very real problems as to how to decide upon what, in a particular instance, constitutes a species.

A particular advance described by Kelley and Xu[1] is determination of the sex of individual, isolated canine teeth using indices of crown height and tooth length. They show that all of the larger canine teeth in the Lufeng sample are from males and that all of the small ones are from females. If this analysis holds up it demolishes Wu and Oxnard's[2,10,11] interpretation of two species distinguished by size, as that model would predict the presence of both sexes in each of the size groups.

In dealing with morphologically homogeneous, but metrically variable samples, two positions have traditionally been adopted — that the sample represents a single, highly dimorphic species; or that it represents two species, each of which displays a relatively low level of dimorphism. But there is a third possibility, which is that the sample represents two dimorphic species whose size ranges overlap. Cope[6] has shown that such could easily be the case with guenons — teeth of two or three species of sympatric *Cercopithecus* that are morphologically homogeneous and overlap in size can be mixed to provide a sample in which two clearly defined size clusters of canine teeth occur, one male and one female, each of which contains a single sex sample of more than one species. So the Lufeng pattern of variation can be mimicked in a multiple-species sample of *Cercopithecus*.

The question that palaeoprimatologists must confront is whether the guenon example is relevant to fossil apes. Kelley[16] feels that it is not, and that only hominoids provide a suitable model for the patterns of geographical distribution and variation. Hominoids however exhibit low species diversity compared to other groups of primates and have few sympatric taxa that can be used to model what might happen in a fossil assemblage. Kelley believes that hominoids of similar morphology and similar size do not occur sympatrically because aspects of ape biology would prohibit it. But we know that this kind of sympatry occurs in guenons, and also in lemurs[20]. Thus, the argument that present hominoid distribution and variation reflects ecological limits requires further analysis before it is accepted as the basis on which we interpret the past. This is particularly the case as most workers recognize the hominoid primates as relict populations. Hominoid primates were once much more speciose and widely distributed than is the case today, and it is well known that species diversity in relict faunas is impoverished. Perhaps modern hominoids are too impoverished to provide a suitable yardstick against which one can compare fossil samples from a time when hominoids were more diverse and more widely distributed.

One might look to the fossil record to resolve this conundrum. But samples of Miocene apes that many workers interpret as containing more than one species, and thus in support of the view that modern apes are impoverished in species diversity (for example *Dryopithecus* fossils in the Miocene of Spain, fossil apes from the middle Miocene of Paşalar, Turkey[17], *Sivapithecus* from Indo-Pakistan, and *Proconsul*[21] from the early Miocene of Kenya) can also be interpreted as single species if Kelley's position is adopted. One's analytical models (and, ultimately, one's inferences) are thus determined by one's perception of hominoid ecology past and present.

If one adheres, as I do, to the principle that hypotheses in science must be falsifiable, then, based on the criteria developed by Cope[6], the Lufeng material is not a single species. Kelley, for one, believes however that falsifiability is not in most cases applicable in the strict sense to historical science such as palaeontology. Likewise, if one believes that morphologically and metrically similar apes are unlikely to occur sympatrically, then one will necessarily interpret all such accumulations in the fossil record as a single taxon. But the circularity of the reasoning prevents the result from corroborating the assumption.

There is no question that Kelley and Xu's work, particularly by adding gender to the equation, has advanced the analysis of palaeontological variation, at least for fossil apes. They could well be right that the Lufeng material represents a single species whose sexual dimorphism extends the limits seen in modern animals. The difficulty is that I can see no method by which we can ever find out whether they are correct or not. □

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