

Sombre prospect

In his presidential address to the American Association for the Advancement of Science in February, of which an abridgement has been published in *Science* for 9 August, Peter H. Raven, director of the Missouri Botanical Garden, St Louis, paints a sombre picture of the future of humanity on this planet. He starts by acknowledging that enormous challenges face a world that has grown rapidly in population, in individual consumption levels, and in changing technologies. Our collective neglect of these relationships has helped to bring about the "dangerous and unstable state of the world in which we find ourselves". Serious neglect of the problems we face has gone on too long, and we have to find "new ways to provide for a human society that presently has outstripped the limits of global sustainability".

Over 400 generations, totalling 10,000 years, the world's population of humans has grown from several million to about 6.1 billion, but we continue to depend on ancient, genetically and socially determined habits and attitudes that may have suited our hunter-gatherer ancestors but no longer suffice to ensure our future. We have manufactured pesticides of increasing toxicity to saturate our agricultural lands at the rate of three million metric tons per year, and fix atmospheric nitrogen in excess of that seen in natural processes.

In the past 50 years alone we have lost a fifth of the world's topsoil, a fifth of its agricultural land, and a third of its forests. We have changed the composition of the atmosphere until global temperature keeps rising and stratospheric ozone is depleted. We have decimated world habitats by intentionally or accidentally introducing new plants and animals. Worst of all, we have induced an irreversible loss of biodiversity. In view of the way in which plants and animals enrich our lives, we continue to destroy them to an incredible degree.

Then our resources are unfairly distributed, with one quarter of humanity surviving on less than one dollar per day and up to half of them being malnourished. Meanwhile the United States, with 4.5 per cent of the world's population, controls 25 per cent of its wealth and produces 30 per cent of its pollution.

We must pay attention to what specific contributions science and technology can make to the development of a sustainable society. Energy is a vital consideration. A combination of wind turbines, solar cells, hydrogen generators and fuel cell engines promises both energy independence and an alternative to the fossil fuels that drive global warming, with its sad consequences. Increased attention is essential to develop educational systems everywhere that will bring the understanding of scientific activity. This is necessary for truly representative democracies and co-operation with science-poorer nations.

Dr Raven believes that within a few years most of the world's population will have

moved into cities, for which better models are urgently required. Nevertheless, increasing attention will be required to the rights and needs of rural dwellers throughout the world. Globalisation may have become irresistible, but we must make it humane. Diversity must become the cornerstone of society. A better understanding of such regions as India and Africa is called for among the western cultures.

And Raven recalls the wise words of Mahatma Gandhi: "The world provides enough to satisfy every man's need, but not every man's greed."

Setting the clock

Five years ago a remarkable report emerged from Cornell University Medical College in New York suggesting that exposure of humans to bright light could affect their circadian rhythm, even if the light was directed on the backs of the knees. The underlying belief in the experiment was that that area has a complex of superficial blood vessels, and it was thought that a timing impulse might be transmitted via the blood as well as the retina. The conclusion was vigorously opposed by other scientists who argued that in all mammals it has been shown that light reaching the "circadian clock" must be transmitted through the eyes, and that no individual devoid of eyes can respond to light by altering their daily physiological rhythms.

In *Science* for 26 July two physiologists from Harvard Medical School have published a paper, which adds support to the sceptics' view. In phase-setting trials over 10 days in 22 inpatients, circadian melatonin was assessed before and after exposure to one of three interventions lasting three hours, due corrections being made for gender. The various experiments involved zero lux exposure to the eyes and behind the knee, zero lux exposure to the eyes and up to 13,000 lux behind the knee, and about 9,500 lux to the eyes with zero lux to the knee.

Subjects were maintained on a sleep schedule and aroused for one episode of light-behind-the-knee exposure for the duration of time and intensity previously reported to produce a circadian delay. During knee illumination subjects were shielded from light to the eyes. Assignments were double blind and random, with light exposure during one circadian phase and one test only. Between measurements the subjects were maintained in very dim light. Melatonin measurements were used to assess circadian phase. Sleep was not extended.

Results for subjects illuminated behind the knees showed no acute melatonin suppression or phase change compared with controls, whereas ocular exposure altered both measurements. Thus there was no

evidence that photic signals are carried from the back of the knee via the circulatory system to the brain.

Clever crows

Those humans who fondly imagine that they belong to a race apart from other inhabitants of this earth and are unique in their brain-power should think again after learning of observations recently carried out on the reasoning faculties of the New Caledonian crow, *Corvus moneduloides*. A note by three Oxford zoologists published in *Science* for 9 August (and taken up widely by the national press) describes how a captive female crow spontaneously bent a length of straight wire into a hook, which it used to lift a bucket containing food from a vertical pipe. In a series of experiments a male and a female crow were given the choice of a straight and a hooked wire, but the male had removed the hooked wire and left the straight length for the attention of the female.

In new trials the birds were presented with a straight wire 0.8mm in diameter and 90mm long placed on top of the food-containing tube. No intervention was made until either bird obtained the food or dropped the wire beyond retrieval into the tube. The only previous experience the crows had undergone had been with flexible pipe cleaners, a year before the current experiment. Ten trials were valid and seven invalid. The female bent the wire and retrieved the food nine times, the male retrieving it once with the straight wire. In order to shape the wire the female either wedged an end in sticky tape at the side of the apparatus or held it with her feet, pulling the other end with her beak. The food was retrieved within two minutes.

In the wild, these crows make at least two types of hook tools, but the captive experiment illustrates a different method, unlikely to be effective with natural materials and not imitated from previous experience.

