

equations then provide an estimated 10 per cent increase in relative humidity over the ocean and a doubling of the wind speed. doubling of the wind speed.

An explanation for the poor or non-existent correlation between precipitation $^{18}\text{O}/^{16}\text{O}$ ratios and seasonal temperature for low-latitude islands comes from Yapp's recent investigation of the influence of the vertical air velocity component and its water vapour mole fraction on the isotopic composition of precipitation⁴. An isotope-precipitation intensity relationship is presented where both the precipitation intensity and the isotopic composition of the rain depend on the temperatures at which condensation begins and ends. The derived equations are applicable if the cooling of the air masses is due entirely to vertical motion, and if vertical velocity, vertical temperature gradient and mole fraction of water vapour are constant over the vertical condensation interval. Isotope ratios of precipitation from two tropical Pacific islands (Johnston and Wake Islands) where the variability in other parameters affecting the isotopic composition is small seem to confirm the predictions. Although factors such as temperature, latitude and altitude generally dominate in determining the isotopic composition of precipitation, Yapp's results identify the influence of other variables, for example the vertical-velocity component of the air and its water vapour mole fraction. These two variables may influence the interpretation of the Pleistocene isotope record, especially since increased humidity and wind speeds were calculated for full glacial conditions by Jouzel *et al.*¹.

This new climatic information on relative humidity and wind speed is important for the understanding of global climatic change, and for tertiary models which link periodicities of $\sim 100,000$, 40,000 and 20,000 yr in temperature measured from deep-sea records⁵ with the eccentricity of the Earth's orbit around the Sun, the tilt of the Earth's axis relative to its orbital plane and the precession of this axis. A quantitative calculation of the effect on climate is needed to prove that the resulting changes in the solar energy input and in the latitudinal distribution of this energy can cause the glacial-interglacial cycles. □

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Animal husbandry

Red velvet and venison

from T. H. Clutton-Brock

LIKE many other exotic species, deer were introduced to New Zealand, which had no indigenous land mammals except for two species of bat, at the end of the nineteenth century¹⁻⁵. Red deer (*Cervus elaphus*) formed the bulk of introductions but fallow, sambar, moose, wapiti, sika, rusa and white-tailed deer were also released. They spread fast and red deer quickly colonized most parts of North and South Islands. By the early 1950s it was clear that they constituted a serious threat to many native plants and animals^{1,6,7}. The understorey of the native beechwood forests was stripped and trampled; the high tussocky grasslands of the Southern Alps were heavily grazed, damaging the habitats of many cursorial birds; and erosion gulleys began to score the steeper slopes.

The situation was saved by a change in control techniques. The widespread use of helicopters allowed hunters to operate in even the most difficult country and to kill far larger numbers of deer than had previously been possible. By the early seventies as many as 100,000 deer were being killed a year and today wild deer numbers have been reduced by over 75 per cent. Meanwhile, New Zealand has developed a major export trade in venison. Recently deer biologists, farmers and exporters from 16 countries met in Dunedin to discuss deer production*.

On established deer farms, 70–80 per cent of breeding hinds wean a calf every year and the value of (live) female yearlings exceeds £400 a head. Thus profits are considerable despite the high costs of the 8-foot fences necessary to enclose the deer.

As meat producers, deer have several advantages over sheep: their meat has a lower fat content, carcass weight represents a higher proportion of live weight (57 per cent versus 45–50 per cent for sheep or 51 per cent for cattle) and haunch, which provides the best cuts, represents a higher proportion of carcass weight (52 per cent versus 40 per cent in sheep)^{8,9}. On some types of pasture, deer are as efficient converters of grass to meat as sheep and have the further advantage of being less susceptible to many forms of parasite infestation. Finally, venison is regarded as a luxury meat by both the main importers (Germany, which imports 20,000 tonnes of game meat a year, and the USA), commanding a higher price than lamb or beef. Farmed venison can meet the most stringent US hygiene requirements and is hard to distinguish from wild venison or even from beef^{10,11}.

But, undoubtedly, the most bizarre aspect of the development of deer farming in New Zealand is the export of what are euphemistically called 'deer products', mainly to Hong Kong and Korea^{8,12-14}. Though deer products include a wide variety of organs, including tails, pizzles, dried blood, heart, fetus and placenta, by far the most important are velvet antlers — cut each year from the living animal before significant ossification has occurred, at around 65 per cent of their ultimate size. Mature red deer stags can produce up to 2.5 kg of velvet antler a year on average, so at £50 per kg, velvet production represents an important component of deer farm profits. Velvet antler is used as an ingredient in Chinese folk medicines.

Most Chinese herbals (pents'ao) take an enthusiastic view of the benefits of eating deer products. One early (200 AD) herbal contends: "Deer velvet tastes sweet, and its property is warm. It is used for treating metrorrhagia, persistent vaginal bloody discharges, lochia, febrile disease, and epilepsy, and also for reinforcing vital energy, strengthening memory and will, generating teeth and delaying the onset of senescence". Two centuries later, the *Pharmacopoeia of the People's Republic* (1977 edition) is only slightly less optimistic and recommends the use of antler or antler products in treatment of lumbago, gonalgia, mastitis, echymosis, carbuncles, tuberculosis, impotence, spermatorrhea, metrorrhagia, frequent urination, wet dreams, vertigo and deficiency of blood. Even the New Zealand scientists are impressed¹², though few have experimented themselves. At the beginning of the Dunedin meeting, all delegates were presented with a 'survival pack' including samples of velvet antler. I'm still waiting for the effects. □

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*A conference on 'The Biology of Deer Production' was held in Dunedin, New Zealand, on 13–18 February under the auspices of the Royal Society of New Zealand and the New Zealand Society of Animal Production.