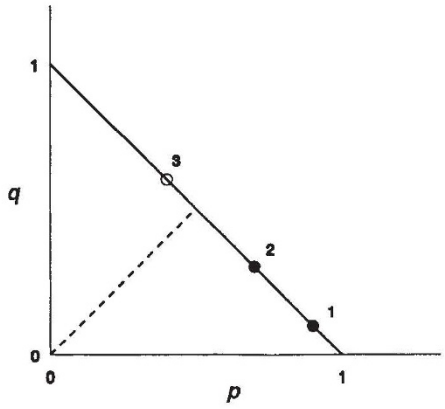

Probabilistic basis of double jeopardy. The preferences (p_i, q_i) of three buyers (i = 1, 2, 3) of two competing brands are defined by the linear constraint $p_i + q_i = 1$ (solid line) and satisfy $\Sigma_i\, p_i/3 = 2/3$ and $\Sigma_i\, q_i/3 = 1/3$. Buyers of major and minor brand (filled and open circles, respectively) are separated by the decision (dashed) line; buying decisions can be absolute (exclusive purchase) or relative (mixed) and are dependent on the values of p_i and q_i. It can be easily shown that $p_1 + p_2 = 1 + q_3$. Because $p_i \leq 1$ for all i, it follows that $q_3 \leq \min(p_1, p_2)$ and the equality holds only if $\max(p_1, p_2) = 1$. In practice, the above probabilistic description of DJ is valid only if market size is large.

brands are N_p and N_q. What can we say about consumer preferences based upon these observations? The answer is given by the conditional probability density in the form of a beta distribution[2] (a two-dimensional version of Dirichlet distribution) $\varphi(p \mid N_p) \equiv C.p^{Np-1}q^{Nq-1}$, where C is a function of N_p and N_q. The bayesian mean estimates for consumer preferences are $p^* = N_p/N$ and $q^* = N_q/N$ so that $p^* > q^*$ if $N_p > N_q$. Thus greater market penetration implies greater consumer loyalty — quantity signifies quality.

As an example, suppose there are only three buyers whose average preferences for two brands are 2/3 and 1/3. From the binomial distribution the market composition is likely to be 2:1. The figure shows that except in extreme cases, the primary patron of the minor brand must necessarily be the least loyal. Thus DJ is dictated by consumer preferences and is completely predictable by the laws of probability.

There is no question that the social sciences can be as quantitative as any branches of science. The discovery of empirical laws is crucial, but mathematical modelling is indispensable if the benefits of the vast body of extant quantitative knowledge are to be realized.

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Late Cretaceous mammals

SIR — Despite Madagascar's renowned subfossil fauna, and with the sole exceptions of a Miocene dugong[1] and an isolated, poorly dated Plio-Pleistocene faunule[2], this island-continent has until now yielded no confirmed pre-Holocene mammal fossils. We report here the discovery of a Late Cretaceous mammal from the Mahajanga (Majunga) Basin of northwestern Madagascar.

Late Cretaceous mammals from the Southern Hemisphere are known only from the Indian subcontinent[3], which at that time lay adjacent to Madagascar and South America[4]; none has previously been recovered from Africa, Australia or Antarctica. The 30 or more million years of the Late Cretaceous is the interval during which the nontherian Multituberculata flourished and the diversification of marsupials and placentals began. However, despite the good record of Late Cretaceous mammals on northern continents[5], the origins of many of the modern orders of placentals remain obscure; at least some probably originated on southern, Gondwanan-derived landmasses[6].

In addition to numerous new records of lower vertebrates and invertebrates, we discovered a single specimen of a mammalian lower(?) cheek-tooth during a 1993 expedition to the Mahajanga Basin. The fossiliferous beds are believed to be of Campanian age[7] and previously yielded only a moderately diverse assemblage of lower vertebrates, including dinosaurs[8]. We found the mammal specimen just east of Berivotra village, in a white unit at the top of the Maevarano Sandstone, below the succeeding Maastrichtian transgression. The specimen is incomplete and exhibits heavy premortem wear, but it is clearly that of a mammal as indicated by the presence of two roots, enamel that does not grade smoothly onto the root but terminates abruptly at the base of the crown, inflation of the crown beyond the dimensions of the roots, and the presence of a cingulum toward the mesial(?) end (see figure). The incomplete and worn nature of the tooth, as well as the paucity of knowledge of contemporaneous mammals from southern continents, precludes a precise identification. The most salient feature of the tooth is its size; it measures 7.55 mm in its longest dimension and is thus from one of the largest known Cretaceous mammals.

We think this specimen is a harbinger of things to come. Future discoveries of Late Cretaceous mammals in Madagascar will undoubtedly provide significant insights into the evolutionary history of mammals on southern continents and, specifically, of the highly endemic, imbalanced Malagasy fauna itself. The biographical origins of the biota of Madagascar, which started separating from the east coast of Africa in the middle Jurassic and reached its current position relative to the continent by the Early Cretaceous[9], is one of the greatest unsolved mysteries of natural history.

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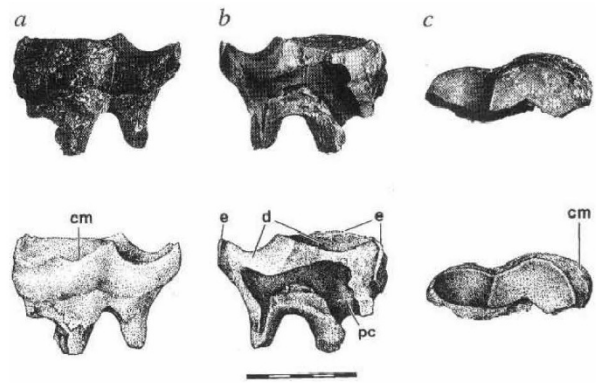

Fragmentary mammalian left (?) lower (?) cheektooth from the Upper Cretaceous Maevarano Sandstone, Mahajanga Basin, northwestern Madagascar in *a*, buccal view; *b*, lingual view of naturally fractured longitudinal section; and *c*, occlusal view. If a left lower tooth, mesial (anterior) is to the left in *a* and to the right in *b* and *c*. Abbreviations: cm, cingulum; d, dentine; e, enamel; pc, pulp cavity. Scale bar, 5 mm.

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