

to which they belong. It is natural enough that a part of the body situated at one of the regions of manifold relations as the tail is, and unappropriated to any special function, should be put to use in various ways, as a prehensile instrument by some monkeys and other animals, or a building tool by the beavers, as a fly-brush by many others, etc.

Mr. Herbert Spencer has already suggested that the wagging of the dog's tail and similar movements of that appendage is in fact an escape of nervous force restrained from other modes of expression at the moment. Looking at the matter from this point of view, which is doubtless quite satisfactory, we may reconcile it perfectly with the views which have just been presented by supposing that the ancient and no longer functional channel of escape for nervous force, the tail, has remained the way of outlet for the suppressed energy of the animal. The older the channel the less easy it is to close it either by volition or by natural selection.

Be the cause of the persistence of the tail and its movement what it may, we are still justified in assuming as the starting point, that the progenitor of the rattlesnake had the alternating motion of the tail common among snakes. It is the opinion of some herpetologists that the rattles are the remains of the skins successively shed by the animal. The rate of development of the rattles, together with the fact that the skins of some serpents are more imperfectly detached from the region about the tail than

at other parts of the body, makes this view very probable. Let us suppose that we had a group of poison-fanged serpents, accidentally tending to keep the tail skin in the peculiar fashion of rattlesnakes and that in some of these it was persistent enough to make the whirring sound of the Cicada when the tail was rapidly moved under excitement. These would survive and breed the most surely and so that feature would become hereditary. The great variability in the number of rattles in the different forms of rattlesnakes and the late time of their development, even among those which differ in no other regard, would seem to indicate that this structure has not yet been firmly fixed by long inheritance.

The reader will please not suppose that because I have boldly followed the lead of the most advanced of the champions of natural selection that I am convinced of its sufficiency as an explanation of the great diversities which exist among animals or of its being sufficient basis for an explanation of the snake's rattle. But having been driven step by step from a decided opposition of the whole theory and compelled to accept it as a *vera causa*, though I think one much more limited in its action among animals than Mr. Darwin believes, I feel it to be my duty to examine every one of those points upon which I have relied for evidence against it.

It must be confessed that the case of the rattlesnake seems to me no longer the bar to the acceptance of the theory it once did.

## Use of the Rattles of the Rattlesnake<sup>5</sup>

J. G. Henderson

It seems that the singular structure from which the subject of these notes derives its name, was intended as a special stumbling block in the path of antidarwinists, or to intensify the "struggle for existence" which the Darwinian theory, like all other theories must undergo.



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J. G. Henderson, also in 1872, disputed Shaler's assumption that rattles were used to attract prey and proposed instead that they serve as a warning directed at potential predators. Many of his observations were of Western Massasaugas (*Sistrurus catenatus tergeminus*), at that time placed in the genus *Crotalophorus*.

In most notices I have seen of the rattles of the rattlesnake, they have been mentioned as though they were of no advantage to the possessor, and that natural selection would never produce them but on the contrary would weed them out, if that theory were correct. It seems to me that the whole trouble in the matter arises from the assumption that the sound of the rattles, as a war-cry, is a disadvantage to the reptile, by calling the attention of its enemies to it and thus inviting its own destruction, and that consequently the only way to reconcile the existence of the rattles with the theory of Darwin, is to show that there is some other use made of them and that in striking the balance between the profit and loss sides of the ledger, the line falls on the side of the former and for that reason natural selection produced and retains the rattles. If I understand him rightly, this is the view of the matter taken by Prof. N. S. Shaler in his paper in the January *NATURALIST*. He says that for some years he has "been teaching that the tail appendage of the rattlesnake was not to be explained upon the theory of natural selection, inasmuch as it could contribute in no way to the advantage of the animal; that is seemed to him quite clear that it was rather calculated to hinder than to help the creature in the race of life by warning its prey of its presence." But he intimates that he is now ready to say, that this appendage can be explained upon

<sup>5</sup> Reprinted from *The American Naturalist* 6:260–263 (May 1872).

the theory of natural selection. He considers the idea that it might be used as a sexual call as untenable, but that the whirring sound of the rattles closely imitates the sound made by the Cicada and for this reason is used as a call-note, as a hunter uses his bone-turkey-caller, to induce the bird to come within the range of his weapon. Now the first question which naturally arises is this: Does the snake sound its rattles when seeking to capture its prey? I have always understood that it is only when it throws itself upon the defensive and prepares for battle that the rattles are sounded; that it is an alarm note, a war-cry, and not a gentle, deceptive invitation to the victim. I have never seen a rattlesnake, and know of course nothing personally of its habits. But if this use is not made of the rattles as suggested by Prof. Shaler, and the sound only serves to call the attention of its enemies and thus invite destruction, then indeed is the theory of natural selection nonplussed. But as I view the matter, instead of inviting his destruction by sounding the rattles, it is one of the most effective means of self protection and is as useful to it in the race for life as is the growl of the tiger when threatened with danger. The snake does not sound its rattles until it considers itself discovered, and not then unless it apprehends danger. It throws itself in position to strike and says in unmistakable language, "Look out, I am ready for you!" If pushed upon, it makes its leap at its antagonist, and again

throws itself in position to renew the conflict, and again sounds the note of defiance; a note calculated to alarm and, like the war-whoop of the Indian, strike terror to the heart of the assailant; but it may be said that the Indian only utters his yells when rushing on his enemy, or when actually engaged in the conflict, and the sounding of the rattles upon the first approach of danger is a disadvantage. Now it seems to me, if this were true and if it be a piece of rashness upon the part of the snake thus early to exhibit his combatativeness, that natural selection would cure the matter by selecting and preserving the more timid, and that, eventually, rattlesnakes would only sound their tail-bells when it would best promote their interests.

We are not to judge of the advantage or disadvantage of the rattles by their effect upon the nerves of man alone, though no doubt many a man has turned his back and been deterred from making an attack by the sound of these rattles and the defiant attitude of their possessor.

The ability of the snake to defend itself does not consist in its strength or size, or in its power of overcoming its adversary by a prolonged conflict, for most of its enemies are its superior in size and strength. Nor does its deadly poison act quickly enough to secure its own safety when it is attacked, but, in most cases, the victim, after the deadly stroke is given may still revenge



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This Western Massasauga (*Sistrurus catenatus tergeminus*) is initiating a strike from a coiled "ambush" position. Rattlesnakes use a sit-and-wait foraging strategy, contradicting the contention that the rattles were disoperative because the sound would "warn" potential prey as the snake approached. Instead, the distinctive "buzz" appears to serve as a warning directed not only at potential predators, but at large grazing mammals that might inadvertently step on an undetected snake.



Prairie Rattlesnakes (*Crotalus viridis*) were locally abundant across the Great Plains at the time these articles were written. Many of the rattlesnake encounters reported by pioneers traversing the Oregon and Mormon trails were with this species. This snake is in a classic “defensive” position.

itself by the destruction of the snake. But the *certainty* of the effect of the poison serves as a warning and is advantageous, not in defense after the attack is made, but in *preventing* an attack from being made. If, then, the color of the rattlesnake were different from all harmless snakes, so much so as to render it conspicuous, this would be beneficial to it, by the readiness with which all animals would recognize it, and thus protect the snake by this notice of the deadly character of its weapons. If then a conspicuous color would be of advantage, it seems to me that any other means which it may be able to use in making known its character to any animal that may come near it, would be advantageous, and would be increased and preserved by natural selection, and that the whirring noise which it produces, in this view of the matter, admirably serves its purpose. In effect it amounts to this, and by experience its enemies learn to understand its language, “I am a *rattlesnake*, armed with what will be death to you if you come too near; give me a wide berth!”

Prof. Shaler remarks that it is a fact well known doubtless to those who have observed serpents, that many when in a state

of excitement vibrate the end of their tail just as the rattlesnake does. This statement reminded me of a South American species described by Darwin in his “Voyage of a Naturalist” (vol. i, p. 123, Harper’s ed.), where he says:—

“Of reptiles there are many kinds: one snake (a *Trigonocephalus*, or *Cophias*), from the size of the poison channel in its fangs, must be very deadly. Cuvier, in opposition to some other naturalists, makes this a sub-genus of the rattlesnake, and intermediate between it and the viper. In conformation of this opinion I observed a fact, which appears to me very curious and instructive, as showing how every character, even though it may be in some degree independent of structure, has a tendency to vary by slow degrees. The extremity of the tail of this snake is terminated by a point, which is very slightly enlarged; and as the animal glides along, it constantly vibrates the last inch; and this part striking against the dry grass and brushwood, produces a rattling noise, which can be distinctly heard at the distance of six feet. As often as the animal was irritated or surprised, its tail was shaken; and the vibrations were extremely rapid. Even as long as the body retained its irritability, a tendency to this habitual movement was evident. The *Trigonocephalus* has, therefore, in some respects, the structure of a viper, with the habits of a rattlesnake; the noise, however, being produced by a simpler device.”

It was these remarks of Darwin that first suggested the problem of the rattlesnake’s tail to my mind, and, as I had thought considerably about the matter, of course I was deeply interested in the paper by Prof. Shaler; but I must acknowledge that, while many of his suggestions are correct and highly valuable, I was disappointed to find that the only advantageous use, in his estimation, of this tail appendage of the rattlesnake, is an imitative call-note to allure birds within its reach, and that, otherwise, it is rather a disadvantage than an advantage to be preserved and perfected by natural selection. If it is useful for both purposes, then there is a double reason for the action of natural selection. If it is not used as an imitative call-note, but is useful in the manner I have pointed out, then I have shown that it is explained by natural selection.

## The Rattle of the Rattlesnake<sup>6</sup>

Professor Samuel Aughey

I wish to contribute my observations on the rattlesnake, having been specially favored in opportunities for the study of this reptile.

Of all the articles that have appeared on the subject in the *NATURALIST* that by Mr. Putnam appears to me to present the most satisfactory theory concerning the use of the rattles. I am satisfied that *one* of their uses is to bring the sexes together.

In July, 1869, I was engaged in surveying along the Logan river in Wayne County, Nebraska. After completing my contract I devoted a day to investigating the natural history of the neighborhood. While washing a collection of unios at the water’s edge, I heard the familiar rattle of the *Massasauga* (*Crotalophorus*

<sup>6</sup> Reprinted from *The American Naturalist* 7:85–86 (February 1873).