58-4	18-2	59-4	18-5	60-4	18-8		
58-5	18-2	59-5	18-5	60-5	18-8		
58-6	18-2	59-6	18-6	60-6	18-9		
58-7	18-3	59-7	18-6	60-7	18-9		
58-8	18-3	59-8	18-6	60-8	18-9		
58-9	18-3	59-9	18-7	60-9	19-0		

NOTE.—For Chir pine $\frac{\text{girth}}{\text{diameter}} = .3093.$

C. P. FOREST POCKET BOOK

TAPER CONSTANTS FOR SAL.

(From U. P. Forest Pocket Book.)

Half length of bole in feet.	Taper constant.	Half length of bole in feet.	Taper constant.	Half length of bole in feet.	Taper constant.
5	.878	15	.773	25	.708
6	.862	16	.765	26	.702
7	.850	17	.757	27	.696
8	.839	18	.750	28	.690
9	.828	19	.743	29	.684
10	.818	20	.737	30	.678
11	.808	21	.731	31	.672
12	.799	22	.725	32	.666
13	.790	23	.719	33	.660
14	.781	24	.713	34	.655

“*Ex.*—[For a tree of bole 36' long and diameter over bark at breast height of 16' 3"']. Half length of bole=18', taper-constant from table=.750. Then diameter under bark at half height : 16' 3" × .750 : 12' 2"'. The calculation for girths is the same”

GENERAL STATISTICS REGARDING TEAK AND SAL

NO. OF STEMS PER ACRE, C. P.
 (Average quality—from thinned Sample Plots,
 C. P.)

Teak.		Sal.	
Diameter.	No. of stems per acre.	Diameter.	No. of stems to the acre.
2"	662	2"	900
4"	290	4"	460
6"	170	6"	275
8"	125	8"	170
10"	100	10"	118
12"	83	12"	78
14"	70	14"	68
16"	58	16"	52
18"	51	18"	45
20"	45	20"	42

NOTE.—The above (especially for sal) refer to plots very heavily thinned (*cf* sal figures on p. 111, U. P. Forest Pocket Book).

C. P. FOREST POCKET BOOK

C. P. BARK THICKNESS FIGURES.

(From measurements of *C. P. type trees.*)

Oak		Sal.	
Over bark diameter in inches.	Bark thickness (diameter) to be deducted to get under bark diameter.	Over bark diameter in inches.	Bark thickness (diameter) to be deducted to get under bark diameter.
2	.20	2	.66
3	.27	3	.80
4	.35	4	.90
5	.42	5	1.02
6	.48	6	1.12
7	.54	7	1.22
8	.61	8	1.32
9	.64	9	1.42
10	.72	10	1.51
11	.77	11	1.61
12	.82	12	1.70
13	.86	13	1.78
14	.90	14	1.87
15	.94	15	1.96
16	.97	16	2.04
17	1.01	17	2.12
18	1.03	18	2.20
19	1.07	19	2.28
20	1.10	20	2.35
21	1.13	21	2.42
22	1.15	22	2.48
23	1.17	23	2.54
24	1.19	24	2.60
25	1.21	25	2.65
26	1.23	26	2.70
27	1.25	27	2.74
28	1.27	28	2.78
29	1.28	29	2.83
30	1.30	30	2.87

NOTE.—The rough rule to allow for bark is to deduct 1" out of every 12" of over-bark girth measurement, i. e., about 16 per cent.

GENERAL STATISTICS REGARDING TEAK AND SAL

C. P. VOLUME TABLES FOR SINGLE TREES.

TEAK.

Volume of timber in the round including bark (local C. P. definition)—quarter girth measurement—by girth classes and height classes to the nearest $\frac{1}{2}$ cubic foot.

Girth class (in inches).	Height class (in feet).				
	11—30	31—50	51—70	71—90	91—110
Over 7— 10	...	...	...	...	...
„ 10— 13	$\frac{1}{2}$	1	$1\frac{1}{2}$	...	...
„ 13— 16	1	$1\frac{1}{2}$	$1\frac{1}{2}$	...	...
„ 16— 19	1	2	$3\frac{1}{2}$	...	...
„ 19— 22	1	$2\frac{1}{2}$	4	...	...
„ 22— 25	$1\frac{1}{2}$	3	5	7	...
„ 25— 31	$1\frac{1}{2}$	4	7	10	...
„ 31— 37	2	$5\frac{1}{2}$	10	$14\frac{1}{2}$	...
„ 37— 43	3	8	14	20	...
„ 43— 49	4	$10\frac{1}{2}$	$18\frac{1}{2}$	26	36
„ 49— 55	$5\frac{1}{2}$	$14\frac{1}{2}$	24	$33\frac{1}{2}$	44
„ 55— 61	$7\frac{1}{2}$	19	$30\frac{1}{2}$	41	$52\frac{1}{2}$
„ 61— 67	10	$23\frac{1}{2}$	37	$49\frac{1}{2}$	62
„ 67— 73	13	$28\frac{1}{2}$	44	58	72
„ 73— 79	...	34	$51\frac{1}{2}$	$67\frac{1}{2}$	83
„ 79— 85	...	40	$59\frac{1}{2}$	77	$94\frac{1}{2}$
„ 85— 91	...	...	67	86	$105\frac{1}{2}$
„ 91— 97	...	...	$75\frac{1}{2}$	$96\frac{1}{2}$	$118\frac{1}{2}$
„ 97—103	...	...	83	$105\frac{1}{2}$	$129\frac{1}{2}$

SAL.

Volume of timber in the round including bark (local C. P. definition)—quarter girth measurement—by girth classes and locality quality classes to the nearest $\frac{1}{2}$ cubic foot.

Girth class (in inches).	Local quality.		
	III	II	I
Over 7— 10	...	...	...
„ 10— 13	...	...	...
„ 13— 16	1	1	1
„ 16— 19	1½	1½	2½
„ 19— 22	2½	3	4
„ 22— 25	3	4½	6
„ 25— 31	4½	6	9½
„ 31— 37	7½	11	15
„ 37— 43	11	16	21½
„ 43— 49	15	21½	28½
„ 49— 55	20½	28	36½
„ 55— 61	26	35	45½
„ 61— 67	32½	42½	54½
„ 67— 73	39	50	64½
„ 73— 79	46	59	75
„ 79— 85	54	68½	86½
„ 85— 91	61½	77½	97½
„ 91— 97	70	87½	109½
„ 97—103	78½	98	122

GENERAL STATISTICS REGARDING TEAK AND SAL

NOTE ON USE OF VOLUME TABLES.

The qualities referred to are those standardized for the province, *viz.* :—

Quality I	... Over 90'	... (Average maximum height of mature trees).
„ II	... 71'—90'	... Do.
„ III	... 51'—70'	... Do.
„ IV	... under 50'	... Do.

The figures given are based on averages and are intended to be applied to averages. The height class figures are the most accurate but demand noting the height of each tree at the time of enumeration. The average girth and average height of each girth class should be calculated and the appropriate volume for each girth class read off.

In using quality class figures the determination of the locality quality depends on individual judgment.

The figures given are ideal figures only and it must be remembered that local deductions for rottenness, etc., must be made.

The Central Provinces quality classes referred to apply to all species. Quality IV may be further sub-divided into—

IV-a	... 41'—50'
IV-b	... 31'—40'

C. P. FOREST POCKET BOOK

Teak Outturn Volume Table. (Bori Range, Hoshangabad Division).

Volume of timber given is actual converted solid volume worth removing 40 miles to railway—

Girth class (in inches).	Av. vol. of timber per tree (in c. ft).	Girth class (in inches).	Av. vol. of timber per tree (in c. ft)
18—23	... 3·2	54—59	... 18·2
24—29	... 5·0	60—65	... 20·9
30—35	... 7·0	66—71	... 26·1
36—41	... 9·8	72—83	... 30·7
42—47	... 13·0	84—95	... 39·1
48—53	... 18·0	96 and over	41·2

NOTE.—The teak in Bori is mostly quality II.

MAIN C. P. COPPICE SPECIES.

Showing mean development of average shoots (unthinned) at different ages in typical C. P. dry Mixed Forest type of Quality III to IV—

Species.	Age.	Mean girth in inches.	Mean height in feet.
Phyllanthus emblica (aonla).	5	2·9	10·5
	10	6·0	16·1
	15	8·0	20·0
	20	10·0	22·9
	25	12·3	24·0
	30	14·2	26·0

GENERAL STATISTICS REGARDING TEAK AND SAL

Species.	Age	Mean girth in inches.	Mean height in feet.
Chloroxylon Swietenia (bhirra, ghirra, satinwood).	5	3.4	7.1
	10	6.3	13.8
	15	9.0	18.8
	20	11.0	23.0
	25	13.5	26.9
	30	15.6	30.1
Anogeissus latifolia (dhaora).	5	2.8	9.1
	10	5.2	14.5
	15	7.4	17.8
	20	9.4	20.3
	25	11.4	21.9
	30	13.1	23.2
Lagerstroemia parviflora (lendia, senha).	5	3.5	8.0
	10	6.3	14.0
	15	8.5	18.5
	20	10.2	21.3
	25	11.8	23.5
	30	13.3	25.0
Soyimida febrifuga, (rohan).	5	2.6	6.5
	10	5.4	11.3
	15	7.7	14.8
	20	10.0	18.0
	25	11.8	21.2
	30	13.5	22.7
Shorea robusta (sal, sarai).	5	6.5	17.0
	10	10.5	23.0
	15	13.5	27.0
	20	16.0	29.6
	25	18.0	31.5

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Species.	Age.	Mean girth in inches.	Mean height of feet.
Aegle marmelos (bel).	5	4.2	7.1
	10	7.5	13.6
	15	9.5	20.0
	20	11.1	25.5
	25	12.2	31.0
	30	13.2	35.0
Pterocarpus marsu- pium (bija).	5	3.0	8.5
	10	5.7	14.2
	15	8.0	18.9
	20	10.1	22.9
	25	11.8	26.2
	30	18.4	2.86
Cleistanthus collinus (garari, karra).	5	3.3	9.0
	10	6.0	14.1
	15	8.0	17.7
	20	9.6	20.9
	25	11.3	23.8
	30	13.0	26.0
Bassia latifolia (moh- wa).	5	3.1	8.0
	10	5.6	13.6
	15	8.0	17.0
	20	9.9	19.3
	25	11.6	21.1
	30	13.2	22.7
Terminalia tomen- tosa (saj, ain).	5	4.4	10.6
	10	8.2	18.1
	15	10.7	22.3
	20	12.9	26.7
	25	15.1	30.4
	30	17.4	33.3

GENERAL STATISTICS REGARDING TEAK AND SAL

Species.	Age.	Mean girth in inches.	Mean height in feet.
<i>Tectona grandis</i> (teak, saigon).	5	4.3	10.6
	10	7.2	16.6
	15	9.9	21.1
	20	12.1	24.9
	25	14.2	28.3
	30	16.1	31.4
<i>Diospyros melanoxylon</i> (tendu).	5	2.7	7.9
	10	5.2	12.5
	15	7.3	16.0
	20	9.5	19.0
	25	11.4	20.8
	30	13.0	21.8
<i>Ougenia dalbergioides</i> (tinsa, tiwas).	5	2.5	7.1
	10	5.0	11.0
	15	7.5	15.5
	20	10.0	18.9
	25	12.2	21.0
	30	14.1	22.0

CHAPTER IX.

USEFUL CONSTANTS AND TABLES.

GENERAL TABLES, CONSTANTS, ETC.

Π = approximately 3.1416 or $\frac{22}{7}$ or $\frac{355}{11}$.

Diameter of circle $\times \Pi$ = Circumference of circle.

(Diameter of circle)² \times .7854 = Area of circle.

(Diameter of sphere)² $\times \Pi$ = Area of surface of sphere.

(Radius of sphere)³ $\times \frac{4}{3} \Pi$ = Volume of sphere.

Area of curved surface of cone =
 $\Pi \times \text{radius} \sqrt{(\text{radius})^2 + (\text{height})^2}$.

or $\Pi \times \text{radius} (\text{slant height} + \text{radius})$.

Volume of cone = $\frac{\Pi}{3} \times (\text{radius})^2 \times \text{height}$.

Area of triangle = $\frac{\text{base} \times \text{height}}{2}$

or $\sqrt{s(s-a)(s-b)(s-c)}$ where S = half the sum of the
 3 sides a, b, c .

Area of ellipse = $0.7854 \times \text{Major Axis} \times \text{Minor Axis}$.

USEFUL CONSTANTS AND TABLES

Surveying Measure (Lineal).

Inches.	Links.	Feet.	Yards.	Chains.	Mile.	Metres.
1 =	.126 =	.0833 =	.0278 =	.0126 =	.0000158 =	.0254
7.92 =	1 =	.66 =	.22 =	.01 =	.000125 =	.2012
12 =	1.515 =	1 =	.333 =	.01,515 =	.000189 =	.3048
36 =	4.545 =	3 =	1 =	.04,545 =	.000568 =	.9144
792 =	100 =	66 =	22 =	1 =	.0125 =	20.116
63,360 =	8,000 =	5,280 =	1,760 =	80 =	1 =	1,609.315

Square Measure.

Inches.	Feet.	Yards.	Perches.	Rods.	Acres.	Sq. Metres.
1 =	.00694 =	.000772 =	.0000255 =	.00000064 =	.000000159 =	.000645
144 =	1 =	.111 =	.0367 =	.0000918 =	.000023 =	.0929
1,296 =	9 =	1 =	.0331 =	.000826 =	.0002062 =	.8.361
39,204 =	272.25 =	30.25 =	1 =	.025 =	.00625 =	25.292
568,160 =	10,890 =	1,210 =	40 =	1 =	.25 =	1,011.7
272,640 =	43,560 =	4,840 =	160 =	4 =	.1 =	4,046.7

C. P. FOREST POCKET BOOK

Interest table according to C. P. Forest Village Taccavi advance rate of Re. 0-0-1.25 per month. Simple interest is charged.

Rupees.	Interest per month.		
	Rs.	a.	p.
1	0	0	1.25
2	0	0	2.5
3	0	0	3.75
4	0	0	5
5	0	0	6.25
6	0	0	7.5
7	0	0	8.75
8	0	0	10
9	0	0	11.25
10	0	1	.5
20	0	2	1
30	0	3	1.5
40	0	4	2
50	0	5	2.5
60	0	6	3
70	0	7	3.5
80	0	8	4
90	0	9	4.5
100	0	10	5

USEFUL CONSTANTS AND TABLES

DAILY WAGES TABLE.

Monthly pay.	28 days in month.	29 days in month.	30 days in month.	31 days in month.
	Per day.	Per day.	Per day.	Per day.
Rs. a.	Re. a. p.	Re. a. p.	Re. a. p.	Rs. a. p.
0 8	0 0 3	0 0 3	0 0 3	0 0 3
1 0	0 0 7	0 0 7	0 0 6	0 0 6
1 8	0 0 10	0 0 10	0 0 10	0 0 9
2 0	0 1 2	0 1 1	0 1 1	0 1 0
2 8	0 1 5	0 1 5	0 1 4	0 1 3
3 0	0 1 9	0 1 8	0 1 7	0 1 7
3 8	0 2 0	0 1 11	0 1 10	0 1 10
4 0	0 2 3	0 2 2	0 2 2	0 2 1
4 8	0 2 7	0 2 6	0 2 5	0 2 4
5 0	0 2 10	0 2 9	0 2 8	0 2 7
5 8	0 3 2	0 3 0	0 2 11	0 2 10
6 0	0 3 5	0 3 4	0 3 2	0 3 1
6 8	0 3 9	0 3 7	0 3 6	0 3 4
7 0	0 4 0	0 3 10	0 3 9	0 3 7
7 8	0 4 3	0 4 2	0 4 0	0 3 10
8 0	0 4 7	0 4 5	0 4 3	0 4 2
8 8	0 4 10	0 4 8	0 4 6	0 4 5
9 0	0 5 2	0 5 0	0 4 10	0 4 8
9 8	0 5 5	0 5 3	0 5 1	0 4 11
10 0	0 5 9	0 5 6	0 5 4	0 5 2
10 8	0 6 0	0 5 10	0 5 7	0 5 5
11 0	0 6 3	0 6 1	0 5 10	0 5 8
11 8	0 6 7	0 6 4	0 6 2	0 5 11
12 0	0 6 10	0 6 7	0 6 5	0 6 2
12 8	0 7 2	0 6 11	0 6 8	0 6 5

C. P. FOREST POCKET BOOK

DAILY WAGES TABLE—*contd.*

Monthly pay.	28 days in month.	29 days in month.	30 days in month.	31 days in month.
	Per day.	Per day.	Per day.	Per day.
Rs. a.	Re. a. p.	Re. a. p.	Re. a. p.	Re. a. p.
13 0	0 7 5	0 7 2	0 6 11	0 6 9
13 8	0 7 9	0 7 5	0 7 2	0 7 0
14 0	0 8 0	0 7 9	0 7 6	0 7 3
14 8	0 8 3	0 8 0	0 7 9	0 7 6
15 0	0 8 7	0 8 3	0 8 0	0 7 9
15 8	0 8 10	0 8 7	0 8 3	0 8 0
16 0	0 9 2	0 8 10	0 8 6	0 8 3
16 8	0 9 5	0 9 1	0 8 10	0 8 6
17 0	0 9 9	0 9 5	0 9 1	0 8 9
17 8	0 10 0	0 9 8	0 9 4	0 9 0
18 0	0 10 3	0 9 11	0 9 7	0 9 3
18 8	0 10 7	0 10 2	0 9 10	0 9 7
19 0	0 10 10	0 10 6	0 10 2	0 9 10
19 8	0 11 2	0 10 9	0 10 5	0 10 1
20 0	0 11 5	0 11 0	0 10 8	0 10 4
20 8	0 11 9	0 11 4	0 10 11	0 10 7
21 0	0 12 0	0 11 7	0 11 2	0 10 10
21 8	0 12 3	0 11 10	0 11 6	0 11 1
22 0	0 12 7	0 12 2	0 11 9	0 11 4
22 8	0 12 10	0 12 5	0 12 0	0 11 7
23 0	0 13 2	0 12 8	0 12 3	0 11 10
23 8	0 13 5	0 13 0	0 12 6	0 12 2
24 0	0 13 9	0 13 3	0 12 10	0 12 5
24 8	0 14 0	0 13 6	0 13 1	0 12 8
25 0	0 14 3	0 13 10	0 13 4	0 12 11

USEFUL CONSTANTS AND TABLES

DAILY WAGES TABLE—*contd.*

Monthly pay.	28 days in month.	29 pays in month.	30 days in month.	31 days in month.
	Per day.	Per day.	Per day.	Per day.
Rs. a.	Re. a. p.	Re. a. p.	Re. a. p.	Re. a. p.
25 8	0 14 7	0 14 1	0 13 7	0 13 2
26 0	0 14 10	0 14 4	0 13 10	0 13 5
26 8	0 15 2	0 14 7	0 14 2	0 13 8
27 0	0 15 5	0 14 11	0 14 5	0 13 11
27 8	0 15 9	0 15 2	0 14 8	0 14 2
28 0	1 0 0	0 15 5	0 14 11	0 14 5
28 8	1 0 3	0 15 9	0 15 2	0 14 9
29 0	1 0 7	1 0 0	0 15 6	0 15 0
29 8	1 0 10	1 0 3	0 15 9	0 15 3
30 0	1 1 2	1 0 7	1 0 0	0 15 6
30 8	1 1 5	1 0 10	1 0 3	0 15 9
31 0	1 1 9	1 1 1	1 0 6	1 0 0
31 8	1 2 0	1 1 5	1 0 10	1 0 3
32 0	1 2 3	1 1 8	1 1 1	1 0 6
32 8	1 2 7	1 1 11	1 1 4	1 0 9
33 0	1 2 10	1 2 2	1 1 7	1 1 0
33 8	1 3 2	1 2 6	1 1 10	1 1 3
34 0	1 3 5	1 2 9	1 2 2	1 1 7
34 8	1 3 9	1 3 0	1 2 5	1 1 10
35 0	1 4 0	1 3 4	1 2 8	1 2 1
35 8	1 4 3	1 3 7	1 2 11	1 2 4
36 0	1 4 7	1 3 10	1 3 2	1 2 7
36 8	1 4 10	1 4 2	1 3 6	1 2 10
37 0	1 5 2	1 4 5	1 3 9	1 3 1
37 8	1 5 5	1 4 8	1 4 0	1 3 4

C. P. FOREST POCKET BOOK

DAILY WAGES TABLE—concl'd.

Monthly pay.	28 days in month.	29 days in month.	30 days in month.	31 days in month.
	Per day.	Per day.	Per day.	Per day.
Rs. a.	Rs, a. p	Rs. a. p.	Rs. a. p.	Rs. a. p.
38 0	1 5 9	1 5 0	1 4 3	1 3 7
38 8	1 6 0	1 5 3	1 4 6	1 3 10
39 0	1 6 3	1 5 6	1 4 10	1 4 2
39 8	1 6 7	1 5 10	1 5 1	1 4 5
40 0	1 6 10	1 6 1	1 5 4	1 4 8
45 0	1 9 9	1 8 10	1 8 0	1 7 3
50 0	1 12 7	1 11 7	1 10 8	1 9 10
60 0	2 2 3	2 1 1	2 0 0	1 15 0
70 0	2 8 0	2 6 7	2 5 4	2 4 2
80 0	2 13 9	2 12 2	2 10 8	2 9 3
90 0	3 3 5	3 1 8	3 0 0	2 14 5
100 0	3 9 2	3 7 2	3 5 4	3 3 7
150 0	5 5 9	5 2 9	5 0 0	4 13 6
200 0	7 2 4	6 14 4	6 10 8	6 7 3
250 0	8 14 10	8 9 11	8 5 4	8 1 0
300 0	10 11 5	10 5 6	10 0 0	9 10 10
350 0	12 8 0	12 1 1	11 10 8	11 4 8
400 0	14 4 7	13 12 8	13 5 4	12 14 5
450 0	16 1 2	15 8 3	15 0 0	14 8 3
500 0	17 13 9	17 3 10	16 10 8	16 2 1
550 0	19 10 3	18 15 5	18 5 4	17 11 10
600 0	26 6 10	20 11 0	20 0 0	19 5 8

USEFUL CONSTANTS AND TABLES

Diameter corresponding to a given girth [true circles of $\frac{\text{girth}}{\text{diam.}} = \pi$].

Girth (inches).	Diameter (inches).	Girth (inches).	Diameter (inches).	Girth (inches).	Diameter (inches).
1	.32	26	8.28	51	16.23
2	.64	27	8.59	52	16.55
3	.95	28	8.91	53	16.87
4	1.27	29	9.23	54	17.19
5	1.59	30	9.55	55	17.51
6	1.91	31	9.87	56	17.83
7	2.23	32	10.19	57	18.15
8	2.55	33	10.50	58	18.46
9	2.86	34	10.82	59	18.78
10	3.18	35	11.14	60	19.10
11	3.50	36	11.46	61	19.42
12	3.82	37	11.78	62	19.72
13	4.14	38	12.10	63	20.05
14	4.46	39	12.41	64	20.37
15	4.77	40	12.73	65	20.69
16	5.09	41	13.05	66	21.00
17	5.41	42	13.37	67	21.33
18	5.73	43	13.69	68	21.65
19	6.05	44	14.01	69	21.96
20	6.37	45	14.32	70	22.28
21	6.68	46	14.64	71	22.60
22	7.00	47	14.96	72	22.92
23	7.32	48	15.28	73	23.24
24	7.64	49	15.60	74	23.55
25	7.96	50	15.92	75	23.87

C. P. FOREST POCKET BOOK

Diameter corresponding to a given girth—*concl'd.*

Girth (inches).	Diameter (inches).	Girth (inches).	Diameter (inches).	Girth (inches).	Diameter (inches).
76	24.19	91	28.97	106	33.74
77	24.51	92	29.28	107	34.06
78	24.83	93	29.60	108	34.38
79	25.15	94	29.92	109	34.70
80	25.46	95	30.24	110	35.01
81	25.78	96	30.56	111	35.33
82	26.10	97	30.88	112	35.65
83	26.42	98	31.19	113	35.97
84	26.74	99	31.51	114	36.29
85	27.06	100	31.83	115	36.60
86	27.37	101	32.15	116	36.92
87	27.69	102	32.47	117	37.24
88	28.01	103	32.79	118	37.56
89	28.33	104	33.10	119	37.88
90	28.65	105	33.42	120	38.19

USEFUL CONSTANTS AND TABLES

Girth corresponding to a given diameter [true circles of $\frac{\text{girth}}{\text{diam}} = \pi$].

Diameter (inches).	Girth (inches).	Diameter (inches).	Girth (inches).	Diameter (inches).	Girth (inches).
1	3.14	18	56.55	35	109.96
2	6.28	19	59.69	36	113.10
3	9.42	20	62.83	37	116.24
4	12.57	21	66.97	38	119.38
5	15.71	22	62.11	39	122.52
6	18.85	23	72.26	40	125.66
7	21.99	24	75.40	41	128.81
8	25.13	25	78.54	42	131.95
9	28.27	26	81.26	43	135.09
10	31.42	27	84.82	44	138.23
11	34.56	28	87.96	45	141.57
12	37.70	29	91.11	46	144.51
13	40.84	30	94.25	47	147.66
14	43.98	31	97.39	48	150.80
15	47.12	32	100.53	49	153.94
16	50.27	33	103.67	50	157.00
17	53.41	34	106.81		

Area of circles of diameters 1 inch to 60 inches.

C. P. FOREST POCKET BOOK

Dia- meters in in- ches.	Area of circle in square feet.	Dia- meters in in- ches.	Area of circle in square feet.	Dia- meters in in- ches.	Area of circle in square feet.	Dia- meters in in- ches.	Area of circle in square feet.	Dia- meters in in- ches.	Area of circle in square feet.
1.0	0.0055	2.0	0.0218	3.0	0.0491	4.0	0.0873	5.0	0.1364
.1	.0067	.1	.0240	.1	.0524	.1	.0917	.1	.1418
.2	.0079	.2	.0264	.2	.0559	.2	.0963	.2	.1474
.3	.0092	.3	.0289	.3	.0594	.3	.1009	.3	.1532
.4	.0107	.4	.0314	.4	.0631	.4	.1056	.4	.1590
.5	.0123	.5	.0341	.5	.0669	.5	.1105	.5	.1650
.6	.0140	.6	.0369	.6	.0707	.6	.1154	.6	.1710
.7	.0158	.7	.0398	.7	.0747	.7	.1205	.7	.1772
.8	.0177	.8	.0428	.8	.0788	.8	.1257	.8	.1835
.9	.0197	.9	.0459	.9	.0830	.9	.1310	.9	.1899

USEFUL CONSTANTS AND TABLES

6.0	0.1963	7.0	0.2673	8.0	0.3491	9.0	0.4418	10.0	0.5454
1	.2029	1	.2750	1	.3579	1	.4517	1	.5564
2	.2096	2	.2828	2	.3668	2	.4617	2	.5675
3	.2164	3	.2907	3	.3758	3	.4718	3	.5787
4	.2234	4	.2937	4	.3849	4	.4820	4	.5900
5	.2304	5	.3068	5	.3941	5	.4923	5	.6014
6	.2376	6	.3151	6	.4034	6	.5027	6	.6129
7	.2448	7	.3234	7	.4129	7	.5132	7	.6245
8	.2522	8	.3319	8	.4224	8	.5238	8	.6362
9	.2597	9	.3404	9	.4321	9	.5345	9	.6481
11.0	0.6600	12.0	0.7854	13.0	0.9218	14.0	1.0690	15.0	1.2272
1	.6721	1	.7986	1	.6630	1	1.0843	1	1.2437
2	.6842	2	.8118	2	.9504	2	1.0997	2	1.2602
3	.6965	3	.8262	3	.9648	3	1.1153	3	1.2768
4	.7089	4	.8387	4	.9794	4	1.1309	4	1.2936
5	.7214	5	.8523	5	.9941	5	1.1467	5	1.3104
6	.7340	6	.8660	6	1.0089	6	1.1626	6	1.3274
7	.7467	7	.8798	7	1.0237	7	1.1785	7	1.3444
8	.7595	8	.8937	8	1.0387	8	1.1946	8	1.3616
9	.7724	9	.9077	9	1.0538	9	1.2108	9	1.3789
16.0	1.3963	17.0	1.5763	18.0	1.7671	19.0	1.9689	20.0	2.1817
1	1.4138	1	1.5949	1	1.7868	1	1.9897	1	2.2036
2	1.4314	2	1.6136	2	1.8066	2	2.0106	2	2.2256

C. P. FOREST POCKET BOOK

Area of circles of diameters 1 inch to 60 inches—concl'd.

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Dia- meters in in- ches.	Area of circle in square feet.	Dia- meters in in- ches.	Area of circle in square feet.	Dia- meters in in- ches.	Area of circle in square feet.	Dia- meters in in- ches.	Area of circle in square feet.	Dia- meters in in- ches.	Area of circle in square feet.
.3	1.4492	.3	1.6324	.3	1.8265	.3	2.0316	.3	2.2477
.4	1.4670	.4	1.6513	.4	1.8465	.4	2.0527	.4	2.2699
.5	1.4849	.5	1.6703	.5	1.8666	.5	2.0739	.5	2.2922
.6	1.5030	.6	1.6894	.6	1.8869	.6	2.0952	.6	2.3146
.7	1.5212	.7	1.7087	.7	1.9072	.7	2.1167	.7	2.3371
.8	1.5394	.8	1.7280	.8	1.9277	.8	2.1382	.8	2.3597
.9	1.5578	.9	1.7475	.9	1.9482	.9	2.1599	.9	2.3825
21.0	2.4053	22.0	2.6398	23.0	2.8852	24.0	3.1416	25.0	3.4088
.1	2.4283	.1	2.6638	.1	2.9103	.1	3.1679	.1	3.4361

USEFUL CONSTANTS AND TABLES

2	2-4514	2	2-9356	2	3-1942	2	3-4636
3	2-4745	3	2-9610	3	3-2207	3	3-4911
4	2-4978	4	2-9864	4	3-2471	4	3-5188
5	2-5212	5	3-0120	5	3-2748	5	3-5465
6	2-5447	6	3-0677	6	3-3006	6	3-5744
7	2-5684	7	3-0635	7	3-3275	7	3-6024
8	2-5921	8	3-0894	8	3-3545	8	3-6305
9	2-6159	9	3-1154	9	3-3816	9	3-6587
40	8-7266	42	9-6211	43	10-0847	44	10-5592
50	13-6354	52	14-7480	53	15-3207	54	15-9043
0	19-6350	...	...	...	...	...	...
26-0	3-6870	28-0	4-2761	29-0	4-5869	30-0	4-9087
1	3-7154	1	4-3067	1	4-6186	1	5-2414
2	3-7439	2	4-3374	2	4-6504	2	5-5851
3	3-7725	3	4-3682	3	4-6823	3	5-9396
4	3-8013	4	4-3991	4	4-7143	4	6-3050
5	3-8301	5	4-4301	5	4-7464	5	6-6813
6	3-8591	6	4-4612	6	4-7787	6	7-0686
7	3-8882	7	4-4925	7	4-8110	7	7-4667
8	3-9174	8	4-5238	8	4-8435	8	6-8758
9	3-9467	9	4-5553	9	4-8760	9	8-2958
45	11-0447	47	12-0482	48	12-5664	49	13-0954
55	16-4988	57	17-7206	58	18-3478	59	18-9859

C. P. FOREST POCKET BOOK
Cubic contents of logs or cylinders [$\frac{1}{4}$ girth]² × length.

Length in feet.	MEAN GIRTH.							
	1"	2"	3"	4"	5"	6"	7"	8'
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	0.00043	0.0017	0.004	0.007	0.011	0.016	0.021	0.028
2	0.00086	0.0035	0.008	0.014	0.022	0.031	0.042	0.055
3	0.00129	0.0052	0.012	0.021	0.032	0.047	0.064	0.083
4	0.00172	0.0069	0.016	0.028	0.043	0.062	0.085	0.111
5	0.00215	0.0086	0.019	0.035	0.054	0.078	0.106	0.139
6	0.00258	0.0104	0.023	0.042	0.065	0.094	0.127	0.167
7	0.00301	0.0121	0.027	0.048	0.076	0.109	0.149	0.194
8	0.00344	0.0138	0.031	0.055	0.087	0.125	0.170	0.222
9	0.00387	0.0156	0.035	0.062	0.098	0.140	0.191	0.250
10	0.00430	0.0173	0.039	0.069	0.108	0.156	0.213	0.278
11	0.00473	0.0190	0.043	0.076	0.119	0.172	0.234	0.305
12	0.00516	0.0208	0.047	0.083	0.130	0.187	0.255	0.333
13	0.00559	0.0225	0.051	0.090	0.141	0.203	0.276	0.361
14	0.00602	0.0242	0.055	0.097	0.152	0.219	0.298	0.389
15	0.00645	0.0259	0.058	0.104	0.163	0.234	0.319	0.416
16	0.00688	0.0277	0.062	0.111	0.174	0.250	0.340	0.444
17	0.00731	0.0294	0.066	0.118	0.184	0.265	0.361	0.472
18	0.00774	0.0311	0.070	0.125	0.195	0.281	0.383	0.500
19	0.00817	0.0329	0.074	0.132	0.206	0.297	0.404	0.528
20	0.00860	0.0346	0.078	0.139	0.217	0.312	0.425	0.555

NOTE.—Quarter girth sectional area = $\frac{G^2}{4} = G^2 \times .0625$.

True sectional area = $G^2 \times .0796$.

Thus true volume is converted to quarter girth volume by deducting 21.5%.

USEFUL CONSTANTS AND TABLES

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	9'	10"	11'	12"	13"	14'	15"	16"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	0.035	0.043	0.052	0.062	0.073	0.085	0.098	0.111
2	0.070	0.087	0.105	0.125	0.147	0.170	0.195	0.222
3	0.105	0.130	0.157	0.197	0.220	0.255	0.293	0.333
4	0.141	0.174	0.280	0.250	0.293	0.340	0.391	0.444
5	0.176	0.217	0.262	0.312	0.367	0.425	0.488	0.555
6	0.211	0.260	0.315	0.375	0.440	0.510	0.586	0.667
7	0.246	0.304	0.367	0.437	0.513	0.595	0.683	0.778
8	0.281	0.347	0.420	0.500	0.587	0.680	0.781	0.889
9	0.316	0.391	0.472	0.562	0.660	0.765	0.879	1.000
10	0.351	0.434	0.525	0.625	0.733	0.851	0.976	1.111
11	0.387	0.477	0.578	0.687	0.807	0.936	1.074	1.222
12	0.422	0.521	0.630	0.750	0.880	1.021	1.172	1.333
13	0.457	0.564	0.683	0.812	0.953	1.106	1.269	1.444
14	0.492	0.608	0.735	0.875	1.068	1.190	1.367	1.555
15	0.527	0.651	0.788	0.937	1.100	1.276	1.465	1.667
16	0.562	0.694	0.840	1.000	1.174	1.361	1.562	1.778
17	0.597	0.738	0.893	1.062	1.247	1.446	1.660	1.889
18	0.633	0.781	0.945	1.125	1.320	1.531	1.758	2.000
19	0.668	0.825	0.998	1.187	1.394	1.616	1.855	2.111
20	0.703	0.868	1.050	1.250	1.467	1.701	1.953	2.222

C. P. FOREST POCKET BOOK

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	17"	18"	19"	20"	21"	22"	23"	24"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	0·125	0·141	0·157	0·174	0·191	0·210	0·230	0·250
2	0·251	0·281	0·313	0·347	0·383	0·420	0·459	0·500
3	0·376	0·422	0·470	0·521	0·574	0·630	0·689	0·750
4	0·502	0·562	0·627	0·694	0·766	0·840	0·918	1·000
5	0·627	0·703	0·783	0·868	0·957	1·050	1·148	1·250
6	0·752	0·844	0·940	1·042	1·148	1·260	1·378	1·500
7	0·878	0·984	1·097	1·215	1·340	1·470	1·607	1·750
8	1·003	1·125	1·253	1·389	1·531	1·680	1·837	2·000
9	1·129	1·265	1·410	1·562	1·723	1·890	2·066	2·250
10	1·254	1·406	1·567	1·736	1·914	2·101	2·296	2·500
11	1·380	1·547	1·723	1·910	2·105	2·311	2·526	2·750
12	1·505	1·687	1·880	2·083	2·297	2·521	2·755	3·000
13	1·630	1·828	2·037	2·257	2·488	2·731	2·985	3·250
14	1·756	1·969	2·193	2·430	2·680	2·941	3·214	3·500
15	1·881	2·109	2·350	2·604	2·871	3·151	3·444	3·750
16	2·007	2·250	2·507	2·778	3·062	3·361	3·674	4·000
17	2·132	2·390	2·663	2·951	3·254	3·571	3·903	4·250
18	2·258	2·531	2·820	3·125	3·445	3·781	4·133	4·500
19	2·383	2·672	2·977	3·298	3·637	3·991	4·362	4·750
20	2·509	2·812	3·134	3·472	3·828	4·201	4·592	5·000

USEFUL CONSTANTS AND TABLES

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	25"	26"	27"	28"	29"	30"	31"	32"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	0.271	0.293	0.316	0.340	0.365	0.391	0.417	0.444
2	0.542	0.587	0.633	0.680	0.730	0.781	0.834	0.889
3	0.814	0.880	0.949	1.021	1.095	1.172	1.251	1.333
4	1.085	1.174	1.266	1.361	1.460	1.562	1.668	1.778
5	1.356	1.467	1.582	1.701	1.825	1.953	2.085	2.222
6	1.627	1.760	1.898	2.042	2.190	2.344	2.503	2.667
7	1.899	2.054	2.215	2.382	2.555	2.734	2.920	3.111
8	2.170	2.347	2.531	2.722	2.920	3.125	3.337	3.555
9	2.441	2.641	2.848	3.062	3.285	3.515	3.754	4.000
10	2.713	2.934	3.164	3.403	3.650	3.906	4.171	4.444
11	2.984	3.227	3.480	3.743	4.015	4.297	4.588	4.889
12	3.255	3.521	3.797	4.083	4.380	4.687	5.005	5.333
13	3.526	3.814	4.113	4.423	4.745	5.078	5.422	5.778
14	3.798	4.108	4.430	4.764	5.110	5.464	5.839	6.222
15	4.069	4.401	4.746	5.104	5.475	5.859	6.356	6.667
16	4.340	4.694	5.062	5.444	5.840	6.250	6.674	7.111
17	4.611	4.988	5.379	5.784	6.205	6.640	7.091	7.555
18	4.883	5.281	5.695	6.125	6.570	7.031	7.508	8.000
19	5.154	5.575	6.012	6.465	6.935	7.422	7.925	8.444
20	5.425	5.868	6.328	6.805	7.300	7.812	8.342	8.889

C. P. FOREST POCKET BOOK

Cubic contents of logs or cylinders —contd.

Length in feet.	MEAN GIRTH.							
	33"	34"	35"	36"	37"	38"	39"	40"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	0.473	0.502	0.532	0.562	0.594	0.627	0.660	0.699
2	0.945	1.003	1.063	1.125	1.188	1.253	1.320	1.384
3	1.418	1.505	1.595	1.687	1.782	1.880	1.980	2.083
4	1.891	1.007	2.127	2.250	2.377	2.507	2.641	2.778
5	2.363	2.509	2.658	2.812	2.971	3.134	3.301	3.472
6	2.836	3.010	3.190	3.375	3.565	3.760	3.961	4.167
7	3.308	3.512	3.722	3.937	4.159	4.387	4.621	4.861
8	3.781	4.014	4.253	4.500	4.753	5.014	5.281	5.555
9	4.254	4.515	4.785	5.062	5.348	5.640	5.941	6.250
10	4.726	5.017	5.317	5.625	5.942	6.267	6.601	6.944
11	5.199	5.519	5.848	6.187	6.536	6.894	7.262	7.639
12	5.672	6.021	6.380	6.750	7.130	7.521	7.922	8.333
13	6.144	6.522	6.912	7.312	7.724	8.147	8.582	9.028
14	6.617	7.024	7.443	7.875	8.318	8.774	9.242	9.722
15	7.090	7.526	7.975	8.437	8.913	9.401	9.902	10.417
16	7.562	8.028	8.507	9.000	9.507	10.028	10.562	11.111
17	8.035	8.529	9.038	9.562	10.101	10.654	11.222	11.805
18	8.508	9.031	9.570	10.125	10.695	11.281	11.883	12.500
19	8.980	9.533	10.102	10.687	11.289	11.908	12.543	13.194
20	9.453	10.035	10.634	11.250	11.884	12.535	13.203	13.889

USEFUL CONSTANTS AND TABLES

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	41"	42"	43"	44"	45"	46"	47"	48"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	0.730	0.766	0.802	0.840	0.879	0.918	0.959	1.000
2	1.459	1.531	1.605	1.680	1.758	1.837	1.917	2.000
3	2.189	2.298	2.407	2.521	2.637	2.755	2.876	3.000
4	2.918	3.062	3.210	3.361	3.516	3.674	3.835	4.000
5	3.648	3.828	4.012	4.201	4.394	4.592	4.794	5.000
6	4.378	4.594	4.815	5.042	5.273	5.510	5.752	6.000
7	5.107	5.359	5.617	5.882	6.152	6.429	6.711	7.000
8	5.837	6.125	6.420	6.722	7.031	7.347	7.670	8.000
9	6.566	6.890	7.222	7.562	7.910	8.265	8.629	9.000
10	7.296	7.656	8.025	8.403	8.789	9.184	9.588	10.000
11	8.026	8.422	8.828	9.243	9.668	10.102	10.546	11.000
12	8.755	9.187	9.630	10.083	10.547	11.021	11.505	12.000
13	9.485	9.953	10.433	10.923	11.426	11.939	12.464	13.000
14	10.214	10.719	11.235	11.764	12.305	12.858	13.423	14.000
15	10.944	11.484	12.038	12.604	13.183	13.776	14.381	15.000
16	11.674	12.250	12.840	13.444	14.062	14.694	15.340	16.000
17	12.403	13.015	13.643	14.284	14.941	15.613	16.299	17.000
18	13.133	13.781	14.445	15.125	15.820	16.531	17.258	18.000
19	13.862	14.547	15.248	15.965	16.699	17.450	18.216	19.000
20	14.592	15.312	16.050	16.805	17.578	18.368	19.175	20.000

C. P. FOREST POCKET BOOK

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	49"	50"	51"	52"	53"	54"	55"	56"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	1.042	1.085	1.129	1.174	1.219	1.266	1.313	1.361
2	2.084	2.170	2.258	2.347	2.438	2.531	2.626	2.722
3	3.126	3.255	3.387	3.521	3.657	3.797	3.939	4.083
4	4.168	4.340	4.516	4.694	4.877	5.062	5.252	5.444
5	5.210	5.425	5.644	5.868	6.096	6.328	6.565	6.805
6	6.253	6.510	6.773	7.042	7.315	7.594	7.877	8.167
7	7.295	7.595	7.902	8.215	8.534	8.859	9.190	9.528
8	8.337	8.680	9.031	9.389	9.753	10.125	10.503	10.889
9	9.379	9.765	10.160	10.562	10.973	11.390	11.816	12.250
10	10.421	10.851	11.289	11.736	12.192	12.656	13.129	13.611
11	11.463	11.936	12.418	12.910	13.411	13.922	14.442	14.972
12	12.505	13.021	13.547	14.083	14.630	15.187	15.755	16.333
13	13.547	14.106	14.676	15.257	15.849	16.453	17.068	17.694
14	14.589	15.191	15.804	16.430	17.068	17.719	18.381	19.055
15	15.631	16.276	16.933	17.604	18.288	18.984	19.694	20.417
16	16.674	17.361	18.062	18.778	19.507	20.250	21.007	21.778
17	17.716	18.446	19.191	19.951	20.726	21.515	22.319	23.139
18	18.758	19.531	20.320	21.125	21.954	22.781	23.633	24.500
19	19.800	20.616	21.449	22.298	23.164	24.047	24.946	25.861
20	20.842	21.701	22.578	23.472	24.384	25.312	26.259	27.222

USEFUL CONSTANTS AND TABLES

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	57"	58"	59"	60"	61"	62"	63"	64"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	1.410	1.460	1.511	1.562	1.615	1.668	1.723	1.778
2	2.820	2.920	3.022	3.125	3.230	3.337	3.445	3.555
3	4.230	4.380	4.532	4.687	4.845	5.005	5.168	5.333
4	5.641	5.840	6.043	6.250	6.460	6.674	6.891	7.111
5	7.051	7.300	7.554	7.812	8.075	8.342	8.613	8.889
6	8.461	8.760	9.065	9.375	9.690	10.010	10.336	10.667
7	9.871	10.220	10.576	10.937	11.305	11.679	12.058	12.444
8	11.281	11.680	12.087	12.500	12.920	13.347	13.781	14.222
9	12.691	13.140	13.598	14.062	14.535	15.016	15.504	16.006
10	14.101	14.601	15.108	15.625	16.150	16.684	17.226	17.778
11	15.512	16.061	16.619	17.187	17.765	18.352	18.949	19.555
12	16.922	17.521	18.130	18.750	19.380	20.021	20.672	21.333
13	18.332	18.981	19.641	20.312	20.995	21.689	22.394	23.111
14	19.742	20.441	21.152	21.875	22.610	23.358	24.117	24.889
15	21.152	21.901	22.663	23.437	24.225	25.026	25.840	26.666
16	22.562	23.361	24.174	25.000	25.840	26.694	27.562	28.444
17	23.972	24.821	25.684	26.562	27.455	28.363	29.285	30.222
18	25.383	26.281	27.195	28.125	29.070	30.031	31.008	32.000
19	26.793	27.741	28.706	29.687	30.685	31.700	32.736	33.778
20	28.203	29.201	30.217	31.250	32.300	33.368	34.453	35.555

C. P. FOREST POCKET BOOK

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	65"	66"	67"	68"	69"	70"	71"	72"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	1·834	1·891	1·948	2·006	2·066	2·127	2·188	2·250
2	3·667	3·781	3·891	4·014	4·133	4·253	4·376	4·500
3	5·511	5·672	5·845	6·021	6·199	6·380	6·564	6·750
4	7·335	7·562	7·793	8·028	8·265	8·507	8·752	9·001
5	9·169	9·453	9·742	10·035	10·333	10·634	10·940	11·250
6	11·002	11·344	11·690	12·042	12·398	12·760	13·127	13·500
7	12·836	13·234	13·638	14·048	14·465	14·887	15·315	15·750
8	14·670	15·125	15·587	16·055	16·531	17·014	17·503	18·000
9	16·504	17·015	17·535	18·062	18·598	19·140	19·691	20·250
10	18·338	18·906	19·483	20·069	20·664	21·267	21·879	22·500
11	20·171	20·797	21·432	22·076	22·730	23·394	24·067	24·750
12	22·005	22·687	23·380	24·083	24·797	25·521	26·255	27·000
13	23·839	24·578	25·328	26·090	26·863	27·647	28·443	29·250
14	25·673	26·469	27·277	28·097	28·930	29·774	30·631	31·500
15	27·506	28·359	29·225	30·104	30·996	31·901	32·819	33·750
16	29·340	30·250	31·174	32·111	33·062	34·028	35·007	36·000
17	31·174	32·140	33·122	34·118	35·129	36·154	37·195	38·250
18	33·008	34·031	35·070	36·125	37·195	38·281	39·383	40·500
19	34·841	35·922	37·109	38·132	39·262	40·408	41·571	42·750
20	36·675	37·812	38·967	40·139	41·328	42·535	43·759	45·000

USEFUL CONSTANTS AND TABLES

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	73"	74"	75"	76"	77"	78"	79"	80"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	2·313	2·377	2·441	2·507	2·573	2·641	2·709	2·778
2	4·626	4·753	4·883	5·014	5·147	5·281	5·417	5·555
3	6·939	7·130	7·324	7·521	7·720	7·922	8·126	8·333
4	9·252	9·507	9·766	10·028	10·293	10·562	10·835	11·111
5	11·585	11·884	12·207	12·535	12·867	13·203	13·544	13·889
6	13·877	14·260	14·648	15·042	15·440	15·844	16·252	16·667
7	16·190	16·637	17·090	17·548	18·013	18·484	18·961	19·444
8	18·503	19·014	19·531	20·056	20·587	21·125	21·670	22·222
9	20·816	21·390	21·973	22·562	23·160	23·756	24·379	25·000
10	23·129	23·767	24·414	25·069	25·733	26·406	27·088	27·778
11	25·442	26·144	26·855	27·576	28·347	29·047	29·796	30·555
12	27·755	28·521	29·297	30·083	30·880	31·687	32·505	33·333
13	30·068	30·897	31·738	32·590	33·453	34·328	35·214	36·111
14	32·381	33·274	34·180	35·097	36·027	36·969	37·923	38·889
15	34·694	35·651	36·621	37·604	38·600	39·609	40·631	41·669
16	37·007	38·028	39·062	40·111	41·174	42·250	43·340	44·444
17	39·320	40·404	41·504	42·618	43·747	44·890	46·049	47·222
18	41·633	42·781	43·945	45·125	46·320	47·531	48·758	50·000
19	43·946	45·158	46·387	47·632	48·894	50·172	51·466	52·775
20	46·259	47·535	48·828	50·139	51·467	52·812	54·175	55·558

C. P. FOREST POCKET BOOK

Cubic contents of logs or cylinders—*contd.*

Length in feet.	MEAN GIRTH.							
	81"	82"	83"	84"	85"	86"	87"	88"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	2·848	2·918	2·990	3·062	3·136	3·210	3·285	3·361
2	5·695	5·837	5·980	6·125	6·272	6·420	6·570	6·722
3	8·543	8·755	8·970	9·187	9·407	9·530	9·855	10·083
4	11·391	11·674	11·960	12·250	12·543	12·840	13·141	13·444
5	14·238	14·592	14·950	15·312	15·679	16·050	16·426	16·805
6	17·086	17·510	17·940	18·375	18·815	19·260	19·711	20·167
7	19·933	20·429	20·930	21·437	21·951	22·470	22·996	23·528
8	22·781	23·347	23·920	24·500	25·087	25·680	26·281	26·889
9	25·629	26·266	26·910	27·562	28·223	28·890	29·566	30·250
10	28·476	29·184	29·900	30·625	31·358	32·101	32·851	33·611
11	31·324	32·102	32·890	33·687	34·494	35·311	36·137	36·972
12	34·172	35·021	35·880	36·750	37·630	38·521	39·422	40·333
13	37·019	37·939	38·870	39·812	40·766	41·731	42·707	43·694
14	39·867	40·858	41·860	42·875	43·902	44·941	45·992	47·055
15	42·715	43·776	44·850	45·937	47·038	48·151	49·277	50·417
16	45·562	46·694	47·840	49·000	50·174	51·361	52·562	53·778
17	48·410	49·613	50·830	52·062	53·309	54·571	55·847	57·139
18	51·258	52·531	53·820	55·125	56·445	57·781	59·133	60·500
19	54·105	55·450	56·810	58·187	59·581	60·991	62·418	63·861
20	56·953	58·368	59·800	61·250	62·717	64·201	65·703	67·222

USEFUL CONSTANTS AND TABLES

Cubic contents of logs or cylinders—*concl.*

Length in feet.	MEAN GIRTH.							
	89"	90"	91"	92"	93"	94"	95"	96"
	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.	Cubic ft.
1	3.438	3.516	3.594	3.673	3.754	3.835	3.917	4.000
2	6.876	7.031	7.188	7.347	7.508	7.670	7.834	8.000
3	10.314	10.547	10.782	11.021	11.262	11.505	11.751	12.000
4	13.752	14.062	14.377	14.694	15.016	15.340	15.668	16.000
5	17.190	17.578	17.971	18.368	18.769	19.175	19.585	20.000
6	20.627	21.094	21.565	22.042	22.523	23.010	23.503	24.000
7	24.066	24.609	25.159	25.715	26.277	26.854	27.420	28.000
8	27.503	28.125	28.753	29.389	30.031	30.680	31.337	32.000
9	30.941	31.640	32.348	33.062	33.785	34.515	35.254	36.000
10	34.379	35.156	35.942	36.736	37.539	38.351	39.171	40.000
11	37.817	38.672	39.536	40.410	41.293	42.186	43.088	44.000
12	41.255	42.187	43.130	44.083	45.047	46.021	47.005	48.000
13	44.693	45.703	46.724	47.757	48.801	49.856	50.922	52.000
14	48.131	49.219	50.318	51.430	52.555	53.691	54.839	56.000
15	51.569	52.734	53.913	55.104	56.308	57.526	58.756	60.000
16	55.007	56.250	57.507	58.778	60.062	61.361	62.674	64.000
17	58.445	59.765	61.101	62.451	63.816	65.196	66.591	68.000
18	61.883	63.281	64.695	66.125	67.570	69.031	70.508	72.000
19	65.321	66.797	68.289	69.798	71.324	72.866	74.425	76.000
20	68.789	70.312	71.884	73.472	75.078	76.701	78.342	80.000

Table of the volumes of cylinders and of the Sum of Circles for diameter of 1 inch to 48 inches.

Length of cylinder or number of circles.	Diameter in inches.							
	1	2	3	4	5	6	7	8
1	0.0055	0.0218	0.0491	0.0873	0.1363	0.1963	0.2673	0.3491
2	0.0110	0.0436	0.0982	0.1746	0.2728	0.3926	0.5346	0.6982
3	0.0165	0.0654	0.1473	0.2619	0.4092	0.5889	0.8019	1.0473
4	0.0220	0.0872	0.1964	0.3492	0.5456	0.7852	1.0692	1.3964
5	0.0275	0.1090	0.2455	0.4365	0.6820	0.9815	1.3365	1.7455
6	0.0330	0.1308	0.2946	0.5238	0.8184	1.1778	1.6038	2.0946
7	0.0385	0.1526	0.3437	0.6111	0.9548	1.3471	1.8711	2.4437
8	0.0440	0.1744	0.3928	0.6984	1.0912	1.5704	2.1384	2.7928
9	0.0495	0.1962	0.4419	0.7857	1.2276	1.7667	2.4057	3.1419

USEFUL CONSTANTS AND TABLES

	9	10	11	12	13	14	15	16
1	0.4418	0.5454	0.6600	0.7854	0.9218	1.0690	1.2272	1.3963
2	0.8836	1.0908	1.3200	1.5708	1.8436	2.1380	2.4544	2.7926
3	1.3254	1.6362	1.9800	2.3562	2.7654	3.2070	3.6816	4.1889
4	1.7672	2.1816	2.6400	3.1416	3.6872	4.2760	4.9088	5.5852
5	2.2090	2.7270	3.3000	3.9270	4.6090	5.3450	6.1360	6.9815
6	2.6508	3.2724	3.9600	4.7124	5.5308	6.4140	7.3632	8.3778
7	3.0926	3.8178	4.6200	5.4978	6.4526	7.4830	8.5904	9.7741
8	3.5344	4.3632	5.2800	6.2832	7.3744	8.5520	9.8176	11.1704
9	3.9762	4.9086	5.9400	7.0686	8.2962	9.6210	11.0448	12.5667
	17	18	19	20	21	22	23	24
1	1.5763	1.7671	1.9689	2.1817	2.4053	2.6398	2.8852	3.1416
2	3.1526	3.5342	3.9378	4.3634	4.8106	5.2796	5.7704	6.2832
3	4.7289	5.3013	5.9067	6.5451	7.2159	7.9194	8.6556	9.4248
4	6.3052	7.0684	7.8756	8.7268	9.6212	10.5592	11.5408	12.5664
5	7.8815	8.8355	9.8445	10.9085	12.0265	13.1990	14.4260	15.7080
6	9.4578	10.6026	11.8134	13.0902	14.4318	15.8388	17.3112	18.8496
7	11.0341	12.3697	13.7823	15.2719	16.8371	18.4786	20.1964	21.9912
8	12.6104	14.1368	15.7512	17.4536	19.2424	21.1184	23.0816	25.1328
9	14.1867	15.9039	17.7201	19.6353	21.6477	23.7582	25.9668	28.2744

C. P. FOREST POCKET BOOK

Table of the volumes of cylinders and of the Sum of Circles for diameter of 1 inch to 48 inches—*concl'd.*

		Diameter in inches.									
Length of cylinder or number of circles.		25	26	27	28	29	30	31	32		
		1	3.4088	3.6870	3.9761	4.2761	4.5839	4.9087	5.2414	5.5851	
2	6.8176	7.3740	7.9522	8.5522	9.1738	9.8174	10.4828	11.1702			
3	10.2264	11.0610	11.9283	12.8283	13.7607	14.7261	15.7242	16.7553			
4	18.6352	14.7480	15.9044	17.1044	18.3476	19.6348	20.9656	22.3404			
5	17.0440	18.4350	19.8805	21.3805	22.9345	24.5435	26.2070	27.9255			
6	20.4528	22.1220	23.8566	25.6566	27.5214	29.4522	31.4484	33.5106			
7	23.8816	25.8090	27.8327	29.9327	32.1983	34.3609	36.6898	39.0957			
8	27.2704	29.4960	31.8088	34.2088	36.6952	39.2696	41.9312	44.6808			
9	30.6792	33.1830	35.7849	38.4849	41.2821	44.1783	47.1726	50.2659			

USEFUL CONSTANTS AND TABLES

	33	34	35	36	37	38	39	40
1	5.9396	6.3050	6.6813	7.0686	7.4667	7.8758	8.2958	8.7266
2	11.8792	12.6100	13.3626	14.1372	14.9334	15.7516	16.5916	17.4532
3	17.8188	18.9150	20.0439	21.2058	22.4001	23.6274	24.8874	26.1798
4	23.7584	25.2200	26.7252	28.2744	29.8668	31.5032	33.1832	34.9064
5	29.6980	31.5250	33.4065	35.3430	37.3335	39.3790	41.4790	43.6330
6	35.6376	37.8300	40.0878	42.4116	44.8002	47.2548	49.7748	52.3596
7	41.5772	44.1350	46.7691	49.4802	52.2669	53.1306	58.0706	61.0862
8	47.5168	50.4400	53.4504	56.5488	59.7336	63.0064	66.3664	69.8128
9	53.4564	56.7450	60.1817	63.6174	67.2003	70.8822	74.6622	78.5394
	41	42	43	44	45	46	47	48
1	9.1684	9.6211	10.0847	10.5592	11.0447	11.5410	12.0482	12.5664
2	18.3368	19.2422	20.1649	21.1184	22.0894	23.0820	24.0964	25.1328
3	27.5052	28.8633	30.2541	31.6776	33.1341	34.6230	36.1446	37.6992
4	36.6736	38.4844	40.3388	42.2368	44.1788	46.1640	48.1928	50.2656
5	45.8420	48.1055	50.4235	52.7960	55.2235	57.7050	60.2410	62.8320
6	55.0104	57.7266	60.5082	63.3552	66.2682	69.2460	72.2892	75.3984
7	64.1788	67.3477	70.5929	73.9144	77.3129	80.7870	84.3374	87.9648
8	73.3472	76.9688	80.6776	84.4736	88.3576	92.3280	96.3856	100.5312
9	82.5156	86.5899	90.7623	95.0328	99.4023	103.8690	108.4338	113.0976

Amount to which a capital of 1 accumulates with compound interest
in n years $C_n = C_0 \times 1.0p^n$.

222

No. of years = n .	Per cent.				
	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5
1	1.0300	1.0350	1.0400	1.0450	1.0500
2	1.0609	1.0712	1.0816	1.0920	1.1025
3	1.0927	1.1087	1.1249	1.1412	1.1576
4	1.1255	1.1475	1.1699	1.1925	1.2155
5	1.1593	1.1877	1.2167	1.2462	1.2763
6	1.1941	1.2293	1.2653	1.3023	1.3401
7	1.2299	1.2723	1.3159	1.3609	1.4071
8	1.2668	1.3168	1.3686	1.4221	1.4775
9	1.3048	1.3629	1.4233	1.4861	1.5513
10	1.3439	1.4106	1.4802	1.5530	1.6289

USEFUL CONSTANTS AND TABLES

15	1.5580	1.6753	1.8009	1.9353	2.0789
20	1.8061	1.9898	2.1911	2.4117	2.6533
25	2.0938	2.3632	2.6658	3.0054	3.3864
30	2.4273	2.8068	3.2434	3.7453	4.3219
35	2.8139	3.3336	3.9461	4.6673	5.5160
40	3.2620	3.9593	4.8010	5.8164	7.0400
45	3.7816	4.7024	5.8412	7.2482	8.9850
50	4.3839	5.5849	7.1057	9.0326	11.4674
55	5.0821	6.6331	8.6464	11.2563	14.6356
60	6.8916	7.8781	10.5196	14.0274	18.6792
65	6.8300	9.3567	12.7987	17.4807	23.8399
70	7.9178	11.1128	15.5716	21.7841	30.4264
75	9.1789	13.1985	18.9452	27.1470	38.8327
80	10.6409	15.6757	23.0498	33.8301	49.5614
85	12.3357	18.6179	28.0436	42.1585	63.2544
90	14.3005	22.1122	34.1193	52.5371	80.7304
95	16.5782	26.2623	41.5114	65.4708	103.0347
100	19.2186	31.1914	50.5049	81.5885	131.5013
110	25.8282	43.9986	74.7597	126.7045	214.2017
120	34.7110	60.0643	110.6626	196.7682	348.9120
130	46.6486	87.5478	163.8076	305.5750	568.3409
140	62.6919	133.4949	242.4753	474.5486	925.7674
150	84.2527	174.2017	358.9227	736.9594	1507.9775
200	369.3558	972.9039	2550.7498	6656.6863	17292.5808

Present Value of a Capital of 1 to be realized after n years : $C_0 =$

$$\frac{C^n}{1-QP^n}$$

224

Per cent.

No. of years = n,	3	3½	4	4½	5
1	0.9707	0.9662	0.9615	0.9569	0.9524
2	.9426	.9335	.9246	.9157	.9070
3	.9151	.9019	.8890	.8763	.8638
4	.8885	.8714	.8548	.8386	.8227
5	.8626	.8420	.8219	.8025	.7835
6	.8375	.8135	.7903	.7679	.7462
7	.8131	.7860	.7599	.7348	.7107
8	.7894	.7594	.7307	.7032	.6768
9	.7664	.7337	.7026	.6729	.6446
10	.7441	.7089	.6756	.6469	.6139

USEFUL CONSTANTS AND TABLES

15	.6419	.5969	.5553	.5167	.4810
20	.5537	.5026	.4564	.4146	.3769
25	.4776	.4231	.3751	.3327	.2953
30	.4120	.3563	.3083	.2670	.2314
35	.3554	.3000	.2534	.2143	.1813
40	.3066	.2526	.2083	.1719	.1420
45	.2644	.2127	.1712	.1380	.1113
50	.2281	.1791	.1407	.1107	.0872
55	.1968	.1508	.1157	.0888	.0683
60	.1697	.1269	.0951	.0713	.0535
65	.1464	.1069	.0771	.0572	.0419
70	.1263	.0900	.0642	.0459	.0329
75	.1089	.0758	.0528	.0368	.0257
80	.0940	.0638	.0434	.0296	.0202
85	.0811	.0337	.0357	.0237	.0158
90	.0699	.0452	.0293	.0190	.0124
95	.0603	.0381	.0241	.0153	.0097
100	.05203	.03206	.01980	.01226	.00761
110	.03872	.02273	.01338	.00789	.00467
120	.02881	.01611	.00904	.00508	.00287
130	.02144	.01142	.00611	.00327	.00176
140	.01694	.00810	.00412	.00211	.00101
150	.01187	.00574	.00279	.00136	.00066
200	.002707	.001028	.000392	.000150	.0000578

C. P. FOREST POCKET BOOK

LOGARITHMS.

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4 9 13	4 8 12	4 7 11	17 21 26	16 20 24	30 34 38				
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4 8 12	4 7 11	4 6 10	15 19 23	14 18 21	27 31 35				
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3 7 11	3 7 10	3 6 9	14 17 20	13 16 20	25 28 32				
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3 7 10	3 6 9	3 5 8	13 16 20	12 15 19	22 25 29				
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3 6 9	3 5 8	3 4 7	12 15 17	11 14 17	20 23 26				
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3 6 8	3 5 8	3 4 7	11 14 17	10 13 16	19 22 25				
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3 5 8	3 4 7	3 3 6	11 14 16	10 13 15	18 21 23				
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	3 5 7	3 4 6	3 3 5	10 12 15	9 12 14	17 20 22				
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2 5 7	2 4 6	2 3 5	9 11 14	8 11 13	16 19 21				
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2 4 7	2 3 5	2 2 4	9 11 13	8 11 13	16 18 20				
						2900	2923	2945	2967	2989	2	4	6	8	11	13	15	17	19	

USEFUL CONSTANTS AND TABLES

20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	4	5	7	8	9	10

C. P. FOREST POCKET BOOK

LOGARITHMS.—*contd.*

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	7	8	9
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	8	9
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	6	7	8	9
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	5	6	7	8	9
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	5	6	7	8	9
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	6

USEFUL CONSTANTS AND TABLES

55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	4	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	4	4	5	6	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	4	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	4	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	4	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	4	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	4	4	5	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5

C. P. FOREST POCKET BOOK

LOGARITHMS.—concl'd.

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	4	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	0	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4

USEFUL CONSTANTS AND TABLES

90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	3	3
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	3	3
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	3	3
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	3	3
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	3	3
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	3	3
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	3	3
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	3	3
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	3	3
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	3	3

C. P. FOREST POCKET BOOK

ANTILOGARITHMS.

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
.00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	1	2	2	2
.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2
.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	2	2	2
.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1	1	2	2	2
.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1	2	2	2	2
.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1	2	2	2	2
.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1	2	2	2	2
.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1	2	2	2	2
.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	2	2	2	2
.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	2	2	2	2
.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	2	2	2	2
.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	1	2	2	2	2
.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	1	2	2	2	2
.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	1	2	2	2	2
.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	1	2	2	2	2

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.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	2	2	2	2	2	2	2	3	3	3	
.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3
.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3

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	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
.35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
.36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3	3	4	4	5
.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3	3	4	4	5
.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	4	5
.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	6
.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	6
.42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	6
.43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	6
.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	6
.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3	4	4	5	6
.46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3	4	4	5	6
.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3	4	4	5	6
.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	3	4	4	5	6
.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	3	4	4	5	6

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.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	2	3	4	4	5	6	7
.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	1	2	2	3	4	4	5	5	6
.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	1	2	2	3	4	4	5	5	6
.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	1	2	2	3	4	4	5	6	6
.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	1	2	2	3	4	4	5	6	6
.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	1	2	2	3	4	4	5	6	7
.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	1	2	3	3	4	4	5	6	7
.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	1	2	3	3	4	4	5	6	7
.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	1	2	3	4	4	4	5	6	7
.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	1	2	3	4	4	5	5	6	7
.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	1	2	3	4	4	5	6	6	7
.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	1	2	3	4	4	5	6	7	8
.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	1	2	3	4	4	5	6	7	8
.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	1	2	3	4	4	5	6	7	8
.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	1	2	3	4	4	5	6	7	8
.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	1	2	3	4	4	5	6	7	8
.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	1	2	3	4	4	5	6	7	9
.67	4677	4688	4699	4710	4721	4732	4742	4755	4764	4775	1	1	2	3	4	4	5	6	7	10
.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	1	2	3	4	4	6	7	8	10
.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	1	2	3	4	5	6	7	8	10

ALPHABETICALLY

ANTILOGARITHMS.—*concl'd.*

C. P. FOREST POCKET BOOK

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11
.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6	8	9	10	11
.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6	8	9	10	12
.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7	8	9	10	12
.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7	8	9	11	12
.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7	8	10	11	12
.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7	8	10	11	13
.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7	9	10	11	13
.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7	9	10	12	13
.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8	9	11	12	14
.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8	9	11	12	14
.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8	9	11	13	14
.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	6	8	10	11	13	15

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.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8	10	12	13	15
.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8	10	12	13	15
.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	3	5	7	9	10	12	14	16
.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9	11	12	14	16
.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	5	7	9	11	13	14	16
.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	13	15	17
.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	8	11	13	15	17	19
.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11	14	16	18	20

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