Creepers contained in the American Museum of Natural History; to Dr. C. Hart Merriam for the use of the specimens in the collection of the Department of Agriculture; and to Mr. Robert Ridgway for his courtesy in allowing similar access to the collection of the National Museum.

FURTHER REMARKS ON THE LAW WHICH UNDERLIES PROTECTIVE COLORATION.

BY ABBOTT H. THAYER.

SINCE writing my article on protective coloration in the April Auk (XIII, 1896, pp. 124–129), I have alighted on the means of still more complete ocular demonstration of the law of protective coloration.

I made some wooden eggs about the size of a Woodcock's body, and provided them with wire legs to poise them six inches above the ground.

Most of these I colored in imitation of the color-gradation of a grouse or hare; earth-color above, to pure white beneath; while to two others I gave a coat of earth-color all over, above and below; then set the whole like a flock of 'shore birds,' on the bare ground in a city lot.[1]

I then summoned a naturalist and let him begin at forty or fifty yards to look for them. He saw immediately the two monochrome ones; but although told exactly where to look, failed to find any of the others, until within six or seven yards, and even then *only by knowing exactly where to look.*

I had also painted bright blue and red spots as big as a silver quarter of a dollar on the brown back of one of the graded eggs. These spots the naturalist saw, when we had come pretty near,

[1] To give the gradation its complete effect, the painting of the wooden eggs should be done after they are placed on the ground and of course by an artist.

though they only passed for details of the ground beyond the egg.

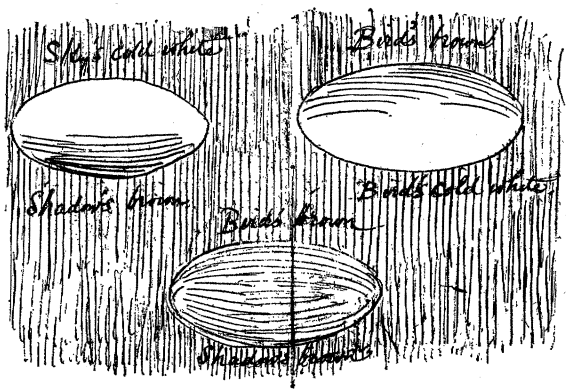
It was to this latter experiment that I alluded in a footnote (l. c., p. 127), when I said that brilliant top colors scarcely tend to interfere with the gradation's power. This statement does not apply, however, to creatures in which, as in a Blue Jay, the bright color so predominates as to form a silhouette shaped like the creature, but only when the bright pattern goes, as it were, its own way, not accompanying the animal's form.

Yet, even in the Jay's case, his gradation down to white under throat and belly diminishes so greatly his conspicuousness in the dim forest shade, that he may be suspected of great indebtedness to this arrangement of color as he skulks among the leaves. He must often be much helped, also, by the fact that whenever his gradation works its charm and denies his substantiality, his blue is *likely*, at least, to appear to belong to whatever surface, far or near, forms his background for the beholder's eye at the moment; as for instance a bit of blue distance seen through the leaves. And often when he is not concealed to this degree, his ghostly appearance still tends to cause the beholder to think him further off than he is, which may be sometimes equivalent to concealment. The reader should compare a graded blue egg with one blue all over, both seen in deep woods. Let me urge the reader to understand these color-phenomena, which are the open door into a new world of most charming study of special cases of protective coloration hitherto misunderstood.

One must remember that by far the greater part of the objects he espies as he walks are first caught sight of *out of the side of his eye;* and it is this *faint seeing* against which all this *faint appearing* is so potent, in countless cases where the animal could not elude the *direct eye.* In my former article I omitted to emphasize the device of nature by which she accomplishes, in the *only possible way*, the bringing the top, sides, throat, and belly of an animal to the exact *color* of the surrounding earth, as well as to the same *degree of darkness.*

The animal's top is brown like the ground about him, and from this brown his color grades steadily colder till it becomes *cold* white on his under surfaces. The latter being in shadow and

bathed in a yellow reflection from the earth, has the exact *color*, as well as *degree of darkness of his top*. Since, obviously, earth-brown bathed in sky light, equals sky light (color of the animal's belly) bathed in earth-yellow and shadow, *i. e.* brown.



This grading to white under-surfaces is precisely what would result if daylight tended to brown animals' coats, and its lack to bleach them. And, from this, one might fancy the whole phenomenon to be the result of such browning and bleaching. But to those who believe in Natural Selection it must be obvious that the gradation's protecting-power proves it a result of such selection. As to a bleaching and browning theory; many facts suggest that light does not tend to darken the coats of animals: Notice for instance the pale inhabitants of treeless regions, such as sandy beaches, etc., compared with wood-dwellers. But this discussion is outside my present purpose.

As an epigrammatic lash to my entire thesis on Protective Coloration, it is important to say that no other conceivable arrangement of light and dark colors could effect the intrinsic unsubstantiality of appearance guaranteed by the gradation therein set forth.