

**Article XXIII.—CONCEALING COLORATION, AN ANSWER TO  
THEODORE ROOSEVELT.<sup>1</sup>**

BY ABBOTT H. THAYER.

First as regards the conspicuousness of white. There is an almost universal idea that white has an intrinsic power to be conspicuous under all circumstances. This comes from the fact that it is conspicuous in the very situations to which mankind devote almost their whole attention. The materials of man's occupations lie mainly below the level of his eye. Tables, desks, tool-benches, the soil of the farm, and the haunts of most of man's game, all habituate his eyes to looking more or less *downward*, and white seen, among these things, *from a higher level*, is the brightest color.

But there are many creatures that look mainly *upward*, in the getting of their living. These are such as live right *on* the ground; toads, snakes, and field-mice, for instance, and as constantly see things against the *sky* as we see them against the *ground*.

But to return to man's view-point. Even the 'Titanic's' disaster is powerless to call attention to the truth. People all think, as Roosevelt does, that white has some intrinsic power to be seen. Here at least, where thousands of lives are at stake, it would pay for schools to work up this matter of optics. Here, as in the former case of the 'Arizona,' a ship ran into an iceberg, *because* white against the night sky (or the sky reflected in a calm sea) is at the minimum of visibility. The 'Titanic's' lookout failed to see the mountain of white ice till they were almost upon it; yet a boat-load of survivors saw from two miles away the 'Titanic's' "great bulk outlined in *black* against the starry sky" (italics mine).

This principle seems to be known in the Norfolk Broads, where they use dark sails, because white ones caused so many collisions by being hard to see at night. Will the world never begin to learn why this is? Distinguishability means *contrasting* in appearance,— as light on dark, or dark on light,— and there is the whole of it.

(In the Bulletin of the Am. Museum of Natural History, Theodore Roosevelt's attack on our book on Concealing Coloration is, without a single exception that I can recall, as wrong at every scientific point as it is

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<sup>1</sup> Revealing and Concealing Coloration. By Theodore Roosevelt. Bull. Amer. Mus. Nat. Hist., Vol. XXX, pp. 119-231, August 23, 1911.

possible to be. He has blindly attacked all the purely optical statements, and these are open to absolute demonstration.)

For my assertion that white on objects' upper slopes, under an open starry sky without the moon or any artificial light far or near, is an absolute match for the sky, Col. Roosevelt can hardly find words to express his contempt, saying many things which must some day look very funny to him when he finds out his error.

To test this sky-matching power of white, place in a wide open field, under such a sky as I have described above, any darkish colored rotund thing, like a sofa-pillow or a stuffed gunny-sack, a few feet above the ground, as a deer's body would be. Then sit down on the ground a few yards off, and look at it against the sky. It will silhouette dark and strong. While you watch it from this position, have some one cover all of it that sticks up above the horizon with a smooth white cloth. The whole white expanse will vanish into the sky, so that you can hardly believe the pillow is not cut off. For another example, try in the same way an imitation skunk (you can make him out of a stuffed black stocking, with a white patch pinned onto his crown, and a white streak down his nose) out in the same field at night with no light but star-light. Lie down nose to nose with him, so that you see his white against the sky, and you will see how the real skunk's white shears off his top, passing it off for the sky, to the sight of mice and turf-insects as he gobbles them up.

Now as to Roosevelt's scoff at the idea that a zebra's white stripes reduce his distinguishability: The accompanying photographs are a total answer.

It only remains to show that this is the view a lion gets *when he is near enough to be dangerous*; and it is this danger-or-difficulty-moment that costumes in general prove to fit. Safe out on the veldt the zebra may or may not happen to show against the watching lion's sky, according to the *relative level* of the two animals, but when the lion is dangerously near he and the zebra are nearly on one level. Take a staff that will stand up a little over four feet when you stick it into the ground. This represents a zebra's shoulder-height. Set it up, out of doors, in a score of situations in both level and hilly country, sitting down within a lion's spring of it (say ten or fifteen feet) and looking at it from the height of a lion's eyes (anywhere from three feet down to his crouching height of one foot) and you will see its top practically *always against the sky*. The only exception will be a view *down on it* from a *very steep* hill-side, or, of course, toward a *very near* cliff.

And it is n't that the lion can't see a moving zebra, but, at a reedy drinking-place such a costume as the zebra's throws all possible difficulties in the lion's way; since so perfect a counterfeit of sky and reeds must cause

the lion the greatest proportion of failures to *notice* the zebra when he is still, or to keep his *outline* in sight as he bounds away.

To prove that these sky counterfeits work still better, if possible, in the woods, try your gunny-sack deer and your skunk there, looking at them still from the lower level as before. You will see that their whites insist

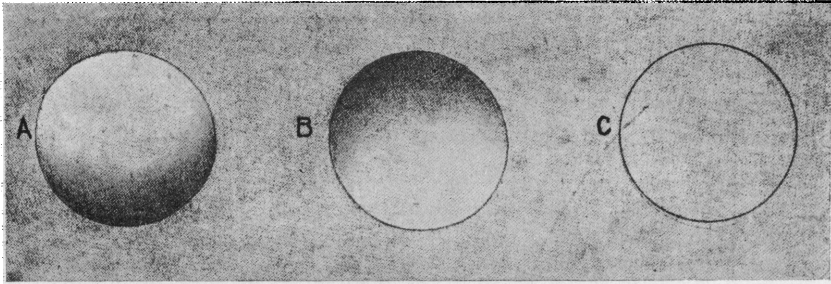


Fig. 1. Under the sky's light, a one-colored globe looks like the drawing on the left. If it is colored after the style of the one in the middle the effects cancel each other and the result is the drawing on the right.

upon passing either for light vistas in the forest top, or for actual sky glimpses, according to how much light they get. Also in the woods they constantly help the animal not to silhouette dark when he is in shadow against light ground. In the woods, especially, any kind of night will *do*.

Next, take what Roosevelt says of countershading which, after the sixteen years since I published it he has never grasped at all. He writes me: "So about countershading. Unquestionably under certain conditions of life, an object colored black or very dark above and white below disappears from view. But when you come practically to apply this, and put a man in a black frock coat and a pair of white duck trousers, you will find that under ordinary conditions you have not by this species of countershading made him invisible, you have on the contrary made him extremely conspicuous under ordinary conditions." The word countershading is an exact description of the real principle. It has to do, as my diagram shows, solely with the chiaroscuro-law of *ROTUND* objects — the law that these show lightest on the side *toward* the light and *vice versa* — and countershading serves to cancel this aspect. What has the coloring of a man's trousers, *all in the one vertical plane of his erect body*, to do with this wonderful law. Could there be a completer failure to grasp a principle?

Roosevelt also says that its part in the concealment of the higher animal forms is "negligible"; and especially that when an animal is graded from *very dark* above to white below he is not countershaded, and wears a *revealing* coloration.

Take three pairs of decoys, made of woolen, stuffed like a rag-doll, and

each mounted on a wire pedestal firmly stitched to its back side. Get an artist (or try yourself) to color these as follows. Set one pair of them on very light colored beach sand (or some imitation of such a ground), and color them with pastel *all over* with the exact tone of this light ground (oil colors on the upper side would be too shiny). In spite of wearing absolutely the color of the ground, if they are six inches long they will be visible a quarter of a mile away. Then have your artist change the color of one of them, until, at a distance of five or six yards, it is almost or quite effaced. He will do this by grading it lighter and lighter from the back down to the belly in a color-gradation from sand color above to cold white below. Do the same thing to one of your other pairs, on a *medium* colored ground, the road or the bare earth of a garden, covering one *all over* as before with the very tone of the soil it stands on, and effacing the other. Do also the same thing to the third pair on some very *dark* soil or burnt over patch. In every case, choose, to increase the severity of the test, as smooth and bare a place as possible.

You will find that while in each case the countershaded one, in order to vanish, has to have the *top* median line even a little *darker* than the ground it stands on, the *bottoms* of every one of them, even of the black one, have to be done with *purest* white oil paint (tube colors). Nothing less white overcomes the shadow at that point.

By these operations you will find yourself producing delicate sand-colored plovers on the pale sand and, on the darker ground, birds like many darker species that haunt this middle colored ground; while on the *black* earth you will evolve a beautiful imitation of some bird like the purple sandpiper or the common oystercatcher: and you will see how wrong is all that Mr. Roosevelt says on the subject.

In open land this necessarily pure white belly is constantly subject to the temporary revealing tendency of the sky's shifting luminosity, which, owing to moving clouds, repeatedly shines, now for a few minutes *too far down the gradation*, making it for the moment too bright, or else not far enough, making it show too dark, *though always magical in its ghostliness compared to the monochrome one*. However, when the shifting light *does* slightly reveal the under white, the animal's aspect is merely a *caricature* of non-existence: the brightest possible stripe of white in this, so to speak, wrong relation to the animal's body, refusing to give away the animal. The idea that it reveals him is purely theoretic. It does serve for *identification*, and for keeping him in view, *after* detection. I have repeatedly proved this upon my spectators, and learned that one of these *caricatures*, with both its dark top and white belly lighted so as to *show*, is still wholly deceptive, passing merely for a dark mark and a light one *on the ground beyond*. Stilts and oyster-catchers, being done merely in two tones — black

above and white below — even commonly show this white along its *upper* edge where the sharp black of the wing cuts it. Roosevelt and the naturalists wholly confound *detection* with *identification* after detection. In fact this is their main difficulty.

As to Roosevelt's saying that the white belly of the white tailed deer is

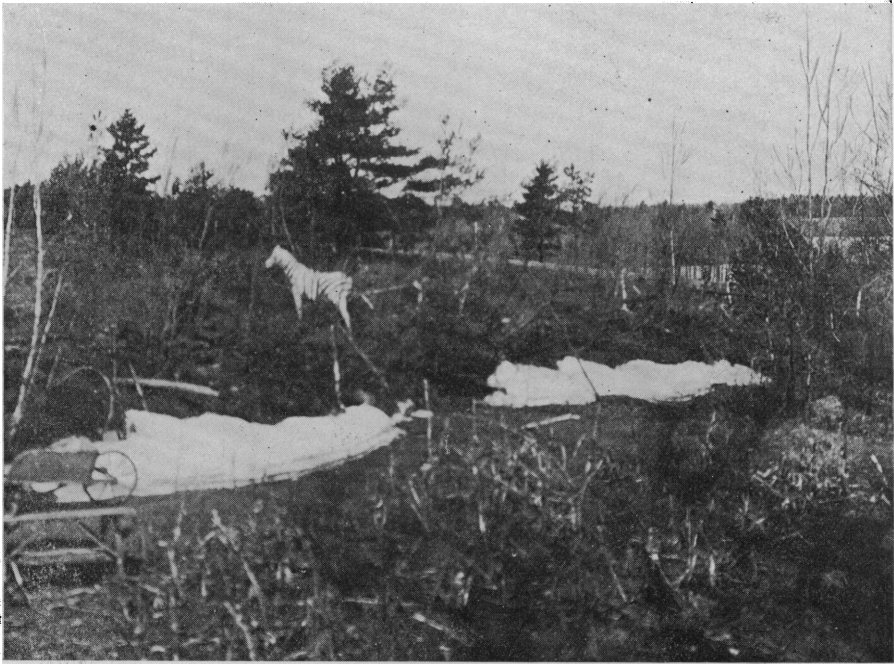


Fig. 2. Zebra and Ass from the average viewpoint of a man. The Zebra conspicuous, the Ass inconspicuous. A man averages *above* a zebra's level. The Zebra conspicuous because seen against the ground, the Ass for the same reason *in*conspicuous.

conspicuous in the woods where he lives, the truth is the contrary. In extensive woods side illumination is absent: the light comes straight *down*; and there an animal's belly is forever in the dark. If you can't watch wild or tame deer in such a wood, take your medium colored decoy in there, and hang it, at the height of a deer, exactly plumb, on one twig after another, and look at it from a few yards away, and you will begin to know that Roosevelt is absolutely wrong in this matter. You will find that the brightest that the pure white belly can there show only suffices to cause it *entirely to vanish* by absolutely matching its background. (Of course you may detect it now and then against an extra black trunk or shadow spot.)

Now read Roosevelt's whole dissertation on countershading, and turn

again to your six decoys all in place on their respective soils. The three that are colored all over exactly like the soil they stand on you can see from



Fig. 3. Zebra and Ass from viewpoint of a near, stalking lion. The Zebra inconspicuous, the Ass conspicuous. The lion looks from a *lower* viewpoint than the Zebra.

afar. If they are six inches long you can see them a quarter of a mile away. The three countershaded ones, if well painted, are totally invisible at five or six yards, and ghostly at two yards. You will see that the dark ground one, with its black top and purest white belly, is just as perfect on its particular soil as the pale topped one on *its* soil; and that for vanishing, the most necessary thing of all, in all your cases, is the *perfection of the pure white* below.



Fig. 4. Artificial Zebra and Ass from viewpoint of a near, stalking lion, viz., a lower level. The Zebra concealed; the Ass revealed.

(To judge from my own success in discovering why one or another species does not wear the colors one would expect him to, I feel confident that in Africa I could soon discover in the habits of hartebeests and gnus why they were neither countershaded nor white-topped, i. e., why they approach the small class of the buffaloes and pachyderms that have no color arrangement at all. The first task, however, is to show the optical effect of these color-schemes, where they are found.)

In the United States this countershading is the color-scheme of all but about twenty of our birds and mammals together, and if Roosevelt could suddenly see them bereft of it, he would see them pass at one bound from the average aspect of your *invisible* three to your quarter-of-a-mile-away *visible* ones!

You will perceive that since your effaced models can stand there invisible not six yards away on bare land, that the place might be *covered* with similarly colored ones, or, just as well, with similarly colored *live* birds or mammals of any kind, and you be none the wiser; and that what Mr. Roosevelt says about countershading failing on a bare plain merely shows his extraordinary ignorance both of its universal operation, and power, and even apparently of many phases of animal life. Many men are well aware that a salt mud flat may be *covered with unseen waders*, so that unless you watch it an hour, or flush them all by a gun-shot, you often fail to detect the main numbers. It is the same on the beach, the same on the sea with the gulls, and how much more on the forest floor where no *side light* can interrupt! Try all this.

The idea that one of these white-bellied creatures crouches to *conceal his white* becomes rather a joke to those who have discovered that purest white at that point *is the concealer*. What crouching does is to reduce their inevitable risk from momentary silhouetting, now light, now dark.

I shall be happy to show to any one coming to Monadnock the equally demonstrable *falsity of every other optical statement in Roosevelt's writings*.

Naturalists seem unable to see that this subject is pure optics. This has cost them all their mistakes. Optics discovers that each of these animals' costumes is a perfect generalization of one of the animal's typical backgrounds. Instead of inferring from this optical fact that *many thus costumed individuals of the animal kingdom must often escape one's sight*, the unthinking scoff at it, and for all argument merely tell how many creatures they *have seen*. This is like denying that woodchucks go into burrows, because you have often seen them sitting up in the clover, or that your neighbor ever steals, because you have often seen him not stealing.

The zebra and ass pictures in this article serve to point out how entirely conspicuousness and inconspicuousness depend on the point of view, and show how necessary it is to investigate each animal's habits in their possible relation to this point of view. They point out, too, how entirely conspicuous in many familiar viewpoints an animal may be, while at the same time he is the most concealed of animals the moment you look at him from the situation of his most dangerous enemy.

Cryptic coloration, then, is only the imitation of the immediate or the typical background.



An animal seen from a level above his own has the dark earth for background, while, at the very same moment, seen from two or three feet lower down he has the *bright sky* instead, or is, at least, seen in the direction in which sky or glimpses of sky are to be expected. The moment this is understood, it becomes obvious that there is no such thing as a cryptic coloration *per se*, and that any amount of *conspicuousness from all other viewpoints* has nothing whatsoever to do with the question. The thing to be expected, then, was that all species in any way dependent on not being seen (or not being *well* seen) by some other species will prove to wear an imitation of the background against which that species would see them. And it would be expected that this imitation would be unmixed with other background-imitation in proportion to how much more important it was for the wearer to escape those particular eyes than to escape those of less dangerous and differently situated foes; and whenever naturalists will go through the tremendous study that this field requires they will discover that this is the very case. They will discover a perfectly astounding correspondence, throughout the animal kingdom, of the cryptic effect of each costume, however gorgeous and elsewhere conspicuous, with the background against which the wearer's most dangerous foe or his most necessary quarry sees him. This correspondence is so unintermitting throughout class after class and order after order (and everywhere so exact as to be only appreciable by colorists), that the naturalists' present idea that it is accident is simply a joke. The number and the perfection of the cases *are* the evidence, and no naturalist has yet even attempted to acquaint himself with either of these things, though some of them may suppose that they have, till they witness what I have to show.

*Monadnock, N. H.,*  
August 29, 1912.

