termittency may be caused by small changes in caliber of the arterioles or by sphincteric activity in an anastomosing portion of the vascular bed.

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Vascular Changes in the Wings of Bats

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In a series of articles published since 1939 it has been proposed that acquisition of progressively higher operating temperatures may have been one of the fundamental factors in the evolutionary processes of terrestrial animals (*2*, *4*, *5*). It has also been suggested that transgression of the threshold of either somatically or germinally tolerable temperatures, particularly the latter, constitutes one of the major hazards to survival (*3*, *4*, *5*, *7*) and even may be the key to extinction in some the the major groups of terrestrial animals (*2*; for contrasting views, see *1*). In these papers it has also been stated by the present writer that the existence of heat sensitivity in male germinal processes, in combination with the thermal progression seeming to characterize major groups of terrestrial animals, may have expedited the process of evolution on land.

Thinking along this line inevitably points to the importance of investigating all instances in which there is an appearance of testicular thermal tolerance equal to that of the somatic cells.

Among terrestrial animals, the exceptionally high normal body temperatures of the birds, especially when considered in conjunction with the internal location of their testes, would seem to indicate that they would fit this category since their spermatogenic activity must take place at abnormally high temperatures. However, until additional observations have been made, this will remain only a partially acceptable assumption. The universality of heat susceptibility in other groups and Riley's findings on interrupted spermatogenesis (*9*) suggest the possibility that temperature may influence spermatogenesis in the English sparrow, and this view is strengthened through the finding by Cowles and Nordstrom (*8*) of an avian analogue to the mammalian phenomenon of testicular descent and possible scrotal thermoregulation. In this avian phenomenon it was demonstrated that the testes of Brewer's blackbird migrate a short distance, so that, while they are spermatogenetically active, they lie between two folds of the abdominal air sac.

Following the same lines of thought that led to investigations on the air sac-testes relationship in birds, it became apparent that a somewhat similar situation might be encountered in some Nearctic bats.

Several species of temperate-zone bats are known to breed in late summer or early fall, and throughout the summer months many of them are daytime occupants of hot attics; yet, despite this exposure to theoretically unfavorable temperatures, they are among the minority of nonscrotal vertebrate animals which reach the peak of spermatogenic activity toward the end, rather than before, the season of maximum summer temperatures. This situation is in marked contrast to conditions found in other terrestrial organisms, since the great majority of birds, most nonscrotal mammals, reptiles, and amphibians give at least the appearance of requiring a prolonged period of cool or cold winter weather prior to resumption of spermatogenesis. This condition (winter rest?) strongly suggests that there is need of moderate thermal conditions for testicular rehabilitation from heat effects. It seems possible that our long, hot summers may explain the widespread regression of the testes characterizing so many temperate-zone animals, a condition that frequently sets in not long after the onset of hot summer weather. Certainly there is a strong resemblance between this situation and that produced in *Xantusia vigilis* by artificial heat sterilization (*7*), and a similar condition is illustrated by the 13-lined ground squirrel (*10*).

Because of the effectiveness of their thermoregulatory device, scrotal mammals seem not to be so rigorously limited to early spring or summer breeding. Although exceptions to this general rule of postwinter breeding are known, they are not numerous. However, because of the known effects of light on gonadal activities it will be necessary to test the respective missions of these two factors.

Although Nearctic bats are hemipoikilothermic organisms, they are characterized by testicular descent and testes migration into the tail membrane, the uropatagium, where cooler conditions should prevail. In spite of this presumable protection, it is possible that this effect might be canceled by two heating factors: (1) the nature of their daytime retreats, which might prevent the normal daytime fall in temperature; and (2) their heat-generating nocturnal activities, chiefly the pursuit of food, which is to a large extent captured while in flight. The importance of this latter factor is accentuated by the bat's notable capacity for heat generation, a requisite for these animals to enable them to preheat their bodies in preparation for flight. Taken together, these two conditions suggest that the bats may either furnish an example of an animal that has succeeded in achieving identical somatic and spermatogenic heat tolerance or that they have some unusually effective means for heat dissipation and thermal regulation.

For a preliminary excursion into the thermal relationships of these animals it was clear that the effectiveness of the flight membranes should be evaluated as heat-dissipating and thermoregulatory structures. These comparatively large areas are usually devoid of hair and are highly vascularized and thus suitable for heat exchange mechanisms. A preliminary rough survey of ratios between the surface areas of the furred body and the naked flight membranes shows that these proportions range from 4:1 to as much as 8:1 in Nearctic bats but 12:1 in the tropical fruit bats.

In the common and rather typical bat, *Myotis yumanensis sociabilis*,[1] a superficial observation on the degree of vascular change in the network of blood vessels in the flight membranes clearly revealed marked changes in the amount of blood passing through these tissues. These changes were readily correlated with body temperatures.

In experiments conducted up to the present time it has been found that engorgement of the vascular plexus in the membranes is induced by elevating the body temperature to be-

[1] For the identity of this bat and for information on the position of the testes in the uropatagium I am indebted to Mr. Kenneth Stager, of the Los Angeles Museum.

tween 40 and 41° C., but that between 10 and 38° C. there are no gross, readily perceptible alterations in the amount of blood flow. Throughout this range the wing and tail membranes retain the comparative pallor characteristic of low-temperature conditions. When the change does occur, it is so sudden and so notable that students readily perceive the difference even at a distance of several feet. Exact measurements of temperature differences between the arterial and venous flow are expected to reveal even more interesting information.

That bats might possess somatic and spermatogenic thermal homogeneity seemed as reasonable as to have supposed that the birds might do so; however, the morphological arrangements in both of these animals seem to point to a provision for heat protection, and it is now reasonable to proceed to the acquisition of more exact physiological data, with the expectation that lower testicular temperatures can be demonstrated during the period of spermatogenesis.

If neither of these animals can be shown to possess somatic and spermatogenic thermal equality, the condition should still be sought in other organisms. However, if it is demonstrated that this thermal difference is universal, as our present limited information suggests it may be, it seems probable that some profound and fundamental difference will be found in the basic physical or chemical attributes of these two classes of cells.

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Carbon and Hydrogen in Rubber Hydrocarbon

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Analyses, by combustion, of rubber hydrocarbon separated from rubber latex and crystallized from ethereal solutions at low temperatures yielded combined percentages of carbon and hydrogen which totaled slightly less than 100 (*4*). Midgley (*1*) assumed the difference to be due to oxygen, and he and his co-workers have used the results to substantiate their argument that natural rubber is not a true hydrocarbon but contains a small amount of oxygen in chemical combination.

Later, Roberts (*2*) reported that he had isolated the portion of rubber which contained oxygen. This he called caoutchol, to distinguish it from the hydrocarbon, which he named caoutchene. He used Midgley's results to confirm his findings, which he attempted to apply in a new way to the familiar two-phase theory of Fessenden as an explanation of the properties of rubber. However, Schidrowitz (*3*) has indicated that the method used by Roberts to separate the caoutchol is not free from possible criticism. Some steps in the procedure, e.g. milling, promote oxidation.

Since publication of the analyses made at the Bureau of Standards the values for the atomic weights of carbon and hydrogen have been changed from 12.00 and 1.0078 to 12.010 and 1.0080, respectively. When these earlier results are recalculated with the new atomic weights, the sums of carbon and hydrogen are increased by 0.061 per cent. When the results reported in the earlier paper are corrected for two typographical errors and this increment is added, the recalculations are as shown in Table 1.

TABLE 1

Composition of Rubber (Recalculated)

	Hydrogen	Carbon	Sum	Ratio Hydrogen: Carbon
Rubber hydrocarbon uncrystallized	11.85	88.03	99.88	0.1346
	11.84	88.11	99.95	.1343
	11.77	87.66	99.43	.1342
	11.85	88.03	99.88	.1346
	11.82	87.92	99.74	.1344
Average			99.78	
Crystallized once	11.86	88.06	99.92	.1346
	11.82	88.02	99.84	.1343
Average			99.89	
Crystallized three times	11.87	88.31	100.18	.1344
	11.86	88.13	99.99	.1345
Average			100.05	
General average			99.87	

Several things should be said about these results if they are to be used as a basis for judging whether oxygen constitutes a part of the normal rubber molecule: (1) The sum of carbon and hydrogen found increased with increasing purification of the rubber. (2) The most carefully purified material gave an average sum of carbon and hydrogen in excess of 100 per cent, and the four analyses of hydrocarbon which had been recrystallized at least once averaged 99.97. (3) The differences between analyses of the same material were greater than the average difference between the sum of hydrogen and carbon and 100 per cent. The latter cannot, therefore, be regarded as certainly significant. (4) The absolute purification of the rubber hydrocarbon cannot be assumed. Substantially all probable impurities, including water, ether, dissolved or adsorbed gases, inorganic material, and products of oxidation of the rubber itself, would have lowered the sums of hydrogen and carbon observed.

Certainly the results leave very little, if any, of the weight of the rubber to be accounted for as normally combined oxygen. This is not all, however. The observed ratio of hydrogen to carbon is higher than the theoretical (0.1343) by an amount that appears less significant than it really is, in comparison with the total weight of carbon and hydrogen, because of the small weight of hydrogen. For the entire