The one good system for combining the production of sawtimber and smallwood

COPPICING-WITH-STANDARDS

by Philip Stewart

In **The Next Whole Earth Catalog** *(p. 84) we enthused in some detail about coppicing as a highly efficient source of firewood. The technique, practiced for centuries everywhere else but America, involves frequent recutting of trees or shrubs that regrow rapidly from the cut stumps, taking full advantage of the large root systems left under the stumps.*

This article explores the somewhat-less-ancient, somewhat-more-sophisticated technique of coppicing with standards, by which you let some trees grow to maturity and thus add sawlogs to your product. Author Philip Stewart is a forester with the Commonwealth Forestry Institute, Oxford University, England. The article is adapted by the author from one he printed in the **Commonwealth Forestry Review,** *volume 59 (1980).*

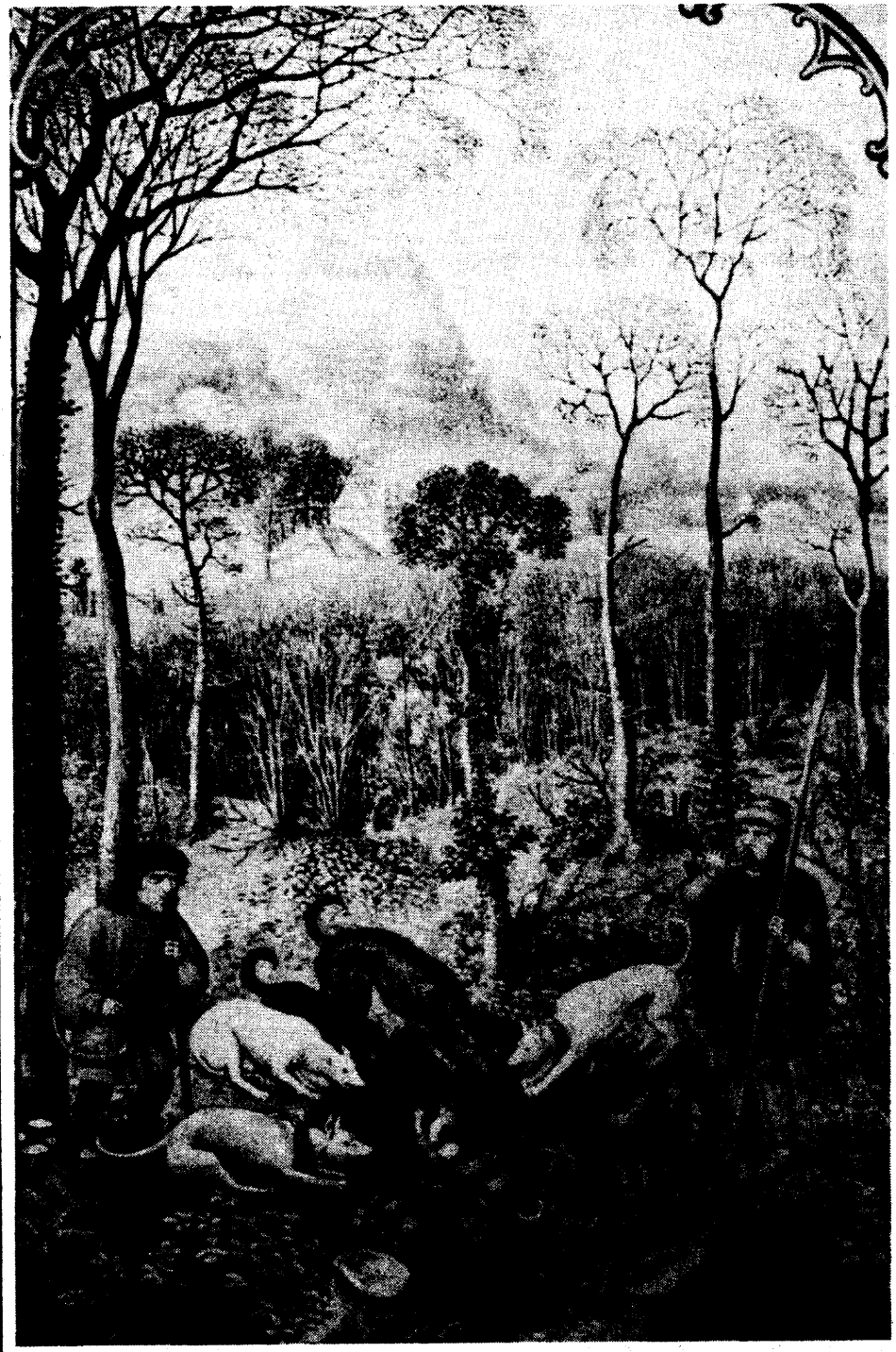
Ancient Woodland *by Oliver Rackham (1980, Edward Arnold, England) is the source of our illustrations and captions except for the drawing by Philip Stewart and Don Ryan. Oliver Rackham says that one by-product of coppicing is a spectacular increase in Spring flowers.*

—SB

IN FORMER TIMES that which came from the ancients was thought to be best, but modern people seem to prefer whatever is new. Neither assumption is very helpful for sorting out the good from the bad (though that which is old has the advantage of proven ability to survive), so the safest procedure is to judge everything on its merits. The present article sets out to show that the ancient silvicultural system of coppice-with-standards has virtues that have been unwisely forgotten, and that it deserves to be revived. Indeed, if it did not already exist, now would be the time to invent it.

Coppice-with-standards may claim to be the oldest of all deliberately adopted systems of forest treatment, for simple coppice is merely what happens in appropriate circumstances if woods are repeatedly cut, and high-forest systems, in

A coppicing scene in the Bradfield Woods near Bury St. Edmund's. The wood consists of underwood, of a great variety of species, with scattered standards of oak and ash. In the foreground the underwood has just been felled to produce the poles which form the principal crop, leaving the timber trees standing. Note that several poles have been cut from each underwood stool. On the left is an area which was felled a year ago and in which, without further treatment, the underwood has grown up to be now five to six feet high. In the background the underwood has grown up about fifteen years and is ready to be cut again. Such a scene has been repeated on this site every few years since at least the thirteenth century. The only serious anachronism in this picture is the bonfire, consuming *spray* and *brushwood* — the tops and branches of underwood poles — which would formerly have been taken away and put to use.



ANCIENT WOODLAND

A woodland scene attributed to Simon Benninck, the late-medieval Flemish artist (c. 1500). The figures are somewhat conventionalized but the scenery is probably the most convincing picture of the interior of a wood ever painted. It is recognizable as a limewood. The underwood in the foreground was felled last year, leaving standing most of the scattered and variable timber trees (standards) of elm and oak. The felled stools are sprouting to form the next underwood crop; among them are 'coppicing plants' which include broom, male-fern, bramble, and the honeysuckle *Lonicera xylosteum*. The toadstool *Oudemansiella radicata* is parasitizing the roots of an elm. In the background tall lime underwood on big stools awaits the next felling.

which re-seeding is deliberately ensured, are relatively recent. The practice of reserving, or "storing," a certain number of trees — the standards — to grow on to maturity when the rest are coppiced, goes back to the European Middle Ages. It is said to have been practised from the 7th century in Germany and since the 12th century on one estate in England. In 1543 Henry VIII made it a statutory obligation to leave twelve standards per acre. The object was to obtain both large and small stems from the same piece of land. The system spread throughout Western Europe and, until quite recently, it was at least as important as high-forest systems. As late as the 1920s one third of all French forests — half the broad-leaved woodlands — were managed in this way.

In the fully developed system the standards, or overwood, may be of a different species from the coppice, or underwood, and they are usually grown from seed cast by previous generations of standards. If there are insufficient seedlings, good coppice shoots may be adopted as standards, but they usually develop a more or less defective butt log and may also suffer from disease entering through the old stump, so it is preferable to make good the shortfall by planting standards. Some standards are cut and new ones reserved at each cutting-over of the coppice, so that their ages are all approximate multiples of the felling cycle. European languages have picturesque terms to refer to these different age — or size — classes. In English they are called, in order of increasing size; teller, standard (second class), standard (first class), veteran. In French there is a name for a fifth size class, which can be translated "oldbark."

In coppice-with-standards the diversity of species and of ages makes for a rich animal and bird population, for all types of woodland habitat are represented in close proximity.

Most existing coppice-with-standards is centuries old and derives originally from natural forest. There are often several species both of coppice and of standards, stabilized by semi-natural selection, with some overlap between the two sets of species. Little is known about the artificial establishment of coppice-with-standards, but this appears to be what is done in the Republic of Korea under the name of the *sunchon* method: timber species are planted in rows separated by rows of leguminous species for firewood coppice.

Woods managed as coppice-with-standards are strikingly different from either even-aged or selection forest. Large well-spaced trees dominate the dense underwood. Here and there the underwood is absent or much reduced after a recent felling, but there are no clear-felled areas. The diversity both of species and of ages makes for a rich animal and bird population, for all types of woodland habitat are represented in close proximity. It seems to be generally agreed that the effect is aesthetically more attractive than that of either simple coppice or even-aged high-forest.

There are just two conditions for choosing this system: a dense enough human population to make silviculture possible and desirable, and a demand for small logs and poles either for rustic construction or for fuel. Absence of the first condition in the early days of colonization meant that the system was never adopted in North America. The disappearance of the second condition in Europe over the last century has led to the system being abandoned in its place of origin, and interest has centered on methods of converting from it to high-forest. There are now few places in Europe where it can still be seen in full operation, and it receives little or no attention in most textbooks and forestry courses. Forest historians have shown interest in the subject, but there has been virtually no modern work on developing and adapting the system. Seemingly, coppice-with-standards is about as live a topic as keep-and-bailey castles.

Times have changed and the two conditions for choosing coppice-with-standards are present again in many places. Few countries are now so sparsely peopled that they can manage without silviculture, and the rising price of alternatives makes fuelwood and poles a good buy again. Indeed, both conditions have been present all along in many of the poorer countries, but the prestige of modern Western techniques prevented foresters from making much use of coppice-with-standards in the tropics. It is time now to look again at the one good system for combining the production of sawtimber and smallwood. We know that it works, for it has lasted at least seven centuries, and we know it is practical, for generations of European peasants operated it long before forestry faculties were opened.

It may be argued that it is simpler and more efficient to separate the two forms of production, setting up high-forest plantations to produce sawlogs and simple coppice to yield fuelwood and poles. However, most such plantations are subject to clear felling, the effects of which on the soil can be detrimental, especially in the tropics.

They are also usually monocultures, which in the case of many species leads to reduction of the soil flora and fauna. Simple coppice moreover tends to impoverish the soil by requiring the produce to be removed in the form of young nutrient-rich stems, though this loss can be minimized by trimming and debarking the wood where it is felled. It is thus possible that in the long term coppice-with-standards, by protecting the soil, will prove more productive than separate blocks of high-forest and simple coppice occupying an equivalent area. Even in the short term the system may be more productive, where the

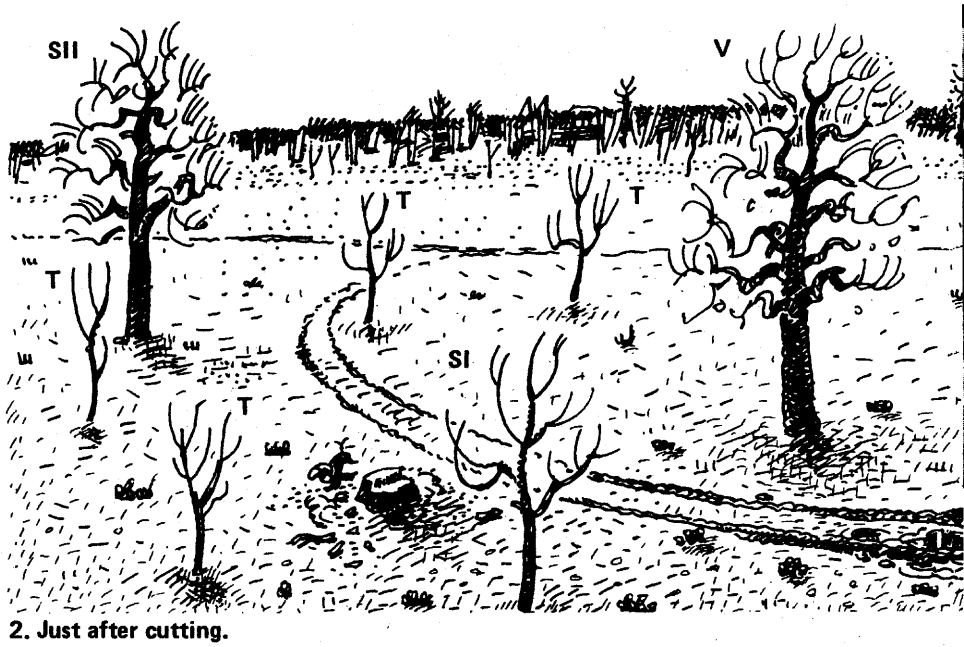
Where reforestation is financed by a private owner or by a small community, the early returns from coppice produce may be the factor that makes it possible to wait for the timber to grow.

overwood and underwood species exploit different levels of the soil, have different nutrient requirements, or grow at different times of the year.

Whatever the biological arguments, there are important economic and social advantages. Coppice-with-standards lends itself to the small scale of operations appropriate for supplying local needs, and it could also conciliate the conflicting interests of rural and urban users, inducing communities to undertake forestry capable of satisfying both markets. Where reforestation is financed by a private owner or by a small community, the early returns from coppice produce may be the factor that makes it possible to wait for the timber to grow. Such owners can also benefit from the

DONALD RYAN

1. Just before cutting. T = teller; SI, SII = standard I and II; V = veteran



2. Just after cutting.

3. Just before cutting again.

flexibility of the system, which allows the felling of standards to be postponed or advanced, within limits, and permits the coppice cycle to be reduced or extended according to the pattern of demand. There is also the possibility of growing food crops between coppice stools for a year or two after coppicing, with the standards providing valuable shelter.

It might be thought difficult to apply such a complex system correctly. Skill is needed to keep a balance between the coppice and the standards and between the different age classes of standards. Where the standards are of the same species as the coppice, the selection of future standards may be difficult for reasons of access and visibility, and it has to be carried out before the coppice is felled. Where standards are planted after a coppice felling, their protection may pose problems. None of these difficulties is insurmountable, but they imply the need to learn a craft in the early years.

In setting the system up, the first step is to pick the species to use as standards (they should grow straight and tall and make good timber), and as coppice (they must re-sprout well from the stump, tolerate some shade, and make good poles or firewood). The number of standards per acre must be calculated so that when all the different age classes are present they are far enough apart to let light through to the underwood, and that will depend on the diameter of the crown at different ages, which depends on the species. And the number of underwood cycles in one overwood life cycle has to be calculated on the basis of their growth rates and desired final size. Once the system is in full operation it becomes much easier; at each cutting-over you reserve enough new standards to replace the old ones that you fell.

Working out the system may not need an expert. The key factor for the spacing of the standards is the so-called "crown-diameter ratio." For each species of tree there is a constant relationship between the horizontal diameter of the crown and the diameter of the trunk at breast height, provided the tree has grown free-standing, without neighbouring trees to make it narrow its crown. If you can find a few isolated trees of the species you want for standards and measure their crown-diameter ratio, this together with a ring count showing the trunk-diameter at different ages gives you the information needed to find how much of the area will be taken up by a given number of standards of each age. The target value should be between one third and two thirds of the area, depending on the shade tolerance of the underwood and the respective quantities of smallwood and timber desired. If in doubt it is better to overestimate the number of standards; they can always be thinned out later.

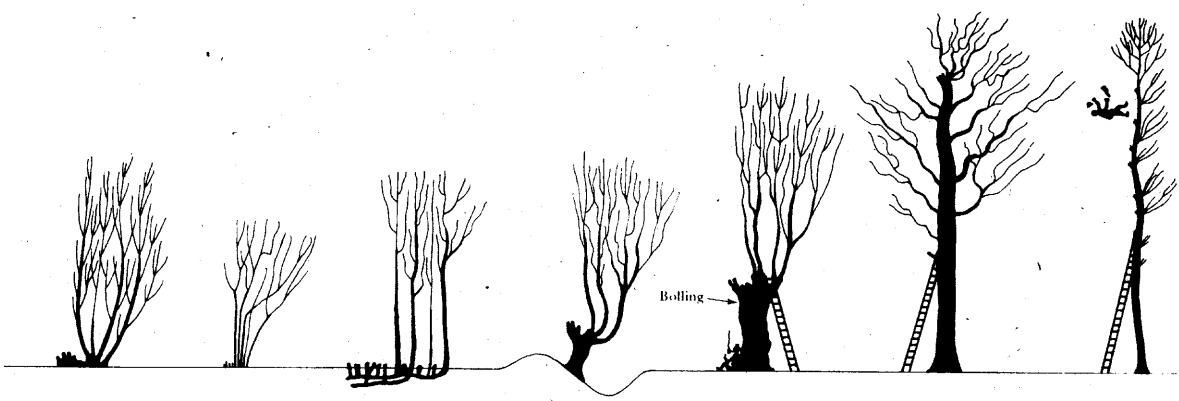
The labour requirement is high compared with that for systems that produce only large logs, for the simple reason that it takes longer to cut a lot of small stems than one big one. But that is true of any system that produces firewood and poles, and if you want to split large logs into firewood that probably takes at least as much work. In any case, perhaps we are moving out of the age in which we were ruled by the dogma that work is an evil to be minimized.

Silviculturally, the system is said to be detrimental both to the standards and to the coppice. The former grow with short boles and large, branchy crowns, (which may be an advantage, for example in reducing the growth stresses in certain eucalypts) while the latter is less vigorous than simple coppice. These however are not general features of the system but depend very much on the species and techniques used. The best genotypes for use as standards are those that grow straight, tall and narrow-crowned even when not forced up by neighbouring trees. High pruning may be used to improve the bole of species that tend to be too branchy, though shade from the underwood may be enough to ensure clean boles. Appropriate choice and treatment of the standards reduce the loss of vigour in the coppice, which in any case is amply compensated by the added production of sawlogs.

There is also the possibility of growing food crops between coppice stools for a year or two after coppicing, with the standards providing valuable shelter.

Certain dangers threaten woodlands managed under the system. As with simple coppice, browsing by wild animals or by uncontrolled domestic animals can do considerable damage at almost any time in the life cycle of the forest. The standards may suffer from wind or snow when they are first liberated by the cutting of the surrounding coppice, and certain species are liable to sun scorch if their smooth, thin bark is exposed too much. By allowing the soil to dry out in a period of drought, felling of the coppice may also cause the standards to suffer more than the trees in high forest. Appropriate choice of species and of felling and pruning times may diminish or eliminate these risks. They should also be compared with the risks from pests and diseases in monoculture and with the risks to the soil in clear felling.

Coppice-with-standards is not just a system for



Methods of producing wood from trees. Left to right: coppice stool above ground (e.g. ash); coppice stool below ground (e.g. hazel); clone of suckers (e.g. elm); stub on boundary-bank; pollard; high pollard; shredded tree. The left-hand half of each has just been cut; the right-hand half is fully regenerated and is about to be cut again.

temperate countries. It has been used in the Mediterranean zone of Europe and in subtropical and tropical climates in India and East Africa, where it was introduced by the colonial forest service. Among the chief standards in India are *Tectona grandis* (teak) and above all *Shorea robusta* (sal). The treatment of sal is particularly interesting, for in some regions it is used partly to protect the coppice from frost damage. This requires at least 40 standards per acre in the early years, but as they grow they have to be thinned – a practice little known in Europe. Teak also makes an excellent standard, but it may need to be used with coppice of another species, for teak coppice does not always tolerate shade. In East Africa some eucalyptus plantations were managed under the system with the same species in both underwood and overwood.

A combination that does not appear to have been tried often under any climate is that of broad-leaved – perhaps leguminous – coppice with coniferous standards. Broad-leaved standards of most species tend to suffer from the defects of short bole and branchy crown. The straight habit of most conifers makes them more likely to reproduce high quality sawtimber when grown widely spaced, and their narrow crowns and often light shade make for favourable conditions for the understorey. The presence of broad-leaved coppice beneath should avoid the soil problems created by the indigestibility and slow decomposition of most coniferous litter. With leguminous coppice species for nitrogen fixation there is still greater potential gain in soil productivity.

The textbooks mention only one example of coppice with coniferous standards: Aleppo pine above evergreen oak on dry limestone sites in Southern France. Another temperate example is found in Korea where pine standards are planted with *Robinia* (black locust). There should be great scope for developing combinations of conifers and legumes. A particularly promising standard is larch with its light, deciduous foliage, and its wide spacing.

It is even possible to imagine using broad-leaved standards with coniferous coppice, if not a purely coniferous combination. Certain conifers coppice well, notably *Tetraclinis* from North Africa, *Cunninghamia* from China, and certain species of *Juniper*. These would not tolerate much shade from standards, but I have seen *Tetraclinis* vigorous under a light cover of eucalyptus in Algeria and would not rule out its possible use. For temperate countries the redwood, *Sequoia*, is a candidate, and some estates in Great Britain have been coppicing it experimentally. Coniferous coppice could be an admirable source of pulpwood, though the species mentioned above are also appropriate for more exacting uses.

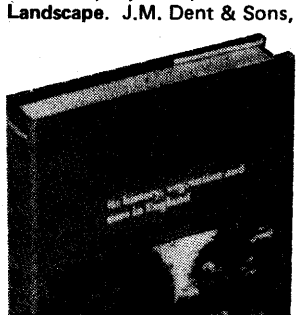
There are thus many reasons for believing that coppice-with-standards could make a valuable contribution to forestry. The immediate need is for research into the best combinations of species, into their productivity, into their effects on the soil, and into the details of management techniques such as optimum density of standards per acre, felling cycles and rotations, and high pruning and wood quality of standards. But the search for solutions does not need to be the monopoly of scientific institutions. Coppice-with-standards was invented and perfected by ordinary people. Perhaps it is time for silviculture to turn back into a folk craft. ■

Useful Sources

National Academy of Science, 1980; **Firewood Crops.** N.A.S., Washington, DC.

National Academy of Science, 1979; **Tropical Legumes.** N.A.S., Washington DC.

Rackham, O., 1976; **Trees and Woodlands in the British Landscape.** J.M. Dent & Sons, London.



Troup, R.S., 1952; **Silvicultural Systems** (2nd Edition), Oxford University Press.

Rackham, Oliver, 1980; **Ancient Woodland** (Its History, Vegetation and Uses in England); Edward Arnold, London (used for some illustrations for this article).