ethanol, and both structural alterations were prevented by administration of antioxidant. Since mitochondria and endoplasmic reticulum are rich in unsaturated fatty acids and since they have lipid peroxidation catalysts, they are prime sites for peroxidation of lipids (*15*). Damage to enzymes and proteins by free radical intermediates of lipid peroxidation (*15*) can also be a significant deteriorative reaction in ethanol-induced liver injury.

The present studies indicate that enhanced peroxidation of liver lipids after administration of ethanol is a factor in the pathogenesis of liver injury. The observed protective action of antioxidants is probably due to inhibition of free-radical formation, with the resulting prevention of lipid peroxidation damage to membranous organelles, as well as possible prevention of reactions of peroxidized lipid with protein (*15*).

Our study denotes that antioxidant capacity or potential of the liver cell may be an important factor in determining the degree and nature of hepatic injury after exposure to certain chemicals, which conceivably stress antioxidant balance. Our results and the results of others (*4–7*) suggest an intimate relation between liver injury induced by ethanol and lipid peroxidation. This finding, in conjunction with the observations that antioxidants prevent ethanol-induced fatty infiltration, ethanol-lipid–induced hypertriglyceridemia, and carbon tetrachloride–induced fatty infiltration, necrosis, and lethality (*5–7*), indicate the potential importance of lipid peroxidation in pathogenesis of liver injury from certain chemicals. These findings contribute not only to a new concept of liver injury but also to the further consideration of antioxidants in the prevention (*4–6*) and treatment (*7*) of experimentally induced liver injury.

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Visual Acuity in a Stumptail Macaque

Abstract. *Visual acuity in a normal stumptail macaque is 1.4 minutes of arc—similar to man's. Destruction of the fovea by photocoagulation decreased acuity to 9 minutes of arc. These facts suggest that the fovea in the macaque has the same physiological role in visual acuity as in man.*

The inferred function of the fovea in primates other than man has been based primarily on analysis of anatomical similarities (*1*). In man the average visual acuity is approximately 1 minute of arc (20/20) under a wide range of photopic lighting conditions (*2*). When the fovea is not functional, acuity declines to 10 minutes of arc (20/200) (*3*). In the tree shrew (*4*), the basis for visual acuity does not appear to change noticeably throughout large portions of the retina. Our earlier work (*5*) on the pigeon eye showed similar results, in that massive lesions in the foveal region did not produce decrements in visual performance. In these animals at least, the different areas of the retina and the fovea do not seem to function in the same way as in man.

Various workers (*6*) assessed the roles of the various elements of the monkey's visual system. Although they agreed on a maximal visual acuity of approximately 1 minute of arc, they did not directly evaluate the function of the fovea. Jacobson *et al.* were unable to find changes in the electroretinogram after macular destruction in a series of monkey eyes (*7*). We have attempted to measure visual acuity in a monkey eye before and after foveal destruction.

A stumptail macaque, *Macaca speciosa,* was housed in a cage (0.9 by 1.2 by 2.1 m) that also served as the test chamber. The response panel contained a peephole through which the monkey could see the visual-acuity target, a white Landolt C on a black background; luminance of the target was determined with a Macbeth photometer.

The monkey was required to press a lever located below the peephole to turn on the light source that transilluminated the Landolt C. The light was programmed to come on after a variable number of lever presses, the average number being 15. The gap in the C faced either left or right, its direction being programmed in accordance with a modified random series (*8*). Once the target was illuminated, the monkey was required to choose a lever indicating the direction of the opening in the C; if he pressed the appropriate lever six times, a correct choice was recorded; if he responded on the inappropriate lever four times, an incorrect choice. A food pellet was delivered for every second correct choice. On every correct choice a buzzer sounded for 2 seconds. Both the size and distance of the Landolt C were varied to obtain as wide a range of visual angles as possible.

A ruby-laser photocoagulater was used to destroy the fovea (*9*). The collimated laser beam was focused on the fovea by the cornea and lens of the eye; neither cornea nor lens absorbed sufficient energy from the unfocused beam to injure them. In each eye a 1-mm lesion was placed in the center of the macula (see cover). Postmortem histological examination showed that the fovea in each eye had been destroyed, while the retina and other tissues appeared normal (*10*).

Data collected prior to any retinal

Table 1. Behavioral data before (intact) and after (destroyed) binocular destruction of monkey foveas. Criterion for acuity threshold was 70-percent correct.

Intact			Destroyed		
Visual angle (min)	Correct (%)	S.E.	Visual angle (min)	Correct (%)	S.E.
1.2	56	5.0	2.9	53	2.3
1.4	74	6.2	5.7	56	2.6
1.9	76	4.3	6.9	56	3.0
2.4	95	2.4	7.8	64	2.1
3.4	93	2.6	9.0	72	3.3
			13.8	90	1.9

lesions indicate that the monkey was able to discriminate 1.4 minutes of visual angle (approximately 20/30 vision) with a target brightness of 220 lux. Data collected after binocular destruction of the foveas indicate loss in acuity such that 9.0 minutes (20/180) was now the smallest visual angle correctly discriminated at the same brightness (Table 1).

When the eyelids of one eye were sewed closed, the monkey showed no signs of discomfort and began work as soon as the effects of the anesthetic disappeared. Performance on these monocular tests did not differ significantly from that when either eye could be used. Thus, in the macaque monkey, foveal lesions appear to produce decrements in visual acuity similar to those in man (*3*). The generality of these findings, of course, awaits further study with a larger number of subjects.

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Sea Cucumber Sibling Species: Polypeptide Chain Types and Oxygen Equilibrium of Hemoglobin

Abstract. *The hemoglobin of the "thin" sibling species of* Thyonella gemmata *(phylum: Echinodermata; class: Holothuria) has three electrophoretically distinct polypeptide chains. In "stout" sibling species of* T. gemmata *there are only two chain types. These results account for the greater number of multiple hemoglobins in "thins" than in "stouts," as well as for differences in the amounts of some of the multiple hemoglobins when comparisons are made of hemolyzates of erythrocytes from the water vascular system and from the main body cavity of the "thin" but not the "stout" sibling species.*

Survey of a population of common intertidal sea cucumbers (holothurians) for hemoglobin variants resulted in the observation that what had been previously considered a single species, *Thyonella gemmata* (Pourtalès), was in fact two distinct populations consistently separable on the basis of elec-

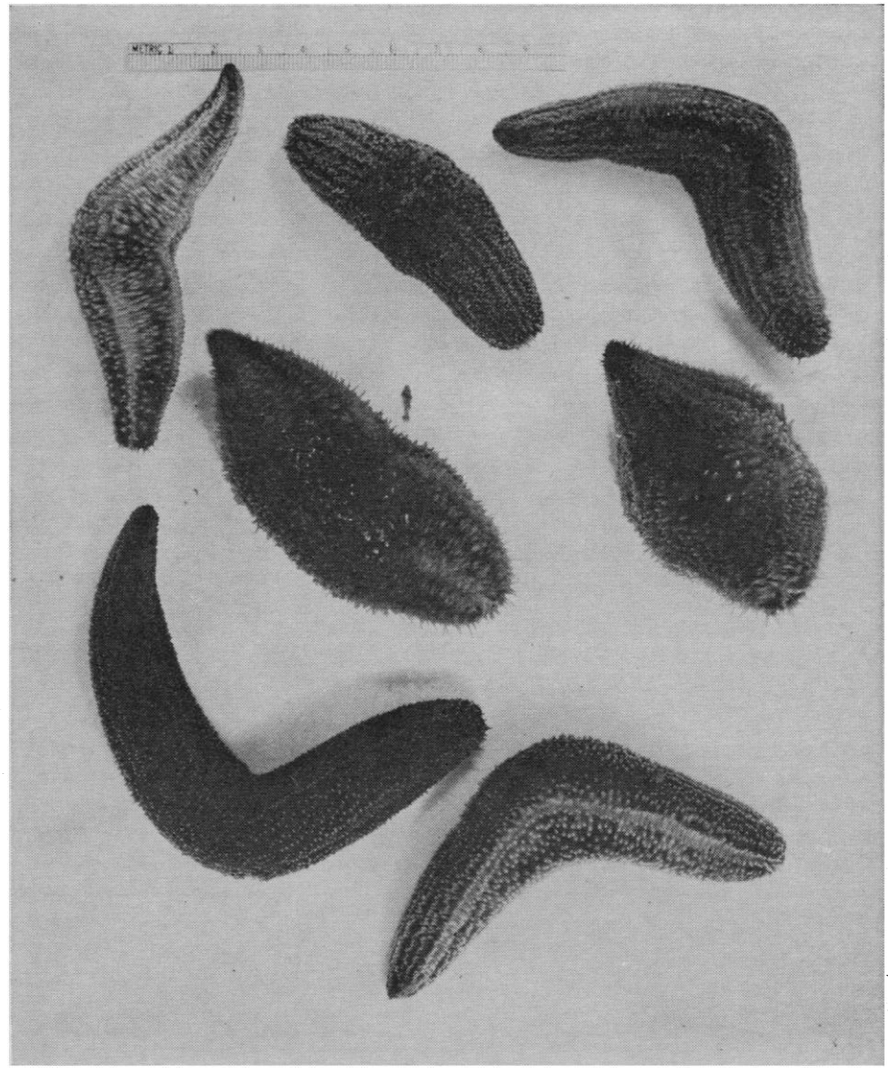

Fig. 1. The sibling species of *Thyonella gemmata*. Five "thins" are at the bottom and top of the picture; two "stouts" are in the middle. The animals have been removed from sea water for 20 minutes; during that time the "thins" retract their tube feet almost completely, whereas the "stouts" do not. This gives the two "stouts" a slightly bushier appearance. "Stouts" are on the whole somewhat fatter than "thins", but the plastic shape of sea cucumbers makes this character unreliable. Other convenient behavioral differences are given in (*1*). "Stouts" tend to have bushier oral tentacles than "thins" and this characteristic is useful when the tentacles are exposed—at night.