Safety of Cameroonian lakes

SIR—In dealing with lethal releases of CO_2 from lakes, the people of Cameroon require firm scientific evidence on which to base decisions for evacuation and disaster control. We are concerned, therefore, by the misleading and speculative letter by Pourchet *et al.*[1] stating "it is likely that many of the crater lakes (in Cameroon) have emitted gas bursts, or will do so". Our recently completed studies suggest that gas bursts from other lakes in Cameroon are, in fact, unlikely.

The accumulation and massive release of CO_2 gas from crater lakes is unique, and has been documented only for lakes Nyos and Monoun in Cameroon[2,3]. The circumstances required for this phenomenon to occur are very rare. There must be an adequate gas supply, such as the CO_2-charged soda springs occurring in Cameroon, and this supply must be trapped by surface deposits or by a deep, strongly stratified lake. There is also good evidence that a build-up of CO_2 and solutes in bottom waters occurs long before any gas burst[2,4]. Our recent limnological survey indicates no such premonitory build-up in any Cameroonian crater lake apart from Nyos and Monoun[4,5].

The argument of Pourchet *et al.* seems to rest on two points. The first is that porewaters and bottom waters of Lake Bambuluwe are "close to gas saturation at the sampling depth (58 m)". But observing gas bubbles in a core brought to the surface, as they did, indicates little more than oversaturation at pressures (below 5.8 atmospheres) greatly reduced from those found in the bottom sediments. Such gas pressures are common in freshwater sediments; indeed nearly all of the sediment cores we have raised from 11 different crater lakes in Cameroon degassed at lake surface pressures.

The second part of their argument links the homogeneous distributions and higher than expected concentrations of ^{210}Pb in sediment cores from lakes Nyos and Bambuluwe. Our sediment cores from lakes Nyos and Monoun were mixed rapidly because of violent degassing at the surface. Pourchet *et al.* do not detail their methods, but only *in situ* sampling or freeze-coring would maintain stratigraphic integrity of the sediment in a gas-charged lake. In Lake Bambuluwe, the uniformly high ^{210}Pb concentrations they report for the upper 15 cm have other explanations. For example, a 1m core taken by us in 1985 revealed an upper 15–20-cm layer of clastic material overlying darker micaceous mud. This surface layer may correspond to the recently built access road around the lake. Such watershed disturbances are known to increase the flux of radiogenic lead to lakes[6]. We believe that the reported similarities between sediment ^{210}Pb in Lake Nyos and Lake Bambuluwe may be spurious, and thus inappropriate for use as predictors of future gas bursts.

GEORGE W. KLING
Marine Biological Laboratory,
Woods Hole,
Massachusetts 02543, USA
MICHELE L. TUTTLE
US Geological Survey,
Denver, Colorado 80225, USA
WILLIAM C. EVANS
US Geological Survey,
Menlo Park, California 94025, USA

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Dominance of South American marsupials

SIR—The discovery of mammal remains from the early Cretaceous of Cameroon by Jacobs *et al.*[1] is of unquestioned importance in interpreting mammalian evolution and biogeography, particularly regarding the key transitions to metatherian and therian 'grades'. The statement by Jacobs *et al.* that metatherian marsupials represent "the dominant living mammals of South America and Australia", is surely coloured by a geological perspective, however.

Although the ecological and evolutionary dominance of Australian marsupials during the Tertiary and Quaternary seems well founded, this is not true of today's American marsupials, despite their remarkable diversity and radiations in the Tertiary[2,3]. Modern New World marsupials comprise only three families, 15 to 19 genera, and 85 species, most endemic to tropical South America[4]. At one comparatively well-studied site in south-eastern Peru (Cocha Cashu in Manu National Park), nine species of marsupials comprise 9 per cent of the known mammal fauna — there, four mammalian orders (Rodentia, Chiroptera, Carnivora and Primates) exceed the familial, generic and specific diversities of marsupials, and Manu records of bats and rodents are incomplete[5]. Elsewhere, 34 genera and 49 species of bats have been recorded at a single locality in Rondônia, western Brazil (specimens in the Museu de Zoologia, Univ. São Pauolo), and that country supports at least 7 families, 53 genera and 183 nominal species of rodents[6].

Although 12 mammalian orders occur in South America, 43 per cent of its mammal species are rodents, including at least 250 species of Sigmodontinae (Muridae)[7]. In terms of diversity and abundance, rodents and bats greatly outstrip marsupials as the most dominant orders of modern South American mammals. Indeed, the contrast in diversity and dominance of marsupial lineages before and after the "Great American Interchange" has been an important focus for studies of faunal dynamics and turnover.

B. D. PATTERSON
Division of Mammals,
Field Museum of Natural History,
Chicago, Illinois 60605, USA

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Black holes dispute

SIR—Gunzig, Géhéniau and Prigogine[1] attempted a numerical evaluation of the inflationary model of black hole production postulated[2] some time ago. Unfortunately, their paper contains several errors. We emphasize that the principal hypothesis[2] is not destroyed as several modifications to the model of Gunzig *et al.* are not only possible, but likely.

First, the matching conditions of equations (14) and (15) of Gunzig *et al.* are stated to imply $\alpha \simeq \sqrt{\beta}$. In fact these conditions are not sufficient and the value of α is very sensitive to the input. Thus, for example, as β / C^2 varies from $(1 - \varepsilon)$ to $(1 + \varepsilon)$, where $\varepsilon \equiv 1 - \Delta_1 \simeq 10^{-27}$, α varies from 0 to $\sqrt{\beta}$. Input must be fine-tuned to 27 decimal places to obtain the result of Gunzig *et al.*. It is equivalent to tuning a discontinuity in temperature between de Sitter and Robertson–Walker stages to the same precision.

Second, Gunzig *et al.* compute t_c using three helicity states. The present count, a lower bound, is 119. Using the model of Casher and Englert[2] to determine the de Sitter temperature (as we consider the determination of Gunzig *et al.* unreliable) the matching radius is reduced by a factor of 10^{-23}. But the hypothesis is not destroyed because the true turnover time is expected to be much greater than t_c.

Third, Gunzig *et al.* determine the mass density of the massy component of matter from the matching condition. To obtain the number density and thence the entropy per proton they divide this by the proton mass. But the matching temperature is $\sim 10^{17}\, m_{\text{proton}}$. So the protons (which are certainly in equilibrium) will be in the β/R^4 term of the energy source and not