INNOVATION AND PROSPERITY IN FORESTRY?

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Yesterday was the 201st anniversary of the birth of Matthew Flinders who was, as you know, the first man to circumnavigate Tasmania and who named Australia. As Australians, you have doubtless been brought up to believe that the name "Australia" derives from the Latin *"Auster"* — the south wind — via *"Terra Australis"* (the name used by Flinders in his great record) — the land of the south wind. I have to tell you, however, that you have been grievously misled; etymological research — and some inkling of the way in which Flinders' mind worked — shows beyond question that the true derivation is from *Aus* — the German for "out", *TR* — an abbreviation of *terra* — and *alia*, the Latin for "other". Australia, therefore, signifies "that other country out there" and aptly describes, as Flinders intended it should, New Zealand's great offshore island!

Matthew Flinders hailed from the English county of Lincolnshire and was one of a small band of such men who contributed significantly to Australia's history; they included Joseph Banks of *Endeavour* fame, George Bass, who discovered that little channel north of here, John Franklin (who became Tasmania's Lieutenant-Governor in 1836), and the Tennysons — one of whom became a Governor-General of Australia and a formidable cricketer.

By this time you will have gathered that I am a Lincolnshire man; but the only thing I can claim in common with this distinguished band of gentlemen is my entitlement to the soubriquet "yellow belly" — the name given to men (and, less flatteringly, to women) who hail from Lincolnshire. The origin of yellow belly is obscure but it is held by many to mean the extreme antithesis of cowardice (as signified by the jaundiced hue of the coward's back!). In England it is sometimes taken to indicate temerity and sometimes sheer bloody-mindedness. It is not, I assure you, the latter that has led me to insert a question-mark at the end of the title given to me for this address; but I am well aware that in question-

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ing what many foresters — and, perhaps the organisers of this Congress — regard as axiomatic, I may be treading upon a few long-cultivated corns. If so, I hope you will forgive me; tact is not the most obvious national characteristic of the English; but, while my purpose is to be controversial, nothing is further from my intention than to be offensive. I want to present a case not for innovation in forestry but, rather, for the restoration and re-emphasis among foresers of some of its original concepts and values; I shall suggest that, in our current preoccupation with technological gimmickry, with overly restrictive economic concepts, and with questions of professional status and our public image, we foresters stand in real danger of losing our proper perspectives and of muddling our priorities. First, however, I want to illustrate the extreme difficulty of finding anything in forestry — whether in policy or practice — which represents a genuine innovation.

During the past decade or so, forest policies in many countries have urged the conservation of indigenous forests and the expansion of man-made plantations (usually of quick-growing exotics and often on degraded or semi-derelict sites); the economics of production forestry have been increasingly emphasized; and the role of trees and woodland habitats in environmental improvement has become an issue of widespread concern. These four items could, I suppose, be described as the major innovatory features of modern forest policies. But just how modern are they? As to the first, we know that in the 4th century B.C. the Greek rulers of Egypt imposed "felling quotas" in native woodlands (see, *e.g.*, McNeil, 1974) and there is abundant evidence in the writings of Theophrastus (4th century B.C.), Cato (2nd century B.C.), Lucretius (1st century B.C.), Virgil (1st century B.C.), the elder Pliny (1st century A.D.) and others, of early concern for the preservation of trees and woods as resources as distinct from their earlier and continuing roles in religion. In Britain, Julius Caesar instituted "Consulares silvae" to protect forests and, later legal constraints — imposing very severe penalties such as the loss of eyes and testicles — were introduced to prevent the felling of immature timber trees. Statutes of Edward IV, Henry VIII and Elizabeth I regulated the "planting, securing, cutting and ordering of woods, coppices," etc. (see Evelyn, 1664). Under a statute of Elizabeth, for example, the use of timber trees as fuel for iron smelting was prohibited "if the tree be greater than 1 foot square" and within 14 miles of the sea, or a navigable river. In America, William Penn's aptly named settlement of Pennsylvania established in 1681 employed a forester from the outset and made provision for retaining "an acre of trees for every five acres cleared".

There is also early evidence of artificial afforestation with exotics — in Assyria and Babylon, as early as 1100 B.C. (see Nicholson, 1970). In Italy, the plane tree was introduced from Greece, and elm, pine, poplar, beech and cypress were extensively planted, not merely as ornamental or shade trees (see, *e.g.*, Geikie, 1912). With respect to commercial timber plantations, however — and to the English speaker — the exhortations of 17th and 18th century proponents of forestry are of greater interest. The prime source here is John Evelyn's *Silva, or a Discourse of Forest-Trees and the Propagation of Timber in his Majesty's Dominions* commissioned by the Royal Society and first published in 1664. The apparent shortage of ship-building timbers led to the Royal Society's interest and, following Evelyn's revelations as to the desirability — and profitability — of forestry, extensive private plantations were established. Evelyn was a strong advocate of exotic species "since we daily find how many rare exotics and strangers, with little care, become endenizoned, and contented to live among us . . ." (p. 326) and of the afforestation of waste ground, swamps and other derelict sites. He cites a Mr Tusser writing more than 100 years previously:

> *In woodland the poor men that have*
> *Scarce fully two acres of land*
> *More merrily live and do save*
> *Than t'other with twenty in hand* (p. 587)

Alexander Hunter, the editor of the 1776 edition of Evelyn's *Silva*, took issue with his mentor over his emphasis on tree planting on poor sites — "An opinion generally prevails," he wrote, "that good land should always be employed in Meadow, Pasturage and Tillage, and that none but the barren and rocky soils should be planted. Such an idea is by no means founded on truth as it may be demonstrated that good land . . . near a navigable river or canal, will yield a better profit when planted, than if it had been employed in pasturage and tillage."

At about the same time (in fact, between 1771 and 1773) an Aberdonian Doctor of Divinity under the pseudonym "Agricola" wrote a series of letters to the *Edinburgh Weekly Amusement* in advocacy of afforestation. This correspondence was subsequently published (Agricola, 1777). The first letter, under the heading "General Observations on the great Profit that may be made by judicious Plantations of Timber Trees" refers extensively to the observations of Arthur Young and others on the economics of short-rotation, intensively managed plantations. For example: "Suppose five acres of larch planted every year; at the end of 16 or 17 years, five acres

will every year be cut down, of the value of £500; from that day a regular produce of £500 a year is gained from the application of 100 acres of land; let to a tenant, these 100 acres produce £40 a year; but planted, they produce £580 a year. What an amazing difference." In some of his financial calculations, "Agricola" makes due allowance for compound interest charges and land rental values. Even so, he claims an annual profit per acre of $5-6-1 from firs at age 40 on land worth 3/- per acre per annum rental and capable of yielding only £1-1-11 per acre profit under agriculture. Other examples range from £4-14-0 per acre per annum for 38-year-old Scots pine *excluding* thinning and grazing income, to a remarkable £41-1-4 per acre per annum for poplar on a rotation of 9 years, and an acceptable £7-6-3 per acre per annum for 5-6 year rotation ash coppice. His Scots pine costings include land rental, a "poor rate" contribution and 20 years of tithes.

In places, Agricola's letters read more like the effusions of a present-day antipodean afforestation company than the thoughts of an eighteenth century divine; he is, however, a realist — "I am sensible," he writes, "that 19 plantations out of 20, which have been made in this country, have been executed with so little judgement that the proprietor does not draw near the one-half of what he might have done by a more judicious proceeding. . . ." Elsewhere, I have written about Agricola's revolutionary ideas concerning the location of plantations with respect to markets, and the relation between tree growth rate and wood density (Richardson, 1959). I will say something more about Agricola's recommendations on silvicultural schedules later in this presentation.

It is, perhaps, of interest that, as early as the sixteenth century in England, plantations over the age of 20 years were exempt from tithes — perhaps the earliest instance of taxation incentives for forestry. Later — in the eighteenth century — philanthropic societies in England and in Ireland offered subsidies for "improvements to woodlands" including planting grants, bounties on nursery sales and a fencing grant (see, *e.g.*, "S.H.", 1794).

The modern foresters' preoccupation with amenity and environmental issues is nothing new. Although, as Passmore (1974) notes, the Graeco-Roman tradition had no place for the aesthetic value of wilderness, there was a shrewd appreciation of the value of orderly groves and arboriculture. The first chapter of Book XVII in Pliny's *Historia Naturalis* (A.D. 77) is entitled, in Philemon Holland's 1634 translation, "Of the wonderful prices of Some Trees". In it, he relates the story of two rival Censors, Crassus and Domitius. Domitius resented the palatial sumptuousness of a house belonging to

Crassus and offered to buy it for 100 million sesterces; Crassus agreed but reserved from the sale 6 ornamental trees. "Tush (quoth Domitius, replying againe) take those Trees away and take all; if they be gone, I will none of the house though I might have it for a single denier. . . ." To up-date this story I should tell you that, according to my classicist friends, 100 million sesterces is equivalent to about 6 million Australian dollars! Even if there is a transcription error here — as is probable — and the figure should read 1 million sesterces, the value set on these 6 ornamental trees is still A$10,000 each!

John Evelyn was much concerned with urban pollution and in 1661 had published *Fumifugium; or the inconvcniences of the air and the smoke of London dissipated, together with some remedies humbly proposed.* To mitigate the effects of "fulginous clouds of smoak and soot, over and about great cities, and other volcanos, continually vomiting out their acrimonious and sometimes pestiferous fervor . . . ," (p. 27) he proposed planning controls for industry and, of course, the planting of urban trees and shrubs. In other situations, he recommended quick-growing poplars "to such late builders as set their houses in naked and unsheltered places, and that would put a guise of antiquity upon any new enclosure" (p. 216).

The ornamentation of temples and sacred shrines by planting trees has, of course, a much longer history in Eastern as well as Western civilizations and antedates the birth of Christ by centuries. Trees as the dwellings of spirits and gods have a special significance in most primitive religions and their preservation influenced the ancient landscapes just as, later on, environmental interests were served by conservation dictated by requirements for sport.

In England, the protection of deer and other game (and in consequence the protection of their habitats) goes back to Saxon times, though it was the Normans who first emphasised hunting for sport. By the Middle Ages, some 5 million acres in England and Wales were set aside as "royal forests, chases and other land for sport" (Stamp, 1955) while in Ireland all timber belonged to the King, and forests were managed "for the maintenance of the King's game" (Evelyn, p. 567). John Evelyn, while approving of forest protection, considered the laws too strict, extending as they did not only to the prohibition of killing deer and felling trees but "even to that of killing little silly birds . . ." (p. 562). He also regarded castration as an excessively harsh punishment for breaking the forest laws. What he would have thought of the treatment which later succeeded it — assisted immigration to "Van Dieman's cruel

shore" (to use the description in the immortal ballad of Maggie May) — can only be left to conjecture!

Nowadays, our notions of sport are, hopefully, more enlightened; we are more catholic in our appreciation of wildlife, and access to forests is not restricted to royalty. There is, however, nothing new in the concept of recreation forestry (Richardson, 1970, 1971).

Turning now to forestry practices, it can be shown that so-called innovations are as illusory as in the area of forestry policy. Of those that have been hailed as revolutionary in recent decades, I have selected the following to illustrate my thesis:

Vegetation site typing as a guide to species selection;

"Ball" or container planting;

"Instant" trees;

Silvicultural schedules involving wide initial spacing, heavy thinning and pruning;

The combination of plantation silviculture and grazing;

Mini-rotation forestry;

Forest fertilization; and

Whole tree utilisation.

I make no mention of nursery practice, tree improvement techniques or forest protection. As to the first two of these areas, nursery practices (including seed selection and pretreatment, seed coating with "manures", irrigation, fertilization, and root-pruning) and the standard tree improvement techniques of rooting, grafting, artificial pollination, etc., were all known to the Greeks (see Theophrastus) and Romans (see Cato, Pliny, etc.) and, while there have certainly been significant developments in techniques (and major advances in our scientific understanding of them), there has been nothing that can be claimed as a radical innovation. As to forest protection, although there have been major developments in, for example, pesticides and their application, I would argue — with my tongue only partially in my cheek — that our new formulations (many of which we can no longer use legally — see Morris, 1972) have been developed with only marginally less empiricism than John Evelyn's "piss and vinegar" for the control of bark beetles (p. 431) and "the reek and smoak of ox-dung wrapt in mungy straw" as a soil fumigant (p. 457).

Nor do I intend to discuss mechanisation of forest operations though, clearly, there have been major changes here in virtually all aspects of forestry practice. Sometimes mechanisa-

tion has increased prosperity; sometimes — and almost always in the less developed countries — its most obvious impact has been to increase unemployment. But I would argue that mechanisation represents development, not innovation — and is, therefore, marginal to my brief.

The use of natural vegetation to assess site productivity was first acclaimed in modern times some 40 years ago in Scandinavia, where the simplicity of the ground flora enables accurate mapping and the restricted plantation possibilities make tree species selection relatively uncomplicated. Vegetation mapping has since spread throughout Europe and North America and is hailed as a significant innovation in applied ecology. In the tropics, however, the vegetation is held to be too complicated for the derivation of site indices. Yet a few years ago — in the primitive highlands of Irian Jaya — I came across a highly sophisticated soil fertility classification, based on indicator tree species in virgin forest cover; some 21 soil types were recognised by indicator species, and used to site food crops under shifting cultivation. With a missionary translator — who, unfortunately, was no botanist — it was impossible to identify the species, but there was no doubt in the mind of our informant that the system had been in use "ever since the earth was born".

Afforestation using tree seedlings raised in discrete containers, or with the roots enclosed in a ball of the rooting medium, has been described as "revolutionary" (Mann, 1973). The various methods developed have been reviewed by Toman and Hocking (1973); tree planting "bullets" have been described (Ackerman, 1965), as has aerial planting by bullets and flighted "bombs" (Walters, 1969; 1972). The principle of the method, however, was first referenced in European literature in 1725 (see Fischer and Dade, 1944) when the plants were described as "clod seedlings", while the use of woven osier baskets as transplanting containers for saplings was advocated by Cato.

Similarly, the transplanting of semi-mature or "instant" trees — which is rapidly becoming a major industry in Western Europe — was probably an early Chinese development and was certainly practised in Greek and Roman civilisations. In eighteenth century Britain (and probably, elsewhere) it was even partially mechanised by a wheeled device ascribed to a Scottish engineer named Robinson (see "S.H.", 1794); it is in no significant way different from machines currently in use, apart from its lack of an engine.

Silvicultural schedules involving wide initial spacing, heavy thinning and pruning for high quality veneer and sawlog production, generally relate to species capable of rapid growth

(several pines, notably *Pinus radiata* and *P. patula*; *Eucalyptus* spp., teak, *Gmelina, Albizzia,* etc., with volume production of round 30 to 50 m^3/ha/yr). The alleged novelty in this approach lies in setting end-use objectives for the final crop production and then designing silvicultural schedules to meet them — rather than, as Fenton (1972) describes them, "Malthusian-based management concepts of maximum volume production". Recent silvicultural analyses began in South Africa under the influence of Craib (see, *e.g.,* Craib, 1939, 1947; de Villiers *et al.,* 1961) and were paralleled by unpublished work in other African countries and, of course, in Queensland; they have been extended significantly in New Zealand (Fenton, 1972) and are beginning to be practised elsewhere (Saint-Vaubery, 1969; Moore and Wilson, 1970). Fenton's "direct" sawlog regime involves planting at *ca.* 4 m × 2 m (1500 stems/ha), thinning to 370 stems/ha at a mean top height of 5.2 m, and to the final crop spacing (198 stems/ha) at a mean top height of 12 m. Rotation age is about 30 to 35 years when the final crop trees will have reached 35 to 36 m mean top height; pruning begins at a mean top height of 8.5 m and is taken in three lifts to 8.2 to 11 m.

Now, as to the need for clear objectives, Agricola had no doubts; "It is not on all occasions enough that wood can be made to grow; for if we have not a market for that wood . . . it can be of very little advantage . . . every circumstance ought to be duly weighted before any considerable plantation is made. . . . For this purpose, it will not only be necessary . . . to consider what kind of trees are most likely to thrive best . . . but also . . . to discover which kind will be most properly adapted to the market. . . . We ought even to pay attention to the *prejudices* of the people . . ." Agricola suggests a general spacing of "squares of 8 ft" and rotations ranging from 16 years (for larch) to 45 years (and a final crop of 250 stems/ha) for Scots pine, while the anonymous Irishman "S.H.", writing in 1794, prescribes general forest trees planting "at about 20 feet asunder", but advises "great care being taken that they are as free from straight lines and regularity as possible, both to give a natural air to the plantation, and to avoid the affect of penetrating winds." As to pruning, Agricola comments on a mature Scots pine: ". . . if these branches had been taken away from the body of the tree when it was but a small diameter, the wood which had been formed by the increase of the tree after that period would be of a uniform texture, free from knots and flaws, and well fitted for carrying burdens, or for any other purpose . . . in many cases it might be an advantage to the wood even to prune off some of the living branches." Much earlier, in 1597, Lawson wrote of prun-

ing — "Yet do I not know (let me speak it with patience of our cunning Arborists) anything within the compass of human affairs so necessary, and so little regarded; not only in orchards, but also in all other timber trees, where or whatsoever. . . ."

The silvicultural regimes advocated by the 18th century writers may not appear particularly radical in Australia or New Zealand, but remember that they relate to Britain where even today they plant Scots pine at about 5 ft spacing, thin to a final crop of 400 stems/ha, do no pruning, and think in terms of 65 years for a sawlog rotation. And if only the U.K. Forestry Commission had heeded advice to avoid straight planting lines, they could have escaped much contumely from the general public.

(As an aside, may I quote a further sentence from Agricola? Despite his convictions, he had a sneaking regard for the quality of Scots pine timber imported into Britain from Norway; it was "of a harder and tougher quality and containing a larger proportion of red wood and more distinct from the blue [!!] than any of our own produce." It may console timber merchants to know that bluestain has been around for a long time!)

In countries like Australia and New Zealand, with highly developed skills in animal production, the logical extension of wide spacing and heavy thinning plantation silviculture is the concept of combining tree plantations with grazing (of domestic or feral stock), in order to obtain intermediate revenue and, perhaps, to increase water yields in catchments, as well as improving visual amenity (see Knowles, 1972; Beveridge and Knowles, 1972). This is a subject receiving increasing attention in North America (see, *e.g.*, Grelen and Englehardt, 1973; Wolters, 1973; Clark and McLean, 1974; and, for a comprehensive recent bibliography, Pearson *et al.*, 1973). It represents a return to a centuries-old practice well known to Varro. John Evelyn recommends thinning "as that you leave straight and even intervals of eighteen or twenty feet for grass . . . the pastures will lie both warm and prove of exceeding delight" (p. 465) and, for "the large spreading oak", "Let the amplitude of the distance which they require be resigned to the care of the Verderer for grazing cattle, deer, etc. Trees planted in this manner form, as it were, a wild Quincunx which presents to the eye a great and masculine beauty" (p. 577). Elizabethan statutes in force at the time of Evelyn's writing prescribed the kind (cattle or horses) and periods of grazing, but allowed considerable flexibility since "of this, every man's experience will direct him". Agricola cites one William Fellowes who reckoned to recover his tithe

payments by letting the grazing Scots pine plantations at 5/- to 7/- per acre.

A so-called "exploding innovation" (Fedkiw, 1970) in forestry practice (and almost the opposite extreme of the wide-spacing, heavy thinning, schedule), is the intensive culture of both hardwoods and softwoods, alternatively described as "mini-rotation forestry" (Schreiner, 1970) and "silage sycamore" (McAlpine *et al.*, 1966). In essence, the system involves close planting (1 to 4 ft), heavy fertilisation and cultivation, coppicing (where appropriate), rotations of less than 10 years, and mechanical harvesting and utilisation of stems, branches, leaves, etc. (see, *e.g.*, Herrick and Brown, 1967; Steinbeck *et al.*, 1972; and, for similar developments in Europe, Stern, 1972); Schreiner (1970) extends the idea to uneven-aged species mixtures to grow three categories of produce — fibre wood, boltwood and timber. Coppicing experiments are also under way with *Eucalyptus* spp., in Israel (Zohar, 1974), here in Tasmania (Cremer, 1973) and, probably, elsewhere. The objective is the maximum production of utilisable wood fibre, the onus of developing means of using juvenile wood and of separating bark, etc. (or using it) being left to the woodchip technologist. Far from being an "exploding innovation", this regime — apart from the mechanical harvesting component — represents a return to perhaps the earliest of all conscious silvicultural systems — coppice with standards. Such plantations were known to Pliny and Varro and eulogised by Evelyn — "if . . . they be so laid out as to grow for several falls, they will prove more profitable and more delightful: more profitable because of their annual succession; and more pleasant because there will always remain some of them standing . . . there is not a more noble and worthy husbandry than in this . . ." (p. 465).

Recent developments in forest fertilisation in North America have been reviewed by Swan (1974) and there is no need, I am sure, for me to say anything here about what is happening in this field in Australia and New Zealand, though whether developments will continue in the face of burgeoning fertiliser costs is questionable The practice is an ancient one and its rationale is expressed in Virgil's *Georgics* — written between 37 and 30 B.C. and quoted here from the remarkable translation prepared by Jermyn (1947) in Changi prison after the fall of Singapore:

> *But to proceed. Whatever trees you plant*
> *Dung them about, and bury the dung deep;*
> *Or dig in thirsty gravel and rough shells:*
> *For, from the water that slips in between,*
> *And the thin, rising steam, crops will take heart.*

John Evelyn, some twelve years after the publication of *Silva* wrote *Terra: a philosophical discourse of Earth, relating to the Culture and Improvement of it for Vegetation and the Propagation of Plants.* . . . It is an extremely detailed discourse on various types of fertilisers and their appropriateness to different soil types. Then, as now, there was an anti-fertiliser movement — "some there be," writes Evelyn, "who affirm any culture of the Earth preferable to dung"; then as now, the main target of the detractors was inorganic nitrogen. Evelyn found this attitude hard to accept for "airy nitre, pregnant with a vital balm, which is the thing we endeavour to find in the materials of composts . . . I cannot . . . but wonder how a thing so eminently sacred and fertile, should come to be the symbol of malediction." Evelyn's editor Hunter, however, belonged to the "muck and mystery" school, claiming that "All the boasted compositions of nitre, and other salts, for increasing the fertility of land . . . are now experimentally found to be of little value. Dung . . . constitutes the only fertilizer. . . ." He included human effluent, observing that "in large families this excellent top-dressing may be easily prepared."

My last example of ancient light thrown on to new problems relates to whole-tree utilisation. In China (see Richardson,, 1966), North America (Koch, 1973; Howard, 1973a, b), Scandinavia (Makela, 1973), here in Tasmania and elsewhere (for a comprehensive literature review, see Keays, 1971), work is in progress which is designed to develop the economic use of root and branch-wood, foliage, bark, etc., as well as logging and mill residues. John Evelyn recognised the value of rootwood — "The very stump of an Oak . . . is many times worth the pains and charge for sundry and hard works . . . I wish only . . . some effectual engine might be devised . . . surely there might be much done by fastening of iron hooks and fangs about one root to extract another . . ." (p. 108). Agricola lists a wide range of minor forest products, including turpentine, resin, tar, pitch, lamp black, potash, charcoal (of several kinds), sugar, wines and syrups, edible seeds, bark, tannin, dyes, medicines and rootwood torches. He writes: "Although there are many situations in which it is impossible to make any profit of the wood of trees in substance, yet many of these yield some other produce of great value . . . which can easily bear the expense of transporting . . .".

Although utilisation is not within my brief, I cannot resist a final quotation from John Evelyn which demonstrates the repetition of history and the rarity of true innovation. Discussing the use of cork for shoe soles he reveals that it was this

use by Grecian ladies which led to their being described as "light-footed". He continues: "I know not whether that epithet do still belong to that sex: but from them it is likely the Venetian Dames took it up for their monstrous choppines; affecting or usurping an artificial eminency above men, which nature has denied them." (p. 364). Clearly, the rejection of platform shoes would have been a more effective symbol for women's lib than the burning of bras!

I hope that this rather lengthy catalogue of historical forest policies and practices, if it has not enlightened, has at least entertained you. What I have to say in the remainder of the time allotted to me is more serious.

In arguing that there has been no real innovation in forestry down the centuries, I am not implying that there has been no *change*. With Disraeli, I believe that nothing is more constant than change. And I want to suggest that in recent years there have been three major changes which merit the concern of this Congress. One is the change in foresters; the second is a change in public attitudes to forestry; and the third is a change in society.

The change in foresters formed the theme of a keynote address given to the Canadian Institute of Foresters in 1972 (Richardson, 1972b). In it, I argued that once — and it seems a very long time ago — foresters managed forests for the provision of goods and services for people; these goods and services were relatively simple, but foresters produced them *without fear or favour*, at the same time protecting or regenerating their resource base. They had no sophisticated tools for this task — only an intimate and holistic knowledge of their forests, a commitment to sustainability, and a subconscious loyalty to the long-term interests of society which, when necessary, overrode the shorter-term interests of governments, industry and even their employers. But nowadays, the traditional forester is an endangered species, threatened externally by predatory economists and internally by environmentalist parasites. He is distracted by questions of status, and his public image; he is badgered by self-styled "specialists" anxious to assume many of his duties; and his ability to provide increasingly sophisticated goods and services in a highly competitive society is being widely debated. In many countries, foresters have responded to these pressures by *uncritically* — sometimes even hypnotically — embracing the axioms of modern science and sociology — commitments to an undefined efficiency and to economies of scale, benefit-cost analysis, and computerology.

Now, I do not question the value to forestry of technological development or of modern economic concepts. But I

believe they should be recognised for what they are — merely tools of the forester's trade, not universal panaceas, and certainly not religious fetishes; their use must be tempered by commonsense, social awareness and that holistic, generalist approach to problems of land management that was once the hall-mark of the good forester. Let me try to illustrate what I mean.

In 1972, I took part in a United Nations Development Programme review mission to a forestry project in a developing country. We found a forestry development plan for large-scale afforestation with exotic conifers and the introduction of modern logging and sawmilling; the project would create 5000 jobs and give an acceptable return on capital invested. But what had *not* been costed was the fact that, in acquiring the land needed for plantations, some 12,000 families would be dispossessed of their small farms, and a further 1600 employees of small (and, in terms of modern economic parameters, no doubt inefficient) sawmills would lose their jobs! Closer to home, as some of you know, I have been involved with forestry development in Irian Jaya. The initial forestry programme for West Irian envisaged 13 projects, of which 7 were small-scale "social-cost" proposals which would never make any money but which, at nugatory cost, would improve the quality of life for several hundred people in the remote and inaccessible highlands. They included the provision of rugged portable log and sawmills, to be driven by wood-burning steam engines. To my personal regret, the priorities given to forestry developments in West Irian — both by government and the international agencies — assigned the social cost projects to the bottom of the list and only one was implemented. Yet they could well have had a more effective — and certainly more pervasive — impact than many of the larger scale projects which were implemented. In both these cases, in my view, preoccupation with restrictive economic concepts prevented any realistic consideration of human needs, and led to the application of inappropriate technology.

The change in public attitudes to forestry — a by-product of the revolution in mass communication — needs no documenting, before an Australian audience which, less than a year ago, suffered the trauma of the Forwood Conference — and the public recriminations which preceded, accompanied and followed it. It is not my intention to get embroiled in Australian environmentalist polemics — to an outsider the battlefield is so overhung with smoke that it is impossible to identify the real location or the objectives of the fighting — but I must declare an interest as a conservationist; that interest, however, is closer to the concerned "human chauvin-

ism" of John Passmore (1974) (and to the philosophy of the President of the Australian Conservation Foundation) than to the hysterical iconoclasm of the Routleys.

The features of changing public attitudes to forestry which seem to me important are two. First, concern for environmental quality — however bizarre and misguided its expression may sometimes appear to be — is sincere; quite simply, more people care more about what is happening to the biosphere; and foresters have the opportunity either to harness that concern or to alienate it. Secondly, the younger generation is far better informed about some aspects of environmental management than is ours. Professor Canny of Monash University, in his 1972 Presidential Address to Section 12 of the ANZAAS Congress, presented statistics for three Australian States of the number of school children who took final examinations in biology from 1960 to 1970; the growth rate was exponential and the doubling time about 4 years. This widespread and growing interest in biology — which is not confined to Australia (see Richardson, 1974) — presents a challenge to all professionals in the business — including foresters; for in future we shall have to explain, and justify, our prescriptions for forest resource management to audiences who will not be fobbed off with paternalistic postures and technical jargon; we shall need all the honesty (and the self-confidence that derives from it) that we can muster; and we shall need a lot of knowledge that at present we are quite unable to muster.

The third change may, in the long run, prove more far-reaching than any other. In 1973, in a speech to a gathering of North American businessmen, Jack Westoby observed that when industrialists look into the future they are inclined to predict solely on the basis of technological and economic indicators; they may make a perfunctory genuflexion towards the idea of socio-political change, but they generally retain the assumption that the basic framework of society will stay substantially the same. In a western industrial context, this means the continuation of what we call the free enterprise system, and the control of supply and demand by relatively unrestricted market forces. We tend to forget that two-thirds of the world's population live in countries where free enterprise either has no role at all or is substantially regulated. (Let's remember, too, that one of those countries, contains over 60% of the world's softwood timber resources.) Moreover, during the immediate past, even in countries avowedly committed to a market economy, unbridled free enterprise has taken a few knocks. The Lonrho and Lowson affairs in the United Kingdom, some of the Watergate disclosures in the U.S.A., the

activities of some mining companies and stockbrokers in Australia — these are features which illustrate what a Conservative Prime Minister in Britain has described as "the unacceptable face of capitalism".

There is even more concern over the sheer size and power of companies. In his presidential speech to the Society of Chemical Industry last year, the Chairman of Courtaulds — Lord Kearton — acknowledged reality when he described society as "everywhere distrustful of the large or over-large company" and where "the so-called multi-nationals have few friends except each other." He went on to condemn "the self-justificatory postures which characterise us all", and to advocate for the boardroom, humility, social responsibility and the merits of thinking small rather than big — a rather surprising piece of advice from the head of one of Britain's ten largest companies. But it is increasingly being echoed from the most unlikely sources, among others by the President of the World Bank (see *e.g.*, McNamara, 1974) and the animal behaviourist, Conrad Lorenz (1974).

Now, I am not attacking multi-national companies; there are some things they do supremely well. In non-industrialised countries, it is often only the multi-national company which can provide essential development infrastructure. This is particularly true of the forest industries. Because of the generally inaccessible areas in which they operate, companies have to provide not merely utilisation plant but schools, hospitals, communication facilities, shops and so on, which would otherwise never be established. Nonetheless, Lord Kearton's advice is both timely and wise.

There are other manifestations of unease about a society that is overwhelmingly profit-orientated — the effectiveness of the Ralph Naders, Consumer Councils, and such organisations as the Friends of the Earth, the Sierra Clubs, etc., are some of them. Also, in a society where machines replace men at every conceivable turn, we are seeing the beginnings of revolt by the people whose skills have atrophied as a result of the machine robbing them of variety and the opportunity to make decisions; and an acknowledgement by management that the mass-producing assembly line is not necessarily the acme of productivity.

To an extent, increasing socialisation in capitalist economies is being matched by the *de facto* adoption of a capitalist ethic in some of the centrally planned economies. But there is one country which has developed its own kind of socialism where, I would guess, this will not happen and where "the combination of modern science with local inventiveness and local responsibility that is at the core of the only really effective and

sustainable ecological balance" (Ward and Dubos, 1972) will flourish and spread beyond international boundaries. That country is, of course, China.

Now, I visited China in 1963 — before it became fashionable — and at a time when Western politicians (and, I am afraid, Australians) were avidly searching under their beds for the reds they are now so anxious to drag into bed with them. I had the good fortune to be there when China confidently announced to the world her rejection of the Soviet blueprint for industrialistion in favour of her own home-produced model. More recent visitors have had the opportunity to judge whether China's confidence was justified and, from most accounts, there can be little doubt that it was.

One key to China's success is the cellular structure of her economy — nation, province, county, commune, production brigade, work-team. At all levels, three maxims are of overriding importance. The first of these — "agriculture the base with industry the leading factor" — exemplifies the rejection of earlier development models which milked the agricultural sector in order to support predetermined industrialisation targets; and for the first time in history it has given some kind of dignity to millions of peasants. (It may be of interest to quote Evelyn's editor, Hunter (p. 176) on the perils of nourishing industry at the expense of agriculture; he notes that in France in the 17th century Colbert esteemed "manufacture and commerce as the sinews of state . . . but forgot that the manufacturer must eat his bread at a moderate price". "The Farmer being discouraged, the necessaries of life became dear — the public galleries were ill-stored — manufactures languished — commerce drooped — a numerous army soon consumed the scanty harvest, and in a short time, Industry fell a sacrifice to the ill-judged policy of the Minister". This potted history will have a not unfamiliar ring to some Australian ears.) The second of China's *leitmotifs* — "self-reliance" — reinforces the first and enables every unit of society to adapt its utilisation of resources to the development possibilities of the local situation. The third dictum — "serve the people" — because of the success of the first two, is not (as in most societies) an empty political slogan; rather it is a pathway, increasingly well trodden, to genuine egalitarianism.

Of course, the dispersion of industry and the great variation in technological sophistication implicit in the Chinese development model, are in conflict with those economic fetishes of other societies to which I have already referred — "economies of scale" and "manpower productivity". But the loss of scale economies and lower productivity per man are more than

offset in China by the effective mobilisation of labour and the intensive and complete utilisation of raw materials. (Elsewhere — see Richardson, 1966 — I have described logging operations in China, and the harvesting of literally every twig; close utilisation of this kind — and the extent of recycling waste materials (Richardson, 1972a) — must be seen to be believed.) Scale and productivity losses are also offset by lower transport costs; the stemming (indeed, through the various rural experience programmes, the reversal) of urban drift; the development of industrial skills in the countryside; and, probably, lessened vulnerability in the event of war.

There are, of course, aspects of Chinese society which to a Westerner are disturbing. The near deification of Chairman Mao is one of them. We should remember, however, the story of Ozymandias, and the fact that ideologies have a greater persistence than their progenitors, be they politicians or pop-stars.

For what we euphemistically call the developing world, the main question prompted by the Chinese economic revolution — and it is nothing less than that — is whether the model can be transferred to other situations. Is its success due to the special genius of the Chinese or does it rest on the ideology? Only time will answer that question, but whatever the answer may be, there is little doubt in my mind that "self-reliance" and "serve the people" are tenets of a faith that must spread far beyond China if that "effective and sustainable ecological balance" is to be achieved. Moreover, they were once basic tenets of the foresters faith; it is time, perhaps, to restore them to the forefront of our profession.

Now, what has all this to do with Australia and Australian forestry? A speaker at one of your earlier congresses had the perception—and the courage before an Australian audience—to draw attention to certain characteristics which Australia has in common with many underdeveloped countries — an economy based on primary production, relatively small markets for the products of advanced technology, a very unevenly distributed population, and a fervent desire for self-sufficiency — to an extent that domestic industry receives what to an outsider appears to be over-protection. Australia's population will never be large and industrialisation will, as in China, have to adapt to the possibilities inherent in the local situation. Australians, too, have a reputation for inventiveness and self-reliance. The challenge for your forest industries, it seems to me, is to harness that inventiveness in such a way that "scale economies" become irrelevant and market size ceases to be either a deterrent to industrial development or an excuse for protective tariffs.

Just before returning to New Zealand last year, I visited a 1000 tonne/day pulp and paper mill in Finland. Not so long ago a 100 tonne/day mill represented a substantial industry and rules of thumb for estimating labour and capital requirements were one man and 5000 dollars/tonne. But now, a 100 tonne/day paper mill is a pilot plant! The mill I visited in Finland cost 150 million dollars, and was run by a computer, a few closed circuit television cameras and 7 men! If that 1000 tonne/day mill becomes the economic optimum (and, inevitably, it will then become the economic minimum size), what hope is there for any developing country ever to have its own viable pulp and paper industry? What hope, indeed, for Australia? If I were a benevolent pulp and paper tycoon (if that is not a contradiction in terms), I would offer the equivalent of a Nobel prize for the development of a 50 tonne/day mill, freely competitive with that 1000 tonne/day monster I visited in Finland. Is this beyond our ingenuity?

Not so long ago I believed that this kind of dilemma would only be resolved by the widespread adoption of labour-intensive, "intermediate", technology. That may yet be the solution in some parts of the world as has been demonstrated in China, but it is scarcely feasible in Australia; nor is intermediate technology politically acceptable in many, more densely populated, countries. I now believe that the kind of technology needed to solve this sort of problem will be even more sophisticated than that required to design and install the 1000 tonne/day mill. We have that kind of sophistication — space travel has demonstrated it — but, so far, its application has been restricted to purposes as socially irrelevant as moon landings. Must it always be so?

I confess that I had posed this question before I had an opportunity to read the *Forwood* report of the Working Party on Pulp and Paper. From that report I learned that the average size of pulp mills in Australia is around 160 tonnes/day but, more importantly, I discovered that you are well aware of the conflict between scale economies and industrial dispersion. You are also aware of the need for advanced technology in the forest industry and of the fact that technology developed overseas may be irrelevant to the local situation. From the country which, in the face of scepticism from the world's pulp and paper technologists, successfully developed the pulping of *Eucalyptus* in the 1930s — and here in Tasmania — this awareness comes as no surprise.

In other fields of forestry, too, your inventiveness and reliance on your own technological resources are well-known. Australia pioneered the harvesting and utilisation of multi-specific bush and, in plantation forestry, the adaptation of

light trucks for softwood harvesting. There are many other examples but those I have cited have particular relevance to the problems of scale which face the non-industrialised countries among your neighbours, and to the solution of which they may, in the light of history, reasonably look to Australia for a substantial and original contribution.

Does not the development of viable (and unprotected) small-scale industries offer a challenge to that renowned Australian inventiveness? There can be little doubt, I think, that the objective is a worthy one; or that the development and export of such technology would be more welcome to your third world neighbours than some of the products with which *Forwood* threatened them.

But perhaps that pioneering ingenuity and self-reliance of which I am speaking has atrophied under your affluent society, as have (dare I say it?) your skills on the football field! If so, then the hope of its resurgence, and its application to the manifold problems of forestry and the forest industries in the Asia-Pacific, must rest with New Zealand. And that surely is a state of affairs which no true Australian could bear even to contemplate!

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