

Article VIII.—REVEALING AND CONCEALING COLORATION IN BIRDS AND MAMMALS.

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INTRODUCTION.

In presenting certain observations bearing on the question of concealing, or protective, coloration in birds and mammals, let me at the outset explain that I do not doubt that as regards certain birds and mammals, and very possibly as regards the larger proportion of the lower forms of animal life, concealing coloration plays an important part. I am convinced, however, that this part has been largely, and by some persons absurdly, exaggerated. The limitations within which the theory can probably be held to apply have been disregarded; and the other, and often conflicting, influences, which have been at work side by side with tendencies which have produced concealing coloration, have been partially or completely ignored.

Sufficient attention has not been paid to certain wide differences of possibility in concealing coloration as affected by the animal's habits. A caterpillar which passes its entire caterpillar life on green leaves or in immediate proximity to them may be most effectually concealed on all occasions by being green. Its own activities are so slight, and its habitat so circumscribed, that it is a simple thing to equip it with a concealing coloration. Higher up in the scale, a tree toad or a wood frog or a green frog are all unquestionably concealingly colored as regards their upper surfaces, and have precisely the coloration that best equips them for concealment under the conditions that surround them during by far the larger part of their lives.¹

But among the higher animals many species have such a wide range of activities, and continually pass over such totally different landscapes and among such totally different surroundings, that the difficulty of devising any concealing coloration would be enormous. For example, consider a wide-ranging hawk like the sharp-shinned hawk, or a wide-ranging carnivore like a wolf. The hawk passes in and out among woods, orchards, gardens, over plains, over meadows and pastures and along hedgerows; it is active in the bright green of summer, and among the snows of winter; in short, no

¹ This does not mean that I admit that all reptiles are protectively colored. One of our common snakes the black snake, for instance, is certainly advertisingly colored, and the whole subject of concealing and advertising coloration amongst reptiles is worth serious study by competent and unprejudiced observers.

pattern and no coloration could always, or even generally, be concealing, and the coloration and pattern it actually possesses have practically no concealing effect whatever. A wolf hunts in the green spring and in the snowy winter, on the open plains and in the thick woods, amid all conceivable surroundings of every conceivable color. Perhaps under such circumstances a nearly uniform but slightly countershaded khaki or drab or gray color would be most concealing or obliterative; and there are wolves with such a type of coloration. But there are also black wolves and white wolves, red wolves, brown wolves, and wolves of a conspicuous iron-gray; while hawks, kites, and eagles are found of many different and exceedingly conspicuous colors and combinations of colors, their coloration patterns being in a very large number of cases of a more or less advertising character, and, under the actual circumstances of their lives, rarely having any obliterative or concealing effect. It thus appears that to hawks and wolves, the question of coloration is of no moment, as regards perpetuating their lives; they depend upon the keenness of their senses, their cunning, their dash, endurance, hardihood, and the formidable nature of their weapons. It is evident, therefore, that the conditions of life as regards concealment are so utterly unlike in the case of a hawk or a wolf as compared with the case of a tree toad or a wood frog or caterpillar that any attempt to lay down a universal law of coloration which would include them all must be entered upon with extreme caution; and yet this is exactly what has been attempted by certain modern writers in the most sweeping terms and with a curiously complacent recklessness.

I propose to discuss purely birds and mammals as affected by the question of coloration. I use the word "concealing" as including both conscious and unconscious forms of concealment; and I use the word "advertising" merely as expressing the opposite of "concealing," that is as any kind of conspicuous coloration which instead of concealing the wearer from attention tends to attract attention without regard to whether the wearer is, or (as is probably much more often the case) is not, conscious that his coloring or any part of it does attract attention. The word "revealing" would express my meaning as well as the word "advertising."

THE DOCTRINE OF CONCEALING COLORATION AS STATED AND APPLIED
BY G. H. AND ABBOTT H. THAYER IN THEIR 'CONCEALING
COLORATION IN THE ANIMAL KINGDOM.'

The doctrine of concealing coloration as an explanation of almost every kind of coloration in the animal kingdom has received its widest application in the book called 'Concealing Coloration in the Animal Kingdom,'

by Messrs. Gerald H. and Abbott H. Thayer. In its extreme form as stated by these gentlemen, the doctrine seems to me to be pushed to such a fantastic extreme and to include such wild absurdities as to call for the application of common sense thereto. The Messrs. Thayer state their position in the most positive form. Fundamentally it is that, in the first place, all or practically all animals are concealingly colored, and in the next place, that while their patterns in all cases help thus to conceal them the chief factor in their concealment is the counter-gradation of shades, their inconspicuousness being due, not to their color being like that of the surrounding objects, but to this counter-gradation causing them to escape being seen at all. In order to show the sweeping claims made by the Messrs. Thayer, and accepted by their scientific followers, I quote their exact language:

"The discovery that patterns and utmost contrasts of color (not to speak of appendages) on animals make wholly for their obliteration, is a fatal blow to the various theories that these patterns exist mainly as nuptial dress, warning colors, mimicry devices, . . . etc., since these are all attempts to explain the entirely false conception that such patterns make their wearers conspicuous. . . . The most gorgeous costumes being, in their own way, climaxes of oblitative coloring scarcely surpassed even by moths and inchworms." "The so-called nuptial colors, etc., are confined to situations where the same colors are to be found in the wearer's background, either at certain periods of his life or all the time. Apparently not one 'mimicry' mark, nor one 'warning color' or 'banner mark', nor one of Gadow's light-and-shadow-begotten marks, nor any 'sexually selective' color, exists anywhere in the world where there is not every reason to believe it is the very best conceivable device for the concealment of its wearer, either through the main part of this wearer's life, or under certain peculiarly important circumstances." "The colors, patterns, and appendages of animals are the most perfect imaginable effacers under the very circumstances wherein such effacement would most serve the wearer." "If creatures were purely and simply 'colored like their surroundings', they would not be inconspicuous at all." "What people commonly fail to perceive in connection with this matter, is that the exposition is really that of a discovery, i. e., of an indisputable optical fact, hitherto unnoticed, and not merely that of one more theory. It is a revelation of how animals' wonderful inconspicuousness in their normal haunts, recognized for centuries but in its essence never understood, is really achieved." "This counter-gradation of shades, from dark mid-backs to white mid-bellies, is . . . precisely the system of coloration of almost all protectively colored animals." "The reader . . . is now in a position to perceive the fallacy of the statement, prevalent in former years, and still made by certain writers, that a protectively colored

animal of the type described above escapes detection because, being of a dull brown color like the ground and the bushes, it looks when it sits motionless like a clod or a stump — or some such inanimate thing. For clods and stumps are solid objects of a uniform tint, and manifest to the eye, by the laws of light-and-shade, not only their solidity, but all their smaller modelings. They are not inconspicuous, except in so far as their great abundance makes the eye inattentive to individual ones. The protectively colored animal, on the other hand, is, as it were, obliterated by his counter-gradation of shades, and in the cases where he escapes notice, it is by virtue, not of the eye's perceiving his solid form, and taking it for that of an inanimate object, but of its failure to recognize it as a solid object of any kind, seeming, if it rests on it at all, to see through it to what is beyond." "All patterns and colors whatsoever of all animals that ever prey or are preyed upon are under certain normal circumstances oblitative." As an explanation of all this the authors say that they attribute it entirely "to natural selection, pure and simple and omnipotent."

MISSTATEMENTS OF FACTS AS SET FORTH BY THEM PICTORIALLY
AND IN THEIR TEXT.

Before discussing these positions and the arguments advanced on behalf of them by the Messrs. Thayer, I wish to call attention to certain arguments of theirs, both in the shape of pictures and in the shape of letter-press, which are really not arguments at all, properly so considered, but are simply misstatements of facts, or wild guesses put forward as facts. I do not for a moment suppose that the misstatements are intentional on the part of the Messrs. Thayer. I believe that they are due to the enthusiasm of a certain type of artistic temperament, an enthusiasm also known to certain types of scientific and business temperaments, and which when it manifests itself in business is as sure to bring the owner into trouble as if he were guilty of deliberate misconduct. For example, the Messrs. Thayer's endeavor is to show that every color and every pattern is oblitative, and among other things that colors fade into the sky. The frontispiece of the book is a picture of a peacock in a tree, with the blue sky showing through the leaves in just sufficient quantity here and there to warrant the author-artists explaining that the wonderful blue hues of the peacock's neck are oblitative because they make it fade into the sky. The peacock is accordingly portrayed under conditions under which he probably would not be seen once in a thousand times. (Incidentally, if the peacock was obliterated under such conditions, the peahen would be conspicuous, which of itself would destroy the Thayer's theory; but this is not the point to

which I am alluding at present.) In order to make their case, the Messrs. Thayer picture the blue neck of the peacock against a patch of *blue* sky, and of exactly the same color as the sky, and fading into it. But in figures 107 and 109, in the body of the book, they portray the white rump on the prongbuck as fading absolutely into the *white* of the sky.¹ Now no two colors could be more unlike than the deep brilliant blue of a peacock's neck and the dazzling white of a prongbuck's rump; and if one of these fades into the sky, then it is perfectly evident that the other is in sharpest contrast to it; yet when they make a picture of the peacock, the Messrs. Thayer make the sky the exact color of the peacock's blue neck, and when they give a picture of the prongbuck they make the sky the exact color of the antelope's white rump. If instead of being an artist, one of the Mr. Thayers were an engineer, and were employed by a business organization to investigate some proposition and report on it, and he based his report upon such action as this, he would be promptly dismissed from his position; and if the corporation tried to float shares on the strength of such a report, its directors would lay themselves open to a prosecution for fraud. Again, in figures 90 and 91, Mr. Thayer purports to show how a zebra is obliterated by its stripes. Accordingly he has one picture of a zebra without stripes, that is, of a wild ass, in reeds, and another picture of the zebra with its stripes in the reeds. Here (exactly as when he draws the peacock, he forgets the existence of the peahen) he forgets that there are just as many kinds of wild ass as of zebra, and that if his figures were true he would only succeed in proving that the zebra is obliteratively colored by proving that the wild ass is advertisingly colored, which would be equally fatal to his thesis. But, aside from this elementary fact, the point to which I now wish to draw attention is that he is utterly unable to be straightforward with himself in such figures; for in the picture of the unstriped zebra he is careful to make all the reeds criss-cross behind it so as to throw the figure out into relief, while with the striped zebra the reeds are in front as well as behind it, so that the effect is in no way parallel. On the same page with these two figures, by the way, there is also a figure of a chipmunk among dead leaves, to show that its stripes render it inconspicuous. The photograph is of no value anyhow, not giving any of the proper colors and improperly leveling the shades; but disregarding this, the elemental fact remains that even in the photograph the stripes do have a slightly advertising effect, and help one to find the chipmunk, for if it were colored as a meadow mouse or mole shrew is colored, without any stripes, it would be a

¹ As Mr. Thayer states that the white rump of the antelope is so colored to deceive animal foes that look up at it from below, he cannot mean that it is only seen against the lighter colored blue of the horizon sky.

little more difficult to see. The picture, however, like the majority of the pictures upon which the Messrs. Thayer most rely is of no value whatever from the standpoint of the serious truthseeker, and is of interest merely as are the puzzle pictures in Sunday newspapers.¹ Again, in figure 61, a chickadee is shown with its head against a dark hole, attention being called to the way the black head markings merge into the dark hole beyond. The chickadee is about to enter the hole. Now of course anyone who is willing to spend an hour in the woods almost anywhere can tell for himself, that this is a photograph of a chickadee in an exceptional position, in which the chickadee would never remain motionless for any time. At any given moment of a chickadee's career, even while it is breeding, the chances are a thousand to one, and probably much more, that it is not sitting motionless with its head against a black hole into which it intends to go, and on the nine hundred and ninety-nine other occasions the bold black and white markings of the head have a strong advertising instead of concealing quality. We think of a chickadee as inconspicuous only because it is small. Its coloration is so conspicuous as to strike the eye at once. If it were as big as a crow, it would probably be hardly as conspicuous as the ordinary wholly black crow, but it would be as conspicuous as the less, but still highly, conspicuous hooded crow of Europe. The chickadee is always on the move, and its coloration is so bold that it is probably safe to say that among our small birds it is the one of all others which practically never owes its escape from any foe to escaping observation. It certainly never owes its immunity from attack to any such combination of circumstances as that set forth in the picture in question, for when it prepares to enter its hole it of course first flies to the tree and then with very little delay enters the hole. The picture is an interesting picture in itself, but it is misleading and deceptive as illustrating Mr. Thayer's² thesis. The very next picture to this figure, for instance, shows a black and white oyster-catcher near its nest on rocky ground, the idea being that the "countershading" and "ruptive pattern" conceal the bird. In the first place they do not conceal the bird, the extremely bold black and white having a high advertising value; and in the next place, Mr. Thayer must be aware of the fact that a

¹ Compare it with serious photographs of animals not posed to prove a theory; compare it for instance with the photos of chipmunks on pp. 167, 169 and 180 in Warren's 'Mammals of Colorado.' Chipmunks are diurnal little animals, with a coloration which is revealing rather than concealing. I suppose I have seen fifty specimens this spring; for although infinitely less plentiful than meadow mice or deer mice, they care so much less for concealment and are so much more conspicuous, in habits even more than in coloration, that they are far more often seen. In fact chipmunks are the most conspicuous, and the most frequently seen of all small mammals of about their size; they trust for safety to their alertness, their agility, and their burrows.

² To avoid continually referring to the "Messrs. Thayer" I shall hereafter use the singular; especially as the book professes to describe "Abbott H. Thayer's discoveries."

species of oyster-catcher of the Pacific Slope is entirely black. If the "countershading" and "ruptive pattern" have any effect, on the Atlantic Coast or European forms, of the kind Mr. Thayer thinks, then, as the black oyster-catcher of the Pacific Slope lacks both, it must furnish a refutation of Mr. Thayer's thesis. As a matter of fact all the oyster-catchers, both the black and the pied forms, possess a brilliant and striking coloration which hardly ever has any concealing properties, and which, for once it conceals the birds, advertises their presence a thousand times; just as is the case with stilts and avocets, and to a slightly less degree with black-bellied and golden plover.

Mr. Thayer's figures include cases where the bird's coloration has a protective quality and cases where it has not. His colored pictures are for the most part completely misleading — and when I use so mild a term I use it merely because Mr. Thayer's intentions are good. His pictures of wood-duck drakes, for instance, are designed to show that these birds are very inconspicuous, and so they are portrayed with the wood drake swimming among water lily blossoms, floating lily-pads, brown sticks and the like, under circumstances that make the vivid coloring of the bird disappear. Yet not five minutes of reflection are necessary to show that these pictures cannot represent anything of value from the scientific standpoint, for the duck is always dull colored, without the extraordinary tints and patterns which Mr. Thayer says make the drake inconspicuous, and for some weeks after the breeding season the drake is colored like the duck. Now of course if the drake's brilliant normal coloring really tends to obliterate him, as Mr. Thayer says, then the dull color of the duck, and of the drake immediately after the breeding season, must, in precisely the same situations, tend to advertise them. Moreover, the black duck, or dusky duck, is found in the same situations, and if the wood drake's coloration tends to conceal him, then the black duck's coloration must tend to advertise and reveal him. As a matter of fact the circumstances under which the brilliant coloring of the wood drake tends to conceal him are wholly abnormal. So far as it has any effect at all, the normal coloration of the wood drake is of a highly advertising quality; but the conditions of life of the wood duck and of the dusky duck are such that, under most circumstances, the surroundings conceal them, *when they are concealed* (usually they are not concealed at all) without regard to their colors. Ordinarily, then, the coloration has little effect; but it is probable that the ducks of both species, and perhaps the drake of the dusky duck, do owe a certain small concealing effect at special times and under special conditions to their colors, whereas the drake of the wood duck, when in the nuptial dress, has what under ordinary conditions is certainly a highly advertising costume. Through-

out the greater part of the year the drake and the duck are in company, haunt the same places, and have the same habits; and it is of course self-evident, as their coloration patterns are so totally unlike, that under such circumstances both cannot be concealing; and to treat them as such, is simply to juggle with words. During the moult, after the breeding season, when the sexes are colored alike, it may very well be that the drake does find his coloration concealing, precisely because it is so widely different from his ordinary (and strikingly revealing) coloration; this being the critical time of the year for him, the only time when he needs concealment. The ducklings, like the young of so many swimmers, waders, and game birds, do try to conceal themselves; and special study (in the field under natural conditions, not under utterly artificial conditions in a laboratory) may very well show that in such a case as this of the wood duck the young and the female, and even the adult male at certain seasons, are concealingly colored, although during most of the year the coloration of the adult male is revealing.

Very many of Mr. Thayer's pictures deliberately reverse the truth. The colored plates of the red spoonbills and flamingoes are worth attention. These are designed to show that the striking coloration of the birds in question—coloration which of course, as any man willing seriously to consider the question for a minute must realize, is normally highly advertising in quality—is really concealing. With singular innocence Mr. Thayer shows both white flamingoes and red flamingoes, on the theory that both of them fade into morning or evening sunlight. Of course if one color does, then the other color does not; and equally of course if these red and white birds are inconspicuous to their prey or to their foes, then the much more numerous black and gray and blue and brown and even yellow water birds, and birds of all kinds of tints which live in the same localities, must be conspicuous.¹ As a matter of fact, for once when, under any conceivable circumstances, the brilliant coloring of a flamingo or a spoonbill or a scarlet ibis tends to disguise it, there are probably ten thousand occasions, or many more, when this coloration is of the most highly advertising quality. Probably none of these colors has any effect one way or the other, as regards the creatures on which the bird preys; the red, white, black, blue, gray, brown

¹ The really wonderful mounted bird groups in the American Museum of Natural History will enable anyone to realize the truth of this at a glance; or let any inquirer turn to the letterpress and photographs—almost equally valuable—in Mr. Chapman's delightful 'Camps and Cruises,' especially the chapters in which he deals with flamingoes, herons, pelicans, skimmers (the young of which, by the way, apparently really do possess concealing coloration and by their conduct in crouching on the sand give it its full value while the strikingly colored adults are very wary and show by their conduct their knowledge that they cannot escape observation); or consult the capital volumes of Herbert K. Job and William L. Finley.

and mottled and diversified wading birds being apparently equally successful in obtaining their food and avoiding their foes.

Among Mr. Thayer's utterly misleading pictures, is his picture of blue jays. He actually pictures the blue jay in winter, in blue shadow on snow, to show that the blue shadow on the snow is of precisely the same color as a blue jay. The shadow is painted so blue that until I read the text I had no idea that it was not a pool of blue water, and it is painted exactly the color of the blue jay's plumage. This winter I carefully studied the blue jays in my neighborhood. The enormous majority of the shadows, in fact all that I saw during the winter, were not blue shadows of the color of a blue jay's plumage; and if they had been, while they might have harmonized with the blue jay, they would have been out of harmony with every other winter bird, with the far more numerous snow birds, for instance, and the fox sparrows and tree sparrows. Moreover, whenever the jay was actually on the snow-covered ground, it was always conspicuous, whether it was in light or shadow; and it knew it was conspicuous, and, on the most distant approach of danger, flew into a tree. It trusted for concealment to keeping among the branches and slipping out on the opposite side of the tree when anyone approached. Here again it ought not to be necessary to say that it is a simple impossibility that the blue jay's coloration can have been developed in order to make the bird invisible under the almost never-occurring conditions when it happens to strike a small patch of shadow on the snow which is of the same bright blue color as its own bright plumage. Moreover the utter folly of such a theory is evident at once to any one who remembers that the species of blue jay in question dwells largely, and many other species of blue jay dwell wholly in regions where snow never falls.

Mr. Thayer's book includes 251 pages. It is impossible to go over page by page the really countless erroneous statements, wild guesses, and absurd interpretations of facts, which the book contains. Some of the pictures help to illustrate truths; others, both paintings and photographs, are elaborately designed to perpetuate glaring error. The same is true of the text. I regret to state that I do not think I know of a professedly serious writer whose text contains a greater number of absolutely misleading statements. I have no question that Mr. Thayer intends to put his facts honestly; but in actual practice he is evidently unable to study facts with the sincere desire of finding out what they are, and of making proper deductions from them. He not merely twists his facts to suit his theory, but in almost every case rejects, alters and rearranges them so as to make them fit into the theory even when, if frankly faced, they prove the direct reverse of what he assumes they prove. Notable examples of this are found in his treatment of zebras, skunks, and flamingoes; but these are only examples. The great majority

of birds and mammals he discusses are treated with the same, not merely disregard but inversion, of the truth, and this in small things as well as in great things. For example — I am choosing almost at random — when he deals with jacanas, he actually speaks of the spurs on the wings of these diminutive birds as being for defence against alligators, tortoises and other foes! Now few things are absolutely impossible, outside of the domain of pure mathematics, but if a jacana can use a wing spur as a defence against an alligator or a big carnivorous snapping-turtle, then the event is so extraordinary that some attempt at proof should be submitted. It would be a feat much like using a pen knife against a thirty-foot shark. Yet this utterly wild suggestion is advanced without one particle of substantiation by Mr. Thayer.

A couple of pages beyond he says that certain minute horizontal flank markings on various ducks are “ripple pictures,” and that these ripple pictures on ducks like the old-squaw, hooded merganser, and red-breasted merganser, disguise the swimming bird and make the eye think that there is nothing there but water. Here again there is no argument to make; all that can be said is that the explanation is preposterous. The hooded merganser, the red-breasted merganser and the old-squaw are birds of extraordinarily conspicuous coloration. The minute patterns in question could not be seen by any eye, and could not “merge” the bird into ripples, unless the observer were within a few yards; and as a matter of fact, if his eyes were worth anything, the duck would have been plainly visible a quarter of a mile or half a mile or a mile away so that the minute “ripple pictures” could never be seen by any foe that had not already, for a substantial period of time, been engaged in observing the duck. All that Mr. Thayer says about the effect of the “vermiculation” of pattern on ducks, and of most of their markings, and indeed nine tenths of what he says about these finer patterns everywhere, is subject to just the same criticism. The minute patterns could not be seen at all until the foe was so close that it would be absolutely impossible for him not long before to have seen, and made out, the wearer.

Again, take the whole chapter on the “masking” of the bill and feet of hawks and predacious birds. Mr. Thayer actually thinks that the feathers around the legs of hawks blur “the deadly feet,” and so reduce the victim’s chance of successful dodging, and he asserts that the fact that the bare feet of hawks are usually light in color must have a deceptive effect “inasmuch as pale bright colors are less characteristic of hard animal substances than of leaves and flowers and grasses”! Of course, in the first place, when hawks pounce, they do it with such inconceivable rapidity that the victim would be totally unable to differentiate in any way among

the minor points of the pattern. In the next place, the victim is hardly ever fighting; it is fleeing, and it does not try to dodge the claws, it tries to dodge the whole bird. In the third place, owls, which strike their prey in darkness and where the animals preyed on cannot possibly see the bird's pattern of coloration, nevertheless have their feet more heavily feathered than hawks. As to the supposition that animals think the feet of hawks are harmless because they are light-colored — really one ought not to be called upon to discuss it. Mr. Thayer's theory about the deceptive effect of the feathered and light-colored legs of hawks, and of the coloring on and about the bills and feet of predacious birds generally, stand on an exact par with a theory which would assert that the lion has a mane in order to distract the attention of his prey from his teeth, and that his teeth and claws are light-colored so that the prey may think that they are soft.

Again, all that Mr. Thayer says about hummingbirds comes in the same category. He actually states that hummingbirds' metallic colors mark the climax of the "high obliterative power of iridescence" and that they have "an almost unrivalled obliterative equipment," and that this obliterative equipment keeps them from the sight of insects lurking among leaves and flowers. What possible way is there of meeting an argument so absurd? Of course if Mr. Thayer's theory were true, instead of self-evidently false, it would mean that the females were not obliteratively colored, that they were not as well equipped to get insects as the males — in itself an unsupposable proposition. In the next place, any effort to prove that the colors of male hummingbirds, and their appendages, are obliterative, stands on an exact par with the statement that a peony or a tulip is obliteratively colored, and is less conspicuous than a violet or a mayflower. If male hummingbirds, because of their appendages and iridescence, are protectively colored, then tulips, peonies and poppies are all inconspicuous and difficult of observation, and far harder to see than violets. The proposition is no more absurd in one case than another, and the mere fact that Mr. Thayer can make such a proposition shows that he has worked himself into such a frame of mind that no single unsupported statement he makes ought to be accepted as needing serious study. He does not advance one fact to justify any one of these positions. They are pure wild guesses; and in what purports to be a serious study of animals they make his book rank with a book on botany which was predicated upon the statement that tiger lilies and sunflowers are much less conspicuous than the tiniest flowers found under the dead leaves in the woods. I mention these cases, be it remembered, merely as examples. From cover to cover his book is filled with just such perversions of fact and such wild guesses masquerading as facts. I could give hundreds of quotations showing positions just as wild and foolish as those I have above mentioned.

One of the difficulties to which Mr. Thayer pays no heed is that if his arguments are true as to certain birds, they thereby at once become false as to other birds. He says, for instance, that the "cormorant's green gloss in the water, looked up at from deeper down, proves to be a perfect match for the translucent water itself." But young cormorants lack the gloss, while loons, grebes, auks and murre are white beneath. If an adult cormorant is a perfect match for the translucent water when seen from below, then the other birds offer a striking contrast to the water. It is possible to argue that one type of coloration is concealing only on the ground that the other is revealing or advertising. This applies to Mr. Thayer's whole argument as to the concealing or obliterative effect of iridescence. If the iridescent male anhinga becomes concealingly or obliteratively colored because of its iridescence, then the lustreless female is revealingly colored. It is possible (and in this case it is the fact) that both birds are advertisingly colored, merely because they are so dark; but it is not possible that both the iridescence and the lack of iridescence, are concealing; it is not possible that iridescence renders certain species, or the males of certain species, obliteratively colored, and that at the same time the lack of iridescence in other species with the same habits, or in the females of the same species, also renders them obliteratively colored. As a matter of fact, of course, iridescence is practically never obliterative; an iridescent bird is under normal conditions almost always of a somewhat more advertising quality than a lustreless bird. Again, Mr. Thayer says that the fact that the scarlet tanager's coloration "divides it into two things, a black and a red thing," shows that it is not "meant to be conspicuous" because in that case it would be "monochrome." But the summer red-bird and the cardinal are both monochrome! Mr. Thayer simply forgets this, and forgets that the argument he advances to show that one is inconspicuous, necessarily shows that the two others are conspicuous. As a matter of fact, of course the plumage of all three birds is highly advertising.

It is possible to meet such statements as these with arguments; but many of Mr. Thayer's assertions it is only possible to answer by saying that they are not so. He says, for instance, "the crow's rainbow sheens, so little thought of as concealers, turn him into such true distance colors as he sits on the nest, as to rank him at this moment almost with the grouse for indistinguishability." Here there is no more chance for an argument than if Mr. Thayer said that a wistaria vine in full bloom, or a mass of purple bourganvillia flowers on the side of a house, was inconspicuous, or that a coal scuttle planted in the middle of a green lawn was inconspicuous. Under all normal conditions a crow's coloration, and the coloration of

ravens, magpies, most jays, all grackles, cowbuntings, and blackbirds and most orioles, is highly advertising. A crow is a very conspicuous bird, on its nest and off its nest, on the ground and in the air, in the forest and in the field. There is no time of its life when its coloration is concealing; its safety is due to its wariness, astuteness and bodily vigor. The fact that Mr. Thayer's eye and brain make him regard a crow on its nest as having concealing color, in the same sense that a grouse has concealing color when on its nest, merely shows that his comments are of interest chiefly from a subjective and not an objective standpoint, that he has permitted himself to become obsessed by his subject.

Mr. Thayer's book is for the most part filled with theories predicated upon observations made under conditions which are designedly abnormal. Any practical expert with colors knows that extraordinary effects can be wrought by a proper arrangement of lights and shadows. If seen against the horizon under certain conditions of light, all animals, no matter what their real color, will seem to be of the same color; and no color can be imagined which will not become inconspicuous, whether on an animal or off an animal, if against certain backgrounds. Mr. Thayer's experiments in concealing animals by the proper use of light and shade, and by putting them against the right type of background, ought to be of value to the large number of people who apparently have no idea what a landscape in nature really is, and who do not understand the extraordinary play of light and shadow, and the variety of color effects, to be found in any forest landscape, especially among the tree tops. But they are of very little value to anyone who has passed this elementary stage; and they are of worse than no value when the conditions arranged are abnormal, and yet are painted or described as normal.¹ The raven's coloration is of course concealing if it is put into a coal scuttle; and if chalk is added to the contents of the coal scuttle, then a magpie's coloration might also become concealing under the same circumstances. Now much of Mr. Thayer's work is predicated on experiments which stand on a par with putting a raven or a magpie into a coal scuttle in order to show that its coloration is concealing.

THE RÔLE OF COUNTERSHADING.

So much for the arguments by which Mr. Thayer sustains his positions. Now for a discussion of the positions themselves, as I quoted them at the outset of this writing. Reading those quotations, it will be seen that he

¹ Since writing this paper I have seen the excellent review of Mr. Thayer's book by Messrs. Barbour and Phillips in 'The Auk.' These gentlemen rightly say: "By skilful jugglings we are shown how anything and everything may be rendered inconspicuous, usually by artificial means, or under artificial conditions. . . . This method of persuasion, while it does appeal to the public, is — there is no other word — simply charlatany however unwitting."

claims that the counter-gradation of shades from dark mid-back to white mid-belly is the essence of concealing coloration, and not the likeness of the animal's color to its surroundings; and that all patterns, no matter how vivid and contrasting, make wholly for the obliteration of their wearers; that all gorgeous costumes have the same effect; that the "so-called" nuptial colors, mimicry marks, warning colors, and sexually selective colors are everywhere in the world the best conceivable devices for the concealment of the wearers, and the most perfect imaginable effacers under the very circumstances wherein such effacement is essential; and that finally "all patterns and colors whatsoever of all animals that ever prey or are ever preyed upon are under certain normal circumstances oblitative."

Stated in this sweeping form again and again, and with continued reassertion, Mr. Thayer's theory is absolutely false. It must be remembered that this theory is not at all that some patterns and some colors are concealing, that some animals are concealed by their coloration, facts which have long been known and universally admitted; his theory is that *all* patterns and *all* colors of *all* animals are concealing, and that the prime factor in the concealment is the countershading, with as secondary factors such pattern schemes as very bold and sharp contrasts between masses of color on the same animal. It is this theory thus sweepingly advanced which is absolutely false. Almost without exception nuptial colors and appendages occur in situations where the same colors are *not* commonly to be found in the wearer's background. Bold patterns and utmost contrasts of color in the majority of cases *do* tend to make their wearers conspicuous, and tell markedly against concealing them. Ordinarily, so-called mimicry marks and warning colors, and sexually selective colors, are usually not only *not* the best conceivable devices for the concealment of the wearer, but devices which, consciously or unconsciously, effectively advertise such wearer. Animals are most inconspicuous when they are purely and simply colored like their surroundings. The counter-gradation of shades from a black or very dark mid-back to a white mid-belly is hardly ever protective; and a protectively colored animal usually escapes detection precisely because it *is* colored like the ground or the bushes and sits motionless like a clod or a stump, amid such surroundings that the eye overlooks it because of the great abundance of the inanimate objects around about. Upon the great majority of animals that prey or are preyed upon there are some patterns or colors which under some normal circumstances are advertising, and as regards many animals all their patterns and colors whatsoever are never under any normal circumstances oblitative but always advertising. In other words, with one exception every single new proposition advanced by Mr. Thayer is contrary to the actual fact, and the only new proposition he advances which has any real merit, that regarding

counter-gradation, although important as a coloristic law, has a very limited application among birds and mammals so far as concealing them is concerned and is false in the extreme form in which he states it.

CONCEALMENT DUE MAINLY TO COVER AND HABITS.

In order that the real facts may be understood it is necessary to keep certain propositions clearly in mind.

Wherever the conditions are such that any object, no matter what its color, is difficult to see, it is a misuse of words to speak of all colors as concealing. The fact simply is that under such circumstances no color has much or any value, either concealing or advertising. In most forests, for instance, especially among the higher branches, there is an infinite variety of colors, of lights and shades, of distances and vistas, and an infinite number of individual objects, leaves, twigs, branches, excrescences on branches, and, on the ground, logs, sticks, heaps of earth, little gullies, stones, mosses, ferns, etc. etc. If the forest is sufficiently rich and the colors in it sufficiently varied, as in some tropical forests, the result is that any small bird or mammal of any color becomes very difficult to see. But this does not mean that the colors are concealing; it means merely that the surroundings are such that the advertising or concealing quality of any color is reduced to the minimum. In a dense tropical forest, as I know by actual experience, huge beasts like elephants, buffalo and rhinoceros, in spite of their size and their conspicuous uniform coloration, may be difficult to make out at any distance in the mass of gloom, in the occasional lights, and amid protecting tree trunks, vines and ground jungle. Very keen eyes, whether those of a savage or a wild beast, will see such animals much quicker than the white man's eyes. I have spent nearly a minute in endeavoring to make out an elephant much less than a hundred yards off which my native companion saw at once; but under such circumstances it would be absurd to speak of the elephant, or the rhinoceros, or the buffalo, as being protectively colored. The fact is simply that the surroundings are such that no coloration has very much effect one way or the other. What is true of these giant creatures is of course infinitely more true of small birds and mammals. If black squirrels, white-bellied squirrels, orange-bellied squirrels, gray squirrels, brilliant red male tanagers, dull green female tanagers, warblers of all conceivable colors, and nearly uniformly-colored vireos, are almost equally difficult to see among the tree tops, it means, not that every kind of coloration is concealing, which would be nonsense, but that the conditions are such that any small mammal or bird which remains motionless is difficult to see, and that its coloration is of little or no account. Again, the difference made by

the mere element of size must continually be taken into account. On the plains of Africa a cock ostrich is at once recognized as a most conspicuous bird because of its size and coloring. But disregarding the element of size, the bobolink and lark bunting are just as conspicuous as the ostrich. No man in his senses would speak of a cock ostrich as being protectively colored under any normal conditions; but it is precisely as great an error to speak of the cock bobolink or the cock lark bunting as being protectively colored. Nobody seriously pretends that the raven is protectively colored; but it is exactly as protectively colored as the cow bunting. The only difference is that the cow bunting is small and the raven big. A Blackburnian warbler the size of a turkey would be regarded as a marvel of advertising coloration; being a small bird, it is difficult to see, merely as a turkey would be difficult to see if it lived in the tops of sequoia trees. In picturing to ourselves the way that small birds and mammals look to the small birds and mammals that prey upon them, we should continually think how big birds and big mammals appear in our own eyes.

Now as to the insistence Mr. Thayer puts on some of his propositions. When he says that "the striking patterns" and "the utmost contrasts of color" on animals "make wholly for their obliteration," really the only way of answering him is by a negative. The red-headed woodpecker exactly fulfills Mr. Thayer's description of an animal with such a pattern and contrast of color. If in Mr. Thayer's eyes a red-headed woodpecker in its normal surroundings is inconspicuous there is no more to be said than we would say to a man who asserted that a large house standing alone on the prairie and colored half black and half white, with a bright red roof, was inconspicuous. The assertion is of interest from the standpoint only of an oculist interested in the observer's eyes. The red-headed woodpecker is one of the most conspicuous of all animate objects. Its habits are such that even a city-bred man must see this. There are innumerable examples of birds and animals as conspicuous, because of brilliant coloration, or because of their appendages, or because of being colored all one noticeable color, or with sharp contrasts of noticeable colors. Skunks, prongbucks, zebras, white goats, ravens, flamingoes, scissor-tailed flycatchers, yellow-headed blackbirds, bobolinks, white egrets are among such animals. There are immense families of birds, hummingbirds for instance, sun-birds, bee-eaters, where there are hundreds of species each of which possesses a coloration and appendages of a highly advertising value, and few or none which possess a coloration which is under normal circumstances of value to the bird for concealing purpose. As regards these numerous birds and mammals, it is hard to imagine how even the most careless or untrained observer can fail to note the advertising quality of their coloration. But as regards

the great majority of animals, we must remember that to the untrained eyes of civilized man they often appear inconspicuous, or as concealingly colored, when in the eyes of a savage hunter or a beast or bird of prey they do not seem inconspicuous at all. An ordinary man, even an ordinary scientific man of the closet variety, who is only acquainted with a zebra or a tanager in a museum, when he visits the wilds unconsciously expects to see the creatures loom up as conspicuously as in show cases; just exactly as a city man when first out after deer cannot even see a buck when it is pointed out. In consequence, instead of realizing that it is his own vision and attitude of mind which are at fault, he thinks that there is some peculiar attribute of invisibility in the animal itself.

Mr. Thayer says that nuptial colors are confined to situations where the same color is to be found in the wearer's background. Let him look out of his window, as I am looking at the Baltimore oriole in the elm, stroll down to his garden and see the orchard oriole in the cherry tree, or look at the red-winged blackbird sitting on a treetop beside the wet meadow, or at the bobolink in the pasture — the males of these four common birds each has a nuptial plumage (permanent or seasonal) with which there is nothing whatever in its normal background to correspond. For once that at any moment any one of these birds while in nuptial dress does find such a background there must be a thousand or ten thousand cases when the reverse is true. These are conspicuous birds, living where it is easy to observe them; but exactly the same thing is true of the hundreds of less conspicuous birds living as recluses round about us. It is true of almost all the warblers, for instance, of which so many species are to be found in our neighborhood, but which as a whole are such inconspicuous little birds.

Again, take what Mr. Thayer says of countershading, and of why a protectively colored animal escapes detection. Mr. Thayer insists that the animal escapes observation, not because its colors match its surroundings, or because it sits motionless like a stump, or clod, or some such inanimate thing, but purely because of its shading, which he says is rendered oblitative by the counter-gradation of shades, so that the eye does not recognize it as a solid object of any kind. That this is not so is proved by the simple fact that on an absolutely flat even surface no animal, whether counter-shaded or not, escapes notice. On a perfectly smooth lawn of very short grass a rabbit can be seen at a very long distance; on the great plains, as Mr. Hornaday has said, a jack rabbit looms up like a deer. On the flat, bare tennis court I can at once make out even a shrew or a mouse if as sometimes happens one of these little creatures strays there. The countershading is of no value in either case simply because there is no cover, no surrounding objects. Save in wholly exceptional cases, the countershading

by itself does *not* obliterate the animal; it does not render the eye apt to fail to recognize it as a solid object of some kind. The two prime features in enabling a dull-colored rabbit or mouse or other small animal to escape notice are, the likeness of the creature's coat in color to some of the surroundings, and the fact that it sits motionless among clods, stones, sticks and other inanimate objects so that the eye picks it out with difficulty from among them. In other words, the facts are the direct reverse of what they are as stated by Mr. Thayer. A muddy tennis ball in a ploughed field or among the dead leaves of a wood, or even in grass, is about as inconspicuous as a meadow mouse; the dull colors in one case harmonize with the surroundings just about as they do in the other. Often in the Rockies I have searched in vain to place woodchucks or pikas which I could hear whistling or squeaking, and finally I would see them only when what I had supposed to be a lump of earth or rock among other lumps of earth or rock move off. But I never found any difficulty in seeing either when I could get it on an entirely smooth surface of rock or ground, unless the color of the surface happened to agree absolutely with the color of the coat. I have already spoken of a rabbit's conspicuousness when on a flat level of short grass. It is difficult to see in long grass, or among tufts of grass, and still more in a wood, just because it is colored like some of the surroundings, and, more especially because the abundance of inanimate objects round about makes it hard to pick out. If it is sitting stern on its countershading practically vanishes for the rump, which is pressed against the ground, is as dark as the fore part or middle part of the back which is slightly raised; yet it is no more easy to make out in this position than if sideways to the observer. This alone shows how slight is the part that countershading plays in concealment, and it represents the results of observations that any one can make if he will look at the rabbits in the woods and fields of his own neighborhood, as I have been looking at them this spring. I have observed dozens of wild rabbits during the last few months. In short grass they are conspicuous, the countershading having no effect whatever, and the brown coat being sharply relieved against the green background. In long grass or thick shrubbery they are exceedingly difficult to see, not in the least because of their coloration, but because of their habit of crouching motionless, and because the cover physically screens them from vision. In the woods or in open undergrowth they are difficult to see (but not impossible to see), because their coloration is dull in tint, not vivid, and in general harmony with the dead leaves, twigs and shadows, and because the light is not bright, or if it is bright there is much play of light and shadow, and because there are so many varying vistas and obstacles and such countless irregularities and projections in the surroundings. If in such cases the

rabbit is sitting sideways to the observer the countershading may possibly play a very small part in helping to make it inconspicuous by rendering the lower outline dim; but I am not sure that even so much as this is true, because, as I have said above, a rabbit sitting with its stern towards the observer, loses all effect of countershading and yet seems just as difficult to make out. This spring, once or twice after heavy rain I have seen meadow mice in unusually open spots where I could examine them having in view this matter of concealing coloration. When they move they are visible at once; when they are still they always crouch nearly flat — their short legs render this necessary — and there is then practically no effect of countershading; it is a negligible element in concealing them; they are concealed because their dull colors, round contours, and absolute immobility make them look like lumps of mud, or other natural objects so that the eye fails to distinguish them from their surroundings, as one fails to distinguish a muddy tennis ball. On an absolutely flat and bare surface they are seen at once. Strolling through the woods this spring, birds such as the redstarts, black and white creepers, and yellow-throats were seen at once, the “countershading” on them not having the slightest effect, because the colors themselves (black, white, yellow, orange red) were so vivid; and the dull colored birds that tried to escape notice always crouched so low that the effect of the countershading practically vanished, and it was merely the general dull tint of the upper parts, together with the screen of the cover, and the varied surroundings, that enabled them, thanks to their habit of crouching motionless, to have a fair chance of escaping observation. All of these birds and mammals were observed under natural, not unnatural, conditions, at the time when, if ever, their coloration patterns and countershading would have been of use in concealing them.

The countershading, therefore, plays a wholly minor and inconsiderable part (usually an entirely negligible part) in the concealment of animals under such conditions. It does, however, I believe, play a certain small part, in some cases, even with birds and mammals, and very possibly a far greater part with lower forms of life; and Mr. Thayer is entitled to full credit for calling attention to this fact. Unfortunately as regards mammals and birds, he has given it a thousand-fold more importance than that to which it is entitled. The first consideration to be remembered in connection with countershading as regards birds and mammals is that it is of no value whatever to the animal unless the general tint is in harmony with some of the surroundings (and unless the ground is sufficiently accidented to confuse the eye of the observer and cause difficulty in picking out the living creature from among the inanimate surroundings). A dark-brown

countershaded animal in a green meadow or on a gray desert is practically as conspicuous as if it were not countershaded at all. Moreover, the countershading avails nothing for protection if the actual color above is black or the actual color below white, or if the pattern of the coloration is vivid.

As I have said again and again, but as I suppose I had better repeat in order to prevent all chance of misunderstanding or of misrepresentation, there is no conceivable color or combination of colors which may not under some exceptional circumstances be concealing. A British grenadier in a red coat and a bearskin hat might find himself, in some fight in a village, surrounded for a moment by red and black objects — red petticoats and black skirts on a wash-line for instance — which would make his coloration-scheme protective; and really it would be no more absurd to speak of the grenadier's uniform as therefore of a concealing character than it is for Mr. Thayer to speak of the red-winged blackbird's coloration as concealing, because it is possible that a hawk sailing overhead may on very rare occasions,—on an infinitesimal number of occasions,—see him against a background of black mud; or to speak of red crossbills and pine grosbeaks as protectively colored because, as he says, in northern winter landscapes the chief colors are "black," "white," "blue," "gray," "green," "golden-brown," "red," "purple" and "vinous ash." (In the first place, of course if all these colors are concealing, then it is quite impossible to imagine any color or combination of colors that shall not be concealing; and in the next place, if the red males of the grosbeaks and crossbills are concealingly colored, then their dull colored mates are not.) There are exceptional circumstances in which a white belly or a black back may be concealing; although hardly any circumstances in which both a white belly and a black back can be concealing. Normally both are advertising for all animals under all conditions where they can be seen at all. Multitudes of small shrews and mice (and outside of Australia ninety-nine per cent of the aggregate of individual mammals are shrews or mice) have brilliant white under parts. Where, as in many species, this white extends up the sides, as in the case of the pouched kangaroo rats, it has a certain advertising effect, or at least would have were it not for the fact that the great majority of these species are either nocturnal or else live in cover so completely protecting or concealing that their coloration is of no consequence. Where the color is simply on the belly, it does not advertise the animal, merely because it is not seen; that is, instead of this coloration concealing the animal, the animal conceals the coloration, and it has no effect one way or the other. It is safe to say that, whatever may be the causes that have produced the predominance of white on the bellies and underparts of so many mammals and birds, these causes have had nothing to do with the production of a concealing coloration.

It is hard to figure to ourselves just the effect that the coloration of mice or shrews has upon the small mammals that may see them from one side — the birds of prey, of course, see them from above, so that white cannot affect these birds one way or the other. Perhaps we can gain an idea by thinking of the effect that large black and white animals have upon our own eyes. The sable antelope of Africa is colored black and white, and it is one of the most conspicuous animals in the entire African fauna. An absolutely black coloration is itself so conspicuous that I hesitate about using a comparative or superlative in connection with it; but if there is anything more conspicuous it is an absolutely black animal with the black relieved by a snow-white belly of which the color extends a short distance up on the sides. The sable antelope of East Africa, however, at noon retires into thick cover to lie down. It is then hidden from the sight of its foes simply because the cover is so thick that its highly advertising coloration becomes of no consequence, and it cannot be hunted with much chance of success. When on the plains in the morning and evening it can be seen at once and makes not the slightest effort to try to evade being seen, simply endeavoring to watch for any foe. The black or blackish old bucks of the white-eared kob are substantially, for their size, as conspicuous as the sable, and are also beasts of the open. As I shall hereafter show, these big antelopes of the plains owe nothing to concealing coloration, any more than buffalo, elephant and rhino do. On a great plain covered with grass two or three feet high every zebra, wildebeest, topi, kongoni, eland, Grant's gazelle or oryx, within range of vision, will be seen at once, as the animals have no idea of hiding, and stand very erect. Yet a lion on such a plain would probably not be seen at all, and a leopard would almost certainly escape observation: and neither of them, even if accidentally seen, could be hunted with any chance of success, simply because each would skulk away under cover of the grass. Their coloration is no more protective than that of the eland or oryx or the big gazelle bucks, and if their habits were like those of the antelope they would be just as conspicuous. It is the difference in habit and in desire and ability to take advantage of cover and not the difference in coloration which under such circumstances make the lion and leopard so very difficult to see under exactly the same conditions which make it impossible for the big antelope to escape observation. Moreover we must always remember that if there is any cover any animal that stays still may escape observation; and if in sufficiently thick cover will in all probability escape observation. In reeds, elephant grass, papyrus and thick jungle, elephant, rhino and buffalo will often stand motionless when they suspect a hunter is following them; and then, in spite of their bulk and of what even Mr. Thayer admits to be their advertising coloration, that is, the dark monochrome of their huge bodies,

they cannot be seen until they are stumbled upon at a short distance; a fact so self evident to every hunter that the danger of following these animals in such cover is proverbial. In short, wherever the cover is at all thick, it is the cover itself and the ability to take advantage of it—in other words the animal's habit of life—that count infinitely more than the coloration; and in the coloration it is the general tint and its harmony with the surroundings that count, infinitely more than the countershading can possibly count. This is more readily seen by us to be true in the case of big mammals and birds, because we can study these with ease from the standpoint of their natural foes or their natural prey; but the facts are fundamentally the same as regards mice and sparrows and as regards antelope and ostriches. These facts ought to be self evident: but if anyone doubts them let him remember the occasions when he has lost a pipe or a penknife in a meadow or a forest, or even on a plain of short grass. The pipe is not countershaded, and the penknife is probably advertisingly colored, and yet an indefinite search may be necessary before either is discovered.

The white or yellow breasts of birds are generally advertising and are generally concealed by the birds crouching as soon as they suspect danger or desire to escape observation. If a wood thrush is sitting facing toward the observer, it is apt to be seen a little more quickly than if it has its back toward him. But the prime need for observers to keep in mind when watching the creatures of the forest, or the creatures of the grass which habitually appear below and not above the level of the grass tops, is that not only does the cover serve as a physical screen, but that by its infinite variety it makes it easy for anything motionless to escape observation. There are in a forest, whether among the branches or on the ground underneath, a myriad lights and shadows, shades of color, vistas of infinitely varied length, and material objects of almost every conceivable shape and size; and in such a wealth of varying detail it is very difficult for the eye to pick out any single motionless object whatever its color. In the grass the same is true to a less extent, and the less variety in, is counter-balanced by the greater thickness, and therefore greater screen effect of, the cover.

It thus appears that the coloration very rarely has a concealing effect unless it is assisted by cover and is in harmony with the surroundings; and that as regards the majority of birds and mammals that seek to conceal themselves cover is a far more important element than coloration, although sometimes coloration is also important. Certain species of mammals and birds, including nighthawks, and many grouse, snipe and desert birds, are concealed by their coloration without regard to cover and show by their actions their ability to take advantage of their concealing coloration; but

cover is generally the vital element. As far as countershading is concerned, it has no oblitative effect whatever if the pattern is of conspicuous colors; a bird colored black or red or blue above and white or yellow or reddish brown below may be countershaded, but it is certainly not oblensively colored. The countershading can be of assistance only when there is a gradual fading from a neutral tint above to a lighter neutral tint below, and when these tints are in substantial harmony with the colors of the landscape. Keep in mind always that movement tends to reveal any animal, no matter how it is colored; coloration conceals chiefly when the wearer is motionless. The habits of a bird or mammal must always be considered before saying whether its coloration is or is not concealing; an animal which possesses a really concealing coloration almost always acts in a manner which will make it useful — as a nighthawk acts when sitting in a field or on a roof in the day time. When a bird behaves as a robin or oriole, for instance, behaves, it indicates that its coloration is not concealing.

To those who think that countershading in the animal world is due to natural selection working in every instance for the production of a concealing coloration I would call attention to the vegetable world. The commonest of all vegetable productions are leaves. They exist in myriads everywhere; and almost all of them are colored dark above and light below. The same thing is true of multitudes of flowers, and of most fruits. In a note recently received from John Burroughs on this subject he says: "Why, pumpkins and melons and apples and peaches are lighter underneath, no doubt with a view to protection from the boys!" The principle of natural selection working toward a concealing coloring is certainly not responsible for what is seen in the plant world, and it may be but little more responsible for what is seen in the animal world. In so far as countershading is, for this purpose, held merely to mean a lightening of neutral tint from above downwards, without violent breaks, it is possible to argue that it has been produced by natural selection working towards the production of a concealing coloration — at least such a position may be defensible (although I am not personally convinced that it is true as a general rule, so far as mammals and birds are concerned). But it is quite impossible that any such cause can have produced the white bellies of animals, which are no more protective or concealing to their owners than are the light under-surfaces of leaves to the leaves. As most animals that rely for defense upon their coloration crouch motionless in order to escape observation, thereby reducing the countershading to a minimum, and as many animals that are not countershaded at all, such as wolverines, fishers and minks, are just as successful in life as others that are countershaded, it follows that Mr. Thayer's prin-

ciple of countershading as a prime factor in helping the wearer by concealing it, cannot apply universally: and it is quite possible that it does not apply at all; personally I am inclined to think that among birds and mammals it may sometimes apply, but only in a very limited number of cases. If we consider the colors of tree trunks, we shall be better prepared to understand that differences of colors in birds and mammals may come in part from causes for which we are at present entirely unable to account. A cinnamon sequoia, a red manzanita, a white birch, a spotted sycamore, a gray beech, a black oak, a white oak, have trunks and stems as differently colored as are the bodies of most birds or most mammals; and the rarity of brilliant bird-hues in mammals may have no more to do with concealing coloration than the rarity of black in tulips.

Above, in commenting on the fact that its small size renders it hard for us to discern the color of a small bird at any distance, or even to distinguish it readily, no matter what its color, when in varied or fairly thick cover, I took the cock ostrich as illustrating, by the way it appears in our eyes, the way in which ordinary birds appear to other birds, or small mammals. The ostrich looms as large to us as a grouse or gallinule to a weasel or mink. The lion, and occasionally the leopard, are foes of the old birds; hyænas, jackals, wildcats, eagles and vultures prey on the chicks or eggs. The cock ostrich, with his black coloration, varied by white, is one of the most conspicuous of living creatures. In the African landscape I found that I could see a cock ostrich farther than any other game except the elephant and giraffe, and possibly the rhinoceros. The hen is neutral tinted. She is visible only at a far shorter distance than the cock; and relatively to him she is concealingly colored. Nevertheless this concealing coloration is of absolutely no advantage to her in her ordinary life. She cannot be seen as far as the cock, but she can be seen at such a distance as to expose her to the attack of any enemy that would attack the cock, and neither of them makes any effort to hide, trusting purely to eyesight, wariness and speed for safety. Both parents lead about the chicks, which run freely as soon as they leave the egg; so that the hen gains nothing from her concealing coloration at this time, and the chicks gain nothing from it. There remains only the period covered by the actual brooding of the eggs. If the hen alone brooded the eggs, it could be said that she was concealingly colored to defend her while performing this vital function. But the cock and the hen brood alternately, and I could never find that his advertising, and her concealing, coloration made any difference as far as discovering the nest was concerned. I have seen it stated that the cock only broods by night; but in observing wild ostriches in East Africa I found the cock on the nest in the daytime as often as the hen. The bird sits on the eggs with its neck out-

stretched on the ground in front of it. The nest — if such it can be called — is placed where bushes and patches of grass are scattered around, so as to screen the bird from the sight of passing creatures unless they come very near. According to my experience hen and cock lie equally close, and, to my astonishment, the cock proved no easier to make out than the hen when on the nest. This was due to the simple fact that unless there had been bushes or other substances serving as a screen, even the dull colored hen would have been seen against the bare ground at a distance of several hundred yards; but inasmuch as there was a screen, which hid the birds without regard to their color, neither cock nor hen paid any heed until the intruder got within forty to a hundred yards; by that time the sitting bird, whether cock or hen, ceased to feel safe, arose, and fled. In this case, therefore, we find two birds, the male and female of the same species, having exactly the same habits, living in exactly the same surroundings, one with a highly advertising coloration, the other with a countershaded concealing coloration; and neither coloration has one particle of effect, to the advantage or disadvantage of either bird. Their way of life is such, their eyesight is so good, their power of lying still and using cover as a screen while on the eggs is so marked, and their wariness and speed at other times are so great, that the effect of their coloration upon their safety is absolutely nil. This is a noteworthy and interesting fact, of genuine importance when we come to consider the effect of concealing coloration upon smaller birds whose habits we are not able to judge from the same plane of common size.

There are many water birds, and a few land birds, which while far inferior in size to the ostrich are yet big enough for us to judge fairly well their qualities of concealment or the reverse. The big African bustards are of the number. These are stately, handsome birds, heavier than a turkey, but standing more like a crane than a turkey, and living in the open. They are equipped with exquisitely delicate tracery patterns, the general effect of their coloration, in most species, being neutral, with strong countershading. But in short grass, on the plains, they are conspicuous at a long distance when standing erect, or walking; their countershading and neutral coloration are of no effect in enabling them to escape notice where there is insufficient cover, and under such conditions they rely for safety purely on their wariness and keen sight. When nesting, or when tired, they seek to escape notice by crouching, always in long grass. Under such circumstances they trust only to the screen of the cover to protect them. The minute pattern of much of their head, neck, and body coloration cannot possibly be of assistance to them; it is the cover that screens them; aided perhaps by the general neutral tint of their plumage, although of this I am

not sure, for some of these big birds which possess advertising marks seem equally difficult to see in the same cover. The countershading is of no consequence to them one way or the other, for it becomes practically negligible when they crouch in thick cover. But the young which rely on hiding for protection, and always seek cover, are probably benefited by their coloration and possibly by countershading — although as regards this last suggestion I am by no means sure, and would like to get the statements of practical observers who have seen the young in a state of nature.

The beautiful African crested crane has a strikingly advertising coloration and the adults never seek safety in concealment. The same is true of our nearly extinct whooping crane. The sandhill crane has a much less advertising coloration; but it no more trusts to concealment than does its bolder-colored brother, the coloration being of no consequence one way or the other to the adults, as far as escaping observation is concerned; the young, however, often seek to hide in cover, using it as a screen, and although as regards them the cover screen must be altogether the chief element in concealing them, it may also be that the coloration plays a subordinate part.

As regards the big waders, the birds of the water's edge and the marsh, coloration plays no part at all in the concealment or protection of the great majority of the species. In North Dakota, Texas, Louisiana, and even in Florida, New York, Maine, New Jersey and California, and above all in Africa, I have watched the big waders and swimmers for hours at a time, under all circumstances; and there are certain facts of which I am sure, and of which any observer, trained or untrained, can be sure if he will watch the birds under favorable conditions, trying really to observe what he sees, and not merely endeavoring to twist and upset the facts so as to make them fit some impossible theory.

The coloration of flamingoes, spoonbills, black and white storks, white, red, black or glossy ibises, and white herons, is in the highest degree advertising. Nevertheless I doubt if this advertising color puts them at even a slight disadvantage compared to the other waders of the same or closely allied genera, and of similar size, which are slaty blue, purple, brown, green, or of varied or even neutral tints. Their habitat and manner of life are such that concealing coloration confers no benefit whatever upon them and advertising coloration does them no harm. No coloration makes the slightest difference to them in catching their prey; this is proved by the fact that the great white heron and great blue heron, and white egret and little blue heron, catch their prey with precisely equal facility in precisely the same surroundings and under precisely the same conditions; yet their colorations are as diverse as it is possible to imagine; so that it is physically impossible that the coloration can have the least effect on their

ability to catch their prey. Indeed the great white heron and the reddish egret each has one white and one colored phase, which prosper indiscriminately. Some of the herons, like the Florida blue heron, have no countershading; others, like the Louisiana, are countershaded, or have white bellies; and neither the presence nor the absence of the countershading makes the slightest difference in concealing the bird or in rendering it easier or harder for it to escape its foes or capture its prey. The nuptial plumes have on the whole a slightly advertising effect (under normal conditions they cannot possibly have a concealing effect once, where they have an advertising effect a hundred times); but the birds are so conspicuous anyhow that the effect of these plumes is of no consequence either way, and in the breeding season the great majority of the species gather in heronries which are so conspicuous — both the heronry itself and the individual nests and the old birds and the young birds — that no plume or nuptial ornament, nor minute pattern, would have the slightest effect either for advertisement or concealment. A curious light is thrown on Mr. Thayer's theory that the white herons are white so as to deceive their prey in the water, by the fact that the commonest white heron in Africa, the little cow heron, which accompanies in flocks the elephant, rhinoceros and buffalo, as well as domestic cattle, is almost purely a land bird, living on the insects disturbed by the feet of its huge, clumsy hosts, and, because of its coloration, being as conspicuous as a bird of its size can be. There are however certain small, generally dull colored members of the heron family, which skulk among the reeds, and are sometimes difficult to see. It would be well worth while to study these birds so as to find out whether they are hidden purely by the screen of reeds, or whether their coloration helps to conceal them. I believe that the coloration of certain bitterns is concealing, and that the bird takes advantage of this feature of its coloration; whereas in the lives of most herons neither cover nor coloration count for anything and the habits of the birds show that they do not trust at all to escaping observation. One small African species of heron or bittern displays much white when it flies, and is then conspicuous; but the instant it lights and folds its wings the white vanishes, and the dull-colored bird eludes the eye against the mud and reeds.

The ralline birds offer somewhat similar problems. The true rails are finished skulkers. They may swarm in a marsh and never be seen unless put up by a boat at high tide. Their coloration is varied, but on the whole is not advertising, and it is probable that as regards some species it has some concealing value. But if this is true, then it is difficult to account for the fact that the coots and gallinules, which live less in the reeds and are more aquatic, and have greater need of concealing coloration, are nevertheless

equipped with what is really a revealing coloration. They are practically monochromes; many of the gallinules are iridescent. Mr. Thayer considers iridescence "concealing" (which of course it is not, as any human being can tell by looking at the first crow or grackle he comes across); if this were the fact, the further fact would remain that the coots, among the most abundant and widely spread of all waterfowl or waders, are dark slate or blackish without iridescence or countershading. The rails seems to be protected chiefly, and perhaps purely, by their skulking habits and method of progress and by the impenetrable screen of the thick cover in which they dwell; indeed keeping in mind the fact that the coots and gallinules which live more in the open are without concealing coloration, it is difficult to believe that their coloration has any effect, one way or the other, upon any of these birds, rails, coots or gallinules, whether in concealing them from their foes or from their prey. It certainly has no effect whatever as regards some of the species. The coots cannot owe their safety to their coloration; if the varied and countershaded coloration of the big rails is concealing then the non-countershaded monochrome of the coot cannot be nor yet the glittering iridescence of the gallinule — except in so far as it may be said that on mud flats and among reeds any dark hue is concealing, any color except white, crimson, or yellow. But the coot lives largely in open water, where its coloration is exceedingly conspicuous.

The jacanas have a highly advertising coloration, and live in the open.

There are certain smaller waders which possess coloration as markedly advertising as those of the storks or ibises. Such are the avocets, stilts, oyster-catchers, turnstones, and the American black-bellied and golden plovers, and many African plovers and coursers. The avocets, stilts, oyster-catchers, and turnstones, except one or two species which are entirely black, are black or brown above, and white below; the black-bellied and golden plover are black below and white or white and brown above. Mr. Thayer speaks of the former as countershaded, and therefore obliteratively colored. If by countershading is meant black prevailing above and white below, then they are countershaded; but such "countershading" represents one of the most highly advertising species of coloration. However, Mr. Thayer says that the golden and black-bellied plover are also inconspicuous just because they are black below. Of course both diametrically opposite patterns cannot be oblitative; and as a matter of fact neither is. In the chapter (XIII) where he deals with these patterns, Mr. Thayer explains that "perfect uniformity of coloration makes a thing conspicuous." If this is so, and his first statements are true, then the black oyster-catcher is conspicuous and the other birds I have mentioned are not. As a matter of fact all are exceedingly conspicuous. Apparently when Mr. Thayer

makes statements like this he forgets what he elsewhere says about pure white birds like herons, dull black birds like dusky grouse and coots, and iridescent birds like crows. At different times he contends that *all* their colorations are concealing; and usually when he is thinking only of one species of coloration, as in this case, he says it is concealing because it is *not* like the others which elsewhere he says *are* concealing. He does this again and again. He says the eiders are protectively colored because they are white above and black below;¹ if he would take the trouble to glance at any book on ornithology (or of course to go out on the winter seas off New England, or on Puget Sound, or inquire of anyone who has sailed north of Nova Scotia or British Columbia) he would see that the scoters, which have substantially the same range as the eiders, are black above and below; that the old squaw, which has the same range, is black and white above and below; that the golden-eyes, with a range which partly coincides with and partly overlaps the range of the eider, are white below and black above; that other ducks of the same regions are totally differently colored; that some geese of the same region are white, some blue-gray, some almost black, some of varied colors. Now, these colors cannot all be concealing. If it is concealing to be black above and white below, it cannot be concealing to bear the colors exactly reversed; or to be black all over; or to be white all over; or to be pied; or to be of mixed colors with a pattern of a totally different kind. Mr. Thayer's statement if true of one set of species must be untrue of all the other sets of species; and as a matter of fact it is not true of any. The fact is that all the black, the white, and the boldly marked black and white, swans, geese and ducks have coloration patterns which are in the highest degree advertising; so have the sheldrakes, mallard, bufflehead, spoonbill, wood duck, canvas-back, redhead and scaups, as far as the drakes (and in some species the ducks) are concerned. But some of the females of these species do seem to have coloration patterns which are concealing or may be so under some circumstances; a serious study of these birds would be of genuine interest, if the student would by actual observation seek to find out whether the female's coloration does actually conceal her when on the nest, and whether at other times it confers upon her any advantage as compared with

¹ The eider drakes of many species (but not of all species) are thus colored. The females are generally dull colored, and may be concealingly colored. The young in the down are very possibly concealingly colored; one mounted in a squatting position (the position it would take), in the American Museum, shows no countershading. An unprejudiced and capable observer of these birds in their homes would be able to tell us whether in the nesting season the females and young are, either or both of them, protectively colored, and whether they behave accordingly. Mr. Chapman's photographs (in his 'Camps and Cruises') show that both questions must probably be answered in the affirmative; the photograph on page 412 also shows the great conspicuousness of the male eider, when on the rock near the female.

the brilliant suit of her mate, and whether the young are concealingly colored. It would be interesting to find whether any real difference under the circumstances of their actual lives in nature is caused by the fact that many of these birds are countershaded, while others, such as the swans, snow geese, dusky ducks, and harlequin ducks are not countershaded, and yet others, such as the black-bellied tree duck, are inversely countershaded, being darkest below. Apparently the countershading has not the slightest effect, one way or the other; of two closely allied species, such as the mallard and dusky duck, or various tree ducks, one may possess it and the other not, and yet both may have the same habits and thrive equally well.

Mr. Thayer's theory when he applies it to other water birds breaks down even more completely than when he applies it to ducks and geese; and this largely because he seeks to apply it to classes of cases which are mutually exclusive. He gives a picture of guillemots (murres ?) designed to show that their "ruptive" coloration, black with a white breast and belly, hides the birds, the white fading into the sky, the black into the rocks. His own picture shows the reverse is the case; the coloration of the murre is always advertising, the white revealing it instantly when on the rocks, and the black at other times. Moreover Mr. Thayer ought to have known that there is one guillemot completely black, with a white spot on the wing coverts, and, if the white belly concealed one guillemot, the black belly would reveal the other. The auks, puffins, guillemots and murres all have advertising coloration, some practically monochrome, most of them boldly bicolor; a point worth trying to work out is the reason why some live in burrows and others nest on bare rocks. Mr. Thayer believes that the cormorants are helped in catching their food by their nearly uniform dark coloration; in which case of course the bicolored plumage of the loons, auks, puffins, and murres would harm them. Neither supposition has any warrant; all these sea birds have advertising coloration; and so have the loons, most grebes, all pelicans, practically all gulls, and most petrels. Mr. Thayer supposes that a white under surface renders soaring, raptorial birds, such as gulls and most hawks, almost invisible to their prey; a supposition he can only maintain by forgetting birds like noddys, skuas, black terns, brown pelicans, brown gulls (the young), shearwaters, rough-legged hawks, various black hawks, and above all those most formidable of raptorial birds, the eagles — all of which are black or dark brown, or some other dark color, below. The fact is that all birds which fly or soar while on the lookout for their prey are so conspicuous anyhow that their coloration has not the slightest concealing or revealing effect one way or the other; and their coloration patterns and countershading, when present, have no effect whether in either helping or hindering

them in the chase of their prey. This is as true of the white gyrfalcon as of the "black" gyrfalcon; of the sharp-shinned hawk or the goshawk as of the black rough-legged buzzard or black band-tailed hawk; of the common duck hawk as of the black peregrine falcon. Our commonest small hawk in this neighborhood, the sharp-shinned, for instance, goes everywhere; it is now in the open, now in the woods; by no possibility could its color conceal it in all localities; and as it is constantly in motion, its coloration in fact never conceals it at all. White-headed eagles, golden eagles, swallow-tailed and white-tailed kites, and many other birds of prey possess strikingly advertising coloration; very few birds of prey are concealingly colored in their natural surroundings. They all pounce with great speed on their quarry, from a distance which renders it absolutely impossible that their minute coloration patterns could in any case be of the slightest assistance to them.

Kingfishers have an advertising coloration; their habits conclusively prove that concealment plays no part in helping the adults to avoid their foes or to catch their prey.

In dealing with the smaller common birds of farm, garden, forest and prairie it is of course not possible to discuss them individually in an article like this. But it is possible to treat of certain general considerations and to treat most of the birds in classes. The claim that a large number of birds each colored utterly unlike the others both in tint and pattern and all living in substantially the same surroundings, are all concealingly colored, can never be tenable. All that is necessary for anyone to do in order to see this, is carefully to study the birds in his immediate neighborhood; constantly keeping in mind the effect of mere size in rendering a bird conspicuous or inconspicuous, and the fact that cover may and generally does act as a screen entirely independent of color. Here, near my house, for instance, there is a hedge or tangle running on one side of the garden and of the back road. In this are to be found thrashers, towhees, catbirds, chats, indigo buntings, and Maryland yellow-throats (together of course with other birds). All six of these birds, if the size of crows, would at once be recognized as conspicuously colored. The red of the thrashers, the gray of the catbird, the boldly varied black, white and chestnut of the towhee, the olive green upper surface and bright yellow under surface of the chat, the black mask varying the green and yellow of the yellow-throat, the uniform iridescent indigo of the male bunting and the uniform lustreless brown of his mate, are as different from one another as they can possibly be, and are equally different from the really inconspicuous, dull, counter-shaded, largely streaked coloration of one or two species of sparrows, such as the bush sparrow, which live in the same kind of thicket. Seen from

any angle, these colors are so utterly unlike that it is impossible that they can all be concealing. From a level the bright yellow breasts of the chat and yellow-throat are vivid to the eye; the towhees and the cock indigo bunting are for their size conspicuous from every standpoint. From above the backs of the different birds are respectively olive green, reddish, black, blue, gray, and brown. The fact is that not one of these birds really has a concealing coloration; the towhee cock (and to a somewhat less extent the towhee hen) and the indigo cock bunting and cock Maryland yellow-throat are advertisingly colored; and so is the chat unless seen directly from above. They owe their concealment to the cover, and to their personal habits. The chat is a very voluble bird, and apt to cut queer antics in the air; its coloration is much more conspicuous than that of the catbird; but it is so shy, and hops and dives in and out among the underbrush with such furtive agility, that it is far harder to see than the catbird. Birds with bright under colors or breast colors like the towhee, chat and yellow-throat are not helped by countershading, which in their case has no concealing value whatever; as regards all the birds in question the countershading is without concealing effect of any kind, unless, very dubiously, in the case of the thrashers; and even as regards the thrashers I doubt very much whether there is any effect, for the foxy red upper parts are generally advertising, and the bird relies for escaping observation upon the thick cover and its own skulking ability. Habit and cover are all important, and the coloration of no importance, as regards concealing these birds and helping them escape from their foes. This is seen when they are menaced by hawks. I have seen at different times hawks stoop at catbirds, mockingbirds and thrashers, all birds of similar habits. Twice the hawk caught the bird at the first stoop. But I saw one bird of each of the three species escape. In each case the hunted bird dove among the branches of a tree or bush, lit, and remained motionless; twice the hawk also lit and looked around, on the third occasion the hawk checked itself and swung round in the air; in each case the hunted bird, before it was again seen, flew suddenly, dodging around the tree and through the branches, and got into such thick cover that it escaped. The mockingbird showed the white on its tail, conspicuously, as it flew and shut the tail when it lit, so as to cheat the eye; but the catbird and thrasher had no white on their tails and yet pursued precisely the same course. Evidently in each case the bird in its desperate need flew into the first available, even partial cover, and crouched motionless to escape the eyes of its pursuer; and then again flew, getting just a little start, and whirling into such a mass of twigs and leaves that its dodging ability rendered it safe. As the three birds are totally differently colored, it could not have been their coloration which enabled them to escape for

the moment the hawk's eyes; he lost sight of them because, in the cover they suddenly stopped and remained motionless, and then dodged off before his eye could pick them out.

In the high woods of oak, hickory and chestnut, at the foot of the hill near my house, the birds are different from those in the hedges of which I have spoken. (I treat only of those that are most common). Oven-birds stroll about on the ground, wood thrushes perch above them, among the lower branches, and higher up come wood pewees, black and white creepers, downy woodpeckers, red-eyed vireos, cuckoos, blue jays, great-crested flycatchers (also found near the house) and scarlet tanagers. The last five are often found among the tree tops, together with various species of warblers during the migrations. Anyone can see that these birds possess many different kinds of coloration. The wood pewee and red-eyed vireo are the least conspicuously colored; yet neither endeavors to hide, and as both are continually in motion, the pewee making intermittent swoops, and the vireo hopping and crawling with leisurely but unintermittent activity among the twigs, they are readily seen. To my eyes the black and white creeper is a conspicuous little bird. But the only birds which are really difficult to see are those that haunt the tree tops. This is because the light is in the eyes of the gazer, and because the leaves and twigs make a mass of confusing objects, with vistas of every length opening among them, and all shot through with a shifting play of light and shadow, so that there are all kinds of color tones. The male tanager is hard to see amid such surroundings, because he is at such a distance that he seems very small, and is easily screened or hidden in whole or in part, for in such surroundings any object is hard to pick out. But he is much easier to see than his greenish mate, or than any of the other less brilliant birds such as the cuckoo; his coloration is in the highest degree advertising; it does not harmonize with the surroundings so as to make him less conspicuous; but his surroundings are such that even his advertising coloration is not as glaringly conspicuous as it would be elsewhere.

Around the house, among the scattered trees and bushes, and on the grass, the birds are seen near by, and are far easier to mark. The Baltimore orioles are very conspicuous; their coloration is never concealing, and under all normal circumstances is highly advertising. The meadowlark tries to conceal itself; its upper coloration is distinctly concealing; but its black and yellow breast is highly advertising, and is very conspicuous when the bird is singing, while it is hidden when the bird crouches or skulks through the grass. The coloration of the robin is less advertising than that of the oriole, and much less advertising than the coloration of its cousin

the European blackbird,¹ which is singularly conspicuous. Nevertheless it is distinctly advertising, having ordinarily a revealing, and hardly ever a concealing effect. How anyone can look at this familiar bird, and believe that it has a concealing coloration is past understanding. It is always conspicuous; it never tries to hide; as nests go, its nest is conspicuous, and the eggs are of a conspicuous color; its coloration, its ways, its boldness, all alike advertise it. Its abundance, and evident success in life, prove how small a part concealing coloration plays in evolving or preserving some of our commonest and best known species. The flickers are conspicuous birds of advertising coloration. When the bluebirds visit us a glance is sufficient to note the highly advertising quality which their coloration possesses under all normal conditions. The kingbirds likewise have a highly advertising coloration; they are conspicuous even when nesting; they rely for safety upon their boldness and truculence. I do not suppose that anyone can deny that the thistle finches have a strongly advertising coloration. The cow buntings that stroll about in the grass are also advertisingly colored, and never seek to hide. But the grasshopper sparrows run through the grass like mice, and while their skulking ability and the cover itself play the leading part in protecting them, their coloration also helps to conceal them. On the other hand the song sparrows, which sometimes nest almost alongside them, do little hiding, and are rather conspicuous little birds. The chippy also is not much given to hiding.

I have thus mentioned a couple of dozen common birds, among the species easiest to study at our very doors. Over half of them clearly possess advertising colorations; that is, all, or some main feature of, the coloration pattern, instead of tending to conceal the wearer, tends to reveal the wearer, under normal conditions. One species, one of the grass sparrows, is an adept in hiding, and has a coloration which clearly aids it in hiding; that is, its coloration is concealing. (In none of these birds is the countershading of any consequence; those which possess it are no more difficult to see than those which do not.) The meadowlark also has a concealing coloration above, which is evidently much trusted by the bird; although its coloration below is advertising. Many of the birds living near the house are birds of scattered groves; some of them are birds which spend their time on the ground; and such of these as possess advertising coloration are really advertised thereby. But the birds of similarly striking colorations which

¹ The European blackbird is certainly most conspicuously colored compared to its close kinsman the European thrush; it is certainly impossible to account for the development of two such diverse types of coloration in two closely allied species of substantially similar habits by any theory of natural selection working towards the development of concealing coloration.

live in the high forest and in the thickets may in reality not be advertised thereby. As a rule, in such cases, the bird's caution, and skill in skulking and hiding, and above all the protection given it by the cover, and the way in which it tends to become lost in its infinitely varied background, all tend to make the coloration of little consequence one way or the other in concealing or revealing it. Of course, this is much less true of those birds with the most vivid coloration; a tanager's coloration is advertising even in the leafy treetops; but it is not as advertising as a Baltimore oriole's is in the oriole's ordinary surroundings. Alertness and ability to dodge among twigs probably count for infinitely more than coloration in enabling most of these birds to escape hawks. But I wish that ornithologists would study these questions closely enough to enable us to tell just what trait or quality it is that enables cedar birds, for instance, which are rather conspicuous, and take comparatively little advantage of cover, and do not seem especially good at dodging, to escape from hawks. What an infinite amount there is yet to learn about even our common neighbors in the world of birds and mammals!

Of course an equally limited area elsewhere might yield a larger percentage of birds with concealing coloration. A little over a year ago, one day in upper Egypt, I rode across a narrow strip of fertile land to the desert's edge. I noticed in the fields white cow herons and black and white spur-winged plover, both birds with colorations so advertising as to be fairly spectacular. There were also a few quail, and numbers of crested larks, in the fields. Both crouched flat on the ground, both were helped by their coloration, and both, especially the former, were difficult to detect. On the edge of the desert I saw desert larks, desert chats, and black and white chats. The latter possessed a strikingly advertising coloration; they stood erect and alert; they never tried to escape observation by crouching; and they could be seen a quarter of a mile away. The desert larks and desert chats, on the contrary, were colored above in beautiful harmony with the desert sand; they crouched flat, and were very difficult to see until closely approached; their ornamentation was purely on the breast, where it was vivid and advertising, but was normally invisible to the birds' aerial foes.

In many families of birds with small, weak feet which spend most of their time on the wing, the colors of almost all the species are advertising. A flying bird is never concealed, and no coloration can conceal it; a dull colored bird in flight is sure to be seen almost or quite as quickly as the most gorgeous sun-bird or bee-eater. Not only the sun-birds, bee-eaters and hummingbirds, but the great majority of the swallows, the diurnal swifts, and the kingfishers, are advertisingly colored.

Only the small size of the wood warblers and the difficulty of observing

them clearly in the high trees and thick shrubbery can blind anyone to the fact that the plumage of most of them is in the highest degree advertising. The prothonotary, the blackburnian, and the redstart for instance, can hardly fail to attract attention unless they are actually screened from sight; and the same can be said for the Kentucky, mourning, magnolia, black-throated blue, black-throated green, blue-winged, golden-winged, and dozens of other warblers. With most of them it is the nuptial coloration of the males that is advertising; the fall coloration is much less conspicuous and may even on the whole be concealing, in so far as it is true that any dull colored bird is hard to make out in the infinite variety of color effect and distance effect incident to life among leaves. The males in the nuptial plumage are not really countershaded, the brilliant white, yellow, black or red of the underparts, having no oblitative quality and being on the contrary highly advertising, just as is the case with the head and throat colorings, and some of the back and tail colorings. Some of the warblers, however, are always dull colored, their coloration patterns being as inconspicuous as those of the vireos and smaller flycatchers.

I have already incidentally alluded to the fact that some of the flycatchers as the phoebe and the wood pewee, because of their habits are always readily observed, their concealing coloration being apparently of no value to them (whereas it might be of great value to them if they had the habits of the grass and brush sparrows). The black phoebe has an advertising coloration, and the Say's phoebe has not: yet the habits of both are such that the latter is as conspicuous and as easy to see as the former. Now, especial attention should be paid to the entirely different life-value of concealing coloration — or what seems to us concealing coloration — in the two classes of cases typified by the wood pewee and phoebe on the one hand, and the desert chat and desert lark on the other. The wood pewee and phoebe are inconspicuously colored birds whose colors harmonize well with the greens prevalent in their habitats during breeding time; yet they make no effort to hide, they are noisy, they perch upright on twigs or stakes, continually making swoops in the air, and they haunt the same neighborhood, so that a pair of them once found can be visited day after day with the certainty of again finding them; and finally their ways of life differ in no essential from those of their kinsfolk with advertising coloration, such as the black phoebe, and even the vermilion flycatcher — which latter by the way not only has a strikingly advertising coloration, but has habits which give the fullest possible advertising effect to this advertising coloration. I cannot see that in their case the concealing coloration really has a concealing value, for it seems a negligible quantity in the bird's life. On the other hand the slightest study of the North African desert chat and desert lark

shows that their coloration has a real concealing value, and that the birds take full advantage of it by continually crouching motionless in places where it will redound most to their advantage; and the habits of the desert chat are in striking contrast to those of its kinsfolk, the conspicuously colored black and white chats. In one set of cases the apparently concealing coloration does conceal; in the other set of cases it does not. It is of course possible that in the one set of cases it has really been developed by a process of natural selection, and in the other has been developed because of some totally different reason, the birds' habits being such that the persistence of the species is unaffected by the coloration, whether it be advertising or concealing, conspicuous or inconspicuous — or at least the effect being so trivial as to be counter-balanced by the other considerations, whatever they may be, which have actually produced different coloration patterns in, for instance, the black phoebe and ordinary phoebe. In the case of the desert chat and desert lark it is of course also possible that their concealing coloration has not been developed as an incident of natural selection, but that they have suited their habits to it, instead of its being developed as suitable to their habits.

The nighthawks and their allies, most of the grouse, partridges and quails, and certain of the snipe family, such as the woodcock, and true snipe offer admirable examples of concealing coloration which really does conceal, and of which the owners take full advantage.¹ A whip-poor-will crouched lengthwise on a mossy limb, a nighthawk on a ploughed field or a leaf strewn bit of sward, are marvellous examples of protective coloration; and both the general hue and the pattern help in rendering them indistinguishable. When the birds are crouched flat, which is always the case when they are endeavoring to escape observation, the countershading is so slight that I doubt whether it has much if any effect in concealing them. Many of the woodland grouse when standing in the dim light of the woods are, I believe, helped by the countershading; for their coloration harmonizes with the surroundings, and the countershading tends to soften the outline, making them look

¹ Mr. Thayer's pictures are ingeniously arranged to support an impossible, indeed a preposterous, theory. Contrast them with the photographs taken merely to aid in finding the truth; such as those in Mr. Job's 'Wild Wings,' 'Sport of Bird Study,' and 'Among the Waterfowl,' and in Mr. Finley's, 'American Birds.' Mr. Job's photographs of nesting nighthawks, whip-poor-wills, grouse, quail, woodcock, snipe, and least sandpipers show birds that actually are concealed by their coloration when on their nests. His photographs of nesting gannets, murres, guillemots, black skimmers, ibises, noddies and pelicans, and his and Mr. Finley's photographs of nesting gulls, terns and herons of many species show birds of a strikingly advertising coloration which coloration reveals them to every onlooker as they sit on their nests. The young herons, although not as advertisingly colored as the adults, have a revealing rather than a concealing coloration; the young anhingas are even more advertisingly colored than the adults; the young of some of the other birds seem to be concealingly colored.

like, or be merged among, the less conspicuous among the surrounding material objects (all of which show with varied conspicuousness under the varying lights and shades) so that the eye has difficulty in picking them out. A grouse standing up on a bare plain is always conspicuous, the effect of the countershading being insufficient to prevent this. But grouse in the open country are generally in more or less long grass or among bushes, and crouch whenever they expect danger; they owe their inconspicuousness to the cover and to their general coloration, the countershading being often negligible under such conditions. In the Old World there are grouse, the capercaillie and blackcock, with distinctly advertising coloration. There are features in the colorations of three of our own grouse which deserve attention. The ranges of the dusky grouse, and two subspecies of ruffed grouse and spruce grouse, overlap. Now all three species are colored differently. The spruce grouse, thanks to the black of his throat and underparts, is in part advertisingly colored, and is not countershaded. The ruffed grouse is countershaded, and its beautifully varied pattern of coloration has a strong concealing quality in the woods. The dusky grouse is of almost uniform dark hue. But all three are difficult to see. I think that it is the thick cover in which they are found, and the ability to remain motionless which count for most in concealing them; and that the different patterns in their coloration amount to comparatively little, any dull tint or combination of tints being sufficiently effective in the deep forest. The hen grouse on her nest, whether in the open or in the woodland, is certainly helped to concealment by her coloration; I doubt if the countershading plays much part, but it may play some; and the mottled patterns, and dull nearly uniform patterns, are all equally effective in hiding the motionless mother, as she sits until nearly trodden underfoot. In short, with grouse habit and cover count for most in their concealment, but in some of the species the coloration also counts very materially, and under certain conditions it is possible that countershading is of some slight, but not very serious, value; and in some of the species with the same way of life as the others, the coloration is, in whole or in part, either revealing, or at least not concealing, especially in the males. This latter fact emphasizes the immense importance of habit and cover compared to coloration, even where the coloration has a concealing quality.

Some of the American quails or partridges are marked in totally different fashion from others that live under practically the same conditions of color surroundings. The beautiful, plumed mountain and valley quail of the Pacific slope are utterly different in ornaments and coloring from homely bob-white of the East; yet in their habits all three are substantially alike. It is the cover, joined to their cursorial habits, far more than their color-

tion, which conceals them; indeed I should hardly call the western birds concealingly colored at all, and they are really inversely countershaded. Under most circumstances the head colorings of all of them, but especially of the two western birds, are advertising, and as in one the throat is black, with a white edge, and in another, the eastern bird, white with a black edge, to call both concealing is merely to say that there is no difference between concealing and revealing colorations — in which case of course all talk of concealing coloration is waste of time. But the female bob-white, when sitting on her nest, is concealingly colored — although when in this position she is not countershaded. The extraordinary scaled and Massena partridges are not countershaded; and I should like to learn from trained and trustworthy experts about their habits and haunts before I said that they were concealingly colored.

The woodcock's beautifully marked and shaded plumage is certainly concealing; and this apparently not only because of the tint but of the pattern; and the countershading may in this case be a real help towards the end, concealment. A nesting woodcock, like a nesting grouse, evidently appreciates her inconspicuousness, and sits very close — for it must always be kept in mind that no coloration can have any concealing value unless the bird or mammal so acts as to take advantage of it. There are a number of grass-haunting sparrows which are certainly concealingly colored, to the extent that the general effect of their coloration is dull, so that it does not attract the eye. But I doubt very much whether Mr. Thayer's minute working out of the likeness of the "patterns" of these and other birds to grass blades, little sticks, etc., has much, if any, justification; it seems more likely that the minute portions of any patterns have no effect one way or the other upon the bird's invisibility, and that, especially in these little birds, it is only the general color effect that counts; while the coloration, itself, even if concealing, plays an insignificant part in the birds' concealment compared to the effect of the cover in which it dwells. Most of the grass-dwelling ground sparrows are streaked; but the seaside finch, which lives side by side with the streaked sharp-tail finch is practically a monochrome above; and yet the two birds hide equally well and are equally prosperous. Evidently the difference in pattern of coloration makes little or no difference as regards concealment. On the other hand, the sparrows that live in bushes, or perch freely in them, are often colored substantially like those that run like mice through the tall grass; but they are as easy to see as the others are difficult to see; no one can help noticing a song sparrow or a chippy, and no one but a skilled expert will even suspect the existence of a Baird's bunting or Henslow's bunting. Evidently the concealment is primarily due to the way the birds take advantage of cover; and natural

selection, if it has had any effect whatever on their coloration, has merely done so by establishing limits of conspicuousness, so to speak; and within these limits scores of coloration patterns have been produced; differing utterly from one another, but all equally concealing if the general effect is dull. Most of the sparrows and finches are probably not concealingly colored in the eyes of their foes. At any rate, their patterns of coloration are so diverse that it is impossible that any one of the patterns can in and of itself be concealing, unless the others are not. The utmost that can be claimed for any one of them is that the general effect is dull; and there are numerous forms for which even this cannot be claimed, as they are boldly and advertisingly colored, and yet are as successful in life as their dull colored cousins.

The streaked and spotted song sparrows of the various varieties, are among the most abundant of American birds; but so are the white-bellied, otherwise uniform slate or rufous colored, juncos; and also the chipping sparrows and their allies, with unstreaked breasts. The juncos certainly do not have a concealing coloration; they are boreal birds, called snowbirds throughout most of their range in the United States, and wherever there is snow their coloration is advertising; and if streaked patterns are concealing, then the coloration of the junco is revealing even during the nesting season while it is not countershaded at all, in the sense of the shading having any obliterative quality. Many of the finches with substantially the same habits as the relatively dull colored song sparrows and chippies, are really rather advertisingly colored; for instance the white-crowned, white-throated, golden-crowned, black-hooded, and black-throated sparrows. Their colorations are not strikingly advertising, as are the colors of the cardinal and the grosbeaks, but on the whole they reveal rather than conceal the birds in their native haunts. Among the sage brush, I always found the sage sparrow easy to see because of its black tail. In winter amid the snow of the Colorado mountains I have been struck with the conspicuousness of the leucostictes, the rosy and umber finches. The snow buntings and longspurs possess colorations each of which is in whole or in part advertising. The lark bunting is as conspicuous as a bobolink — which means that, for its size, its coloration is as advertising as that of a black or white swan. The evening, pine, rose-breasted, black-headed and blue grosbeaks, the crossbills, cardinals, thistle finches, purple and house finches and the indigo, lazuli and painted buntings have in one or both sexes strikingly advertising colorations. Many of these birds live in such fashion that it is obvious that concealment plays no part in their lives; others seek the concealment of thick cover, and seemingly profit by it as much as do their dull colored kinsfolk in the same places, in spite of the fact that their own

coloration is revealing, and not concealing. Remember, that in each case I am speaking of the bird as it would be looked at by its natural enemies; hawks, cats or weasels, especially hawks. The bobolink, for instance, is just as conspicuous from below as from above or from one side; the same is only less true of the robin, and is equally true of the grosbeaks; the Baltimore orioles outside my window at this moment, are equally conspicuous whether seen from the piazza below, from the second story on a level with them, or from the windows of the gun room in the third story above them.

Mr. Thayer speaks of the woodpeckers as obliteratively colored, the oblitative coloring of the northern forms being due to their black and white resembling "adequate generalized pictures of bits of winter landscape" — which if true would mean that they were not obliteratively colored in spring and summer, when breeding and when the young are growing, and the need for oblitative coloring is greatest. He states that the downy and hairy woodpeckers are whitest towards the north, where the "evident winter-picturing in their costumes" is most needed. This is a typical instance of his hasty generalization from, and refusal to face, facts. The three-toed woodpeckers, the most northern of all, have less white in their plumage than the hairy and downy, one having an entirely black back; and the big northern log-cock has less white than the still bigger southern ivory-bill. The southern red-cockaded, Texan, and Nuttall woodpeckers have more white in their plumage than have the three-toed woodpeckers of the sub-arctic forests. Most of the woodpeckers of the United States have a strongly advertising coloration; the ivory-bill, log-cock, red-headed woodpecker, white-headed woodpecker, California woodpecker, Lewis's woodpecker, the sapsuckers, and flickers. All of these I have myself closely watched in their homes; and also the red-bellied. As to the coloration of the last, I am in doubt whether to call it concealing or not; in the great Louisiana swamps where I studied it, it was rather hard to see, but I think this was due to the fact that it was generally among the tops of the giant trees, and I question whether its coloration would have seemed concealing to a hawk. The red head was certainly advertising, and the belly too, wherever it could be seen at all. As for the hairy, the downy, and the three-toed woodpeckers, I do not think that their coloration is really either concealing or advertising. The brown creeper has a concealing coloration, and no doubt profits by it; but the nuthatches and the small woodpeckers never seem to me to be concealingly colored. If the forest is thick, they cannot be seen a long way off, and if the trees are high, they, because of their size, are difficult to make out among the tops. But both the woodpeckers and the nuthatches are noisy; the former are always drumming as an incident of earning their livelihood; and the latter keep uttering their unmistakable notes; so that

it is difficult to avoid knowing of their existence if any are in the neighborhood; and once placed by sound, both their coloration and their busy restlessness make them rather easy to observe. At any rate, if the coloration of the tree-creeper is concealing, then the coloration patterns of the nuthatch and the downy and hairy woodpeckers are not, and if the white and black back of the two woodpeckers is concealing, then the uniform slate blue of the nuthatch's back is not. Evidently habit, and secondarily cover, are all important with the nuthatches and woodpeckers, and their coloration a well nigh or altogether negligible factor in protecting them from their foes — while no coloration would have any effect on their prey.

The crows and blackbirds contain a large number of species in most of which the coloration is strikingly advertising; and most of them live under conditions which forbid their getting much or any benefit from cover. The ravens, crows, magpies, piñon jays, nutcrackers, orioles, grackles, red-winged blackbirds, bobolinks, cow buntings, yellow-headed blackbirds, and many of the jays, are colored so that they attract the attention of the least observing. The ravens and crows, the blackbirds and grackles live in the open, where there is nothing in the way of cover to shield them from sight. The bigger among them may owe to their size and truculence a certain immunity from attack, just as the kingbird's boldness and agility may help him; but the bobolinks, cow buntings, grackles, and other blackbirds, and orioles are no larger nor more able to defend themselves than thrushes or larks. Evidently the need for concealing coloration has played no part in their development; and yet they also dispense with the ability to profit by cover which so often supplies the lack of concealing coloration.

I could go on with a long list of common American birds of advertising coloration, such as the beautiful scissor-tailed flycatcher, the Louisiana tanager, the phænopepla, the mockingbird, the shrikes; but I have said enough to make my case clear. There are certain important families about which I am in doubt. The wrens are dull colored little birds, as a rule; their coloration is certainly not advertising, and under many conditions it might well be concealing as regards certain species; yet what I have seen of the different species — the winter wren of the north woods, the marsh wren, the Bewick's wren, the Carolina wren, the house wren of the east, the cactus wren, which is rapidly becoming a very familiar house-bird in the southwest, the rock wren, the cañon wren — makes me question whether they really trust at all to their coloration for protection; for they are very wide-awake, are ceaselessly in motion, and dodge in and out among brushes and rocks with an agility that defies pursuit. The shore birds, the snipe, offer another problem. They are rarely advertisingly colored, aside from the nuptial markings of the males on certain species; and the general coloration

tion of a number of them I should be inclined to regard as on the whole concealing. But this is not a point which it is possible to settle by scattered observations, still less by theories evolved in the closet or from fanciful pictures. What is needed is careful and prolonged study in the field, to find out whether there are differences of habit among the species in so far as endeavoring to outwit their foes by eluding observation is concerned, whether any or all of them crouch motionless on the mud or sand or marsh to escape the observation of hawks; what the other foes of any of the species are; and which species never try to elude observation. Some of the species, like the curlews, godwits, willets, yellow-legs and tattlers, are wary about man; they do not seek to evade his observation, or trust in concealment so far as he is concerned (except the nesting females), being watchful and flying off while he is still a long way distant. The belly markings of some species are revealing and some of the species certainly never seek concealment or profit by it.

Everyone can observe for himself the nuptial colors, seasonal or otherwise, of many common birds, such as the tanager, summer redbird, red-winged blackbird, bobolink, Baltimore oriole, and if there is a single instance where the nuptial colors are concealing, and not advertising I am not acquainted with it. At any rate, in the immense majority of instances the nuptial colors, if they have any effect on the bird's conspicuousness in its normal surroundings, are advertising. I have rarely had the chance to observe nuptial appendages. The scissor-tailed flycatcher's tail can hardly be called a nuptial appendage, although in the female it is smaller than in the male; this graceful and beautiful bird is conspicuous in shape, in color and in habits, has no concealing coloration, and never conceals itself. Its long tail merely adds to its already great conspicuousness.

But in Africa I did see certain birds the males of which bore nuptial appendages; one of the nighthawks, and several of the whydah finches. The male of the nighthawk in question has two of the wing quills developed to an extraordinary length; they are bare of webbing except at the very end. When the bird flies the two broad tips flutter behind him like a pair of butterflies, and at first take the eyes off the actual bird by their conspicuousness. At first blush it would seem as if this might be a device of defensive value in the bird; but on thinking it over I doubt this. Any bird of prey (the only foe the appendage could deceive) would doubtless be able to single out and seize the bird's body anyhow, as the appendages would have no interest for it; and, what is more important, if they really did contribute to the bird's safety, it is likely that the female would also grow them, and that the other species which lack them would be crowded out instead of being the more plentiful. In the case of the whydah finches there is no doubt whatever.

The females of the different species are dull colored, inconspicuous birds, hard to recognize as of the same species with the males, which are variously, but always advertisingly, colored, in the breeding season, and with very long tail feathers. The males of some at least of the species make dancing rings in the grass in which they jump and posture. Their nuptial coloration, their nuptial plumes, and their habits in the nuptial season, are all three extremely advertising; and in addition their long tail feathers offer such a mechanical impediment to their flight as to make them noticeably slower and more clumsy than their mates when in the air. I believe that disinterested observation will develop the fact that the plumes and colors of male peacocks, pheasants and birds of paradise are what they look — highly advertising in so far as they have any effect at all. Great tropical forests are so bathed in color, and flooded with lights and shades, the vegetation is so dense, and the trees so tall, that it is easy for any bird to escape notice. Therefore in such a forest all birds of paradise may be difficult to see. But, as the females are totally unlike the males in color and in shape (thanks to the nuptial plumes), and as the males of the various species are totally unlike one another, one of three things must be true; either the female is more conspicuous than the male, in which case her color and failure to acquire appendages give her, as compared with him, an advertising quality — which would be hopelessly detrimental to the species, and of course unthinkable; or his coloration and plumage give him, as compared to her, an advertising quality; or else all the cocks and all the hens of all the various species, representing every imaginable variation in color and shape of plumage, are equally difficult to see, which would mean, not (as Mr. Thayer supposes) that the colors and plumage of the male have a concealing value, but that the surroundings are such as to render it impossible for any color, any appendage, any bodily attributes of any kind, to have any effect one way or the other in either concealing or revealing any one of the birds, male or female. Probably in actual fact, it will be found that the forest conditions are such as to tend towards making all the birds difficult to see, but that the wonderful plumage of the males does have a certain, although variable, advertising effect. Friends who have hunted in Asia, especially in the Himalayas, assure me that the cocks of most of the species of pheasants are extraordinarily conspicuous birds, their coloration being in the highest degree advertising, and their habits showing their knowledge of this fact; and that this is equally true of the peacocks and argus pheasants.¹

¹ Messrs. Barbour and Phillips state (*Auk*, XXVIII, pp. 179-188, April, 1911) from actual experience, that in their native haunts male birds of paradise are very conspicuous and easily seen. The comments they make on the pigeons of the Papuaasian forests and on such birds as the snow-white cotinga of the tropical forests of South America are in themselves enough to show the baselessness of Mr. Thayer's extreme claims.

A careful study should be made of the concealing and advertising colors of nesting birds, their eggs and their young. Aside from eggs in burrows and in covered nests, the eggs deposited in open nests are of many different colors and patterns, and some of them are certainly advertising, tending to attract the eye instead of eluding observation, while others are inconspicuous. Very young birds, as a rule certainly seem to be less conspicuous than their parents, this being especially true of those that are active from birth; as regards many of them, at least, the coloration is concealing. It is difficult to account for the facts in some of the cases. Cormorants, herons, guillemots, murres, and many other birds build conspicuous nests or lay their eggs in conspicuous places, and their young are very conspicuous; there is no concealing quality about the nests, eggs, or young in the nest; and yet it would certainly seem as if such concealing quality would be very useful, for the rookeries of these birds are always haunted by numbers of gulls or crows, inveterate enemies of the young and eggs. The downy young of gulls and terns are (relatively to their parents) concealingly colored; but the old birds nest in masses, crowded close together, both the sitting birds and the eggs being so conspicuous that they could not escape the eye of any foe. Among the passerine birds, by far the most plentiful, the nest is usually difficult to find whether in the grass or in the bushes or trees.¹ The nesting bird usually sits very close. In burrows or covered nests her coloration does not matter. In open nests, unless they are very shallow, only the uppermost part of the body is visible, so that countershading plays no part in concealing the mother bird at the very time when concealment is most vitally necessary to her. Usually she is less advertisingly colored — and very rarely more advertisingly colored — than the male, and any bright colors that she does have are usually on her under surface; so that only the comparatively dull colored back is seen. But as regards a very large number, perhaps a majority of the smaller birds — the perchers — the back of the female, although not of an advertising, can not be said to be of a concealing, color. Kingbirds and robins nest right beside my house; the nesting bird in each case is conspicuous. In the bushes, nearby, the thrasher, catbird, and chat nest; and their reddish, gray, and olive-green backs, all among the same surroundings, cannot all be concealing, except as all colors save a few very varied ones may in such surroundings fail to attract attention — which would mean that the principle producing such coloration, if at work at all, does not produce or favor

¹ Mr. Thayer, who lays much stress upon the part played by "countershading" in concealment, should remember that nests are much more difficult to find than birds, although of course not countershaded; simply because the nest is screened and, in materials, resembles more or less the surrounding objects.

any one type, but merely sets bounds to the variation, and permits the unchecked development of any type which does not transgress the wide limits thus set. In most cases cover and immobility evidently count for infinitely more than color in enabling the sitting bird to escape observation; but there are birds, such as the nighthawks, most grouse, and desert chats, where the coloration itself is a very important factor — in a very few cases perhaps the most important factor, immobility being also essential, and cover not counting at all. In studying coloration one important field should be that covering the large class of cases where the young in their first plumage are unlike either parent, and where the young males then pass through a period during which they resemble the dull colored female, or, if the male's distinctive coloration is only worn during the breeding season, where they resemble both the female, and the male in his fall and winter plumage. There are very many such birds in which the coloration of both sexes is the same, and there is substantially no seasonal change, while the young, once out of the downy stage, resemble the parents; as is true with most of the dull colored sparrows, for instance. Sometimes, as with the gulls, both sexes are alike, and both may undergo seasonal changes in plumage, while the young are differently colored. In some hawks both sexes are alike when adult, and undergo no seasonal changes, while the young have a different and dull coloration. In other cases the sexes are unlike and the young are like the female. In many of these cases the change in coloration from immaturity to age has no effect on concealing the bird, even when the coloration of the adult is by far the more advertising of the two; yet in other cases it certainly seems as if the young were wearing a coloration which (whether the ordinary coloration of their remote ancestors or not) does have a concealing quality which may be of use to them, and which is lost in the adult. To endeavor to explain all these utterly different and contradictory phenomena by referring them to one manifestly inadequate cause serves only to darken wisdom, and to impede any effort seriously to ascertain the truth.

There is need of careful and intelligent study, in the field, of large groups of birds in order to determine all such points. Take the duck family for instance. In the swans the adults of both sexes wear the same highly advertising plumage at all seasons; the young have a dull coloration. The geese show substantially the same state of affairs. Are the young cygnets helped by their seemingly concealing coloration? If so, can we find any reason why the old birds have lost it? Most of the ducks show an entirely different type of coloration development. The males are advertizingly colored; they take no part in brooding the eggs; and during the moult assume substantially the colors of the females. The females are much duller colored

than the males, and while at most seasons their dull coloration probably makes little difference, it is possible and indeed probable, that, as regards many species, it is of real concealing value at the vital period when the birds are nesting. The young males go through a stage when they are colored like the females. A full and thorough investigation of the family must be made before all the various important qualifications and exceptions to the above statements can be set forth, and before any attempt can be made to assign reasons for the utterly different coloration phases which distinguish sex and age in the life-histories of the different species. But the above facts are substantially true as regards many species. It may be that these species are descended from more dull-colored forms; and that the brilliant plumage of the adult males — at certain or all seasons — has been especially developed, either by sexual selection, or by the mere intense vigor of vitality of the male, seasonal or otherwise, or for some other reason; in which case one sex has been changed from a possibly concealing to an advertising coloration, the forces telling in favor of the latter having overcome the forces telling in favor of the former. At present we are only able to guess as to these points. We know enough to recognize the absurdity of endeavoring to explain all the utterly different color phases of the ducks by some one universal cause, such as the development of concealing coloration by natural selection; but we are not as yet fully acquainted with the facts, and have no knowledge sufficient to permit us to generalize as to the complex tissue of causation responsible for these facts.

Before considering mammals, I wish to quote two or three sentences of Mr. Thayer, in which he states some very important facts with partial correctness, but with complete misapprehension of their meaning: "Species that live amidst vegetation are looked at through a certain average amount of interposed foliage and twiggery.... Since the whole panorama of outdoor objects is just one complexity of millions of outlines made by different colored objects relieving one against another, each one showing against a more distant one, it follows that amidst this vast embroidery, a scrap of imitation of it must generally pass unnoticed unless it takes the liberty of moving about. All the patterns and ornaments of the animal world are scraps of such imitation scenery, and their wearers are hunted both by man and beast in the same way — viz, the watching with a relaxed eye as large a tract as possible for the least hint of motion." It is not true that all the patterns and ornaments of the animal world are scraps of imitation scenery. No "scenery" is imitated by the coloration of a red-headed woodpecker or the tail feathers of a cock whydah finch in nuptial dress; and indeed the minute patterns, and many of the bolder and larger patterns, of most birds and mammals are not "scraps of imitation scenery" at all, and fade into the

landscape merely because at a little distance their details become indistinguishable and they all merge and blend into a single neutral shade of color. Moreover, Mr. Thayer's statement is in effect that every color or combination of colors as seen on a bird or mammal must "generally pass unnoticed." If this means anything it means that every color or pattern of colors is concealing — for birds and mammals are of all colors and combinations of colors. Of course the statement that every color is concealing is equivalent to the statement that no color or combination of colors can ever be revealing; or in other words that there is no such thing as concealing coloration, because there is no such thing as revealing or advertising coloration — for the existence of the one is only possible if we pre-suppose the existence of the other. The statement, then, would be a *reductio ad absurdum* of Mr. Thayer's whole argument, if it were true; but as a matter of fact, it is entirely untrue, as regards a multitude of animals, from prongbucks to ravens.

But while Mr. Thayer's exact words, applied universally, as he applies them, much overstate the case, he does describe very accurately certain situations, and incidentally disproves his own thesis by showing why, in those situations, concealing coloration is almost or quite a negligible factor in the lives of birds and mammals. In very many forests, for instance, there are just the millions of outlines, vistas and colors which he describes and also the interposed foliage and twiggery, and this, and not any pattern of coloration, is the main reason why in such forests the spotted jaguar and monochrome cougar are equally hard to see, why the beautifully striped and tinted bongo and the dark monochrome forest hog are equally difficult to get, why, in other forests, small birds of every conceivable pattern are equally safe and equally exposed to danger. In other words, in many situations in nature, the character of the surroundings is such, that the animal's coloration is of no moment one way or the other, if it is able to take advantage of the surrounding cover; and there are other situations which are such that the question of coloration, whether concealing or revealing, is of entirely secondary importance, although it probably counts somewhat. It would be impossible to show more clearly than Mr. Thayer in the quoted sentences has shown, why his own theory has, as regards many birds and mammals, no foundation in fact.

There are however other large classes of birds and mammals, which have advertising coloration-patterns, and which live under conditions that are erroneously described in the sentences just quoted from Mr. Thayer. The big antelopes of the plains, both the prongbuck and the African antelopes, the birds of the ocean and the barren islands like guillemots, fulmars, gulls and puffins, the birds of the flats by river and lake, such as most herons, ibises,

storks and pelicans, and the smaller birds of the meadows and pastures and scattered woodland which live usually above the grass tops, such as the crows, grackles, shrikes, bluebirds, kingbirds, are examples of these classes. They do not live amid the "complexity of millions of outlines" and colors and vistas with foliage and twiggery intervening. They pass their lives for the most part against simple and uniform backgrounds, backgrounds against which a wildebeest or a gull or a heron or a blackbird stands out prominently. These animals are not shielded by cover, and when, as is often the case, their coloration patterns are really advertising there is nothing in the surroundings to minimize the effect of this advertising quality. Here all we can say is, first, as to actual facts; that hundreds of species living under these conditions have coloration patterns of advertising quality; and second, as a matter of belief, that evidently in the evolution of these species the possible advantages of a concealing coloration have been so far outweighed by other aptitudes, physical and mental, that concealing coloration as a factor has wholly dropped out of their life schemes. It thus appears, first that there are multitudes of species of birds and mammals living under conditions which conceal or blur the outlines and colors of all these birds and mammals, and thus render concealing and revealing coloration patterns alike of little account; and, next, that there are multitudes of other species living under conditions which permit their advertising coloration really to advertise them, but which have developed aptitudes and characteristics which in their turn render the question of revealing or concealing coloration a matter of indifference as far as the perpetuation of the species is concerned. In the first case the physical surroundings are such as to minimize the quality of either concealing or advertising coloration; in the other case, the surroundings emphasize the quality of the advertising coloration, but its effect is rendered null by the traits and aptitudes and manner of life of the animal.

In his paper on "The Influence of Physical Conditions in the Genesis of Species"¹ Mr. Allen has, as it seems to me, shown that in many geographical areas, often of large size, a multitude of species are affected alike, as regards various physical characters, including coloration, not by the selection of individuals for survival, but by the direct action on all the individuals alike of the conditions of life.² He shows that this is in all probability the case as regards the general gray tints of the birds and mammals of the semi-arid

¹ *Radical Review*, Vol. I, pp. 108-140, May, 1877; reprinted in *Smithsonian Report* for 1905, pp. 375-402 (1907).

² I need hardly say that as regards almost all these questions Darwin himself wrote with sanity and caution, even where more ample material and more ample investigation have proved some of his conclusions to be erroneous; it is among his followers that we find the unwarrantably extreme positions.

regions of the United States, and the heavy dull colors of those dwelling in the humid northwest; and Selous calls attention to the similar conditions obtaining in South Africa, as regards, for instance, zebras, quaggas, and blesbocks. But of course there are many exceptions to any such rule. Among the birds of the semi-arid regions the distinctive markings of the males in breeding plumage are often as deep and vivid as elsewhere. A more striking exception occurs in the arctic and sub-arctic regions. In these boreal lands, even the most unobservant are struck by the fact that most birds and mammals are largely or entirely white, either all the time or in winter. But the musk-ox and the raven, and the wolverine as far north as it extends, remain as dark as elsewhere, under conditions that give their coloration the most intensely advertising effect. It is said that the raven may only be a comparatively recent immigrant into the polar regions, having followed the whalers; this is probably not so, but in any event the raven has always been an inhabitant of Scandinavia, Finland, the Barren Grounds and Labrador, where like the wolverine, the black-coated creature has lived for ages side by side with ptarmigans, gyrfalcons, white foxes, white wolves, arctic caribou, boreal rabbits, and ermines, without showing the slightest tendency to share their general type of coloration. The wolverine's range overlaps that of the white wolf and white fox, and is on the average more boreal than that of the white weasel;¹ if the white is a benefit to the wolf, fox and weasel, then the black must be a harm to the equally carnivorous wolverine. Wolves feed on musk-ox calves just as much as on caribou; if the white is protective to the latter, then the coloration of the former is damaging to them. If their color helps the snowy owl and gyrfalcon, then the raven is harmed by his. As a matter of fact, however, the four carnivorous quadrupeds spoken of all hunt primarily by scent, and their eyes are such that if at all close they can see their prey move no matter how it is colored; and therefore concealing coloration plays no part in serving either the beasts of prey or their victims. As to the birds of prey, I have already shown that their coloration neither has, nor can have, any effect in either helping or hindering them while hunting.

Mr. Thayer particularly mentions marine mammals, whales, as equipped with a "fully developed oblitative shading of surface colors." If he had turned to such a book as 'The Marine Mammalia,' by that fine old hunter-naturalist of the high seas, Captain Scammon, he would have realized that it is quite impossible to make any such assertion about whales, porpoises and dolphins. Closely allied species and even the different sexes of the same species have utterly different patterns of coloration. There are species

¹ That is, the white weasel goes farther north than the wolverine but also much farther south.

that are white all over, others that are black or brown all over, others that are black above and white or whitish beneath, and yet others that are black with strange white or lavender markings across the back as well as below. Yet nothing has been shown to warrant any belief that these markings indicate difference of habits. If the white bellies render some of the whales and porpoises inconspicuous, then this simply means that the black bellies of other whales and porpoises are advertising. Either way the result is fatal to Mr. Thayer's theory; and as a matter of fact all the probabilities are that neither type of coloration has any effect in concealing the animal from its foes or its prey.

SIZE AND COLORATION IN MAMMALS IN RELATION TO CONSPICUOUSNESS.

Failure to remember the effect of mere size upon our eyes necessarily causes us to misestimate the qualities that tell for or against any given animal. Thus, Mr. Thayer states that ordinarily bears are not obliteratively colored, and adds that they are too big and powerful to need defensive coloration, and are also nocturnal. (As a matter of fact they are usually less nocturnal, when dwelling in regions remote from man, than most other carnivores; certainly they are no more nocturnal — Mr. Thayer's statement being one of the innumerable instances of his recklessness in unconsciously manipulating facts so that they fit his theory.) But there are many small mammals that are colored like bears; minks, for instance, and wolverines, fishers, and even sables, and the same is practically true of mole shrews and many meadow mice and even some marmots. These are no more obliteratively colored than are most bears, and if they were as large as bears and lived in the same places, they would be just as easy to see. When bears live in dense brush or tall grass or among thick forests hunters find it extremely difficult to get them; and this is true even of the glossy black bears of the hardwood forests of the eastern United States. Even Mr. Thayer admits that their coloring is not oblitative or concealing; and when, as is generally the case, they are hard to see, it is because of the thick cover in which they live and because of their wariness. If meadow mice or marmots were as big as bears they would be almost or quite as conspicuous; doubtless they seem more conspicuous to weasels than bears do to us; and when above ground they escape observation, just as bears do, because they live in thick cover — cover, which relatively to their size, is far more sheltering than that in which bears usually live. Of the species and varieties of Rocky Mountain woodchucks many are colored substantially like the various silver tip, cinnamon, and brown bears, and, relatively to their size, are at least as conspicuous; they are wary, their shrill alarm whistle being one of the common sounds of the mountains, and when they crouch they are hard to make out among the boulders and small rocks;

but their coloration is no more concealing or protective than that of the bears. The meadow mice and mole shrews spend most of their time in burrows or in tunnels under the grass and leaves; but I have often seen them in the open, and they are then for their size, and according to their surroundings, just as conspicuous as bears; for when a meadow mouse is not moving it always squats and then all the effect of the very slight countershading vanishes. They do not owe their concealment to obliterative coloration, but to their habits and to the density of the cover in which they pass their lives. The all importance of cover and habit, as compared to coloration, in the lives of meadow mice, is shown by their extreme reluctance to leave the cover of the grass and venture on bare ground. The mice will often destroy the trees in orchards, and nurseries, if matted grass or snow is left around the trunk; but a cleared, hard space of only 18 inches will create a barrier which the mice will not pass. It would be impossible to get more convincing proof of the vital importance of cover to the meadow mouse and the comparative and probably absolute unimportance of coloration.¹ Among the species of mole shrews and meadow mice, are some which in multitude of individuals surpass all our other mammals, except possibly the white-footed mice. They swarm in such numbers that probably they equal the number of all other species of north temperate American mammals put together. In other words, over half the individual mammals of America are either not protected by obliterative "concealing" coloration at all, or only to the insignificant extent that bears are protected, and owe their immunity from harm to their habits and surroundings. When these meadow mice, mole shrews, cotton rats, pocket mice, and other similarly colored small creatures, crouch motionless, and thereby escape observation, they are not countershaded at all. At the Bronx Zoo some cotton rats are kept in an open cage in the snake house; by glancing at them, in their ordinary attitude, anyone can see that in this ordinary attitude there is no countershading of their coats and that so far as their coloration does tend to conceal them it is not because of countershading, but because their dull coloring is inconspicuous and makes it difficult to pick them out among their ordinary surroundings. These mice and shrews always squat when they are not moving.

But this is not all. I have assumed that Mr. Thayer is right and that bears (which, as he properly says, are not obliteratively or defensively colored) and those woodchucks, meadow mice, and mole shrews which are colored, as regards tint and shading, like bears, are less obliteratively, or defensively concealingly-colored than those animals which, like deer, cotton

¹ See Ernest Ingersoll's 'Animal Competitors.' Some species like the pine mouse live in burrows and are nocturnal so that their coloration is of no effect either way.

rats, kangaroo rats, white-footed mice, true shrews, weasels, and the like, shade from dark above to clear, brilliant white, or, more rarely yellow or fulvous, below. But this assumption is contrary to the truth. In their normal and ordinary surroundings, and under the conditions of their normal and ordinary lives, the brilliant white of these latter animals, when visible, at all, always has an advertising and not a concealing quality. If a bear were colored like a weasel or a black-footed ferret, it would be rather more, and not rather less, conspicuous than it is now. It is only the difference in size between the animals that prevents us from seeing this. The weasel's upper-body coloration is concealing only as a bear's is; and the bright lower parts make it more and not less conspicuous. It is the weasel's stealthy, silent, snake-like progress, its caution, and its extraordinary agility and speed, and the cover in which it is found, that make it invisible. The small white-bellied rodents and shrews are inconspicuous not because, but in spite of, their white bellies, and especially because when motionless they crouch so that the white is hardly visible. One night-fall in the late dusk, I saw two white-footed mice in a big bush; apparently they had come out of an old bird's nest. As they climbed among the twigs, I could place them only by the glint of the white bellies (I once noticed the same thing with a flying squirrel). The white underparts had an advertising effect. A bear with white underparts would be more conspicuous than he actually is; that is, he would be slightly more conspicuous than at present if he were colored like a white-footed mouse instead of being colored like a mole shrew or meadow mouse. The little rodents in question escape observation if within ken of vision only when they squat motionless; they then always lose most and generally all, of the effect of countershading, and the white is not seen.

It thus appears that the large majority of our mammals in point of species, and the immense, the incalculable majority in point of individuals — that is, the small rodents, insectivores, and carnivores that live on the ground, whether in the forest or the tall grass,— are in all probability in no way dependent upon countershading for concealment, and it is certain that if the countershading does play any part at all in their concealment, it is a wholly insignificant part. If they have white upon them, this color, when seen at all, usually has an advertising, and practically never a concealing, effect. Many of these species, like the white-footed mice, are nocturnal; and as regards these the coloration has almost no effect one way or the other. The brilliant white underparts have on the whole an advertising quality; but this is unimportant for when the animal is motionless it squats, so that instead of the white belly concealing (or revealing) the animal, the animal conceals the white belly; and if the animal is nocturnal

the precise hue or shading of the upper parts can be of no effect. So far as the coloration of these little creatures has any concealing effect at all it is due to its harmonizing with the surroundings — the sticks, stones, patches of bare earth, grass, dead leaves, lights and shadows — and not to any countershading, or any oblitative quality dependent upon countershading. But it is not certain that the color has any great effect in concealing these animals; at any rate, the species include animals colored orange, russet, dark plumbeous or blackish, gray, and brown of many shades; some of them are nearly uniform in color, others have white bellies; all seem equally hard to see, and seem to thrive equally well. The probability is that each of these little animals owes its escape from the vision of any foe purely to its remaining motionless among surroundings such that any small motionless object of almost any color (aside from the very brilliant colors) is exceedingly difficult for the eye to pick out. As soon as the little animal moves it becomes visible to its keen sighted foes. Hawks and owls have eyes so keen that they are doubtless attracted by the slightest motion; they do not trust to scent, and rarely pounce on a mouse or shrew that is not moving. Foxes, as I have myself seen, sometimes listen for a mouse's squeak, or watch for and pounce on one when it moves; but they also scent them. Weasels almost always follow by scent, on the open ground or through the runways, tunnels and burrows. Against weasels and foxes the coloration is probably of no consequence as a defence. The weasel follows the quarry by scent until almost upon it, and as soon as it moves the weasel instantly sees and seizes it, the murderous skill, agility, and eyesight of the marauder being such that the quarry has no chance. The final rush or pounce is made by sight, but the quarry is then in motion, and its "countershading" and "pattern of coloration" have ceased to be of the slightest use for defensive purposes. A man can hardly put himself in such a position as to be able to imagine just how the little animals hide from, or are discerned by, their foes; but he can get a fair idea of the relative parts played by scent and by sight in their pursuit by thinking of his own experience in hunting bear and deer in thick forest or other similar cover. On the open plains of short grass or among bare mountains, the rifleman may safely rely only on himself. In thick forest hounds improve his chances a hundred fold, simply because they can always scent the game and follow it, while he rarely gets even a glimpse of it until it is roused by the pack and on the run, when he has no difficulty in seeing it. The nose plays a far more important part than the eye, up to the last moment. The glossy pelt of the black bear is very conspicuous, but in forest cover, color counts for so little compared to other qualities that a bear is less often seen than a deer. A white-footed, white-bellied mouse or a white-bellied weasel is for its size as conspicuous in point

of coloration as a black bear, and more conspicuous than a brown bear; each eludes observation in thick cover for substantially the same reasons as in the case of the bear; and (keeping the element of size constantly in view) neither is normally more difficult to observe among twigs and leaves than is a bear which lies motionless among stumps and timber. Most of the small animals that live in the forest, and in the meadows in and under the grass, owe their invisibility primarily to the cover in which they live, to their nocturnal habits, to their clinging to their burrows; probably some of them are helped by their coloration; but very many of them are certainly no more helped by their coloration than a black bear is by his.

The element of size makes it so very difficult for us to tell how conspicuous or inconspicuous small mammals are, that it is well worth while for us carefully to consider the quality of conspicuousness in game animals, which stand to us in point of size much as mice and hares stand to weasels and other small carnivores. I shall speak not only of American big game, but also of African big game animals, because in number of species and individuals they surpass those of all other lands.

In North America the bison and musk-ox are colored substantially like the bears; so is the moose. In all three the coloration is substantially advertising rather than concealing. There is no effect of countershading. The habitat of the musk-ox is such that it can never escape observation when once within the range of vision of its foes, and the same was true of the bison of the plains. The bison of the woods is sometimes hard to make out in its habitat merely because of the denseness of the shadows and the thickness of the cover. The moose is very conspicuous if in open country or along the edge of a stream or pond, its usual summer haunts; if in thick woods it is hard to make out for the same reasons that make the wood bison — or any other animal — difficult of observation under such circumstances; and it often stands motionless when slightly alarmed, and occasionally does so when wounded and followed up. But on the whole, its black bulk, if it can be seen at all, is more apt to attract than to elude attention; and it trusts only to its wariness, its keen senses and the cover in which it dwells for safety. The white goat is an extraordinarily conspicuous animal all through the summer months, and even in winter it is quite conspicuous, as the cliffs among which it dwells are rarely completely snow covered, and the black horns and muzzles make points of dark which can be seen a long way. On the whole its coloration has a highly advertising value. The wolves, cougars, and other carnivores which occasionally prey on it, are probably not helped by the white goat's coloration except in the case of the kids. But it certainly does seem as if the highly advertising coloration of the kids must put them at a disadvantage in the presence of eagles and four-

footed carnivores. Apparently the goats trust purely to their truculence and watchfulness, and to their climbing ability, and the inaccessible nature of their haunts, for safety; and I may add that, as against human foes, goats seem as deficient in wariness as they are in concealing quality, the difficulty in approaching them being due almost solely to the physical circumstances of their surroundings.

The bighorn, on the contrary, in the United States at least, as well as in Mexico, is colored much like its ordinary surroundings. Its coat harmonizes well with the rocks and clays of the mountains and badlands. I doubt whether the countershading of the coat has anything to do with this concealing quality, for the sheep are more difficult to make out when lying down than when standing up, and they often lie down with outstretched necks when consciously hiding; this being the attitude of the young lambs. Doubtless the concealing quality of their coloration is of chief use in the case of the young lambs, the older sheep seeming to trust almost entirely to their wariness, and their sharp senses for safety, and not to escaping observation. The light rump patch is much the most conspicuous feature about the bighorn, and practically always has an advertising quality. The far northern species of sheep is white; this tends to conceal it in winter, but renders it very conspicuous in summer; the lambs being as conspicuous as the white goat kids, at the very time that a concealing coloration would be of most use to them.

The pronghorn antelope has an advertising coloration as marked as that of the white goat itself; and in its case I am inclined to think that the advertisement is sometimes conscious and deliberate. I cannot be sure of this, for the hairs of the white rump patch are erected in chrysanthemum fashion whenever the beast is alarmed, excited or interested. But when herds of antelope feed into sight of one another, at a distance of a couple of miles, I have seen the rump patches on both sides flash into dazzling white in a way suggestive of signals or recognition marks. The advertising marks on the prongbuck are not confined to the rump; the white and dark bands of the head and throat are conspicuous; but the white rump patch is one of the most conspicuous marks worn by any wild animal. It is practically never oblitative or concealing; it is always highly advertising. Mr. Thayer has asserted the contrary, and attempts to show it by picturing the animal in a straight stern-on-view, with the rump above the sky line, and everything else below. This picture is wholly misleading. For once that a wolf or cougar catches its first and only glimpse of a prongbuck in just such a position, where the rump (if the sun happens to be in a given quarter of the horizon) is oblitative, there are probably a thousand or ten thousand cases where the animal is in some other position, and where the rump is

advertising. Unless nearby, the difference between the level eyesight of a wolf and cougar and of a man would be of no consequence, a fact known practically to every hunter or observer; for in looking for antelope such hunter or observer is most apt to be crouching or lying down, with his eyes as low as those of a wolf or cougar, and yet he is just as sure to see his game when in such a position as when standing erect. Moreover the antelope country is usually slightly rolling, and not dead level, and the antelope are not apt to be seen against the sky line; and if seen except against the skyline the rump becomes advertising; again, the animal is of course, in accordance with the doctrine of chances, much more apt to be seen standing sideways or quartering than exactly rear end on, and except in the latter position the rump could not obliterate the body; and as the beast of prey would be moving the chances are infinitesimal that in an advance of a few feet he would not get into a position where the rump patch would cease to become oblitative and would probably become advertising. Again, even against the sky line the rump is always advertising at night, and most beasts of prey hunt at night. Finally Mr. Thayer's theory shows complete ignorance of the habits of the prongbuck. The adult prongbuck, like almost all the game of the open plains, trusts for escape from its foes solely to vigilance, eyesight, and speed, never to stealth or to escaping observation. When on its feet it rarely stands motionless, and never for any length of time, and of course absolute immobility for a considerable period would alone give Mr. Thayer's theory any, even the smallest, chance to be realized in practice. Pronghorns are motionless for any length of time only when they lie down. Sometimes they lie down in exposed places, evidently still trusting to their vigilance for safety; but I have also seen them lie down in hollows, or in long grass, where it really was difficult to see them at a distance. When lying down the effect of the white of the rump almost or quite vanishes. The fawns try to escape observation by lying flat on the ground with outstretched head, the white shown being at a minimum. Thus the most elementary study of prongbucks amid their natural surroundings shows that there is not even the smallest foundation for Mr. Thayer's theory. The white rump is a striking instance of purely advertising coloration. It is usually what first catches the eye when an antelope is within ken of vision; and it is often seen distinctly long before the rest of the antelope is visible.

In most forms of the caribou, the coloration is at least as much advertising as concealing. The caribou trusts to its senses and vigor, and not to concealment, for protection. The vast majority of caribou are found in the open; the woodland caribou are difficult to make out in the woods merely as all animals, whatever their color, are difficult to make out in cover.

The wapiti does sometimes try to hide. On such occasions I have seen

the huge beast lie motionless on the ground, with outstretched head, as if it were a fawn. It also at times, when in thick forest, endeavors to escape observation by standing still or sneaking stealthily away. Normally it trusts for safety solely to vigilance and flight, and makes no effort to conceal itself. Its coloration is rather conspicuous in the open; in woods it has not much effect, the animal when hidden owing its concealment chiefly to the thick cover and deep shadowings, as with the moose and wood bison, although helped by the monotone of a coloration which is neither black, white, nor vivid red. The light patch on the rump is never of concealing or obliterative value; it is conspicuous, and is often the first thing about the beast to attract attention; it is on the whole an advertising mark. The theory that it is ever, under any circumstances, of use to the wapiti by misleading some beasts of prey when about to spring on it, is too ridiculous to need attention. Wapiti calves, like the young of all other deer, and indeed of all or almost all other ruminants, crouch flat and motionless. In sum, I should say that the wapiti, in spite of its size, possesses a coloration which in the woods may have on the whole of a very slight concealing value, except the light rump patch, which is usually advertising; but it is not countershaded, the dark legs and throat and belly hairs indeed making the back appear lighter than the under parts. It thus appears that the wapiti, which does sometimes trust to concealment, and may be slightly helped to this end by its coloration, lacks the countershading on which Mr. Thayer puts such stress. Evidently the presence or absence of countershading is of no consequence in such a case, and a monochrome coloration, even on a very big animal, may assist the animal to escape observation, if the animal by its actions shows that it can take advantage of the coloration; although even in this case the coloration is of utterly insignificant importance compared to habit and cover in helping it to elude the observation of its foes, while its scent, wariness and speed are the prime factors in its preservation.

The common blacktail deer lives largely in ground where it trusts to its vigilance, sharp nose and eyes, and ability as a runner and climber, for protection. But in some of the Rocky Mountain forests, it lives much like a whitetail deer; and even in the open country it lies in cedar thickets and cover-filled ravines, where it crouches motionless to escape observation. In such spots it is hard to see, but this is chiefly due to the thickness of the cover. Ordinarily the white rump has an advertising value, especially when the deer is standing; but when motionless, and striving to escape observation, the deer is generally lying down. When thus lying down there is little or no effect from countershading; the deer is inconspicuous simply because the hide that is visible is of a neutral tint, and because the cover is thick and there is a medley of colors and shadings, in which any pattern

of coloration — short perhaps, of some vivid black, white, or red or pied — would be inconspicuous. Mr. Thayer's theory of the all-important effect of countershading is worth considering in connection with the relative conspicuousness of the wapiti and the blacktail. The blacktail in some of its forms is slightly countershaded (at least when seen sideways), the wapiti is not; but a careful study of the animals in the wilds fails to show that this has any effect one way or the other on their conspicuousness; the wapiti is bigger and darker and therefore more easily seen as a rule, although the white rump of the blacktail attracts attention at a great distance.

The Columbian blacktail is, as regards this matter, substantially in the class with the blacktail; in the American Museum the mounted Sitka deer is really inversely countershaded, thanks to the black hairs on the chest, while some of the mounted Rocky Mountain blacktail, or mule deer, show no countershading whatever.

The whitetail is of all American cervines the one in the life of which concealment plays the biggest part. Given equal conditions, as compared with any other species, the whitetail is on the whole hardest for the hunter to find and see. Its power of concealment is greater than that of any of its fellows, and for this reason it tends to outlast them all. Yet its coloration is less concealing than theirs, and has on the whole a greater advertising value. As compared with the wapiti, for instance, the whitetail's coloration is less concealing, in spite of its countershading; but its smaller size, the dense cover in which it usually dwells, and its stealthy skulking ways, more than offset the brighter and more conspicuous coloration, and make it more difficult to see than the wapiti. The winter coat of the whitetail, the so-called "blue" of hunters, is not conspicuous, especially in the usual surroundings of the northern part of its range. But the bright red summer coat is conspicuous, especially against the bright green of the grass, brush and underwood amid which it dwells. It is almost as conspicuous as the glossy coat of the eastern black bear. Moreover the pure white belly, and the flaunting white tail, are very conspicuous. Its summer coloration is not concealing, but advertising, especially in its normal surroundings; while the upright carriage of the spread tail, the "flag," when interested, excited or alarmed makes it an almost startling advertisement mark. It is then a striking example of what Mr. Thayer calls the "rear-end sky pictures" which he says "obliterate fleeing deer, antelopes, hares, etc." Mr. Thayer — without a particle of proof, and evolving his theory out of pure guess work — says that these rear-end sky-patterns are "most beneficent to the hunted beasts," especially at night because their enemies look upwards at them, and are so confused by the white stern blotting out the fore-shortened body as to miss their spring. The first answer to this

theory is, of course, the sufficiently obvious one that at night white is not normally a sky color, and so that these white stern marks are *not* "sky pattern marks" at the very time when, according to his theory, they serve as such. They are advertising marks; for once that they would puzzle the hunted animal's enemies, as Mr. Thayer supposes, there would be scores or hundreds of instances in which whatever effect they had would be to render the quarry a little more evident to the hunter. The attacking cougar or wolf is practically on a level with the "sky picture" in question; he is at least as apt to look at it from a level as from below. I have lived in regions where I have seen the carcasses of hundreds of deer, and a score or so of antelope and wapiti, that had been killed by cougars and wolves; in most cases snow was on the ground; in no instance was there the slightest evidence of anything having happened like what Mr. Thayer supposes, nor have I ever heard of such an incident occurring. Mr. Thayer's theory on this point is a pure guess, advanced without a particle of proof, utterly unwarranted by any facts I have ever observed, contrary to all observed facts and to all probabilities, and, as I believe, on its face without even the smallest foundation or justification. The whitetail is an animal of the forest, and so, whether the cougar or wolf looks up at him or not, the white rump and tail are in the great majority of cases seen not against the sky, but against trees or brush, and so become advertising.

The pure white belly so far as it has any effect at all — which is very slight — is always advertising, not only in summer but in fall and spring, and in winter when there is no snow. It does not "finish the general effect of the countershading of the back and sides," but appears, when the animal is sideways to the observer, as a vivid white line, contrasting strongly with almost every background. If possible, however, the animal crouches flat in order to avoid observation and in such position the effect of the white is minimized; when it stands motionless or steals noiselessly through the bushes, to avoid being seen, the head is held low and the tail is tight down. The fawn is brilliantly spotted. In certain lights these spots render it inconspicuous. Of course when this is the case it necessarily means that, under the same conditions, the unspotted coat of the mother is conspicuous — it shows how great is the need of common sense in considering these matters that it is necessary to point out the obvious fact that if spots tend to conceal an animal, then the absence of spots tends to reveal it. The bright uniform red coat of the doe and the brilliantly white-spotted red coat of the fawn cannot both be concealing. Perhaps neither is; but if either is, it is that of the fawn — and if this is so and if, as is probable, the coloration of the fawn represents the ancestral coloration of the adult, then we develop the curious further fact that the deer

has actually lost the concealing coloration it once possessed, a sure proof that such coloration was of no consequence in its life. The fact seems to be that the whitetail in its summer coat owes practically nothing in the way of concealment to its coloration. In June, when the young are nearly helpless, whether in the Louisianian swamps and cane brakes, or in the hardwood forests of Pennsylvania and Virginia, the coloration of the whitetail is almost as conspicuous against the vivid green of the undergrowth, as is the coloration of the black bear; and this is at the very time of the year when it is most important for both animals to be concealed. Yet as a matter of fact both animals *are* concealed, and this for the simple reason that the haunts and habits of both animals are infinitely more important in working for their concealment than their coloration could be. The natural foes of the old and the young deer, and of the young bears, trust far more to nose than to eye in finding them — any owner of a pack of hounds will realize this; and where the cover is dense, and therefore where there are all varieties of light and shade, and strong color contrasts, any animal which keeps still, which is wary, and which moves stealthily, is exceedingly difficult to see. Any hunter knows how extraordinarily difficult it is even to catch a glimpse of a deer or bear when he is hunting, unaccompanied by hounds, in dense forests of great extent; and when this is the case with the large animals which are strikingly colored, it ought to be easy to understand that the difficulty of seeing small beasts in the same woods is due, not to their coloration, but chiefly to the simple fact that they live in cover so dense, and amid surroundings so varied, as to tend to conceal any small animal of practically any coloration.

How little countershading amounts to one way or the other, in helping conceal an animal is vividly demonstrated by a study of the life habits of these deer. Compare, for instance, the moose and wapiti, both of which are inversely countershaded, so to speak, that is both of which as a rule appear darkest below and lightest above, with the blacktail and whitetail, both of which are countershaded. The wapiti often tries to escape notice, not only by skulking but by lying flat, just as the smaller deer do; and his lack of countershading does not interfere in the least with this attitude on his part. Usually he dwells in substantially the same kind of country as the blacktail, and here his superior size and dark color make him more conspicuous, and he vanishes before man quicker than the blacktail (though he holds his own rather better if anything when the only foes are wild beasts). But in summer his coat has a much more concealing quality than that of the whitetail, when both are in thick cover; although the fact that the whitetail is such a finished skulker, and dwells in such thick cover, enables it to outlast the wapiti in the presence of man. The moose, because of its wari-

ness, but above all because of the thick cover it loves, will outlast both the wapiti and the blacktail in the presence of man. A hundred and fifty years ago there were probably many more wapiti than there were moose east of the Mississippi; now the wapiti have vanished and the moose still remain. Fifty years ago there were many times as many blacktail in Dakota as there were moose in Maine; now the moose in Maine probably outnumber the blacktail in the Dakotas. The countershading on the smaller deer is not of the smallest benefit to them, the white beneath having an advertising effect; and the lack of countershading on the moose and wapiti has not been of the smallest harm to them. The fact that the moose's coloration and the whitetail's summer coloration, are on the whole advertising, does not harm them in the least, because they lie in thick cover and know how to use it to the best advantage. On the whole, it is safe to say that the coloration of these deer is of small consequence, perhaps of none, and the countershading of certainly none, so far as yielding them concealment or protection is concerned. Now, what is true of these big animals in the presence of wolves and cougars is in all probability true of rabbits, woodchucks, ground squirrels and mice in the presence of foxes, bobcats, and ferrets and weasels.

The Texas peccary has a dark although not very conspicuous median back line; but it is not really countershaded; and the mounted group of Mexican peccaries in the American Museum show that these animals are in certain forms really inversely countershaded. The peccary's coloration is if anything slightly revealing; but I do not think that it really has much effect, one way or the other, in concealing or revealing the fierce little hog. It sleeps and rests in holes or hollow logs, or other such places, where its coloration is of no consequence; and when it moves abroad it goes in small troops, which make no effort to hide, and as a matter of fact must be readily observed by all possible enemies, for some members of the troop are always in motion. Peccaries trust for defence chiefly to their truculence and their power of concerted action.

The cougar is an interesting beast from every standpoint, including its coloration; and a study of the effect of its coloration from the "concealing" standpoint is, or at least ought to be, illuminating, when taken in consideration with much that is written about the concealing quality of the coloration of leopards, tigers and other cats. My experience, in accord with the experience of almost all other hunters and outdoor naturalists, is that the cougar is of all our American big animals the one most difficult to see and most rarely seen. The cougar's neutral-tinted, nearly unicolored, countershaded coat, unquestionably has a concealing quality, in the woods and among clay banks and rocks under ordinary conditions; and for a long time I,

in common with most observers, accepted this as the chief element in explaining the way in which the cougar escapes observation. But when I came to think out the matter I realized that in many parts of its range the landscape is in winter snow covered, and that a totally different theory must be invoked to account for the cougar's invisibility when snow is on the ground. I have spent some time where cougars were common, both in the Rockies and on the Little Missouri; in both places, but especially in the Rockies, the winters were long and there was much snow. The country was not thickly forested in the regions where I came across cougars or their sign, except on Clarke's Fork, and in parts of the Yellowstone Park. Elsewhere in the Rockies, where I penetrated their haunts, they lived in a land of mountains and hills covered sparsely with piñon and cedar, and with thick timber only in patches in the ravines. In the Bad Lands the cover was still more scanty and the patches of dense cover still fewer and smaller. It was always good blacktail country, and usually good wapiti country, and there was never difficulty in finding either of these animals while they continued in the land. But the cougars who preyed on them were invisible. Sometimes they were trapped, and they were readily found and killed with trained hounds; but the still hunter came across them very rarely. Hardly any of the numerous professional hunters I knew had come across them more than two or three times in the course of many years solitary hunting. Now, the fact to which I wish to call attention is that this was just as true in the winter, when the landscape was snow covered and the cougar's coloration could have no effect in concealing it, as at any other time. Occasionally a hunter tracked a cougar in the snow; but except as a result of tracking the cougar was not more often seen in winter when its color was advertising than in summer when its color was concealing; and yet this was in regions where the cover was comparatively sparse, and where in consequence it was possible continually to see wapiti and blacktail (whereas in regions of as great extent but thickly forested the deer also would have been practically invisible). This means that the cougar's coloration was really an insignificant and practically negligible factor in its concealment. The prime factors in keeping the cougar invisible were its nocturnal habits, its caution and wariness, its sharp senses, its wonderful ability to take advantage of even the scantiest cover, and its power of lying indefinitely motionless and of advancing with inconceivably noiseless and crouching stealth.

It seems to me that this side of the cougar's life history has an important bearing upon several problems connected with concealing and advertising coloration. The cougar is equally at home among the Rockies and Andes, in bare broken plains with scanty cover, in cold northern pine forests, and

in steaming tropical forests and jungles. In lands of thick cover and lands of scanty cover he is almost equally invisible; so his case is not parallel with the cases of the black bear and whitetail deer, which owe their invisibility principally to the thick cover in which they dwell and are almost or quite as visible as the grizzly and the blacktail when they live in open country. He is no easier to see in places where for months the landscape is snow covered than in jungles where there is never any snow. It is evident therefore that as regards concealment he owes practically nothing to his coloration and everything to his habits and attributes. This explains at once why spotted leopards and jaguars and striped tigers are no more and no less apt to be seen than black leopards and black jaguars; why the jaguar (colored precisely like the leopard) is no more and no less visible, in the same surroundings, than the mono-colored cougar; why in South America mono-colored cats of several kinds, and spotted and variegated cats of various kinds, are all equally hard to see under the same conditions, although if the coloration of one kind is concealing the coloration of some of the other kinds cannot be. The truth is that the habits and attributes and ways of life of the various cats constitute the prime factors in their invisibility, and from this standpoint are so infinitely more important than the coloration that it is difficult to say whether the spotted or striped hides, or the merely uniformly black or tawny hides, really have any appreciable effect one way or the other as regards either concealment or advertisement.

Furthermore the facts in the case of the cougar, an animal big enough to permit us to be certain just what the facts are, enable us to appreciate the real conditions which render it difficult to see so many smaller creatures. The dark brown, or black, nearly unicolored mink, the red-brown, white-bellied weasel, the light bodied, black-footed ferret, have utterly different colorations, and yet all flourish and all are rarely seen. The mink has almost no countershading, the black legs of the ferret make it really countershaded the wrong way, the countershading of the weasel results in giving it a conspicuous white throat and belly; the three types of coloration cannot all be concealing, and probably no one of them is — indeed they can almost be called advertising. Evidently the three animals owe their comparative invisibility, the rarity with which they are seen when compared with squirrels and rabbits, entirely, or almost entirely, to their habits and traits, to the speed and yet gliding stealth of their movements, to their wariness, their supple ability to take cover, and their liking for darkness. Probably the same statement would apply to many species of mice and shrews, including all those that are nocturnal or that show much white. In the case of multitudes of these smaller creatures which are rarely seen, it is probable that their coloration either plays a wholly minor part, or no part at all, in keeping them concealed.

The lynxes stand substantially in the same class with the cougar.

The gray fox has a coloration which may possibly be slightly concealing; but the coloration of the red fox, including the cross and black foxes, is highly advertising, the animal owing its safety purely to its habits, its astuteness and its sharp senses. The red form of the red fox is slightly countershaded; the cross fox is inversely countershaded, being black below, as is shown in the mounted specimen in the American Museum; but the two forms are equally successful in life, and are equally conspicuous, the countershading having no effect one way or the other; and the conspicuous coloration is of no consequence because the fox relies exclusively on its cunning, wariness, sharp senses and physical address, coupled with ability to dodge through, and to take advantage of, cover. The coyote is one of the very few mammals where the countershading really does sometimes reduce the animal's visibility, even when it is standing up, a long distance from the observer, in its ordinary haunts on the plains; I am inclined to think that its color and its countershading combined really may at times be of some use to it. But I am by no means certain that this is the case, because of what is true as regards its bigger brother the wolf. In some of its forms the wolf is colored much like the coyote; but in various places white wolves, red wolves, and black wolves are or have been as plentiful as the gray or brown wolves, evidently thriving as well; and the coloration of the white wolf of the western plains and the coloration of the widely distributed black wolves, which are found in Florida as well as in the sub-arctic forests, are both highly advertising. Evidently the color of a wolf's coat, and its countershading, have no bearing on the wolf's success in catching his prey or evading any possible foe, his habits and traits being such that the concealing or advertising qualities of his coloration have no result on his welfare; and where this is evidently true of the big wolf it may also be true of his smaller brother.

In Africa I was able to study for nearly a year the habits of the teeming myriads of great game, and many of my observations were made with special reference to this question of concealing coloration. The first, and by far the most important, fact brought home to any competent observer is that as regards the great majority of these animals the question of cover infinitely outweighs the question of coloration in the problem of concealment; this being so true that when there is no adequate cover most of the big animals do not trust to concealment at all, and concealment, whether of coloration or otherwise, plays no part in making their lives successful. Next comes the fact that there are some animals, chiefly the cats, whose peculiar physical address in hiding and in stealthy approach and escape is such that their ability in this respect far outweighs the question of coloration.

tion, and even the question of cover, provided the cover is in any way adequate. Finally, there are some animals as to which it is possible that the coloration does have a concealing effect of some importance.

The game that dwells in thick cover is extremely hard, not merely to shoot, but even to see; and it is the cover, and not the coloration of the animals, that is responsible for this. Indeed mere size seems to have a far greater effect on visibility than does color; the bigger the animal, the easier it is to see. But sufficiently heavy cover shields even the heaviest game. In the high elephant grass, and in bamboos, as well as in dense forest, elephants disappear so completely that they can only be procured by following on their trail, and even their giant bodies, looming black and large, are not visible to the peering, expectant hunter until but a few yards away. The buffalo, big, black, easily trailed, are, just because smaller, even more difficult to follow and see in thick cover, whether of reeds or jungle. Neither animal gets the slightest advantage from its color; indeed the coloration of both is advertising; but in such cover the coloration is of no consequence, one way or the other. The hunter follows the trail, and if the beast does not hear or wind him, he finally catches a glimpse of it close up — just as the weasel follows the trail of a rabbit or mouse until close enough for the jump. The difference is merely that the hunter follows the trail by sight, and the weasel by scent; doubtless the latter's sharp eyes come in use when the scent warns it that its quarry is close by; and there is no more warrant for supposing that the weasel is misled by the "white stern sky pattern" on such of his victims as happen to possess such a pattern than for supposing that the hunter would be misled if an elephant were similarly ornamented.

Those rhinoceroses that dwell in the bush are hard to see and hunt, whereas in the plains they are, next to the elephant and the giraffe, the most conspicuous animals. In the bush they owe their invisibility solely to the cover; their coloration is of no consequence one way or the other.

The lesser game animals of the thick cover vary so widely in coloration as to render it impossible that the coloration of any one of them can be of real protective or concealing value. In the gloomy, wet mountain forests, choked with vines and undergrowth and down timber, the giant hog and the bongo are the two typical big game animals. The giant hog is almost black; the bongo, an antelope as big as an alderney cow, is brilliantly colored. The coloration of the bongo is, if anything, advertising rather than concealing — it is certainly advertising under any conditions which make the color of its co-dweller in the same haunts, the giant hog, concealing. But as a matter of fact the coloration has not the slightest effect in either revealing or concealing the presence of either animal. Each is so wary, and the extreme thickness of the cover serves each as such a complete shield, that

they are hardly ever seen or shot by the best and most persevering white hunters, and only rarely killed by the wild, naked wood men themselves, unless with the assistance of dogs. The same is true as regards the effect of the coloration of the smaller animals found in the edges of the heavy timber, or in the lighter forests; the bush buck, reed buck, water buck, and bush pig. The bush buck in all its phases is a brilliantly colored antelope, bright chestnut or reddish, varied with white. Its coloration is always advertising. At first I thought the reed buck's coloration was under certain circumstances concealing, but further experience made me come to the conclusion that this was not so, and that I had been misled by the fact that its coloration was not so boldly advertising as the bush buck's. When driven out of a reed bed or thicket or when startled and dashing through one, the advertising effect of the vivid coloration was at once evident. The reed buck was much the easier of the two to see or shoot simply because it was generally found in more open ground. Both owed their invisibility purely to the thick cover in which they dwelt and to their own ability in lying close or skulking stealthily off; their coloration, where it had any effect, was revealing and not concealing. But the effect of the coloration is probably negligible. It was practically impossible to see the grass-dwelling reed buck while the grass was really long; and it became quite conspicuous as soon as the grass was burned. It was the grass and not the coloration which determined whether it should be visible to the eyes of its foes. When it ran it showed its white flag much like a whitetail deer. The water bucks, of two species, were sometimes found in thin forest or patches of dense forest, and in papyrus beds, but more commonly in comparatively open country. When in thick cover they often tried to escape notice by standing motionless or sneaking quietly off, and their coloration was certainly less conspicuous than that of the two smaller antelope; but they themselves were always more conspicuous because of their larger size, their greater clumsiness in skulking, and especially the more open nature of their haunts. One of the two kinds of water buck had a white patch round the rump; which was advertising. The bush pig was a dark colored beast, less conspicuous than the antelope.

We found two antelopes dwelling in the thick swamps, the situtunga and the white-withered lechwe. Both are handsome, striking looking antelopes. The situtunga has a shaggy, dark, nearly monocolored coat. Its coloration is not advertising, in the sense that black or white is advertising, but neither is it concealing, save as any nearly uniform rather dull color is concealing; the extreme difficulty in seeing it — and save its cousin the bongo it is the most difficult of all the big antelopes of East Africa to see — arises practically exclusively from its secretive, stealthy nature,

and the impenetrable cover afforded by the beds of reeds and papyrus in which it dwells. It ventures beyond the edges only at night, and then for but a short distance. The white-withered lechwe dwells in the reed beds and the edges of the papyrus swamps of the middle White Nile. Its coloration is advertising instead of concealing, the old bucks in particular being very conspicuous because of the white of their withers and the upper sides of their necks; and it is a noisy creature, grunting continually. But it is not nearly as easy to see or to shoot as are the antelope of the open plains, for it lives in dense cover and seeks to avoid observation; it will stand motionless in the thick reeds or sneak off through them with neck outstretched and head held low; it does not habitually jump up on ant hills to look about as is the custom of its cousin the kob. The coloration of the doe is almost exactly the same as that of the kob doe, although the habitat and surroundings are different; the kob dwelling on the open plains or among sparsely scattered clumps of grass, bush and trees, where it is very visible, and makes little effort to avoid observation, usually trusting to its vigilance and sharp sight to enable it to see its foes at a distance (although occasionally lying close like a reed buck, in long grass); while the white-withered lechwe spends its whole time in the reed beds, trusting to its surroundings to shield it from the sight of any foe, these surroundings being such that its coloration probably makes no difference either way as far as concealment goes. At any rate the bright red of the does, and the brilliant white back and neck markings of the old bucks, seen against the dark green of the endless reeds, must always be advertising where they have any effect at all.

Here are two water, or swamp, antelope, each trusting for safety mainly to eluding observation, and both living in practically the same surroundings, yet totally different in color; and the one with the less concealing coloration is the one which lives under conditions that would make it more important to have a concealing coloration. The coloration in these cases must be a well nigh or altogether negligible element from the concealing standpoint. A similar lesson was impressed on me by my experience with the various antelope in the Lado, on the west bank of the upper White Nile, during our hunt after the white rhinoceros. For miles around our camp the country was open, covered with tall grass and a sparse, scattering growth of thorn trees, with occasional patches of brush and scrub. During our stay most of the grass was burnt. Where the grass was very long it was almost impossible to see or find any of the antelope, but where it was short or sparse, and especially where it was burnt, the difficulty vanished. Hartebeest, water buck, kob, bush buck, oribi, and dyker were abundant. The bush buck's red coat was marked with white stripes and spots making

the "checkered sun-fleck and leaf-shadowed" pattern which Mr. Thayer considers so potently obliterative. The other species were almost uniformly colored — bright foxy red, straw-tinted, gray, brown. Of course if any one of these coloration patterns was concealing the others must have been advertising. But the difference in coloration sank into insignificance, so far as giving concealment was concerned, compared to the difference in size. The bush buck was harder to see and kill than the water buck, kob or hartebeest, simply because it kept closer to the thickets and patches of long grass and was more given to skulking; but the dyker was harder to see and kill than the bush buck, in the Lado, although its coat was uniform in color without any of the (purely fanciful) advantages Mr. Thayer believes to come from such a "checkered" pattern as the bush buck's; and this merely because the dyker was smaller and was an even greater adept at twisting and skulking through the grass and underbrush. All the antelope were frequently found in exactly the same country; although as a rule the water buck was the only one of the bigger antelope which habitually wandered into the places most affected by the bush buck and dyker — and it was also habitually found in the favorite haunts of the kob and hartebeest. The utterly different colorations of the different animals had, in reality, no effect whatever as regards rendering any one of them more invisible than the others; but of these antelopes those that normally dwell in the open plains were more visible than the others, under like conditions, because they did not try to hide themselves.

So much for the animals which seek to conceal themselves, and which owe their escape from notice to the cover in which they dwell and their ability to hide and skulk. The majority of the big game of the parts of Africa which I traversed dwell in the open, or very sparsely wooded, plains, and do not seek to elude observation at all. One thing that struck me about these animals was the fact that the "countershading" on which Mr. Thayer lays such stress played, so far as I could see, practically no part whatever in concealing them. The animals of the open plain were just as much countershaded as those of the jungle; and, exactly as the animals with least countershading in the jungle were nevertheless as hard to see as the others, so on the open plain those with most countershading were no more concealed than those with practically none. The color itself, the hue of the animal, was of infinitely more consequence than the countershading; although, if the ground was flat and the grass short, the color itself was of no consequence, because the animal, if standing up, could be seen as far as the eye had power. Of two different species, both countershaded — zebras or hartebeests, for instance and oryx or common eland — the first, if colored conspicuously, would be seen a mile or two off, while the other was still

invisible; the difference of course being due to the difference in tint, the countershading being the same, and having practically no effect. I do not mean that the countershading could have been neglected from the artistic or pictorial standpoint. Under certain circumstances, it did make the animal lose its sharpness of outline at a slightly less distance than would otherwise have been the case. But it was of no consequence compared to the general hue of the coloration; and of course, if this general hue was unlike the surroundings, if there was no cover of bushes or of tall grass, and if the ground was flat, the animal could be made out anyhow, by any hunter, brute or human, at a very long distance; within a few hundred yards or less, the outlines were so vivid that the countershading was of no consequence whatever.

The giant eland of the Lado dwelt in a dry sunburnt country, covered with a sparse open growth of scantily leaved trees and bushes; the general tint of the coat, like the general tint of the coat of the roan antelope which dwelt in the same locality, merged well with that of the general landscape; but neither animal sought to skulk or hide, or trusted to concealment, each placing reliance only on its keen senses, and wariness. In East Africa, a buck Grant's gazelle — not the doe or young, which have the conspicuous lateral black stripe — an ordinary eland, a roan, or an oryx, except when either of the latter animals was looking round, so as to show the highly advertising face coloring, might be difficult for the eye to pick up at a distance, even when the wildebeest, topi, hartebeest or zebra in the same landscape were plainly visible; but this was merely because the coats of the four animals first named were of much less conspicuous color than the coats of the second four. The countershading on a wildebeest, which shows dark against the green or brown or yellowish plains, had, not merely practically, but absolutely, no effect whatever in rendering it invisible, for it could be seen as far as a black tree stump, for instance, could be seen. Among leafless bushes and small thickets, and clumps of tall dried grass, an oryx or roan or buck Grant might, if motionless, for a short time escape the notice of untrained eyes, not because of the countershading, but simply because in the flood of bright sunlight, the light, washed-out color of the surrounding objects prevented any vivid contrast and made the eye hesitate in picking out the motionless antelope from its accented, motionless, shaded and lighted, not very differently colored, surroundings, although these surroundings were solid objects. In other words, the reason for even this partial invisibility was the direct reverse of what Mr. Thayer claims; it was not in the least because the animals were countershaded, for if their general color was in contrast to that of their surroundings they stood out in bold relief; it was simply because the eye was inattentive to individual

objects in the multiplicity of objects, the effects of light and shade being practically the same on the buck and its surroundings, so that among the rocks and bushes and grass clumps and small euphorbias, the body of the buck was not readily picked out. It was chiefly to my own eyes, however, that the trouble was due; the native hunters who were with me could usually pick out the animal at once if within any reasonable distance. Doubtless the same is true of a beast of prey, for evidently none of these antelope, even when they ventured off the open bare plain into the brush, trusted to concealment; they made no effort to hide, and were constantly on the alert to detect foes. But if in very thick and tall grass they did hide, lying still, in confidence that they could not be seen unless stumbled upon; here of course their coloration had nothing to do with their concealment, which was due purely to the dense cover. The only occasions when they were ever in any degree difficult to make out while in the bare open plains was when they laid down, when of course the countershading was at a minimum compared to when they were standing up; the resting antelope looking like some inanimate object. But in the open, even where lying down the antelope were watchful, and trusted in no way to concealment; only the very young fawns sought safety in trying to escape observation, lying motionless with head and neck outstretched.

It was instructive to study the habits of the oribi under changed conditions. The oribi is a small, graceful, swift antelope, well countershaded, with a neutral tinted back, and no advertising marks. Where the grass is long its habits are substantially those of the reed buck, stein-buck and dyker; it lies close, trusting to the protection of the thick cover, and is very difficult to see. But when the grass has been burned, unlike the stein-buck and dyker it takes to the bare open plains, and shows itself as much at home on them as if it were a gazelle. Under these changed conditions it ceases to make any effort to conceal itself, or to trust in any way to concealment for protection, relying purely on its eyesight, wariness, and speed. Although without such advertising markings as those of the Tommy Gazelle, the oribi becomes conspicuous, simply because any animal is conspicuous when on a bare plain, the "counter-gradation" of so-called obliterative shadings entirely failing to conceal any creature, when it alone is in question. Where fire had passed over the plains shooting oribi was like shooting the small gazelle; the little creature was easy to make out a long way off, but great care was needful in order to stalk it within rather long rifle range without being noticed.

Of the game habitually seen on the plains I have already spoken of the elephant, rhinoceros, and even the buffalo, all of which are also found — and in places much more frequently found — in forest or dense jungle.

The giraffe is ordinarily a beast of the open plains, feeding where there is a sparse growth of thorn trees. Mr. Thayer states that the giraffe's countershading and pattern "adequately obliterate" it. As a matter of fact the giraffe is never "adequately obliterated" by countershading or coloration pattern, or by anything else. It is, except the elephant, the most conspicuous of all animals. Its size and shape advertise it unerringly to the dullest sighted lion or native hunter; it can escape observation only if at such a distance that no detail of its coloration would by any chance be visible. The giraffe never under any circumstances seeks to avoid observation. Its one concern is to be so placed that it can itself observe any possible foe. We often found it in the same country with the rhinoceros, a monocolored beast; and in speaking of leopards and giraffe (beasts by the way, which it is as absurd to treat together as so to treat lions and elephants) Mr. Thayer especially dwells on their invisibility as compared with beasts which are "monochrome objects." But the rhinoceros more often eluded hasty observation than did the giraffe, and was less often seen at a very long distance, simple because the height and shape of the giraffe, and the fact that it hardly ever lays down, made it the more conspicuous object of the two. Any animal, of any size, shape or color, may under certain circumstances escape observation, and a man of poor or untrained vision may fail to see animals which could not possibly elude keen eyes, brute or human, if accustomed to the wilderness. But save under wholly exceptional circumstances no brute or human foe of the giraffe could possibly fail to see the huge creature if fairly close by; and at a distance the pattern of the coloration would be lost. The giraffe owes nothing to concealment; its coloration has not the slightest concealing or oblitative effect so far as its foes are concerned.

The zebra has also, very absurdly, been taken as an example of "concealing coloration." Men unused to the consideration of the subject are often surprised when they go outdoors to discern how difficult it is to see any animal — just as a raw city-bred recruit, during his first campaigns, finds it difficult to locate even a civilized foe, and impossible to locate a savage foe, such as an Indian. The more conspicuous the animal the greater is the surprise of the average man when he fails to find it as conspicuous in the landscape as he had supposed; he thinks of a zebra, for instance, as jumping to the eye as it does in a menagerie; and when he finds this not to be the case, he goes to the opposite extreme and supposes that the zebra's coloration is concealing. As a matter of fact it is not concealing, it is highly advertising, when close at hand; but when over three or four hundred yards off the black and white stripes merge together, and the coat becomes monocolored, but catches the sunlight in such shape as still to

render the bearer conspicuous. The narrow stripes of the big Grévey's zebra fade together at a shorter distance than is the case with the broader stripes of the smaller zebra; the broad bands on the rump of the latter can be seen at a long distance. The zebra is purely a beast of the open plains; it never seeks to conceal itself, but trusts always to seeing its foes. When under or among thin leaved, scattered thorn trees it is still usually conspicuous; although now and then a peculiar light and shadow effect may conceal it. It never goes into thick cover save at drinking places, and then only if it is unavoidable; it does not come down stealthily to drink, but openly and warily, always on the watch and continually galloping off on false alarms; it returns to the plains as soon as it has drank; and as such an animal can never escape observation when in motion, and as it is never motionless when at or near the drinking places, it is impossible that its coloration can in any way conceal it at such times. Mr. Thayer's ingenious theories of how all the various stripings on a zebra obliterate it are without the smallest foundation in fact. So far as the coloration of the zebra has any effect at all, as regards beasts of prey, it is an advertising, not a concealing, effect. The wildebeest and topi, which are found in company with it, are more conspicuous; the hartebeests sometimes more and sometimes less, according to the sunlight; the eland and oryx and gazelle less. A moment's thought ought to show Mr. Thayer and his adherents that animals so differently colored as these, all leading their lives under similar conditions, cannot possibly all be concealingly colored. As a matter of fact none of them owe their safety to concealing coloration, and the majority of them are advertisingly colored. In East Africa the lion preys chiefly on zebra and hartebeest, which live under precisely the same conditions, have the same habits and associate in the same herds; yet two more differently colored animals cannot be imagined, and neither is concealed in the slightest degree by its coloration. Among the hunter-naturalists to whom we owe most of our knowledge of the enthrallingly interesting life-histories of African big game, Captain Stigand comes second only to Mr. Selous. When I wrote of protective coloration in 'African Game Trails,' I had had opportunity only to glance at Stigand's admirable book on the game of British East Africa. In this he discusses the subject in masterly fashion, and with a knowledge that could only come to a trained big game hunter and field naturalist gifted with exceptionally keen powers of observation and analysis. I quote a few lines: "Very few animals seem to rely on protective coloration as a means of escaping observation, however they may be colored. They appear to rely on fleetness of foot, quickness of eye and ear, or on scenting powers.... (the animals that do trust to hiding) seem to rely more on cover and concealment or partial concealment

than on any great similarity to natural objects. . . . even if (the larger game of the plains) were perfect examples of protective harmony, which I do not admit, it would avail them little when their lives are spent in walking about in the open. For a moving object even if it assimilates in color to its surroundings always catches the eye of a practiced observer. The two most absurd, but often quoted, examples of wonderful instances of protective coloration are the zebra and the giraffe. It is true that the zebra in very long grass is sometimes difficult to pick out, but so is any animal almost entirely concealed from view — even an elephant if the grass is long enough. In their usual East African habitat (the plains) zebras are strikingly conspicuous, turning from black to white as they move and their sides are alternately in shadow or exposed sunlight. . . . A giraffe near, or even in the far distance, when not screened from view, is a most conspicuous object to the practiced eye.”¹

The other common plains game, in order of conspicuousness I have already mentioned — wildebeest, topi, hartebeest, eland, oryx, the gazelles. The latter on account of their advertising lateral stripes, would be more conspicuous than the eland were it not for their small size. In one of the appendices in my ‘African Game Trails’ I have discussed their conspicuousness more at length. The various species and subspecies of eland which I encountered in Africa are striped, the stripes being very narrow. Mr. Thayer says these stripes are “secantly oblitative”; — that “they bring down as it were narrow slips of the sky into the beast’s smooth contour” or “carry the aspect of stray, gleaming grasses or reed stems upwards across the eland’s earth-colored obliterated-shaded body.” They do nothing of the sort, and this utterly wild and foolish guess, without one particle of justification in fact, is typical of the recklessness with which

¹ In a recent statement by Mr. Thayer, he says that those who do not agree with him are “childish,” in misapprehending his thesis, which is that the coloration of all animals is “oblitative” at “the crucial moments when they are on the verge of catching or being caught.” He reiterates his position as follows: — “The zebra and the African antelopes, the peacock and the bobolink, are all . . . marvels of concealing coloration in situations where concealing coloration is of use to them. . . . concealing coloration is *universal* among species that catch or are caught.” Any schoolboy fit to be trusted out of doors alone can set Mr. Thayer right as to the bobolink; Mr. Beebe, in his forthcoming book about his Asiatic trip, will deal with the peacock and pheasants. As for the zebra and the African antelope, Messrs. Stigand and Selous have stated the exact facts; and their statements are based on years of patient, keen intelligent study and observation in the field and cannot be successfully controverted. Mr. Thayer’s assertion, as regards the zebra and most African antelope, has not even the smallest justification in truth. In all that I have said above about the coloration and habits of the zebra, and the big antelopes which have similar ways of life, I have kept steadily in mind (as Messrs. Selous and Stigand have done) the view point of the beasts that prey on them, and the actual conditions at the crucial moments when the zebra and the antelope are either caught or escape; and at these moments, so far from being “marvels of concealing coloration,” the animals are not concealingly colored, and receive not the smallest help from their coloration.

Mr. Thayer calls on his imagination to furnish backing for his theories. The eland's body is countershaded; but it is not "obliterated," at all. It lives in the bare open plains or among thin brush and thorn trees. It is not as conspicuous as the wildebeest or topi; but it can always be seen a mile away, unless screened. The stripes cannot be seen at all until the eland is so close that no brute or human hunter could possibly fail to see the animal. The eland while unhurt never seeks concealment; its one desire is to be on the lookout for its foes. Its stripes never, under any circumstances, help to conceal it in even the smallest degree; any more than the lack of such stripes on the bodies of the oryx and roan antelope (which in many regions are associated with it) in any way reveals or advertises them. Any knowledge of the habits of these animals and of the fact that they dwell amid exactly the same surroundings, or any serious effort to think out the facts, instead of manufacturing facts to bolster an absurd theory, would have prevented Mr. Thayer from supposing that either the presence or the absence of these stripes had the slightest concealing effect. The southern form of eland which lived under exactly the same conditions was unstriped. On the same page on which he records this theory, Mr. Thayer advances the still wilder one, that the white markings on the harnessed bush buck resemble "flecks of water shine"; and to back up this theory he supposes that these bush buck spend an unusually large proportion of their time in and about wet swamps and river borders. They spend much less time in such places than the situtunga or lechwe, which lack the spots; less time than the gray or reddish water-buck; no more than many other antelopes; and of the many I came across, not one was ever in such a position as to render it possible that even the most foolish onlooker could mistake its spots for "flecks of water shine." I dislike to speak harshly of a well meaning enthusiast like Mr. Thayer, but from cover to cover his book is filled with such phantasmagoria as this; only the smallest fraction of what he writes deserves consideration; and yet he has received much consideration even from scientific men who cannot plead any of the excuses which can be advanced to shield Mr. Thayer from criticism; and therefore, in the simple interest of truth, I am reluctantly compelled to say what ought to be said of his book.

Most of the smaller patterns on big animals never can have any effect either in concealing or advertising them; probably patterns have to be as big as the face markings on the roan of oryx before they have such an effect, which is then advertising. The face markings on the roan and the oryx were beyond question advertising. On the Guasi Gishu plateau we saw one topi with a blaze of white on its face; this made it very conspicuous among its fellows (like the face of its South African cousin the blesbok). The face markings on an eland are too small to be advertising. Ordinarily

the details of a small pattern merely merge into one broad mass of color; the brindled hide of a wildebeest looks in most lights as if it were one color. The coloration of the sable antelope is strikingly advertising; that of the roan is very much less so; yet it is an illustration of how little coloration counts in concealment that the two species have substantially the same habits, and the roan no more trusts to, or benefits by, its coloration than does the sable. When in the open neither tries in any way to escape observation; and in cover both trust purely to the cover for concealment. The white-eared kob of the middle White Nile is advertisingly colored, especially in the case of the old bucks, but the common kob and Vaughn's kob are also, although less markedly, advertisingly colored. The impalla is another antelope with an advertising coloration; the buck, when under the influence of erotic emotion, spreads the hair of his rump in chrysanthemum fashion, like our pronghorn.

The warthog, a beast of the plains, is dull colored; but it is always easy to see unless it is screened by grass or brush.

Five small antelopes can be treated together — the dikdik, dyker, steinbuck, Chanler's buck and klipspringer. The first three dwell in grass and brush, the last two on rugged and stony hills. I always found the klipspringer and Chanler's buck difficult to see among the rocks; their coats harmonized with the varied earth and rock surroundings; and they were the only two antelope I saw in Africa of which it could perhaps be said that they were helped by their countershading. All the other antelope and the zebra, pig, etc., either live boldly in the open, paying no heed to concealment, and not being concealed, or else live in cover and trust for concealment, not to their coloration, but to the screen of the cover, which protects them no matter how glaringly they are colored; and none of these animals seem to be affected one way or the other by their coloration, and would not be damaged if their "countershading" were reversed, and they were colored lightest on top. This last, indeed, is precisely what happens in the case of the white-withered leekwe, with its white withers and upper neck, while the black lateral stripes on the gazelles practically invert the countershading. On the topi the countershading is actually and completely inverted, the back being lighter than the sides and especially than the shoulders and haunches: yet this inverted countershading makes not the slightest difference in their habits or visibility as compared with the ordinary countershaded hartebeest and wildebeest. The klipspringer and Chanler's buck were certainly hard to place, apparently because of their coloring, when they were standing in range of vision among the rocks — although I am by no means sure that this was not due to lack of keen eyes on my part, for my native hunting companions almost always saw them, and the klipspringer was a

noisy, alert little animal, not seeking to hide, while the white on the belly and around the tail of the Chanler's buck now and then served as a striking advertisement. It may therefore be that neither is really helped by its color in concealing itself from any of its natural foes; but I mention both, because they were the only antelopes I saw for which it is even possible to make out a claim for the possession of concealing coloration. The other three small buck, the dyker, dikdik and steinbuck, afford yet one more illustration of the fact that with most game animals coloration makes no difference one way or the other. They trust to the brush and grass for concealment. The two first, in the region in which I hunted, were dull colored, while the steinbuck's coat was a foxy red, unlike its surroundings at every season of the year, and always conspicuous; yet all three had the same habit of lying down to hide, and of sneaking stealthily or rushing madly through the grass and brush, and it was evident that all three were equally protected without regard to their coloration, by their habits and by the screen afforded by the cover in which they dwelt.

Among the several carnivores the black-backed jackal was conspicuous in coloration compared to his silver-backed brother; but the coloration evidently had no effect one way or the other on either, so far as revealing it to prey or to foes was concerned. The white-backed, black-bodied ratel and white-tailed mongoose were advertisingly colored; most of the small cats, civets, and ichneumons, whether monocolored or variegated, were hard to see, chiefly because they were nocturnal and lived in the brush and grass — although as regards one or two of them I believe a case could be made for concealing coloration. The spotted, and still more the striped, hyænas were nocturnal. The hunting dog and cheetah were rather easy to see; at a distance the latter looked like a lioness. The lion, and even more the leopard, however, were past masters in the art of concealment. The coat of one is a uniform tawny, that of the other is beautifully spotted; they are as unlike as possible, and when the animal is crouched flat, as always when hiding, the effect of the countershading is almost nil on either. Their habits overlap, and from actual experience I can testify to the fact that in the same seemingly scant patches of brush and grass both animals — and also the serval, which is found in the same places — are able to conceal themselves almost equally well. The way they will both hide in apparently inadequate cover is marvelous. The lion's mane, especially if black, is advertising; yet he is practically as difficult to make out as a lioness when in cover. The chief and overwhelming element in the concealment of either big cat is its extraordinary ability to crouch flat and motionless, and to crawl stealthily and noiselessly, very low and near the ground, taking advantage of every scrap of cover. If we keep in mind the case of the cougar we shall

realize the exact facts. Mr. Thayer gives a picture of the jaguar, the American leopard, with an artificial leaf landscape background (incidentally not merely an artificial but an untruthful landscape) designed to show that the spots, because of their likeness to a "sunfleck and leaf shadow pattern" obliterate the animal; and states that he has "demonstrated" the fact that such a highly spotted body is visible against a plain background and also "the noticeableness of a monochrome object against a patterned background." Now, in the first place, Mr. Thayer ignores the fact that cougars are just as plentiful as (indeed probably much more plentiful than) jaguars in just such leaf landscapes as he depicts, and that therefore he has "demonstrated" the noticeableness, or advertising, or revealing quality, of the cougar in what are on the whole its most ordinary surroundings — which is a false demonstration; and in the second place he ignores the fact that leopards are continually found in grass, where there are no leaf shadow patterns, and yet that they are just as hard to place under such conditions as are lions and servals — disregarding the matter of size. One of the leopards my son shot was in the grass on an ant hill, but it was as difficult to see as we found lionesses and servals to be under similar conditions. I believe that the lion's coloration, like the cougar's, is on the whole more concealing or oblitative or protective than any other; but the leopard's pattern, although perhaps less concealing, is not an advertising pattern when compared with solid black or white for instance; and moreover the fact that black-maned lions, and in places entirely black leopards and servals, keep in as good condition, and are as successful in eluding observation and catching prey as their normally colored kinsfolk, and the further fact that monocolored cougars are under the same conditions as prosperous as jaguars, prove that the question of coloration is of very slight, if any, importance, and at any rate of wholly minor importance, in concealing these great cats. Their sinuous, gliding stealth of movement, the flexibility with which their bodies mould themselves along or around objects, their power to lie motionless, their wariness — in short their genius for seizing every opportunity to hide, and the extraordinary skill with which they use cover, not to mention their generally nocturnal habits, are what render them able to conceal themselves in such marvelous fashion.

These statements of fact, are based on my personal observations in the field, and on those of my son Kermit. They are the result of conscientious and painstaking, although necessarily far from exhaustive, first hand studies, in their haunts, of the following big game, and carnivores, in North America and Eastern and Middle Africa:

North America.

Cougar.	White goat.
Lynx.	Prongbuck.
Coyote.	Moose.
Red fox.	Caribou.
Gray fox.	Wapiti.
Grizzly bear.	Whitetail deer.
Black bear.	Rocky Mountain blacktail deer.
Bison.	Coast blacktail deer.
Bighorn.	Peccary.

Africa.

Lion.	Sable antelope.
Leopard.	Roan antelope (two subspecies).
Cheetah.	Oryx.
Serval.	Grant's gazelle (three subspecies).
Spotted hyæna.	Thomson's gazelle.
Striped hyæna.	Gerunuk.
Hunting hound.	Impalla.
Aard wolf.	Chanler's rock buck.
Black-backed jackal.	Reed buck (two subspecies).
Silver-backed jackal.	Common kob.
Elephant.	Red white-eared kob.
White rhinoceros.	White-eared kob.
Black rhinoceros.	Common water buck.
Grévey's zebra.	Sing-sing water buck (two subspecies).
Common zebra.	White-withered lechwe.
Hippopotamus.	Gray dyker (two subspecies).
Warthog.	Rufous dyker.
Bush pig.	Steinbok.
Forest hog.	Oribi (two species or subspecies).
Common giraffe.	Dikdik.
Reticulated giraffe.	Klipspringer.
East African buffalo.	Wildebeest.
Abyssinian buffalo.	Topi.
Giant eland.	Jackson's hartebeest.
Common eland.	Uganda hartebeest.
Bongo.	Kongoni hartebeest.
Bush buck.	Neuman's hartebeest.
Koodoo.	Nile hartebeest.
Situtunga.	

This makes a total of between seventy and eighty animals which because of their size must on the whole be looked at by hunters from about the standpoint that the big cats and the wolves look at their prey; from the standpoint that bobcats, foxes, minks and weasels look at rabbits, woodchucks, gophers and mice. The animals observed were sufficiently numerous in species and individuals — of some I must, all told, have seen many thousands, under every conceivable circumstance and surrounding — to give some warrant in generalizing about them. I have touched above on the coloration characters of some of them; the characters of those I have omitted are similar and teach identically the same lessons.

Among these animals a fair proportion are not merely not concealingly colored, but have a strikingly advertising or revealing coloration. The prongbuck, white goat, black bear, the wolf when either in the white or the black coat, the giraffes, zebras, sable antelope, wildebeest, topi, white-eared kob, and white-withered lechwe are so colored that unless screened by cover it is almost impossible for them to avoid attracting attention under normal conditions. Many of the other animals, although not so glaringly conspicuous, nevertheless possess a coloration sufficiently conspicuous to ensure their being seen by any brute or human foe that trusts to eyesight at all; for instance, the impalla, bongo, bush buck, whitetail deer, and all the plains antelopes of Africa, not one of which, from the eland, roan and oryx to the gazelles, ever tries to escape observation or lives under conditions which would enable it to escape observation. There remains a minority of the grass-eating animals, which live in forests or swamps, whose coloration if not exactly concealing is at least not conspicuous. These, however, do not seem to be any better able to shift for themselves than such of their neighbors as happen to be advertisingly colored; the little antelopes that are foxy red do just as well as their neutral tinted neighbors; and the same is true of their big kinsfolk. The forest and swamp dwellers of dull and uniform coloration and those of bright and varied coloration get on equally well, and are equally hard to see or kill; it is evidently the cover and the beast's shy, wary watchfulness, and not the coloration, that count.

The coyote may possibly be helped by countershading. In only two other cases, and in both of those very doubtfully, does it seem as if this countershading, on which Mr. Thayer lays such stress, can play even the smallest part in protecting or concealing these creatures. A glance at the facts in connection with their lives shows, in the first place, that the countershading is of absolutely no consequence if the general hue is not the same as that of the background. The wildebeest and hartebeest for instance are countershaded; but they are not "obliterated" at all, simply because the plains on which they dwell are always green or dull brown or faded

yellowish brown, and against such coloring their own vivid colorations stand out with advertising distinctness. Moreover, it cannot too often be repeated that if the animal is black above or white below, such coloration, whether called "countershading" or anything else, is always advertising, in so far as either color can be seen. Of course, if the white belly is invisible it becomes, not a *concealing* color, but a *concealed* color — which is wholly different. A favorite expedient of Mr. Thayer's is to request his hearers to consider how conspicuous these animals would be if upside down, especially because of their white bellies. He instances the tiger as a case in point. Of course, if the tiger's coloration were reversed it would make the animal conspicuous, but this would only be because the white, which had hitherto been hidden, had been made visible. As a tiger actually stalks his prey, the white on his underparts does not "obliterate" him; he crouches so that it is itself obliterated; if it were seen at all, it would advertise him, no matter what part of his body it was on. As a matter of fact, judging from what is true with the lion, cougar, leopard and black leopard, it would probably make no difference whatever to a tiger, so far as his prey is concerned, whether the non-white portion of his coloration were or were not countershaded. The sambur, the big jungle deer of India on which the tiger frequently preys, actually is inversely countershaded, being darkest below, and of a general monochrome tint; but it is hard to see, nevertheless.¹ On this point the cases of the topi and the white-withered lechwe are illuminating. The topi is inversely countershaded, in exactly the way that Mr. Thayer says would be most advertising; but the topi is not as conspicuous as the countershaded wildebeest, bull sable and buck white-eared kob, simply because their colors are even more striking than his, and because the intensity of the color is much more important than the pattern of coloration or than the shading. The white-withered lechwe actually does have the white on its back as Mr. Thayer supposes of his inverted tiger; but the effect on the animal's "concealment" is almost nil, simply because it trusts, not at all to its coloration, but purely to the screen afforded by the cover in which it dwells; just as is true of the bongo, situtunga, bush buck, dyker, etc., in not one of which does the coloration play any concealing part whatever.

I have seen a cow elk with a calf, whitetail deer, and blacktail deer in summer, seek to escape notice by lying motionless on the ground with outstretched necks; but in each case it was the cover, and the absence of motion, that gave concealment, and not the coloration; for the red coat of

¹ In Mr. Hornaday's 'Two Years in the Jungle' he mentions that he found the sambur very hard to see, because of its coloration; evidently the lack of countershading was of no effect. The only tiger he came across he speaks of as strikingly and conspicuously colored.

the whitetail was really conspicuous, and so was the pale rump of the blacktail. Similarly, in fairly thick brush, I have come close on water-buck cows and impalla does lying down with their young; but as the background was the same in both cases, it was of course impossible that the gray of one and the bright red of the other, could both be concealing; and as they were lying down the countershading had no effect. Evidently, the question of color was negligible compared to the thickness of cover and absence of motion. Once I mistook a water buck cow lying down for a log, just as once or twice I have been unable to tell whether what I saw was a black bear or a stump; but this merely means that any motionless object, of any color, may at times be mistaken for an inanimate object, if the surroundings are right. In sum, the study of these seventy-odd animals shows that, as far as they are concerned, coloration plays an insignificant, and counter-gradation a practically negligible, part in protecting or concealing them from their foes. The cats are adept at concealment no matter what their color. The herbivores, if they live on open plains are never concealed, and never seek concealment or profit by it; if they live in cover they are concealed, but they owe this concealment almost purely to the screen afforded by the cover, and thrive equally well, apparently, whether their coloration is or is not advertising. That cover, and not coloration, is the all important element in concealing crouching animals, is shown by the fact that wapiti, deer, water buck and impalla never crouch or squat on bare open plains, although they often crouch or squat in long grass or thickets. The fact that countershading is of no consequence is shown by the case of the inversely countershaded topi, as compared with the countershaded wildebeest and hartebeest, in Africa; and of the inversely countershaded, or non-countershaded, moose and wapiti, as compared with the countershaded small deer in America. The topi's habits and visibility are the same as those of his kinsfolk the wildebeest and hartebeest; the moose gains the same advantage from cover that the whitetail does; and the wapiti crouches flat to escape observation just like the whitetail. The presence or absence of countershading makes absolutely no difference in the habits or the conspicuousness of these animals. It has in all probability just as little effect as regards the immense majority of small mammals, like mice and shrews.

Mr. Thayer's theory leads him into rather startling vagaries when he applies it to rabbits. Rabbits when squatting are undoubtedly concealed by their general neutral coloration, and it is just possible that a case can be made for the effects of countershading as far as they are concerned (although in a crouching rabbit seen from behind the effect of the countershading vanishes); but Mr. Thayer is not content with this, and en-

deavors to show that certain conspicuously advertising features of their coloration are really concealing. Indeed Mr. Thayer seems driven by an imp of the perverse, for in addition to insisting that the advertising features of the rabbit's coloration are oblitative, he also insists that the features of its coloration which really are oblitative, are advertising. He states that the white tail of a running rabbit obliterates it, in the sight of a weasel or fox, that its "white rump vanishes against the sky from the sight of the creeping fox or other quadruped pursuer. The fox's eyes are at that moment lower than the hare's tail, and he sees it against the sky (or, in the woods, the sky's light through the leaves)." Then he states that a crouching hare is "boldly conspicuous" when seen from the position of any "quadruped pursuer" that would have to look upwards at the hare's tail. One trouble in arguing against this theory is that encountered so often in controverting Mr. Thayer: the theory is so preposterous that to controvert it is a little like arguing with a man who says that two and two make five. If a sitting rabbit is "boldly conspicuous" to an animal on a level with it, then all of Mr. Thayer's theories go by the board at once, and all animals are always "boldly conspicuous," to their foes; for if a sitting rabbit in the woods is not inconspicuous, whether to a weasel or any other creeping foe, then no mammal alive is inconspicuous in the eyes of any ordinary ground foe. But it is an equally wild absurdity to suppose that the white rump of a fleeing rabbit even for a moment obliterates it from any foe. It is not seen against the sky line, by a weasel or fox or wildcat, once, for the hundreds of times when it is seen against a background of forests or bushes or grass, and then it is always conspicuous. Whether the rabbit is above or below the level line of vision of the enemy makes not the slightest difference. A rabbit running away on the hillside above one is exactly as conspicuous as a rabbit running away down hill. A man a hundred yards off has his line of vision practically on a level with that of a fox close up; and yet if the man's eyes are good he can see the bobbing white rump at that distance, even if he can see little else. In creeping up to big game I have more than once startled rabbits, and though my eyes were then on a level with those of a fox, I could see the white rump of the rabbit just as well as if I had been erect. Indeed, this proposition is so self-evident that it is well nigh impossible to understand how any man who has walked in the woods can for a moment accept such a fantastic theory as Mr. Thayer's. The white, the advertising color of the rabbit, is invisible while it crouches motionless seeking to evade observation, but as soon as it runs the white becomes so conspicuous that no animal — whether an enemy or a young rabbit — whatever the position of its eyes, if it can see at all, can avoid seeing the advertising white mark and the rabbit itself.

Whether the white rump marking is more than unconsciously advertising, I cannot say; but Mr. Nelson in his very interesting study of North American hares has shown that certain jack-rabbits do consciously advertise themselves when they run, in extraordinary fashion, drawing the white belly skin round so as to make first one side and then the other side show white.

Mr. Thayer's pictures of rabbits illustrate both his inability to understand the circumstances which make white an advertising color, and his, of course unconscious, arrangement of facts so as to twist them into support of his theory. He states that "almost all mammals" are "equipped with a full oblitative shading," white being "by far the commonest color" for the middle of their undersides, and the dark of the upper sides often culminating in a black medium line. This mere statement of his case shows that he has wholly failed to grasp the fact that under normal conditions in nature countershading is never oblitative unless the animal's general tint agrees with the general color of its surroundings, and unless the countershading is not abrupt and marks merely a change of intensity in what remains practically the same color. His statement of the fact as to the frequent occurrence of a black dorsal line and the general occurrence of a white belly among mammals is correct, and this is merely another way of stating that generally they are *not* equipped with a full oblitative countershading; for such a black dorsal line is generally advertising or revealing, and a white belly or underside is under normal conditions always, and to a higher degree, advertising *whenever it can be seen at all*. A rabbit sitting in normal position has no dorsal black line, and all, or practically all, the white is concealed; there remains merely a neutral tinted object, very difficult to observe in thick cover or in any landscape where there are roughnesses and inequalities, lights and shadows, and grays, browns and drabs. I am inclined to believe that such a sitting rabbit if seen from the side is slightly helped towards concealment by its countershading; nevertheless the countershading is certainly a minor, and is perhaps a negligible, factor in the concealment; for it plays no part if the animal is sitting rear end on; and on a bare open plain, where there is no cover, and no stones or clods to distract the eye, a sitting rabbit will be seen at once, a jack-rabbit, for instance, looming up on such a plain while still very far off. This shows that the countershading by itself counts for little or nothing, and that the only part it plays — certainly a very small part, if any — is slightly to aid in concealment by a slight blurring of the sharpness of outline when the rabbit is shielded by grass or crouches among similarly colored and shaded inanimate objects.

Mr. Thayer gives two photographs designed to show that the rabbit

owes its concealment to countershading. The first gives a rabbit sitting in a natural position; the second the same animal on its back, upside down. (In the second photo, incidentally, the background is made much darker, so as to bring out the white in sharp relief; while in the first photo the ground is made so white around the white tail as to harmonize with it.)¹ These photos are interesting because they show that even with the facts before his eyes Mr. Thayer does not realize the essential truth that when in normal sitting attitude, *the white does not conceal the rabbit, but the rabbit conceals the white*. The white is not concealing; it is itself concealed. In the second picture the white on the rabbit is rendered conspicuous primarily because the white is visible. The white tail which in the picture is underneath one end of the rabbit is just as conspicuous as the white belly, which is uppermost. The position of the white, whether above or below, is of no consequence; it is the fact that it is *seen* that makes it conspicuous; of course as long as it is invisible it cannot be conspicuous. When the rabbit is still it sits on, and completely hides, its own advertising color; and this is one chief reason why it is then so inconspicuous, compared to its great conspicuousness in motion. It trusts for concealment chiefly to the actual screen of the cover, but partly also to its coloration, to the general neutral effect of its coloring, which harmonizes with the tints common in woodland landscapes and in open landscapes where there are bushes, clods of earth and patches of dry or half dry grass.

Mr. Thayer frequently attempts to substitute for an entirely well-known and accepted truth some brand new, and glaring, error. His treatment of the skunks affords one of the best instances of this trait. These pied black and white creatures are among the most conspicuous objects, animate or inanimate, in nature. Therefore Mr. Thayer, with ingenious wrong-headedness, endeavors to show that they are really concealingly colored. At first he seems inclined to think that skunks may be conspicuous when seen from above; but by the end of the book he has worked himself up to the belief that for one skunk thus seen there are "thousands of other skunks absolutely unrecognizable through the disruptive effect of their bleached leaf-and-shadow colors," and that, as regards the mice and insects on which the skunk preys, it is obliteratively colored, the "paramount function" of its coloration pattern being "the picture of sky," because the "white on its

¹ Contrast these pictures, carefully chosen to bolster an untenable theory, with those in Mr. Warren's 'Mammals of Colorado,' taken merely to show the facts. On pp. 48 to 51 he shows a cotton-tail in the open and a cotton-tail under a sage brush. Although sitting sideways to the camera, the rabbit photographed in the open shows practically no countershading; its coloration would help it only if of the same tint as the background. The rabbit under the sage brush is far harder to see; merely because cover counts for infinitely more than color in concealment, even when, as in the case of the rabbit, the coloration also has a concealing quality under certain conditions.

upper side . . . serves to imitate, to picture, the shining sky from which the underside is shaded." He illustrates this by a series of as thoroughly misleading pictures as even his book contains. He explicitly states that skunks are nocturnal; and it does seem incredible that he should believe that white is inconspicuous at night. This is one of those elementary facts as to which it is not possible to argue; it is only possible to state them. White is far and away the most conspicuous color at night. On the western cattle ranches we often used to choose a white night horse just because we could most easily see him. If we have to follow a mounted guide at night we always prefer one with a white horse; and in marking the color it makes little difference whether he is above us, on a hill side, or below us; the white horse is always more visible than a horse of any other color would be. Let any man go out into his pasture after night fall; he will find that the white cow is the easiest seen. Let him follow a friend through the woods at night; he can follow a white shirt better than a black coat. If we wish to shoot at night we tie white along or around the rifle barrel, whether we expect an animal to appear over the sky line or not. Moreover the skunk hunts chiefly in forest, in brush, or in high grass, only occasionally in short grass; so that a mouse or cricket, if it sees the skunk at all, must see him hundreds of times against a background of leaves or grass for once it sees him against the sky. All this also applies to Mr. Thayer's theory as to the effect the white head markings of a skunk have in puzzling its prey; together with the additional fact that among the skunks, ratels, zorillas and kindred beasts of bold black and white coloration, most of them, including many or most of the skunks, wholly lack these head stripes. Very little of what Mr. Thayer says about "sky pictures" has any more substantial foundation than in the case of the skunks — in other words it has no foundation whatever in fact. So with what he says of "ruptive" and "secant" colors. They are generally highly advertising, this being the case with skunks, colobus monkeys, black and white chats, red-headed woodpeckers, guillemots, murrees, auks, oyster-catchers, eider ducks, black and white storks, etc.

Often and often, like most hunters and field naturalists, I have run across skunks at night; they were usually the only ground animals I could see at night at all; and I saw them equally well whether below me or on a hillside above the level of my eyes. Now and then, on a dark night or even in moonlight, I came across a skunk under conditions which made it difficult to see; but under these same conditions any ordinarily colored animal would have been not merely difficult but impossible to see. The simple fact is that, disregarding exceptional and abnormal conditions, the skunk's coloration is, in all places and at all times, in the highest degree advertising, and this whether it is seen from above, from below, or from

one side. It is no more concealing than a sunflower's coloration is concealing; and to speak of a skunk as inconspicuous is precisely as if one used the same term in describing an isolated clump of sunflowers on a Nebraska prairie, where they loom up like a steeple.

Squirrels vary widely in color. The gray seems to me to be concealingly colored as far as his upper parts are concerned; but the white belly, wherever seen, is advertising; and the coloration of the black variety is certainly advertising. The big fox squirrel of the south, in almost all its varieties, but especially when black, or dusky, or orange-bellied, possesses a highly advertising coloration. The red squirrel's coloration seems to me on the whole advertising; and the chipmunk's unquestionably is, in most surroundings. If the chipmunk were as big as a deer we should realize that its stripes and bright red body color, with its white belly, make it very conspicuous. The flying squirrel is nocturnal, or occasionally crepuscular; its upper body colors may possibly be called concealing, although probably almost any color would be equally concealing at the time this little creature is abroad; but the white of the underparts is always advertising when it can be seen at all.

Taking into account the way in which the black and orange-bellied squirrels thrive, and the fact that so many of the squirrels carry pure white beneath or on the sides, it seems that the arboreal squirrels are not affected one way or the other by their coloration, which is sometimes advertising and sometimes concealing. Evidently their watchfulness, agility, and ability to use the cover of the trunk, branches and leaves, count for so much in preserving their lives that from this standpoint their coloration becomes insignificant, and probably negligible.

The spermophiles, or gophers, striped, spotted or plain colored, offer a slightly more puzzling problem. They live in burrows, and are watchful when above ground; one of the favorite poses of certain species is to stand erect, looking like picket pins. But most of the species have a coloration which at a short distance merges into a neutral tint, not readily distinguishable in the dried grass and among the earth clods of its usual haunts, and fairly to be called concealing. The exact pattern is of no consequence; in all these beasts and birds the minute patterns, or minute portions of patterns, cannot be distinguished at a sufficient distance to make their tiny differences of any effect in concealing or revealing their wearers; it is merely the general effect which counts; and the general effect may be obtained indifferently by a uniform dull gray or drab or brown, or by faded stripes or dull spots. The rock spermophile is hard to make out in its native haunts, because its coloration harmonizes with the surroundings; but when not in motion it squats; and when squatting it shows no countershading, as may be seen by inspecting the mounted specimen in the American Museum.

A considerable number of these gophers, and ground squirrels, then, may be deemed to possess concealing coloration, or at least to possess various coloration patterns none of which are advertising. But some of them, and their near kinsmen, are advertisingly colored; for instance, the curious little antelope squirrel, whose tail is used in a way only compatible with the theory that it is an advertising mark, and indeed probably consciously or semi-consciously used for advertising or revealing purposes. Many of the woodchucks and prairie dogs are certainly not concealingly colored. The ordinary prairie dog is advertisingly colored when in grass, whether green or dry; its color harmonizes well with much of the soil in which its towns are placed; but as it never seeks to hide, is always jerking its tail or otherwise in motion, and trusts exclusively to its watchfulness and its burrow for protection, I think that every competent observer who has ever watched its habits in a state of nature will agree that concealing coloration neither plays nor can play any part whatever in its life. It is a diurnal animal, whose habits are such that although it is diurnal it never seeks concealment above ground nor trusts to either cover or coloration for concealment; whereas multitudes of animals which are nocturnal trust purely to the cover of the night and not to their coloration, for concealment and protection. Woodchucks, unlike prairie dogs lead their lives under such conditions that certain species at times may be benefited by concealing coloration. Ordinarily, however, concealing coloration plays a very small part in their protection, and countershading practically no part at all. The coloration is only advertising when the dark-colored animal is amid green or light colored surroundings. In the Rocky Mountains the woodchucks are wary, ever ready to whistle their shrill alarm note, and by day rarely venture far from their holes; they are difficult to make out, merely as the conies are, because the eye picks them out with difficulty among the broken rocks, pebble heaps, bushes and plant tufts; as far as I can tell, their countershading plays absolutely no part in concealing them, the effects of light and shade on their motionless crouching or sitting bodies, colored brown or gray, making them hard to distinguish from the browns and grays of the variously shaded and lighted surrounding inanimate objects. The eastern woodchuck is largely nocturnal; according to my observations it rarely ventures far from its burrows into open country during daylight, and then trusts to its watchfulness to warn it of the approach of a foe in time to permit of flight to its home. In a clover field a woodchuck, unless completely screened from view, is very conspicuous, because of the color contrast of its body against the green. In the woods it is generally more difficult to see, and here its coloration is at least not advertising, as is a skunk's for instance; but I do not think that even in the woods the exact shading of a

woodchuck's coat is of any consequence in protecting it; the concealment comes merely from the fact that the coloration is not sufficiently vivid or strongly marked, either in color or pattern, to advertise it to a degree that would offset the advantage conferred by the actual screen of twigs and leaves, or the obscurity of the light and the bewildering effect on the eyes of countless different shadings and forms of the surroundings. In other words it is not the woodchuck itself which is so colored as to be invisible (it is readily seen on any flat surface, clear of inanimate objects); it is the many colored and many shaded, obscurely lighted, highly accidented surroundings, which tend to make it difficult for the eye to pick out from among them any motionless creature unless the latter is colored in some bold and striking fashion. In the woodchuck's case, and in an immense multitude of similar cases, any one of hundreds of patterns of coloration, varied or uniform, would be equally concealing; all that natural selection can have done in this line, if anything, is to have prevented the development of such bold and striking coloration as that of the skunk or wolverene or logcock or red-headed woodpecker, leaving the exact pattern or tint to be determined, within very wide limits, by some wholly different cause or causes. The prime qualities necessary to the woodchuck's preservation are certain life habits, such as remaining in the day time near enough to its burrow to enter it very speedily, venturing on long rambles only at night; watchfulness, ability to crouch motionless if it suspects danger when far from home, and the use of grass or bush cover. Some species of woodchuck are slightly countershaded; others, as can be seen by inspecting the mounted specimens in the American Museum, are not countershaded at all; and neither the presence nor the absence of the countershading has the least effect on the beasts' conspicuousness or habits.¹

RECAPITULATION.

To sum up and recapitulate,² Mr. Thayer's contribution to the old doctrine of "concealing coloration" (which is substantially although not quite completely, the equivalent of the older phrase "protective coloration") consists in making it universal and all sufficient to explain any color of any kind on practically every animal; and in basing it upon countershading which he asserts to be the overwhelmingly dominant factor in producing it; and he regards this universal concealing coloration as the product of

¹ The western woodchuck of Colorado is slightly countershaded; yet the photograph of it from life in Warren's book shows that in an ordinary light the effect may be as if the countershading were inverted.

² Let me here call attention to Mr. Selous's 'African Nature Notes' in which there is an admirable discussion of protective coloration from first hand observation; and to Captain Stigand's 'Game of British East Africa' where the subject is also excellently treated.

natural selection. His assertion that concealing coloration is universal or nearly so, and sufficient to account for all coloration, is in flat contradiction of the facts as regards birds and mammals; I have shown that there are such sweeping exceptions to the principle, including thousands of species, as to make it impossible seriously to consider it as of universal or nearly universal application. There remains the doctrine of counter-gradation as the main factor in producing concealing coloration. Mr. Thayer deserves credit for pointing out the fact that counter-gradation of shades does (in some cases) help toward the obliteration of an animal's form. But his preposterous misrepresentation of the importance of his newly discovered principle destroys almost all the value of the conclusions he bases upon it. The countershading of a mammal's or bird's coat, when it exists (and it is often absent) is never more than a minor factor in concealing it and in the immense majority of cases is a negligible factor. In all probability the general shading of animals, darker above and lighter below, has nothing to do with natural selection or with concealing coloration, but is based on some such principle or law as that at work in the vegetable world which makes leaves darker on their upper than their under surfaces and similarly affects fruits. The fact that this law under certain circumstances tends toward concealment is of far more importance from the standpoint of the artistic colorist than from the standpoint of the naturalist or at least of the mammalogist and ornithologist; because in nature so many other elements enter into the problem that the working of the law is of practical effect in the cases of only a few mammals and birds. The countershading is not of concealing value where it translates itself into vivid colors of an advertising quality. Normally, birds and animals which are black above, are of an advertising coloration; and when the countershading assumes the form of snow white below it is advertising. Even if the countershading is gradual, it is of no use from the standpoint of concealment, if the general tint is out of harmony with the surroundings.

Taking all these facts together, it appears that as regards the great majority of birds and mammals, the countershading is of no concealing value, or else of a value so small as to be negligible. The only case where it is of concealing value is where the shading is gradual, and the change from above to below comparatively slight; and even then, only if the general tint is in harmony with the background and surroundings — which never can be the case if the change from above to below is either great or abrupt. Save in the limited proportion of cases which fulfil these requirements, countershading is a negligible factor in concealing coloration; and even in these comparatively few cases it is almost always of entirely secondary importance to the actual color.

So much for Mr. Thayer's especial theories. Now for the general subject

of concealing (protective) coloration. What I say is based on study of the mammals and birds of temperate and boreal North America and of tropical Eastern and Middle Africa. Doubtless what is true of these is true of other birds and mammals. Of the mammals, I have observed in their haunts, or have studied the skins of, most of those found in both countries; but of African birds I know only the waders, the swimmers, the birds of prey, the bigger land birds, and some of the more conspicuous smaller birds, such as some of the hornbills, nighthawks, swifts, swallows, sun-birds, bee-eaters, kingfishers, barbets, bulbuls, plaitain eaters, parrots, and whydah finches.

The first thing to realize in discussing concealing coloration is that to any but trained hunters' eyes, all birds and mammals out of doors seem far more inconspicuous than previous acquaintance with them in the museum or menagerie or in book pictures leads the observer to expect; and moreover when the mammal or bird is small, or is seen against the light, as must be the case where it is in the tree tops, the difficulty of making it out is immeasurably increased. Any man who has tried to photograph wild animals out of doors will realize how often he sees the animal at a range sufficient to warrant his shooting at it, and how rarely he is able by the utmost effort to get near enough to make a good picture of it. This, by the way, is one of the reasons, but by no means the only reason, why photographs, if not taken by men especially fitted to understand not only the uses but the limitations of their instrument, are so often entirely unsatisfactory and misleading as representations of nature. Even when taken close up photographs may give a completely erroneous representation of natural objects. Admirable work for science has been done of recent years by highly skilled naturalists and observers of nature who are also adepts in the use of the camera; but unless used by a very conscientious, and also very capable, observer, photographs may be a positive hindrance to knowledge.

The next thing to remember is that (entirely apart from the limitations of vision and observation of the ordinary man who is not a trained hunter,¹ that is, of the man who has not the eye of a bushman or of the most sharp-sighted wild beasts and birds) the difficulties of seeing any animal, merely because of the variety of the landscape, are far greater than most men, who have not thought out the subject, understand. There are landscapes that are almost flat monochrome; lakes and bare plains, for instance; and animals

¹ When I speak of a trained hunter I do not mean merely the ordinary hunter, with the ordinary power of reasonably good out-of-door vision, which most of us possess who have done a good deal of hunting or who have lived on ranches and out of doors. I mean the vision of the really wild hunters, like the 'Ndorobo with whom I hunted occasionally in the African forests, and who, I found, regarded not merely my vision, but the vision of my native Wakamba gun bearers, which was far superior to mine, as being immeasurably deficient.

on these, gulls or loons on lakes, and antelopes on the plains, are conspicuous. There are other landscapes, such as lawns thinly scattered with trees, where birds that do not try to conceal themselves, such as orioles and blackbirds, are conspicuous. But even in grassy plains or in marshes animals that pass their lives below the level of the grass tops or reed tops are very hard to see, and in forests the chance of an animal, even a conspicuous animal, remaining unseen, is very great. If the animal actually dwells in such thick cover that there are almost always physical obstructions between it and the sight of any possible foe, it escapes notice just as anything escapes notice behind a screen. If it does not venture out except at night, it escapes notice in the daytime for the very excellent reason that it is not where it can be seen; and at night, unless its color is white, it does not make very much difference what color it is. A multitude of mammals, especially small mammals, including most mice and shrews, come under one of these two categories; they are always either under the screen of night or under the screen of cover which shields them from view about as effectively as night does. But even where animals are diurnal in habit, and do not live in such thick cover as to be physically screened from all foes, a thick and high forest, especially a tropical forest, offers them extraordinary protection. Near the ground the light is dull, and among the shadows only very bright colors are conspicuous. In the upper branches the difficulty is just the reverse. There the myriads of leaves and twigs cause a well-nigh infinite variety of colors, lights and shades, and no small object stands out distinctly, as in the open. This is why the brilliant and abundant scarlet tanagers which dwell in the tree tops are relatively so very much more rarely seen than the Baltimore orioles around our houses, the bobolinks in the fields, and the red-winged blackbirds beside the ponds and swamps. In the forests the advertising colors do have some effect, and the male tanager is much more easily seen than a female tanager; but they have very much less effect than in the open. In consequence the birds and diurnal animals of the forest are difficult to see, no matter what their coloration, compared to what is the case on the plains. The same holds true of any accidented landscape: this is why it is often hard to pick out a pika in a mass of slide-rock, even though he may be really in sight and can be heard uttering his querulous note; and why in a varied mountain or hill landscape close scrutiny is necessary in order to see a marmot feeding, or a mountain sheep lying down, or a klipspringer going about his daily business.

CONCLUSIONS.

Keeping in mind these considerations we can tentatively draw the following conclusions as to concealing and protective coloration — and the most important of these conclusions are those which state the limitations of our present knowledge.

(1) Speaking roughly and generally, there is a tendency for certain general types of coloration to be found among all the birds and mammals affected by the same physical conditions. Those of the tree tops are apt to have a lighter, brighter, more varied coloration than those dwelling in the more sombre and uniform surroundings near the ground, beneath the forest trees. There is a tendency for arctic and alpine animals to be light colored and in many cases white, in winter; there is a tendency among desert animals to have very pale tints; there is a tendency for mammals and birds that dwell on or near the ground in thick forests to be dull colored; and animals of the semi-arid regions tend to be paler than those of cold or temperate humid regions, which tend to develop dark lusterless hues, as compared to the gorgeous hues so apt to be found where humidity and heat go together. There are multitudes of exceptions to all these tendencies, exceptions so numerous that it is out of the question to speak of the tendencies as laws that are always binding; and there are many areas where the types of coloration are so varied that it is impossible to state the case generally, the types of coloration being of what looks like haphazard incongruity, showing that many and conflicting principles of selection have been at work.

As regards this type of tendency, it is possible that it represents the result of natural selection picking out for the majority of birds and mammals colors which may conceal them. It is possible, and to my mind much more probable, that the major part of the tendency is due, as regards birds and mammals, not to natural selection for this purpose at all, but to the effect of physical surroundings upon all the individuals of a very great number of species. In any event there remain as to each locality many exceptions; that is there are in each locality many species, the coloration patterns of which have developed along directly opposite lines to those along which the coloration patterns of most of the other species of the locality have developed. Such exceptions include the musk-ox, raven and wolverine of the boreal regions; the cock ostrich and black and white chat among desert animals; the skunk, yellow-headed blackbird and lark bunting of the semi-arid regions of the United States: the tanagers, cardinals, and innumerable other birds in the moist temperate parts of North America. Moreover the general coloration tendency, where it exists, seems to affect

alike birds and mammals which might possibly be benefited by it, and birds and mammals which because of their nocturnal habits or for other reasons cannot possibly receive such benefit. The eagle owl of America, for instance, tends to be gray in the semi-arid region, and whitish toward the North; but its habits are such that it is impossible that these slight differences in its coloration can have any advantageous effect upon the individuals so colored. The same statement applies to the black duck-hawk of the Puget Sound region.

(2) There are certain birds and certain mammals whose coloration is unquestionably concealing, either for most of the time, or at certain vital periods, as when nesting, or, in the case of nocturnal birds, when crouching motionless during the daytime. Nighthawks and many grouse are striking examples of this. So, to a much less degree, are most rabbits, although these rabbits when in motion have a highly advertising rear-end coloration. All these animals deliberately strive to escape observation by remaining motionless. The chief factor in enabling them to do so, aside from cover, is their actual tint, whether uniform, or varied, or so minutely varied as to convey at a very short distance an impression of uniformity; but in some cases the concealing power of the coloration is probably slightly helped by countershading. These mammals and birds of unquestionably concealing coloration, where the concealing coloration is the principal factor in their concealment, are not many in number.

(3) Many mammals are advertisingly colored. This is true of many of the dog family, of most of the highly predacious weasel family, of many arboreal squirrels, and of very large numbers of the big grass-eating mammals. Some of these animals live in the open plain or on high mountains, and are very conspicuous and easy to see. Others live in thick forests and yet are exactly as hard to see as if they were obliteratedly colored, because of their wariness and their ability to take advantage of the deep cover in which they dwell. Utility can have no part in developing such coloration patterns.

(4) Most small mammals, especially those of the forest and the thickets and the tall grass, have a coloration which can hardly be called especially revealing or especially concealing; they rely on the cover and on their habits, and not upon their coloration, for concealment. The utmost that can with any show of reason, be claimed as regards these is, that the law of natural selection, or whatever law it is that is responsible for their coloring, has set wide coloration limits, which the species cannot transgress, but within these wide limits has allowed each species to develop any kind of coloration pattern. It is of course very difficult to define the exact boundary lines separating the large classes of animals with a very slightly concealing or very slightly revealing coloration from the still larger class where

the coloration can scarcely be called either revealing or concealing. Many birds, such as many of the sparrows which live in the grass, are inconspicuous, and may be said to have a concealing coloration; and yet their close kinsfolk, with a substantially similar coloration, may live under conditions which make their coloration really possess little of either revealing or concealing quality.

(5) As regards the majority of birds and mammals the prime factors in securing their safety, are habit (including bodily capacity) if they do not trust to concealment, and habit and cover if they do trust to concealment. Among these birds and mammals the coloration is always a minor, and often a negligible, factor, and the countershading has no effect whatever, one way or the other.

(6) A large majority, probably at least three fourths or over of the birds of temperate North America, have coloration patterns which, either in whole or in part, either all the time in both sexes, or all the time in one sex, or some of the time in one sex, are advertising and not concealing. This is also true of those birds of Africa to which I paid attention, that is, the water birds, the bee-eaters, sun-birds, and the like. Often the female is concealingly colored or at least has a non-advertising coloration, where the coloration of the male is highly advertising. There are large numbers of birds, including various species of woodpeckers, crows, blackbirds, shrikes, flycatchers, swans, pelicans, herons, cormorants, gulls, guillemots, puffins and hawks which have in both sexes, and all the time, a strongly advertising coloration. In many other birds the coloration may be advertising, over the whole body, but only in one sex and for part of the year. In yet others the advertising coloration, temporary or permanent may be confined to one part of the body, such as the breast or head. The young birds may have a concealing coloration, even when the coloration of the parents is at all times, including the most critical moments of their lives, as when on the nest, highly advertising (as examples, take the skimmers, stilts, terns, gulls); or they may have a coloration as revealing, or almost as revealing, as that of the parents, this being true of pelicans, herons, cormorants, and anhingas, for instance.¹

Among the ducks, ordinarily one sex develops strongly advertising coloration for almost all the year. The male cardinal has a strongly advertising coloration all the year. The tanager and bobolink have strongly advertising coloration patterns for part of the year. There are numerous other small birds possessing highly advertising patterns of body coloration.

¹ Photographs of the adults and young of all these birds are given in Mr. Chapman's 'Camps and Cruises', one of the most instructive and most delightfully interesting books of the kind that has ever been written.

There are still larger numbers of birds, including many sparrows and most warblers, where the males, at least in spring, possess a coloration which is highly advertising on certain parts of the body, usually the breast and around the head and neck. Taking all these classes together, they make up very much more than a majority of American species, each of which either all the time as regards both sexes, or, as regards one sex, for all the time or part of the time, are in whole or in part advertisingly colored. In the semi-arid West, for example, the male lark bunting has a plumage pattern which is advertising in its entirety, just as much so as a raven's; the male longspurs possess such an advertising pattern only on the head, neck and breast; whereas, for instance, the Baird's sparrow lacks it entirely, both sexes being similar and both seeking safety in actual physical concealment in the grass.

(7) These advertising colors represent several different principles or tendencies. As regards many of the crows, woodpeckers and blackbirds, it is evident that in the development of the different species, the tendencies, whatever they are, that have made for a concealing coloration, that is, for a coloration that would be in harmony with the landscape and the immediate surroundings of the birds, have been completely overcome by other tendencies that have acted with equal force on both sexes, or, if not with equal force, at least with sufficient force to make even the female, though perhaps less brightly colored, not concealingly colored. If, as in the red-headed woodpecker, where both sexes are alike, the bright coloration of the male is due to sexual selection, then either the same principle has been at work as regards the female, or else some other principle has affected both sexes in such a way and with such strength as to completely overcome any tendency to produce a concealing coloration. In the case of many ducks and tanagers, where, unlike what is true of ravens and red-headed woodpeckers, there is a strong sex difference, and where the male is much more advertisingly colored than the female, it is of course possible that the principle, whatever it may be, which is working for concealing coloration has been powerful enough to overcome any other tendencies as regards the female, but that the principle of sexual selection (or whatever principle it is which so frequently gives superiority in brightness of coloration, in ornamentation, and in bodily vigor, to the male) has been so strong as completely to overcome all tendencies that make for a dull or concealing coloration in the male. The white so common on the outer tail feathers of birds, which is only shown in flight, must represent a totally different tendency or set of tendencies; it is advertising; it is sometimes displayed in courtship; it may serve as a recognition mark when birds are in a flock; by its display in flight and its disappearance the instant a bird lights it may mislead a pursuer; and

of any pair of closely allied species, such as the vesper finch and savanna sparrow, or mockingbird and catbird, one may possess it and the other lack it, without any apparent difference in habits being produced thereby; while even in the same species, as in the robin, one form may possess these white markings, while another form lacks them.

(8) There are only rarely cases in which under the same conditions, all the kinds of concealing coloration tend to be of the same type. This is another way of saying, both that the principle of natural selection working towards a concealing coloration is in every case complicated by the workings of other principles and tendencies and also that even birds and mammals of comparatively restricted life-areas live under conditions of sufficient variety to make it impossible to develop coloration patterns showing such complete mimicry of their surroundings as are shown by the coloration patterns of certain insects and even reptiles. Under most conditions of bird and mammal life one pattern seems about as good as another if of the right general tint. Observers who get obsessed by their theory often pick out with triumph peculiarities which have no effect whatever, or even the reverse effect of that which they ascribe to them, and speak as if these peculiarities were essential to concealment. Thus it is alleged that the black tip of the ermine's tail, and the black tails of certain species of ptarmigan are concealing; yet the Arctic fox has no black tip to its tail, and there are white-tailed ptarmigan. It is evident that either the black on the tails of the weasel and of some ptarmigan has no especial effect, or else that the lack of it on the tails of the fox and of other ptarmigan, does have a special effect. If the black tail is concealing, then the white tail is revealing; and vice versa; or else no particular effect is produced either way. Doubtless the last is the case. Not only are minute patterns rarely of any real weight in concealing their wearers, but wide differences of pattern have no effect, if the general hue is one in sufficient harmony with the ordinary surroundings. This becomes apparent when we consider the utterly different coloration patterns of different sparrows, warblers and thrushes which live under substantially the same conditions and are equally hard to make out. A careful examination of those birds which really do have a concealing coloration, and may be beneficially affected thereby, goes to show that with the possible exception of a very few cases, it is out of the question that all the widely varying types of coloration, in any given set of surroundings, can have been produced by the same agency. In so far as the principle of natural selection, working toward the production of a concealing coloration, has affected all these numerous species of birds, it has done so, not by producing each of the countless and totally different types of coloration, but by setting bounds beyond which the coloration cannot vary in any adver-

tising direction, and allowing other circumstances to determine the exact pattern within these bounds. As already shown, countershading, among birds and mammals, generally plays an insignificant or negligible part in helping produce a concealing coloration.

(9) In many situations the quality of the landscape, or the quality of the cover, is such that neither any concealing quality in the coloration, nor any advertising quality, is of more than infinitesimal consequence to the animal compared with the development of other qualities — wariness, shrewdness, courage, speed, insistence upon living in the densest cover, or ability to take advantage of comparatively scant cover. A study of the big antelopes that live in the reeds, and of the big and small antelopes that live in the jungle, and of most of the birds of the tree tops, will show that in all these places with very thick cover, or with varied cover, concealing coloration plays little or no part; for the animals that do not possess it thrive as successfully as those that do.

(10) It is easy to understand that advertising and concealing coloration should alike be indifferent to animals that live in such cover as to hide both them and their coloration. But many mammals and birds live absolutely or practically in the open, or under conditions where advertising coloration does in fact advertise them at a much greater distance than would be the case if they lacked it; and yet even under these conditions hundreds of species of a highly advertising coloration prosper as well as, although apparently no better than, those with a concealing coloration. Gulls, cormorants, loons, grebes, guillemots, fulmars on the water; herons, storks, ibises, plover on the plains, or the edges of marshes, lakes and rivers; big antelope and zebra on the plains; blackbirds, grackles and bobolinks in the meadows and pastures; all illustrate this fact. The numerous species of bee-eater which I saw in Africa all had an intensely advertising coloration, and lived under conditions which accentuated the advertising quality of the coloration. The topi, with its very bold and inversely countergraded coloration is no more nor less at home in the places where it dwells than is the counter-shaded eland with its much less conspicuous coloration. A male Grant's gazelle which is countershaded and not very advertisingly colored, is no less and no more at home than the female of the same species which has an advertising black stripe along the body, or than the smaller Thomson's gazelle, which also has the black stripe, together with the habit of perpetually twitching its tail whenever it is standing up. The yellow-headed blackbird has an extraordinarily advertising coloration; but I cannot see that it affects the welfare of the species one way or the other.

Among certain species of birds, however, there is a contrast in the behavior of those that are advertisingly colored and those that are not.

On the plains, thrashers always skulk and seek cover in which to hide, while blackbirds, which of course are infinitely more conspicuously colored than the thrashers, walk and sit boldly in the open. The meadowlark which has a highly advertising breast coloration, but a concealing back coloration, skulks and takes advantage of cover in a way which the robin never does. On the other hand there are other cases where birds that are concealingly colored take no advantage of their coloration and behave exactly as do their kinsfolks that are advertisingly colored. The kingbirds, and especially the scissors-tailed flycatchers, are very conspicuous, and are good examples of advertising coloration, when in their ordinary surroundings. Most of their near kin, the phœbes, are inconspicuously colored; but neither the phœbes nor the wood pewees seem to take advantage of their coloration in order to try to conceal themselves. Most of the small flycatchers do live in thickets, where their inconspicuous coloration may be of benefit to them; but the great-crowned flycatcher, which is colored substantially like the Western kingbird, is unlike the kingbird in its habits, and at least sometimes seeks to take advantage of cover. There are innumerable instances of this kind.

(11) In short, as one might anticipate, when we deal with the coloration of birds and mammals we deal not with any one cause, but with a varied and complex tissue of causes. Forces have been at work to develop concealing coloration in many species, and countervailing forces have worked with greater or less strength to counteract the influence of the first, in some species completely succeeding and in others partially succeeding. Some birds and mammals are so colored that normally or at certain important times their coloration helps to obliterate them from the sight of their foes. Others are so colored that their coloration under all normal conditions and from every viewpoint, and at the most critical periods of their lives, tends to reveal them to their foes. In others the coloration is of little consequence, one way or the other. Birds and mammals living under precisely the same conditions have totally different types of coloration, and display totally different traits and habits when seeking to escape from enemies or to capture prey. No universal laws can be laid down. Tentatively, it is possible to give adherence to the conclusions which I have sketched in loose outline above. We know that many birds and mammals are concealingly colored. It is hard to say, at least in some cases, whether this concealing coloration has been produced by natural selection, or whether, however produced, it has merely then been taken advantage of by the animals, which have conformed their habits thereto, so as to get the utmost benefit from it. In many birds and mammals sexual selection or some similar principle has completely obscured in one sex the workings of the law which tends to produce conceal-

ing coloration. In many other birds and mammals both sexes are advertisingly colored, and whatever be the cause that has produced this advertising coloration it is evident that the circumstances of their lives are such, that their habits and traits of mind are such, as to render the question of concealing coloration a negligible element in their development.

The species of birds and mammals with a complete oblitative, or concealing, or protective, coloration, are few in number compared to those which possess (either all the time, or part of the time, or in one sex for all the time or part of the time) a conspicuous or revealing or advertising coloration, and to those in which the coloration is neither especially advertising nor especially concealing. As regards the great majority of the species, the coloration, whether concealing or not, is of slight importance from the standpoint of jeopardizing or preserving the bird's or mammal's life, compared to its cunning, wariness, ferocity, speed, ability to take advantage of cover and other traits and habits, and compared to the character of its surroundings.

So much for the conclusions to which, it seems to me, our present knowledge of the subject points. But the most important conclusion is that as yet we do not know enough to be able to explain all, or anything like all, the different kinds of coloration and their probable origins; and that we are not as yet by any means in a position to say with any certainty, in reference to large classes of birds and mammals, whether they do or do not possess a concealing coloration. We can say with certainty that hundreds of birds and mammals possess a revealing, and other hundreds a concealing coloration; after even a slight effort to look at the facts honestly there is no doubt on this point; and, after such effort has once been made, it is as idle to discuss whether for instance flamingoes, spoonbills, ravens, egrets, red-headed woodpeckers, scissor-tailed flycatchers, yellow-headed blackbirds, cormorants, prongbucks, skunks, sable antelopes, are concealingly colored, as it would be to discuss whether the world is flat, or whether every extinct and existing "species" came into being by a special act of creation.

But there is room for wide differences of opinion as to how great the part played by concealing coloration is, so far as multitudes of other birds and mammals are concerned. Many skilled field ornithologists of great experience — men like Mr. Chapman, for instance — for whose judgment I have the most unqualified respect, believe that concealing coloration is far more widespread, and plays a much more important part than I have admitted. I believe that it plays a large and important part; I believe that there are many cases where it is a main factor, in helping the wearer

in the struggle for life, and a far greater number of cases where, although not a main factor, it yet exercises an appreciable influence; but I believe that on the whole, among birds and mammals, the main factors are, first and universally, habit, and, second and by no means universally, cover. Whether the part it plays is larger, even very much larger, than I am at present prepared to admit must be determined by the studies of many such first-class observers as Mr. Chapman, Mr. Job, Mr. Finley, Mr. Beebe, Mr. Kearton. Take for example the descriptions and photographs of waterbirds by Messrs. Chapman and Job; no one can look at the photos of the black skimmer and stilt on their nests without seeing that even in that critical position their coloration is highly advertising, while the coloration of their young is concealing; no one can look at the photographs of the nesting egrets, anhingas, cormorants and pelicans without seeing that both the adults and the young are exceedingly conspicuous, without a vestige of concealing coloration; no one can look at the photographs of the nesting woodcock, nighthawk, Wilson's snipe, bob-white, and upland plover without seeing that they possess a concealing coloration. In the same way, I think that the conclusions, based on prolonged and careful personal observation, which I have reached as regards the larger carnivores and game animals, of North America and Africa, as set forth in this paper and in the appendix to my 'African Game Trails,' cannot be successfully controverted. The problems in these cases are comparatively simple. There are many more obscure problems; such as the determination of the parts respectively played by habit, cover and coloration in concealing, or favoring, minks, weasels, rabbits, meadow mice, warblers, finches, titmice, vireos. I believe that the general conclusions which I have above set forth are, within broad limits, correct; but no one will welcome more heartily than I shall the conscientious and exhaustive study, of the many groups of birds and mammals, in their own native haunts, under natural conditions, which will finally enable naturalists to say just what these limits are.

APPENDIX.

REPLY TO CRITICISMS OF A. H. THAYER IN 'POPULAR SCIENCE MONTHLY'
FOR JULY, 1911.

In the July 'Popular Science Monthly' Mr. Thayer has an article in answer to the appendix (as he calls it, the "extraordinary tirade") in 'African Game Trails,' on the subject of concealing coloration. Mr. Thayer's habit of mind is inaccurate; and his inability to be accurate in matters biological extends also to inability to quote correctly what I have written. Thus he makes a diagram to show that I am "exactly wrong" in my (purely imaginary) statement "that to the lower-levelled eye of a wolf or cougar a prongbuck's white rump shows now against the sky and now below it, according to the enemy's distance." I made no such statement; I suppose that Mr. Thayer's attributing it to me must be pardoned in view of his "artistic temperament," which, in ascertaining facts, he exalts so far above the scientific. What I actually said was that Mr. Thayer's theory could be sound only on the supposition that the wolf or cougar "never glanced in its (the antelope's) direction save at just the one particular moment" when "it happened to be standing stern-on in such a position that the rump was above the sky line and all the rest of the body below it. Ten steps further back or ten steps further forward would in each case make it visible instantly." This is true; so true, that Mr. Thayer cannot refute it, and therefore attributes to me a statement which I did not make in order that he may get something which he can refute. Mr. Thayer's theory — an absurd theory anyhow — could have value only on the supposition that the wolf never looked at the prongbuck save when the animal stood absolutely end on to him, so that the rump concealed the entire fore part of the body; and I was pointing out this fact. This is wholly aside from the fact that the prongbuck usually lives in a somewhat rolling country, so that in actual life it is more apt to be seen against the landscape than against the sky line; and when approached in a rolling or broken country, or of course where there are bushes or trees, the antelope or deer must necessarily often be seen at a distance against a background of bush or hill, even though when looked up to from close by it would be seen against the sky. Again Mr. Thayer states that when I said that "bears have no white on them" I erred because several foreign species have (as of course I well knew). A glance at my appendix will show that Mr. Thayer must have known perfectly well that I was speaking of our common skunks as compared with our common bears. My statement as to these was minutely accurate. I was comparing animals with white and animals without white; the point I was making was wholly aside from, and had nothing to do with, the different coloration of bears, and of skunk-like animals, in other continents (although I could also have made the same point by considering these). Again, Mr. Thayer states that I said that there was "never any difficulty in seeing" game which was hidden from me by "a haze of interposed scrub growth," which at some point was "wholly covered by the scrub," was "actually hidden by accumulated twiggery." This is a rather flagrant instance of giving full rein to "an artistic temperament." I never said anything of the kind; either Mr. Thayer

knows this, or he knows nothing of any game country. I was contrasting the bush antelopes, which do elude observation and are difficult to see, with the antelopes of the bare, open grassy plains of East Africa where there is no bush, no scrub, no twiggery, no cover; and of this game of the bare plains I said "On the open plains . . . there is never any difficulty in seeing (the game); the difficulty is to prevent their seeing the hunter." This is the exact fact. Mr. Thayer would not need to be told that such is the case if he had the slightest knowledge of the conditions of the African wild life concerning which he dogmatizes so glibly. Any naturalist or hunter accustomed to accurate observation who has been in East Africa will accept the statement as a matter of course; and if Mr. Thayer will turn to such a book as Captain Stigand's he will find the fact stated again and again. In the ordinary bush I found all game difficult to see and in the thick forest I found it almost impossible to see; the forest hog and bongo are hardly ever seen by white men, and even in their less densely wooded haunts the bush pig and bush buck must be carefully and skilfully looked for; whereas the plains game can be seen by anybody who crosses the plains, even in a railroad train. The veriest tyro who rides across the Athi or Kapiti plains, or in the Sotik country, or along the Guaso Nyero of the north, or in the neighborhood of Sergoi Hill, cannot help seeing the zebra, oryx, hartebeest, topi, and wildebeest. If he is a good hunter he will see practically all of these animals that are to be found in any locality he is hunting. In each camp in which we stayed for any length of time we soon grew to know most of the different herds of game on the plains in the neighborhood, and indeed some of the individual animals; for we generally found that each herd or individual had a certain beat in which it was apt to be found. If he will turn to Mr. Chapman's 'Camps and Cruises' Mr. Thayer will see that Mr. Chapman has stated the same fact, for our own western plains, even more strongly than I have done, stating that every antelope, coyote, fox, badger and gopher is visible on the bare, grassy, open plains, whereas it is impossible to find out just what animals a square mile of forest contains.

It ought not to be necessary to tell such simple and elementary facts to any man who writes a book of such pretentiousness as Mr. Thayer's. I have given samples only of the way in which he misrepresents what I have said. It would be pointless to multiply the instances.

Now, take what is much more important, Mr. Thayer's effort to prove the truth of his theories that flamingoes, male wood ducks, male bobolinks, zebra, oryx, etc., are concealingly colored. All I need say as to the wood duck is to refer to what I have already written in this article. But Mr. Thayer advances some new ideas as to the zebra and oryx. He protests against my alleged statement that "if one coloration is a concealer, a different one in an animal of the same general habits is not." As usual Mr. Thayer suffers from his inability to state facts correctly. What I really said was "The beasts above enumerated (zebra, wildebeest, topi, hartebeest, oryx, eland gazelle) are colored in widely different fashions. If any one of them was really obliteratively colored, it would mean that some or all of the others were not so colored." This is the exact truth. Any animal of any color if it keeps still may under certain conditions escape detection; and most birds and mammals seem to know this, for from elephant, rhinoceros, buffalo and bear down to field mice and nesting warblers and vireos they all at times "freeze" or stand motionless, their immobility thereby giving them a chance to escape observation no matter what may be their size, shape or color (I have seen all the four big creatures above mentioned, which even Mr. Thayer admits not to be concealingly colored, stand motionless

to escape the notice of the hunter, just as I have seen timid animals with concealing coloration patterns stand motionless for the same purpose). Moreover, there may under certain conditions be several styles of coloration each of which can fairly be called concealing; but if of several coloration patterns each is in direct and striking contrast to one or more of the others, they cannot all be concealing under the same circumstances. A drab, a dull gray, a dull greenish brown, a dull yellowish brown, may all be concealing, not because one is somewhat yellowish, another more greenish, another more brownish, but because all are dull; but if the surroundings are such that a vivid red is concealing, then a deep blue or a brilliant white cannot be — for if they all escape notice it simply means that the surroundings are such that no color can attract attention, and therefore that no color is either concealing or revealing. If an animal is concealed because of the fact that it is black, then its mate, if yellow brown, cannot be concealed because of the fact that it is *not* black. A male Grant's gazelle, a roan, an oryx, an eland, might under certain circumstances be considered all to have concealing coloration, because, although not colored exactly alike, their general body tints have a certain likeness; but if this is so, a sable, a pallah, a wildebeest, a topi, a hartebeest, a zebra, colored one black, another red, another purplish, another brindled slate, another black and white, cannot all of them — or any of them — also be concealingly colored. If under precisely the same conditions one animal is concealed because it is striped, another cannot owe its concealment to the fact that it is *not* striped; all that can be said is that under such circumstances the stripes do not count one way or the other, being neither concealing nor revealing, or else that, if one phase is concealing, then that the other is revealing.

Mr. Thayer begins his article by giving an experiment with "a small stuffed deer that wore from its dorsal line down its sides two white stripes in imitation of those of certain African antelopes. These stripes were in every respect such as Theodore Roosevelt says have no concealing virtue of any kind whatever." (Incidentally I cannot find such a statement by me in the article to which he refers, and therefore do not know what particular kind of stripe he supposes I had in mind.) He states that at ten yards' distance these stripes rendered the deer invisible to "forty naturalists"; but that when these white stripes were removed and the deer left colored as it actually was colored by nature, "the spectators exclaimed at how clearly one could now see the deer." Apparently neither Mr. Thayer nor his "forty naturalists" appreciated the most significant feature of his exhibition, which was that (if his experiment was exactly as he describes) *he proved that the actual coloration of the deer was not concealing, and that it had to be concealed by giving it a coloration it did not actually possess.* In other words, Mr. Thayer proved that natural selection had not given this deer a concealing coloration, that its coloration was not such as to give it the most protection possible (and therefore that concealing coloration played an unimportant part in its life compared to other factors — such as habit and cover). If neither Mr. Thayer nor any of the "forty naturalists" saw this obvious fact, then it is evident that both the artistic temperament and the scientific temperament at times stand in urgent need of being based on a foundation of common sense.

In Selater and Thomas's 'Book of the Antelopes,' some 120 African antelope are given, of which about 12, all but one of them tragelaphs, are in some fashion striped. Now if Mr. Thayer's experiment proves anything (aside from the fact that nature did not furnish a concealing coloration to the animal experimented upon, and that

Mr. Thayer had to step in and supply the omission) it is that the *absence* of stripes advertises the antelope; which would mean that he had shown that nine tenths of African antelope, big and little, bush dwellers and plain dwellers, were by his own standards advertisingly colored. I know nothing as to the kind of stripes he used, nor as to the kind of African antelope he made believe that he was imitating — I have never seen one with only two white stripes such as he describes. The eland and bush buck were the striped antelope I had a chance to study when wild. Ordinarily the eland lives in the bare plains, where it is conspicuous. The East African eland has thin stripes; the South African eland, so closely kin to it as probably to belong to the same species, has no stripes; both have exactly the same habits, live under exactly the same conditions, have exactly the same foes; both, in a state of nature, prospered equally; neither is either revealed or concealed by either the presence or the absence of the stripes. At times, in bush, the eland and the roan are both difficult to see, partly, doubtless, because their general coloration harmonizes with that of the dry landscape; but neither the absence of stripes in the roan, nor their presence in the eland, makes any difference in this case, as I can testify from personal observation in the field. It is therefore absurd to lay any stress one way or the other on the fancied concealing quality of this particular feature of the animals' coloration; but it is essential to keep in mind that if Mr. Thayer is correct in saying that one form of eland is concealed because of its stripes, then the lack of stripes must be a revealing feature in the other, as well as in the roan, the oryx, the hartebeest and the gazelles which are found in the same habitat with the striped eland. This of itself would be fatal to Mr. Thayer's theory, which is that *all* animals are protectively or concealingly colored. So with the bush buck as compared with the unstriped dyker, steinbuck and reed buck, one or all of which I have almost always found dwelling in the same cover with it. The steinbuck, dyker and reed buck are colored substantially like Mr. Thayer's "small stuffed deer" which he says in the natural coat could be so "clearly" seen. Mr. Thayer's experiment therefore, if it proves anything (which as a matter of fact it does not), proves that most deer and antelope are "clearly" visible, and only a small fraction concealingly colored. The bush buck changes from a bright tropical form much striped and spotted to a dark south African form in which the male has practically lost these bands and spots (just as the southern forms of the eland and zebra, or quagga, lost, in one case all, in another case almost all, of the striping); and the animal remains just as hard to see in one case as the other.

Mr. Thayer then says that the trouble is largely because I "carried into Africa the regulation down-looker's misconception of the subject. . . . Man is mainly a looker down . . . he hunts . . . largely or wholly looking downward." This statement is simply not so. Except when tracking, a big game hunter in Africa or elsewhere is not often looking down, and is continually looking far ahead and around him; and from a distance in looking at a big antelope the effect of the difference in level between a man's eyes and a lion's eyes disappears. Nor is this all. In the actual stalk the hunter generally advances crouching, or on all fours, or wriggling flat on the ground; so that at the "crucial moment," of which Mr. Thayer speaks as the one for which the animals' coloration is designed, the hunter is apt to be looking up, just exactly as one of the animal's natural foes would be looking up. Except at these moments lions and tigers look up so rarely that a man in ambush in a tree usually escapes their observation; and at the crucial moment they look up only as the hunter at such a moment is apt to look up. Mr. Thayer says that he has been

wholly unable to convince naturalists of the importance of looking up at animals or to get more than an occasional man ("scarcely one man") to lie on the ground so as to "let this immense fact rush upon his consciousness." If he had ever in his life taken the trouble to talk with the right type of a big game hunter, or field naturalist he would have found that the "immense fact" referred to was a matter of familiar knowledge to the hunter or naturalist, merely because he as a matter of course is continually lying on the ground and looking upward, or looking at animals from a distance such that his angle of vision is exactly that of a wolf or cougar.

Mr. Thayer in this article takes up the zebra and oryx. As to the zebra he has abandoned much of the attitude he took in his book. He no longer speaks of the zebra's coloration as being "effectively oblitative at a great distance"; on the contrary he says that "out in the open, the zebra's watchful eye and ear, backed by his agility, ensure his safety." He no longer says of the zebra as he comes to drink that "from far or near the watching eye of the hunter (bestial or human) is likely to see nothing but reed-stripes"; on the contrary he says "the crouching lion sees him come into the reeds — sees him all the time — and if the zebra comes within range, springs upon him, but . . . has inevitable difficulty in distinguishing the zebra's outlines because of the absolute similarity of the zebra's imitation of reeds and sky to the real ones. The zebra's uneasiness keeps both the real and the counterfeit in motion together . . . the lion's . . . second spring . . . must be guided by a lightning-swift perception which of the violently agitated sky-and-reed-stripes are the zebra and which are not." Mr. Thayer knows nothing whatever of the zebra's habits or looks in nature, and has evolved his successive theories purely from his inner consciousness; and, as it happens, he has merely shifted from one absurdity to a worse absurdity. When a moving zebra is so close that a lion can spring on it there is not one chance in a thousand that the lion will mistake the moving zebra for a "sky-and-reed-picture"; why, I have never known such a thing happen even to a dull-sighted white hunter. Every action of the lion and every experience of the observant hunter go to prove that when the zebra is moving, close by, the lion does not and cannot make such mistakes as Mr. Thayer supposes; a lion of such dull wit and sense would starve at once. Nor is this all. Here, as with his striped antelope, Mr. Thayer proves too much. If the zebra is concealed by his stripes at his drinking place or elsewhere, then the wild ass (an unstriped zebra) must be revealed by his lack of stripes; Mr. Thayer ought to show his sincerity by admitting such facts as this, which he cannot deny and so merely avoids discussing. Moreover, the zebra is intimately associated with the hartebeests, wildebeests and oryx, all of which have the same habits, and the hartebeests are even more plentiful throughout the greater part of the zebra's range. If the zebra's stripes conceal him at the "crucial moment" of his life, as Mr. Thayer contends, then at this same crucial moment the hartebeest is revealed by the dark monochrome of his upper body; so is the wildebeest, so is the topi. Mr. Thayer's theory is self destructive.

Mr. Thayer gives half a dozen pictures of an imitation oryx head to prove that the bold head markings of the oryx conceal it at the "crucial moment" when it is going to drink. The pictures show "an imitation oryx head, looked up at, simulating branches against the sky — as at a reedy drinking place it would simulate reeds," and also a "brown countershaded" antelope's head; "the former inconspicuous, the latter less so," and in another picture the former "hard to distinguish . . . against the sky," the latter "very conspicuous." In the first place it would be well to know which sky Mr. Thayer means; his deep blue sky which matches a peacock's neck,

or his pure white sky which matches a prongbuck's rump; they cannot both act concealingly to the head of the oryx. Moreover, there are two flagrant follies in the theory illustrated by this set of pictures. Most antelopes which lead similar lives to the oryx — the topi, wildebeest, hartebeest, eland — actually possess the very type of head coloration which he admits to be conspicuous; so that if his belief were true, he could only show that the oryx had a concealing coloration by admitting that a dozen other antelope had revealing coloration patterns — which would of course destroy his whole theory, for the number of antelope with "brown counter-shaded heads" which have the same habits as those with oryx-like markings on the head far outnumber the latter. But the idea set forth in the picture is shown to be foolish by a moment's consideration of the fact that neither the oryx nor any other antelope stands motionless at a watering hole. The very fact of coming down to drink implies motion, and motion in such a case instantly takes away all concealing power from any coloration. I have often watched antelopes coming down to drink; and Mr. Thayer has not the slightest idea of their habits, or he would never advance such a theory. After coming to drink they at once leave, never lying down or resting at the drinking place. About the zebra, Mr. Thayer has at least learned this elementary fact; but he forgets it again as soon as he becomes obsessed with the thought of a new puzzle picture with the head of an oryx as the subject. An oryx or other antelope with similar habits approaching to drink alternately moves and halts, and is most of its time in the open; and the lion or leopard lying in wait could not possibly fail to see an animal thus approaching, so that the marking on its head could by no chance have any effect whatever in puzzling or deceiving its foe. Its movements would have betrayed it as soon as it came anywhere near, and it would never again have been hidden from the lion or leopard. Photographs such as these of the imitation oryx heads are no more useful than would be a photograph of a stuffed bear, arranged sitting upright among burnt stumps so as to show his "concealing coloration" and protective resemblance to a stump. Any animal's head seen through branches may be difficult to make out and any such head can be posed so as to make it difficult to see; but so is a bear difficult to see among stumps, and by no means unlikely to be mistaken for a stump (as I have seen happen). Such incidents teach no real lesson and when manipulated by Mr. Thayer teach the exact reverse of the truth.

All this moreover is aside from the fact that in the great majority of cases the lion kills by night, when the exact coloration of his prey is of very little, or absolutely no effect. Mr. Thayer always assumes that the beast of prey invariably looks *up* at its prey. As a matter of fact it usually only looks *up* at the last moment, when it is so close that it cannot possibly be misled by any of the so-called concealing marks; at a distance it looks at its prey practically from a level, its viewpoint being then practically the same as that of a human hunter.

Mr. Thayer says that concealing coloration does not primarily help an animal when it is trying to hide; but on the contrary, "the more an animal does not hide, the more nature has to help him by coloring, precisely as in the case of the zebra at the drinking place, or the hummingbird with his head stuck into a flower, or the flamingo at dawn with his head in the mud." This is equivalent to saying that Baltimore orioles, blackbirds and crows which don't hide, are more concealingly colored than grass sparrows and woodcock and snipe, which do hide. There is scant need to refute such a proposition. In the great majority of cases concealing coloration only benefits the animals which, by remaining motionless or skulking

allow it to come into play. This is true even of different individuals of the same species; an advertisingly colored adult nesting skimmer or other similarly colored water bird never tries to hide itself, whereas the concealingly colored young crouch motionless on the sand so that their coloration may help them when they are trying to hide. Of course if natural selection, as Mr. Thayer supposes, produces concealing coloration, it must also produce the power to take advantage of it, or the animal would derive little benefit from it. Zebras and flamingoes I discuss in this article; since I have been writing it a hummingbird outside the window has been "sticking his head into a flower" and the iridescence on his back, his vibrating wings, and his hum, made him so conspicuous that no creature with eyes and ears could possibly have failed to notice him; while in the dark caused by his head in the flower the little insects therein could n't possibly have told whether he was or was n't iridescent about the head (according to another of Mr. Thayer's child-fairy-story theories).

Instead of considering animals which have not concealing coloration, consider for a moment those that have. Doubtless coloration sometimes helps a fleeing or dodging bird or mammal, but normally the great benefit comes to the animal which is motionless. A cock prairie hen, at the love ring, squats motionless as a hawk comes near, losing every particle of his previous conspicuousness, and profiting by all the concealing coloration he has, so as to hide from the vision of his foe. The mother grouse on the eggs hides in just the same way, with the same consciousness. So does a squatted nighthawk. A squatted deer or antelope is certainly consciously trying to hide; the instant it catches the hunter's eye it bounds off, at once abandoning, and losing all benefit from, its concealing coloration. Mr. Thayer's position is wholly incorrect and indefensible.

It is hardly worth while to discuss all of Mr. Thayer's statements, such as his assertion that no man knows anything of the "laws of optics" who believes that the white of a prongbuck or skunk makes the wearer more apt to be visible at night than are animals which lack white. Last night under the "clear moonless night sky" which Mr. Thayer demands, I took out into an open field, and then among trees, a black cloth, a brown cloth, and a white towel about the size of a prongbuck's rump pattern. I hung them on a wire fence and then on tree limbs above my head; I looked at them from below and from one side and from every angle and from above. Against the sky line, especially when seen from below, the differences among them were least; and under certain conditions, of course, none of them could be seen at all; but the white did *not* ordinarily fade into the sky line (exactly as I had already said, from my experience with living animals); it was conspicuous when seen from below at the distance of a cougar's spring; it was by far the most conspicuous of all the colors when seen from below against a hillside or a bush or tree; it was by far the most conspicuous color when seen from the same level, as prowling beasts of prey generally first see their game. Every statement I made about the white on prongbucks or skunks was exactly borne out by these observations. Black, under certain conditions, is more visible at night than dull yellowish brown. Under most conditions and against the largest number of backgrounds, white is on the whole, at night, very much more conspicuous or revealing than any other color; taking together moonlight nights, and nights without the moon, and all the various cloud effects. The black and white stripes of the zebra merge into a monochrome at a few hundred yards in the bright day, and at a few dozen yards in the late evening; in the moonlight I have seen zebras show as if they were a uniform silvery white; but normally at

night, when I could see them at all, even when very close, they seemed rather formless shapes of the same indistinct shade as any other beasts at that time. When *very* close up the white of the stripes doubtless glimmers dimly, and then has a very slight advertising value.

On this point, as on so many others, it is difficult to argue with Mr. Thayer because of the utter absurdity of his position. There is no need of knowledge of the "laws of optics" in order to realize that on the whole white is the most revealing color at night, if the conditions are such that any color can have any revealing effect at all. Every out of doors man knows this and shapes his conduct in accordance with this knowledge; and failure to realize it denotes, not "knowledge of the laws of optics" but inability or deliberate refusal to observe ordinary facts and to understand and apply them when observed.

Mr. Thayer says that the breeding cock bobolink has a "potently obliterative dress" from the hawk's viewpoint. As the bobolink when breeding sings continually, from telegraph poles, low posts, small trees, on weeds, in the air, and on or near the ground, a man is quite as apt to see him from below or to one side as from above, and therefore is apt to see him from several of the usual viewpoints of hawks (excluding the soaring buzzards, which are least dangerous to him). Moreover if the coloring of his upper parts obliterate him in the view of hawks, then the lack of such coloring in the cow buntings, purple and rusty grackles, yellow-headed and red-winged blackbirds, must advertise them, for they are all birds of habitually the same surroundings; so that Mr. Thayer has merely again fallen into one of his most common and rather comical errors. As a matter of fact the males of all these birds in mating plumage are extraordinarily conspicuous, and never more so than when seen from above against their ordinary backgrounds, the viewpoint of the hawk of which Mr. Thayer speaks.

Among all the wild absurdities to which Mr. Thayer has committed himself, probably the wildest is his theory that flamingoes are concealingly colored because their foes mistake them for sunsets. In this article he solemnly reiterates and expands this belief; and incidentally, as showing that they are most apt to be seen at the water's edge at sunrise and sunset, he advances the old idea that the flamingo is nocturnal, apparently not having taken the trouble to read Mr. Chapman's book in which it is shown that they feed both by night and by day. As with so many of Mr. Thayer's theories, there is a certain difficulty in meeting this, merely because of the fact that it is utterly absurd. It is difficult to meet a statement of what is against the evidence of the senses by an appeal to the senses; there is absolutely no use in arguing with a man whose mind is such that he is capable of making such a statement; but when he is accepted seriously by people who ought to know better, who ought to understand something of the worth of accurately observed facts, and of rational appreciation of the value to be put upon, and the deduction to be drawn from, observed facts, it becomes really necessary for someone, however reluctant he may be to hurt Mr. Thayer's feelings, to show just what Mr. Thayer's guesses and "experiments" amount to. Remember that he has never studied flamingoes in their haunts, he knows nothing personally of their habits or their enemies or their ways of avoiding their enemies (I suppose — although it may be a violent supposition — that even Mr. Thayer does not imagine that the small gasteropods and other little creatures of low organization on which the flamingo feeds mistake it for a sunrise or sunset) and certainly has never read anything to justify his suppositions; these suppositions represent nothing but pure guesswork, and even to call them guesswork is a little

over-conservative, for they come nearer to the obscure mental processes which are responsible for dreams. He speaks of my having written of a flock of flamingoes "looking like a pink cloud" as if it were a kind of justification of his theory; I have also often spoken, as so many, many men and women have spoken, of the bluebird's back as being like a patch of sky, and he might just as well treat this as an admission that a bluebird is concealingly colored because a hawk may think it a patch of sky which has fallen to the ground. One supposition is no wilder than the other. Mr. Chapman studied the breeding habits of the American flamingoes which live on islands on the ocean and feed in water so shallow that they can hardly be attacked by either sharks or alligators. The flamingoes we saw in Africa lived in the interior of the continent. I saw a few on Lake Naivasha; but my son saw enormous numbers of them at Lake Hannington, and carefully studied their habits. He did not find them breeding. They were extraordinarily conspicuous birds. The adults were red, the color being most vivid when they spread their wings; the well grown young, almost or quite as large as the parents, were white. They spent their time standing on the grassy or muddy flats, feeding in the shallows, and floating — swimming — in the lake, usually in the shallow parts, but often in the middle, where it was deep. They were occasionally found in small parties, but usually in huge flocks and very rarely singly. They were to be found feeding at all times, more or less, but most commonly in the morning, up to ten or twelve o'clock, and again in the late afternoon and evening. Unlike herons, when they fed they were always moving, and in any flock which was feeding there was always motion, so that at any reasonable distance no creature with eyes, no creature capable of seeing them at all, could by any possibility fail to distinguish what they were, or mistake them for clouds, or sunrise, or sunset, — a supposition so ridiculous that I am ashamed even to repeat it, — or anything inanimate. They were extraordinarily conspicuous, whether seen from below, from above, or from one side, and the angle of vision made no difference in recognizing them (this I found to be the fact myself). When floating in companies on the water they often seemed motionless, and also when drawn up in companies on the grassy beaches or mud flats. Now the extraordinary thing was that Lake Hannington abounded not only in hippos but in crocodiles; and in driving their herds and flocks to drink at the inlet the natives had to exercise much care to protect them from the crocodiles. In Lake Naivasha there are no crocodiles, and it swarms with geese, cormorants, pelicans, ducks, gulls, coots, and herons (all of which I have also found swarming in lakes containing crocodiles); yet from time immemorial, since the days long before the advent of the white man, the flamingo has frequented Lake Naivasha only in small numbers, and has swarmed in and around the brackish crocodile-infested waters of Hannington, and not only feeds in the shallows to which a crocodile cannot penetrate, but in shallows with so much water as to be easily navigable for crocodiles, and moreover floats in companies for hours at a time, at noon and in the morning and afternoon, in waters amply deep enough to be the regular haunts of the sinister reptiles. Throughout the day, of course, there is no sunrise or sunset for the huge pink birds to resemble — aside from the fact that the full grown young, not yet in the adult plumage, are white, although if there were any concealing virtue in red they would certainly need it more than their experienced parents. I can give no explanation, unless it be found in the birds' intelligence, wariness and keen senses, of how they avoid crocodiles. But it certainly cannot be because of any concealing quality in the flamingo's gorgeous plumage. In the waters in which crocodiles live we found myriads of brown geese, brown and parti-

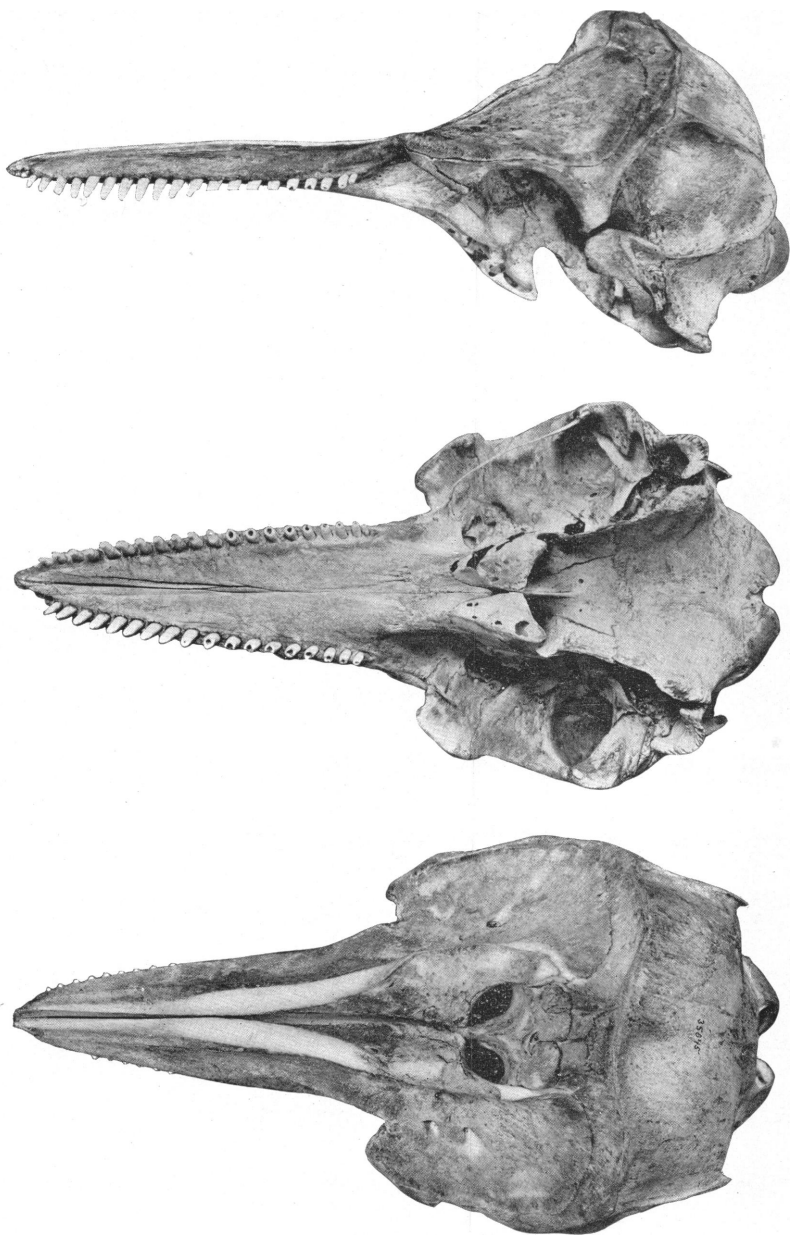
colored ducks, white pelicans, black iridescent adult male cormorants and anhingas, and dull, lustreless black or dark gray young cormorants and female anhingas and coots, and bicolored grebes, and on the edges herons and storks and ibises and spoon-bills, blue, white, black, rosy, purple, slatecolor, greenish, grayish, brownish, of all imaginable shades and combinations of hue (once we found the remains of a heron in a crocodile and I have known of them containing the remains of geese, ibis, ducks, coots and flamingos); and it is a physical impossibility that all these colors can be concealing, unless we accept the view that no color or combination of colors can ever be anything except concealing — which of course makes the whole discussion meaningless.

I have spoken of Mr. Thayer as well-meaning; but it is difficult to admit that certain of his pictures and statements are to be pardoned on the ground that he is merely a well-meaning and ill-balanced enthusiast. Some of them are such striking perversions, and inversions, of the truth that Mr. Thayer seems to have more to account for than bad judgment — very bad though his judgment is. Certainly his experiments, and the pictures by which he illustrates them, can have little real value until he learns to study and portray facts with the sincere intention of finding out the truth, and not with the purpose to exercise a misdirected ingenuity in twisting and distorting the facts so as to back up the many portions of his theory which have no substantial foundation whatever. Nothing is to be gained by such conduct, or by studying the results of such conduct. A “laboratory” carried on in such fashion, and with such experiments, is of worse than no help to the truth-seeker, and serves no better purpose than to amuse and puzzle well-meaning persons who naturally do not think out the matter for themselves. Such a “laboratory” is of no more use than a dime museum, and the “experiments” in it are of very much less use than really good juggling feats.

This is not a case of differences in observing facts, or in forming judgments upon them when observed. Very good men often differ radically in such matters; and the most faithful observers make errors, and under some circumstances make many errors, and draw many wrong conclusions. Even Mr. Selous and Captain Stigand, to whom more than to any other men we owe our knowledge of the natural history of African big game, now and then state facts with which the facts as I have observed them do not seem to agree, or occasionally draw conclusions from which I am inclined cautiously to dissent; and where such experts as these men occasionally make slips, it behooves the rest of us to be exceedingly humble-minded. On this very subject of concealing coloration two such naturalists as Mr. Chapman and Mr. Allen are not in entire accord, Mr. Chapman believing that the coloration of most birds has a larger share in concealing them than has seemed to me probable, while Mr. Allen holds the view that any coloration is protective as long as the animal is motionless, and that “coloration is a minor asset in an animal's protection in comparison with its other qualities — alertness, truculence, and other traits that make for its protection.” Such differences among competent men sincerely seeking to find out the exact facts make for truth, and tell in favor of right thinking. The exact proportion of soundness and of error in our various views must largely be determined by further and exhaustive investigations; all that we ask is that these investigations be undertaken by capable and efficient men who desire to find out the truth, whatever it may be, and who are incapable of misrecording or manipulating facts in order to fit them into their own pet theories. For instance, take the question of the light-rump patch so frequent on ruminants, which Mr. Thayer

treats as always concealing. In its extreme form, as on the prongbuck, it is certainly advertising. But in its simplest form it is practically the same on many ruminants and on many carnivores; I have before me at the moment the skins of a topi and a lion, which show it in almost precisely similar fashion; and even Mr. Thayer can hardly suppose that the light-rump patch of a lion is designed to mislead some animal which may spring on him from behind. What is here needed is such wide investigation as will show whether these light patches have any effect at all on the animals' lives and whether they have any effect whatever.

As an example of precisely the kind of investigation needed I may mention Mr. Reighard's 'Experimental Field-study of Warning Coloration in Coral-reef Fishes,' published in Vol. II of 'Papers from the Tortugas Laboratory of the Carnegie Institution of Washington.' In this paper Mr. Reighard shows that many coral-reef fishes have a highly advertising coloration, which never has any concealing, but always a revealing quality, this advertising coloration having apparently been developed because their habits and habitat have rendered concealing coloration of no consequence to them, so that their brilliant coloration patterns have developed unhampered by selection, as the result of some tendency, of some internal force or principle having no relation to utility; which is exactly the conclusion I have reached above as regards multitudes of species of birds with widely varying, and often highly advertising, coloration patterns, which dwell by the lakes and rivers, in tree tops or hedges, and in many other localities.



Tursiops nuuanu sp. nov.

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