Large tree top in a forest in northern New South Wales. Such tops are usually left where they fall.

Chipping away at wood wastes

To many conservationists, 'woodchips' is a dirty word. For them it conjures up images of a once-forested landscape devastated by clear-felling. The hullabaloo about woodchips really started a few years ago, when companies began clear-felling eucalypts for export to Japanese pulp and paper mills. In fact, the practice had already been going on for many years, albeit on a smaller scale, to keep the local Australian paper industry supplied.

As it happens, there are two other sources, much less eye-catching than clear-felled forests, that could, at least in part, be used instead. These are the waste wood from sawmills and the 'residues' remaining behind in the forests after selective logging for sawlogs has taken place.

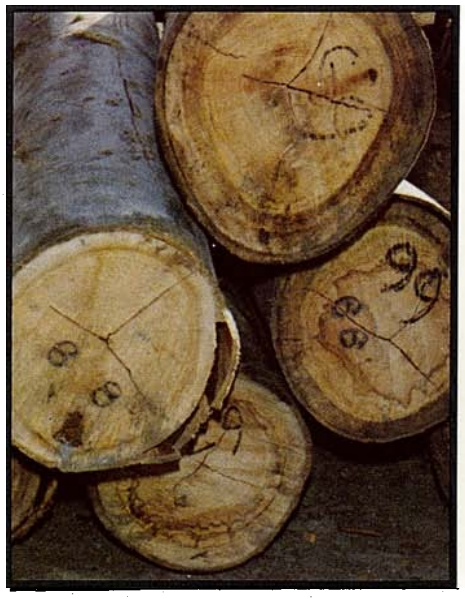
Each year our sawmilling and wood-processing operations yield wood residue equivalent to some 5½ million cubic metres of sawn timber. This waste consists mainly of sawdust and offcuts produced when converting the round logs into squared-off pieces of timber. At some mills, accumulating bark is also causing difficulties.

At present much of this residue gets burnt, with little use being made of the heat given off. Not only is this wasteful, but the smoke has become a nuisance in a number of country towns. It is possible to design burners that don't smoke (see *Ecos* 3), but most sawmills have little use for the heat.

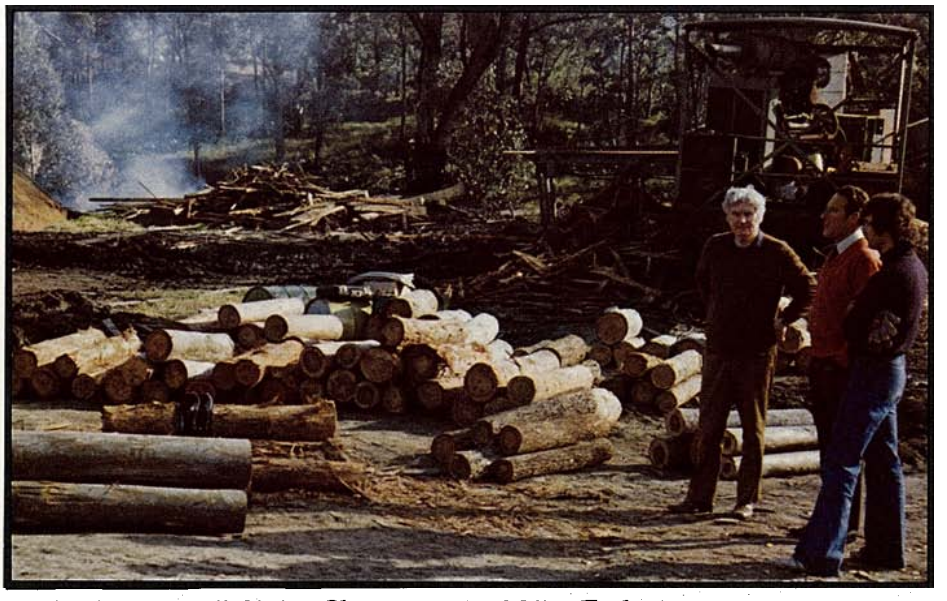
At the CSIRO Division of Chemical Technology, Dr Huntly Higgins and his colleagues have looked into the technicalities of using these sawmill wastes and the residues that remain in the forest for paper-making. Mr Bill Balodis has calculated that the sawmill wastes alone could provide 3½ million tonnes of woodchips annually—enough to yield twice as much paper pulp as Australia produced each year during the early 1970s. From a survey in East Gippsland, Vic., he concluded that about one-third of the volume of sawlogs entering the sawmills there becomes available as offcuts suitable for chipping. An independent Tasmanian study group came up with a very similar conclusion.

The wastes from sawmills usually contain a high proportion of sapwood, which makes them very suitable for conversion to paper pulp. Sawdust presents rather more of a problem. However, Dr Peter Nelson at the Division has shown that pulp made from pine sawdust can be

The sawmill wastes alone could provide 3 · 5 million tonnes of woodchips.



Hardwood 'tops' cut into lengths for experimental chipping.



Dr Huntly Higgins (left), Mr Clem Hogarth of Allen Taylor Pty Ltd, and Mr John Ward (right) inspect residue logs after they had been transported to a mobile chipper at Moruya on the New South Wales coast.

successfully combined with pulp from woodchips—up to about 10%—without greatly affecting the resulting paper quality. Overseas research has shown that some pulp from hardwood sawdust may also be able to find a use in the corrugated layer in fibreboards.

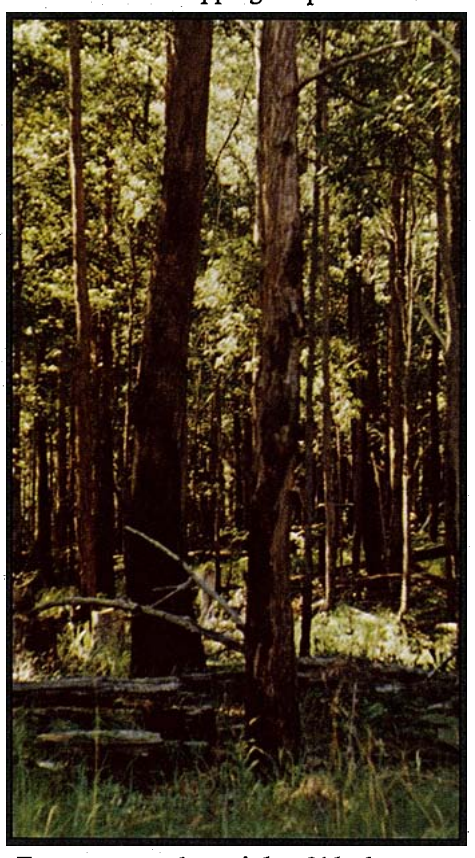
Not a pipe-dream

The idea of using sawmill wastes as a source of chips for export is more than just a pipe-dream—in fact it's already being done in several States. A particularly large operation is in train in Gippsland. Here a group of sawmillers around the town of Orbost have contracted to supply the Eden chipping company Harris–Daishowa with some 100 000 tonnes of chips each year—that's about 17% of the company's export permit. Orbost lies some 150 km from Eden, yet the enterprise seems to be successfully absorbing the costs of transporting the woodchips over such a distance.

Then in northern New South Wales a number of companies have put up proposals, separately, to develop a chipping operation for export at Coffs Harbour. These companies are not proposing to clear-fell, as is being done around Eden. Instead they will use sawmill wastes. However, the resource in this region may well not be large enough to support a viable chipping operation on its own. The companies are therefore proposing to supplement the sawmill wastes with thinnings and residue material left in the forest after selective logging.

From the point of view of maintaining a clean environment, chipping the wastes at sawmills and exporting them for paper pulp seems laudable. The situation with using residues remaining in the forests is not so clear-cut.

The New South Wales Forestry Commission is being cautious about the proposals. For one thing it considers that the size of the resource, even when the forest residues are included, may only be enough to supply about 400 000 tonnes per annum—large enough in the Commission's view to support only one commercial chipping operation. In addition, both technical and environmental problems may arise.



Forest regrowth, mainly of blackbutt, of the type that could be thinned and used for pulpwood.

Forest residues

What exactly are the forest residues? Sawmillers require large good-quality logs of specified tree species that experience has shown will give saleable timber. So logging operations in our native forests are concentrated on the straighter specimens of the species that are in demand. Even then, only the bottom parts of the trees' trunks are taken, and these 'merchantable boles' usually represent less than one-third of the tree. This part is extracted, and the rest remains in the forest. Although unsuitable for producing sawlogs, a good deal of the parts of the tree that remain could be chipped.

Management of the forests for sawlog production involves cutting out some additional trees, to favour the younger specimens of the desirable species that will provide the next crop. Some of these extra trees will be old or twisted examples of the desired species, and some will be of other species. Once again these culled trees could possibly be chipped.

In addition, what could be a major source of chippable material occurs in forests that are regenerating after a major fire or after clear-felling. If managed for producing timber, these young forests need thinning; and chipping the thinnings may help to defray costs.

Technical problems

Putting aside the environmental consequences of using these residues for the moment, we still have to face technical

difficulties. Existing contracts for supplying woodchips to Japan lay down that the proportion of bark in the chips should be very low, usually less than 0·5%. At present, taking the bark off the smaller or more twisted branches or trees can be difficult and expensive. The New South Wales Forestry Commission therefore approached the Division of Chemical Technology to see whether pulp made from logs chipped with the bark on could produce good-quality paper.

The Japanese pulp mills probably demand such a low proportion of bark in the chips because traditionally paper has been made from conifers. Their bark does not make good paper. It contains a low proportion of cellulose fibres, so it yields little pulp. In addition it causes black spots in the paper. The barks of eucalypts and most other hardwoods are different. They contain a large proportion of cellulose fibre, and seem much more promising for paper-making.

In the study that followed the Commission's approach, the Division's pulp and paper group concentrated in particular on blackbutt (*Eucalyptus pilularis*)—the commonest species around Coffs Harbour. They also tried chipping about a dozen other types of tree. These included those most commonly used at sawmills, and the species most likely to be available as thinnings. Some had smooth bark, others rough.

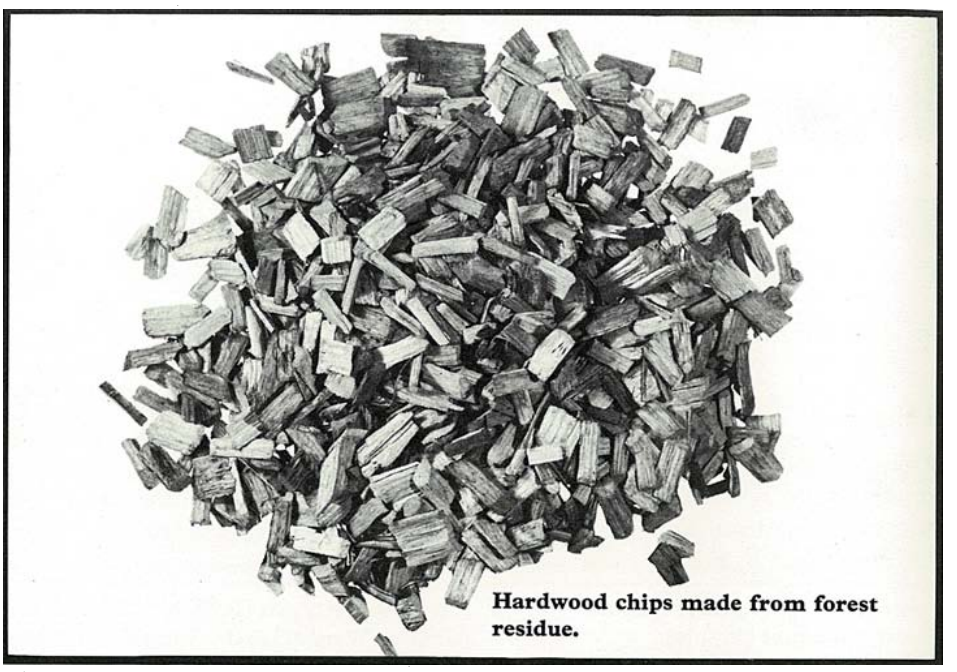
Using chips made from forest thinnings and from the 'tops' of trees selectively logged for sawmilling purposes, the group made pulps from trees chipped with and without the bark on, using the kraft method. (This process is only one of half a dozen used in Australia, but is the one most commonly used for imported hardwood chips in Japan. It involves cooking up the chips with various chemicals to extract the lignin and coloured matter from the wood.)

Blackened blackbutts

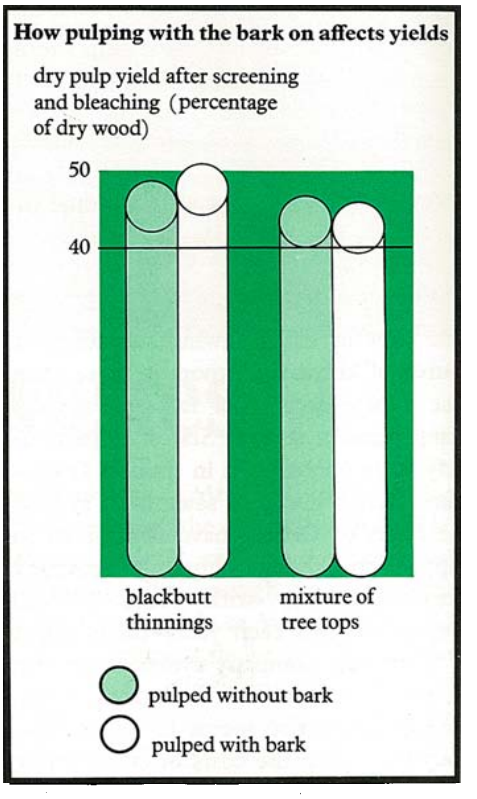
Carbon resulting from charring of the bark during bushfires is a particularly troublesome material when making printing or writing papers. It is this blackening that gives the blackbutt its name. For this reason, blackbutt samples were scraped with wire brushes, which removed the loose black outer layer. Much of the bark still remained after brushing.

The tests showed that high-quality paper could indeed be made from logs chipped with the bark on. Blackbutt thinnings pulped with the bark on yielded slightly more pulp than those debarked first, and produced paper only slightly less strong. The accompanying photographs taken with a scanning electron microscope show that paper made from blackbutt thinnings including bark is virtually indistinguishable from that made from debarked ones. In addition, it was still possible to obtain paper with high degrees of whiteness. Compared with the thinnings, forest 'tops' yielded only slightly less pulp, but they did require more chemical during pulping.

So it is technically feasible to produce good-quality paper pulp from forest residues while leaving the bark on. If the Japanese mills accept this, then a major hurdle along the road to using forest residues will have been overcome. But what would be the effects on the forest environment?



Hardwood chips made from forest residue.



Pulping blackbutt thinnings by the kraft process with the bark still on slightly increased pulp yields.

Environmental effects

In some ways they may be similar to those of clear-felling, but not so great. There will for example be disturbance of the local wildlife, and logging activities using vehicles must have some effect on the soil hydrology. If it permits residue use in northern New South Wales, the Forestry Commission will lay down very strict limitations on the operators. These restrictions may well dent the economics of residue use.

Of concern when using forest residues, and even more when clear-felling, is the question of whether so much in the way of nutrients will be taken out of the forest with the logs that future growth of the vegetation will be slowed down.

Nutrients held above ground in mature eucalypt forests—and even more particularly in rainforests found on sandy soils—represent a pool that needs recycling if future productivity is to continue at the same level. The loss of nutrients may

reduce growth of the vegetation if these are not quickly replenished.

The problem in a forest that is selectively logged every now and then is that any reduction in productivity would be a slow process, very hard to detect. The forest would always contain large numbers of growing trees of different ages. In a clear-felled area, detecting this difference would be much easier, since it would be possible to compare growth rates from one crop to the next.

Nutrient losses studied

Few studies have been made in Australia of the quantities of nutrients that go out with harvested trees.

After looking at the messmate stringybark (*Eucalyptus obliqua*) forests in Victoria, Dr Peter Attiwill of the University of Melbourne thought that phosphorus removal may well become a problem. He concluded that, as these forests grow, the trees hold more and more of the phosphorus available from the soil. He calculated that the amount of this element in the mature forest vegetation may in fact at least equal that available in the soil. On the other hand a rather smaller proportion of calcium and potassium remain above ground, and these elements seem to be recycled more quickly than phosphorus.

In Australian forests, loss of all this phosphorus in particular through the entire removal of all trees may be important. Most of our forests stand on very ancient soils that cannot quickly replenish their nutrient content from the rocks beneath. (Younger, more fertile soils do this readily.)

High-quality paper could indeed be made from logs chipped with the bark on.

In practice, of course, not all the vegetation is ever removed, so the losses of phosphorus and other nutrients would be smaller. Even in clear-felled forests, most branches and all the mineral-rich leaves remain. Nevertheless, Dr Attiwill calculated that if all the trees were harvested some 40% of the aboveground phosphorus would be removed in the stem wood alone, as would about 20% of the potassium and 10% of the calcium and magnesium. If the bark was left on the stem wood, then more than 60% of the total amounts of these four elements originally in the standing vegetation would be removed.

Selective logging of a forest never requires more than half of the standing trees to be cut down. Thus this form of harvesting will remove less nutrients than clear-felling in each separate cut.

Nutrients held above ground in mature eucalypt forests represent a pool that needs recycling.

Even so, Dr Attiwill showed that some 15% of the arboreal phosphorus and potassium and 20% of the calcium and magnesium occur in the branch wood that would be used if the forest residues were chipped. In addition, the size of the nutrient drain would vary, depending on whether the residues were chipped with the bark on or not.

In the long term, some sort of a rundown of forest nutrient levels in many of our selectively logged forests seems very possible, regardless of whether the residues are removed and used. No doubt using the residues will accelerate this process a little, thus hastening the day when fertilizers will have to be used to replace the lost nutrients.

More about the topic

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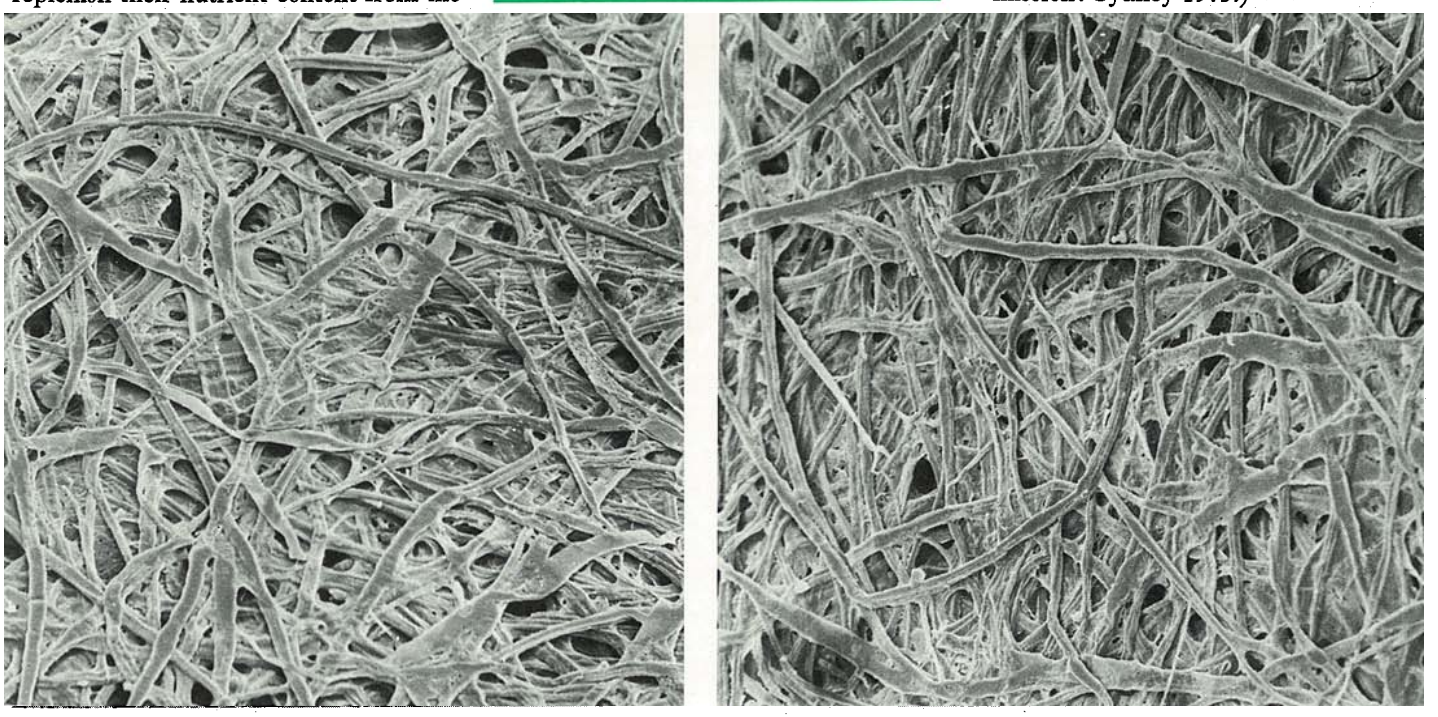

It's hard to tell the difference between these two photographs made with a scanning electron microscope. They are of paper surfaces made from blackbutt thinnings pulped with the bark on (left) and without the bark.