bination of characters as *Pongo*. The uniqueness of this combination leads us to interpret this morphological pattern as a synapomorphy shared by the two taxa.

By contrast, the combination of characters observable on the zygomatic of *Hylobates lar carpenteri*, despite the somewhat elevated number of zygomaxillary facial foramina, differs from that of *Pongo* in the following features: foramina situated at or below the inferior orbital rim, far from the frontozygomatic suture; very slender zygomatic; and convex surface of the zygomatic. The morphology of zygomatics of African apes is comparable to that of *Hylobates*, but they generally have fewer zygomaxillary facial foramina.

We have now added two new characters observable on both, CLL-18000 and *Pongo* crania: low position of the frontozygomatic suture; and low position of the glenoid fossa relative to the external auditory meatus. Both these characters strengthen the hypothesis that *Dryopithecus* is linked to the *Pongo* clade[1] and reinforce the idea that the zygomatics of *Pongo* and *Dryopithecus* are not fortuitously similar. Further confirmation is provided by the consistent presence of a similar combination of characters in another facial specimen of *Dryopithecus*[3,4].

S. Moyà-Solà
M. Köhler
Institut de Paleontologia, M. Crusafont, 08201 Sabadell, Barcelona, Spain

1. Solà, S. Moyà. & Köhler, M. K. *Nature* **365**, 543–545 (1993).
2. Eckhardt, R B. *Nature* **328**, 333–335 (1987).
3. Solà, S. Moyà. & Köhler, M. K. *J. hum. Evol.* (in the press).
4. Kordos, L. *L'Antrophologie* **95**, 343–362 (1991).

Health risks of energy saving

SIR — The use of reduced ventilation for domestic energy conservation (draught proofing or double glazing) increases the household's radiation dose from radon gas. The health impact of this in an average home in the United Kingdom is at least 10–100 times greater than the health impact of electricity production and supply.

Scientific discussions on energy policy have focused on comparing different means of energy supply. Conservation seems to be universally viewed as having no risks attached; indeed, conservation is advocated indiscriminately by many pressure groups. Two domestic energy conservation measures, draught proofing and double glazing, deserve special consideration because they work by reducing ventilation. This reduction produces an increase in the radon level in the building's atmosphere, resulting in an increased radiation dose to the occupants.

The energy savings produced by draught proofing or double glazing[1] and the increase in radon level produced by these same measures[2] have been discussed previously. The health 'cost' of the increase in radiation dose is simply:

$$\text{Cost} = D \times P \times O \times C \times V/E \sim 7 \text{ pence per kWh}$$

Where D = average person's dose due to radon in the home (1.1 millisievert per year); P = fractional increase in radon level due to reduced ventilation (0.3; from ref. 2) ; O = number of individuals per average household (2.4); C = probability of dying from a radiation-related cancer (0.05 per sievert; ref. 3); V = value of a statistical life (£2 million; ref. 4); and E = energy conserved by draught proofing or double glazing (1,200 kWh per year; ref. 1).

HEALTH COSTS OF PRIMARY ENERGY SOURCES

External health cost adder (pence per kWh)	Source of primary energy
0.01– 0.1	Supply of electricity by nuclear, solar, wind, hydro or gas
0.01– 0.1	Supply of electricity by coal or oil
1–10	Energy conservation by draught proofing or double glazing

Evaluating the health impact as a cost allows it to be compared directly with the health impact of means of energy supply. Such a cost is usually described as an external adder as it is not included in the prevailing market cost and should be added to it to reflect the 'true' overall cost. In high radon areas, the health risk posed by this gas in individual properties could be up to about 100 times greater than the average.

The health impacts of electricity production have been evaluated in, for example, refs 4 and 5, and the results are summarized in the table. It can be seen that the use of reduced ventilation for domestic energy conservation has a health cost 10–100 times greater than the health cost of supplying primary energy to the domestic consumer.

Those faced with making choices between energy policy options, or involved in giving advice to the public, need to be aware that at least one generic form of energy conservation carries a very significantly larger human health risk than means of supplying energy. The public needs to keep the risks posed by, say, the radioactive discharges from nuclear power stations in perspective — draught proofing and double glazing present a much greater threat to human health.

Edward W. Thornton
Nuclear Electric, Berkeley Technology Centre, Berkeley, GL13 9PB, UK

1. UK Department of Energy Efficiency Office, *Read How Helping the Earth Begins at Home*, **93** EP 702 (October 1993).
2. Wrixon, A D *et al. Natural Radiation Exposure in UK Dwellings* NRPB-R190 (1988).
3. *Recommendations of the International Commission on Radiological Protection* ICRP Publi. 60, (1991).
4. Pearce, D., Bann, C. & Georgiou, S. *The Social Cost of Fuel Cycles* CSERGE Report to the UK Department of Trade and Industry (1992).
5. Ball, D. J., Roberts, L. E. J. & Simpson, A. C. D. *An Analysis of Electricity Generation Health Risks — A United Kingdom Perspective* CERM Research Report No. 20 (1994).

Acid water and fish death

SIR — Acidification of rivers and lakes has caused decline in fish stocks in many areas affected by man-made emissions of sulphur dioxide and nitrogen oxides[1]. Deaths of fish typically occur in acid 'episodes', when there is high runoff from the surface of acid soils. In addition to the direct atmospheric input, ion-exchange processes and accumulated sulphate and nitrate in the soils partly cause the acidity and toxicity of the runoff water.

Here we report on a major episode of fish deaths in southern Norway. On this occasion, the acid surge was caused by very high deposition of sea salts, resulting in the release of hydrogen and aluminium ions from the soil by ion exchange. To our knowledge, this is the first reported incidence of large-scale episodic acidification and fish deaths due to the sea-salt effect. Such sea-salt episodes cause short-term acidification of watercourses in coastal regions both in Norway[2] and the eastern United States[3]. The effect has also been demonstrated by artificial dosage of dilute sea water to a small catchment[4].

The sea-salt effect[5] is a direct ion-exchange process, in which Na^+ ions in the percolating water exchange with H^+, Al^{3+} and base cations. Cl^- acts as a mobile anion and passes through the soil in relatively unaltered concentration. The acidification of the runoff will be noticeable only if either there are large amounts of precipitation with much higher concentrations of sea salts than usual, or there is large dry deposition of sea salt followed by rain. Because the release of H^+ and other cations from the soil is related to Na^+ retention, the concentration of Na relative to Cl provides a measure of the acidification potential caused by the sea-salt effect.

From 4 to 24 January 1993, an extremely low pressure over the North Atlantic gave strong southwesterly winds and large amounts of precipitation in southwestern Norway. Wind speeds at the coast were typically between 10 and 25 m s^{-1}, and daily precipitation a few kilometres inland were 10–70 mm, resulting in monthly precipitation of 200–700 mm. (annual precipitation is 1,500–3,500 mm).