Monetary values have been attached to the natural environment, even in the absence of any real market. Conflict occurred between the instrumental and intrinsic ends of a value continuum. The contingent valuation method, with a hypothetical market, was used in the USA and trialled by the RAC. But it relied on doubtful survey techniques. Since the Mabo Case and the Coronation Hill Inquiry, Aboriginal cultural values have become decisive factors in environmental assessment. A value matrix model, incorporating a science-culture axis, is proposed.

"That a thing may have any value in exchange, two conditions are necessary. It must be of some use...it must conduce to some purpose, satisfy some desire. No one will pay a price or part with anything which serves some of his purposes, to obtain a thing which serves none of them. But, secondly, the thing must not only have some utility, there must also be some difficulty in its attainment." — J. S. Mill, 1847, *Principles of Political Economy*

Many people desire the conservation of a natural resource for posterity, but others prefer the utility of its rapid exploitation. In the ongoing forest conflict between loggers and conservationists, the instrumental value of timber harvested is often pitted against the intrinsic value of a protected forest. Saw logs (or woodchips) have uses which can be measured in dollars in a real market. If the trees are left to grow in the forest, the measurement of value becomes much more difficult. The utility of a pristine ecosystem is enigmatic. Perhaps it could be considered as capital, a long-term investment which could pay dividends when harvested in later years. Or it could be used for recreation and never harvested. Other uses might include scientific research, wildlife conservation, catchment protection or reduction in "greenhouse" emissions — all worthwhile but difficult to quantify. Without actually "exchanging" some component for money, the market value of a natural resource is not easy to establish. A continuum between instrumental and intrinsic values could be imagined: ranging from resources that were readily exchanged by humans for cash, to entities that purely belonged to themselves by their very nature (Fig 1).

At one end of the continuum, an *anthropocentric* view sees value in the use and exchange of the resource for humans. At the other end, a *biocentric* view recognizes aesthetic and ethical values pertaining to the resource in its own right.

Trained to use an anthropocentric view of the world, environmental economists have attempted to deal with the natural resources by assigning various instrumental values when no real market existed (Hamilton 1994). These included:

- existence value — benefit of knowing a resource exists;
- option value — benefit of retaining options for use;
- bequest value — benefit of inter-generational equity.

In search for meaningful comparisons, economic rationalists have tried to construct a common framework for all values, using the monetary units of the market. They cling to a measurement system which is not based on any physical quantity. Money has no intrinsic or instrumental value *per se*. It was created as a means of exchange, a way of measuring the relative values of material objects and services by assigning prices. This was seen by Horne (1976) as a kind of mathematics: "In the form of price, money is a powerful language, transforming something that can be seen and felt and touched into something that exists as a mathematical measurement."

Relying on such mathematics, economists devised a formula for determining the price of money itself (Galbraith 1977). This contains variables for cash in circulation, bank deposits, the rate of spending and the number of transactions — all artificial constructs that are not necessarily related to any tangible entity. Money was therefore deemed to have value in its own right, without comparison to the natural world. The rate of spending was once limited by the time taken to move coin or paper between buyer and seller; a few minutes in a local market,
weeks or even months for overseas transactions. At the end of the twentieth century, huge sums are transferred electronically around the globe at the speed of light. Even central banks have little influence over the ephemeral value of this electronic money (Kleiner 1995). Nevertheless the advocates of a free market continue to claim that everything should have a monetary value.

Cost-benefit analysis purported to assess activities in terms of money in a real or imaginary market. Hamilton (1994) characterized it as, "...an attempt to anticipate or reproduce the outcome that markets would produce if they could be made to work." The orthodox view was that markets worked best without human intervention. Yet intervention in the environment was encouraged in the name of development. Economists measured environmental costs and benefits in terms of dollars rather than in the physical quantities used by science (Stewart 1993). This has led to a conflict between economic and ecological perspectives, described by James (1991): "The divergence of views on the benefits of natural resource protection is the focus of the current conflict between economic and ecological concepts of sustainable development. Most rational conservationists would argue that we need to be more cautious in exploiting natural resources and look more carefully at the relevant costs and benefits. Many are sceptical, furthermore, that such costs and benefits can be measured in economic terms."

Environmental impact assessment was developed to compare environmental variables by weighing costs and benefits of various activities in a common value system. The concept of sustainability was applied to both ecology and economics by Brundtland et al. (1987):

"The common theme throughout this strategy for sustainable development is the need to integrate economic and ecological considerations in decision making. They are, after all, integrated in the workings of the real world."

However, sustainability tended to be considered without integration of the disciplines: the popular acronym "ESD" could mean either "Ecologically Sustainable Development" or "Economically Sustainable Development", depending on who was using it. There was no common value system and little dialogue between ecologists and economists. The concept of sustainable development could
be seen as derived from the simplistic agricultural and fisheries notion of maximum sustainable yield of exploited species. This had more to do with continuing profits than it had with maintaining ecosystems.

European culture has been based on an assumption that economics is the dominant element in government policy-making (Horne 1976). This belief was reinforced during the 1980s by the resurgence of the laissez-faire doctrine — now known (pretentiously) as "neo-classical economics", or as "economic rationalism". Its irrational precept implied that market forces were omnipotent and all pervasive. Economic rationalists argued that government policy should be subservient to monetarism. They promoted the dollar as the exclusive unit for measuring national wellbeing. It followed that natural resources had to be measured against this universal yardstick. Even politicians who professed concern for the environment paid homage to the market. In the USA, Vice President Gore (1992), asserted that:

"The stunning victory of free market economics over communism in the global war of ideas has brought with it a new obligation to change those features of our economic philosophy that we know are flawed in light of the ecological destruction they legitimize, and even encourage . . . Everything in nature is simply assumed to be limitless and free . . . But for each misleading formula, we need to substitute an appropriate method of valuing the ecological consequences of market decisions."

From this could be inferred the belief that ecology must conform to economics — that victory over communism was somehow a prerequisite for mastery of nature. The ownership of natural resources was targeted by the economic rationalists who now influenced many governments around the world. Privatization of natural resources such as water and forests was advocated in the name of economic "efficiency" — meaning lower taxes and higher profits. Government involvement in resource assessment and management was discounted. It was argued that natural areas had been neglected because they were not in private ownership and not subject to a free market. Hamilton (1994) identified the underlying tendency in this property rights approach: "The appeal of free market environmentalism to many in the economics profession is that it makes redundant the detailed investigation of the costs and benefits of government decision making . . . Market signals replace government and community deliberation."

The increasing dominance of neo-classical economics in the processes of government had important implications for the development and operation of environmental impact assessment mechanisms. If the environment was considered a subset of the economy, and if the economy was a self-regulating system, then there would be less need for assessment or intervention by government authorities or community groups. The market could be left to assess and control nature. By 1995, monetarism was being carried to an extreme by a Republican majority of members in the United States Congress, as part of their "Contract With America". They introduced a bill (HR9, 1995), "to create jobs, enhance wages, strengthen property rights, maintain certain economic liberties, decentralize and reduce the power of the Federal Government". This created a new assessment mechanism based on mandatory assignment of monetary values to environmental risks and benefits. Each Federal environment protection "rule" was required to, "employ performance or other market-based mechanisms that permit the greatest flexibility in achieving the identified benefits of the rule". The Republicans had been elected with a mandate to cut "Big Government" controls and expenditures. But rather than discarding the environmental laws created over the previous twenty five years, the tactic was to add a new layer of controls, including "regulatory impact analysis". Helen Caldicott (1994), an environmental activist, saw this as having the effect of jamming the whole mechanism: "So instead of actually changing the environment laws, the Republicans have produced a vast new bureaucratic gridlock which effectively emasculates these laws and gives free rein to corporations to pollute the environment at will. They have dramatically restricted the implementation of environmental laws without actually rewriting them — analysis by paralysis." Ironically, the legislative mechanism held up passage of this bill. It was referred to a committee of the Senate for detailed consideration, a common tactic to indefinitely delay legislation.

In Australia, one of the innovations which had been attempted by the Resources Assessment Commission (RAC) was contingent valuation — putting a price on natural resources through surveys of public opinion of a hypothetical market. This methodology was employed in a nation-wide sample survey to assess the conservation value of the Kakadu Conservation Zone (Imber et al.
1991. The results were not included in the inquiry's final evaluations. Nevertheless, the survey alarmed the mining industry because people across Australia seemed willing to pay $640 million to protect the Zone, far more than the projected total mining profit of $82 million. The RAC was criticized for examining the application of such techniques to conflict resolution (Stewart and McColl 1994). It was also criticized for giving too much attention to the culture of indigenous people, who used a very different system of values.

Contingent valuation became an accepted procedure in the United States, where it was written into legislation and upheld by the courts as a means of assessing damages from major environmental impacts (Hamilton 1994). A notable example was the Exxon-Valdez oil spill, where surveys showed a huge public demand for compensation, and the Exxon Company settled by paying more than $1 billion to the affected parties.

In principle, contingent valuation surveys were designed to fit elusive natural values into a neat balance sheet. A hypothetical market is set up in the subject's mind to balance the desire for an "environmental good" against the desire for goods which could be otherwise purchased in a real market. Unfortunately, the concept of assigning money to "exchange" parts of the flora or fauna was fraught with difficulty. Survival of a threatened species was not easily equated with the proportion of a household budget that might otherwise be spent on groceries or rent. Plainly, the desire for immediate human sustenance would have different imperatives to the desire for protecting remote wilderness.

Methods of pricing related to real markets included the travel cost method, the hedonic pricing technique and the damage cost method. In the travel cost method, the value of a national park might be estimated from the amount of money spent by visitors on travel to the park. Hedonic pricing used movements in actual property prices to assess the impact of some activity in the relevant environment. The damage-cost method estimated the cost of rectifying environmental degradation. All these approaches had obvious quantitative and qualitative limitations: natural resources could have many uses that were not related to visitors; property prices could be influenced by various factors that were unrelated to specific environmental impacts, some types of environmental degradation could not be reversed.

Implicit in contingent and related-market valuations was the assumption that everything in the environment could be assigned a monetary price. In contrast to this narrow view, Ashby (1978) had proposed a range of values — from those measured in cash to those which could be considered priceless: "The word 'value' can mean cost in the market place, quantified as cash. Or it can mean usefulness, expressed as utility for persons or welfare for society. It can also mean what Locke called 'intrinsic natural worth,' which he sharply distinguished from cost in the marketplace; the former is an objective quality of the thing itself, the latter is its value only in relation to the value of other things that can be acquired in its stead. Finally, the word 'value' can be attached, sometimes passionately, to symbols or concepts, such as a national flag or liberty. The same thing can carry all these values. Thus a piece of land has a market value; it has value-as-use for the farmer or developer; it may have intrinsic worth for its beauty; and it may be the symbol of homeland, to be defended to the death against enemies."

Some government authorities and conservation groups sought market-related means of environmental control, as part of a pricing mechanism. These controls could be negative — such as taxes for activities that caused adverse impacts; or positive — such as tax concessions and subsidies for activities that enhanced or protected the environment. Carbon taxes were advocated as a means of reducing industrial emissions and controlling global warming (Pearce et al. 1989). The Hawke Government granted large funds to local communities for tree planting. Tax concessions for the cost of EIA itself were proposed, linked to profits derived from the subject activity. And so the tendency towards assessing all environmental costs and benefits in units of money continued. Depending on where and when they were applied, monetary controls not only affected the cost-benefit equation, but also moderated the subject activities themselves. But no firm relationship between markets and physical variables was established. Market prices were not capable of reflecting all human needs and aspirations, much less the subtle values of nature.

Controlling market prices by imposing ecological constraints was proposed as an alternative to a strictly monetarist policy. This might be implemented by allocating rights for the use of resources according to ecologically sustainable limits. Unlike taxes and grants, such rights would use physical quantities. Young (1993) considered "resource-rights systems" to be superior because: "As physical quantities, not prices, affect ecosystems there is less risk to society when
ecological constraints are set and then price, demand and technological forces are allowed to work themselves out. In contrast, input taxes and pollution levies leave prices unchanged and work themselves out by changing rates of depletion and pollution."

As most economists promoted the market to replace elected government in deciding the destiny of the nation, a powerful countervailing force was felt in Australian society: the push for Aboriginal land rights. This followed a completely different value system, involving spiritual beliefs about the land which were often opposite to those of Europeans. The white settlers claimed that they owned portions of the country, which could be repeatedly bought and sold for money. Conversely, the black people held that the country owned them, that they were bound to it for ever and ever. European private ownership and free enterprise clashed with collective Aboriginal ties to a spiritual home. This Aboriginal perception of land had been described in detail in the early literature of anthropology (such as Elkin 1948). But spiritual values only became politically significant during the Aboriginal land rights debate, as exemplified in the "Coronation Hill" inquiry and "Mabo" legislation of 1990s (Toyne 1994).

The Aboriginal value system was biocentric rather than anthropocentric, and spiritual rather than materialistic. At Coronation Hill, belief in the presence of Bula determined the issue of mining, and science and economics had to fall into line. Debunking the myth of terra nullius meant recognizing an indigenous relationship with land, as opposed to an alien domination of it. The cultural values in that relationship were enduring and unique, and the basis of an economy which was sustained for tens of thousands of years. From this point, another dimension would have to be taken into account in natural resource management. The model with a single continuum between instrumental and intrinsic values had been replaced by a matrix that included an axis between science and culture (Fig. 1). Science could objectively produce evidence of past events and predict future impacts. Culture could react to the evidence and subjectively choose its preferences. At Coronation Hill, the value of Aboriginal culture was given preference, with the decision being made in that sector (c). This was in contrast to the previous decision to allow mining at the nearby Ranger site, when the instrumental/scientific sector (a) prevailed. Many proposals would continue to involve instrumental and European cultural values (d). Debate about the conservation of endangered species could lead to the scientific/intrinsic sector (b).

For two hundred years, transplanted English law and culture has favoured instrumental values in exploiting the resources of an alien continent. The rise of environmental concern in the 1970s had forced consideration of enduring intrinsic values. In the 1990s, after Mabo and Coronation Hill, attention was being directed to a range of issues with wider scientific and cultural aspects. This is indeed a heady mix of ethics, money and politics. The zoologist will do well to see the dilemmas while holding on to the intrinsic values of studying the animal world.

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QUESTIONS AND ANSWERS

TERRY DAWSON: I was at a symposium on sustainable development in the University of Utah where there was a great deal of debate about these matters. There was considerable acrimony associated with the debate because where there are public lands you have hunting, ranching, and conservation issues
involved. The notion of being able to put money values on some of these things was where the debate really bogged down and a lot of people drew some very, very odd conclusions.

GISELLE HOWARD: Alan, I find what you say to be refreshing. Time and time again in my field of work in a state government organization we come across this problem. The economic side is given and then the other values are just dismissed. As a question to you, in an EIA document how would you go about presenting these issues? Obviously it is very difficult to put the dollar values on some things, so how would you raise them as being important?

ALAN STEWART: If you are out in the field doing some sort of an assessment I think you have to come up with objective physical values so you can measure whatever there is out there, whether it is the number the trees, the number of possums, or whatever. This is what a lot of us in this room have been trained to do with some degree of accuracy. So I would say you would do that over in the top right-hand sector (see Fig. 1). As the decision-making process takes over, you are moving downwards across the horizontal axis into the cultural area. It depends on whether you are a pure scientist, an applied scientist or an administrator as to whether you should cross over that axis or not. But the decision that is made on the cultural sector should be based on scientific information. Of course, you have to remember that it is driven by the economic imperative too. We have all to be paid.

DOMINIC FANNING: A couple of points, Alan. The first is that essentially all of the EIA process, what people like me and others in this room do, is in that top left-hand corner (see Fig. 1). This is the supposedly objective and the instrumental side of things. I think you will find that there are a number of people who will suggest that people like me are not particularly good at being objective. The argument is that the EIA process is not good because supposedly there are non-objective things involved. So I think part of the point is that the whole thing is being driven that way. The demand is for objectivity, that scientists be objective, but it is not the role of the biologist to make cultural and biocentric evaluations. It is to be both instrumental and objective. Whether we all achieve that or not is another question.

ALAN STEWART: I take a little bit of issue with you there, Dominic. I would agree that up until recently that it was the case that we were over there in the top left-hand corner [see Fig. 1]. I think science since the Mabo decision is also moving across to the right, into the sector which involves intrinsic value. It is necessary for scientists to have some input into the idea of preserving a forest — or perhaps conserving is a better word — even though we cannot put a monetary value on it. I think of that in the terms used by a previous Minister for the Environment, that is: "whatever it takes".

Given that you have an area that has World Heritage, for example, you make that decision first. Okay, it has to be kept. It is an intrinsic reason. Then you have to figure out how much it is going to cost to maintain it, and other consequential costs if you cannot mine it there so it has to be mined elsewhere. I accept that these things have costs, but it is a matter of what side of the coin you are looking at. I am suggesting that lots of things are now emanating from the cultural and intrinsic side of the vertical axis. They impinge on the left-hand side, on the instrumental side, but they do not always originate there. I argue this since Coronation Hill decision which was not instrumental and not scientific, but it had consequences that were instrumental and scientific.

DOMINIC FANNING: In response, I am glad you agree with me that the role of consultants is not actually to be totally objective and totally scientific, it is in fact to interpret; that is what I believe.

The other point I would make is with contingency analysis. There have been a number of cases where this question of how much would people be prepared to pay to save something has come up. I have yet to see a single instance in which it has actually been operated on. I am involved in a number of projects in Coffs Harbour and I am saying we can put koalas in development — we can have development and we can have koalas together — "But you, the community, have to pay. It's going to cost you an increase in your rates of 25 per cent or 50 per cent for you to have koalas in this environment." I have yet to see that implemented and when I see it implemented then I will believe that contingency analyses — this approach of what people are prepared to pay for environmental costs — is actually anything other than pure mythology.

ALAN STEWART: Yes — I think to make it accurate you would have to get them to write out a cheque on the spot because otherwise people say, "Sure, I'd like to do all sorts of things," but if they do not have to pay for it there and then, well, so what?

TERRY DAWSON: Thank you.