out in the paper[8], we do not know the relationship of rods and cones to the observed funduscopic pathology. (2) Thermal effects are minimised only for long term exposure to the shorter wavelengths in the visible spectrum where maximum temperatures in the retina do not exceed a few °C above ambient. The absorption spectrum of melanin would be expected to correspond to the action spectrum for thermal damage. Our action spectrum includes both thermal and photochemical damage and its relationship to the melanin absorption spectrum is suspect but should not be overlooked. (3) The hazard to the retina rather than the vitreous for aphakic eyes is emphasised because the vitreous does not absorb radiation appreciably between 300 and 1,400 nm (ref. 9). (4) The morphology of the lesion is not ignored but undetermined to date. Extensive efforts are under way, using both light and electron microscopy, to determine the nature of the lesion. The subtleties of these lesions bear no relationship to those reported by Marshall *et al.*[5]. Calculations show that the minimal irradiance on the retina in their experiments was greater by a factor of 10^3 than those we reported[8]. In other words, Marshall *et al.*, were dealing with a totally different phenomenon, thermal injury, whereas we were seeking to characterise a long term photic damage mechanism or mechanisms in the retina.

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Exudate-eating and tree-gouging in marmosets

KINZEY *et al.*[1] discuss an unusual sap-eating behaviour in the pygmy marmoset (*Cebuella pygmaea*) of upper Amazonian South America. We have observed similar exudate-eating behaviour patterns in southern Brazilian marmosets of the genus *Callithrix* and and would like to discuss briefly their significance.

Like *Cebuella*, *Callithrix* spp. are "short tusked"[2]: in other words, they have an unusual lower anterior dentition in which the canines are short and the incisors long and roughly equal in length to the canines. The other two callitrichid genera, *Leontopithecus* and *Saguinus*, are "long tusked", with normal, long lower canines and short lower incisors. In *Callithrix* and *Cebuella*, the "short tusked" lower anterior dentition is apparently used as a gouge or scraper to perforate the bark and the superficial layer of the cambium of certain trees. When attacked in this manner, the trees exude gums and sap which are important food sources for the marmosets.

Free-living *Callithrix jacchus* have been observed gouging several species of trees (*Anacardium occidentale*, Anacardiaceae; *Tapirira guianensis*, Anacardiaceae; *Terminalia catappa*, Combretaceae) in the Brazilian states of Alagoas and Rio de Janeiro. Favourite trees are sometimes riddled with holes on all surfaces. Captive *Callithrix* (including *C. flaviceps*, *C. geoffroyi*, *C. jacchus* and *C. penicillata*) gouge holes in fresh branches and also in the dry wooden fixtures of their cages (Fig. 1). In addition to feeding on exudates that flow from holes in the fresh branches, captive (and probably also wild) *Callithrix* use the holes in both dry and fresh wood as foci for marking behaviour. High-ranking males and females frequently urinate in them and genital-rub in their vicinity. The gouging process in *Callithrix* is usually accomplished by anchoring the upper incisors on the substratum and scraping with the lower anterior teeth (Fig 1). In both *Cebuella* and *Callithrix*, wear patterns on the occlusal surface of the upper incisors indicate that they are used to hone the tips of the lower incisors (personal communication from R. D. Martin). Depending on their hardness, exudates are either licked up or collected with teeth. In contrast to *Cebuella* and *Callithrix*, the "long-tusked" *Leontopithecus* and *Saguinus* have never been observed gouging holes in wood, although they occasionally chew on strips of bark and feed on already-exuded gums if they happen to come across them.

Fig. 1 Captive *Callithrix geoffroyi* gouging hole in dry branch in its cage. Note the positions of the upper and lower teeth.

An analysis of the gum of *Anacardium occidentale* gives an indication of the food value of exudates. The gum of this species is 84% carbohydrate and contains several minerals, including iron, aluminum, calcium, silicon, potassium and traces of magnesium and sodium[3]. These substances therefore provide small primates like *Callithrix* and *Cebuella* with a high energy food source not used to any great extent by larger primates and other potential competitors, and helps them to, at least in part, avoid competition for fruit, the major high energy food source for many tropical mammals and birds.

Sporadic exudate-eating from sites where insect infestation or mechanical damage has caused it to flow is a fairly common pattern in primates. The same can be said for occasional use of the teeth to pry, gouge, strip or break bark from trees. In addition, certain prosimians (for example, *Euoticus elegantulus*, *Microcebus murinus* and *Galago senegalensis*) use their specialised "tooth combs" or "tooth scrapers", formed by the lower anterior dentitions, as scoops to collect gums from areas where they have already exuded (personal communication from R. D. Martin). But, the regular use of tree gouging specifically to elicit exudate flow has so far been found only in *Callithrix*, *Cebuella* and the Madagascan fork-marked dwarf lemur *Phaner furcifer*[5] and seems to be rare not only among primates but among vertebrates in general.

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