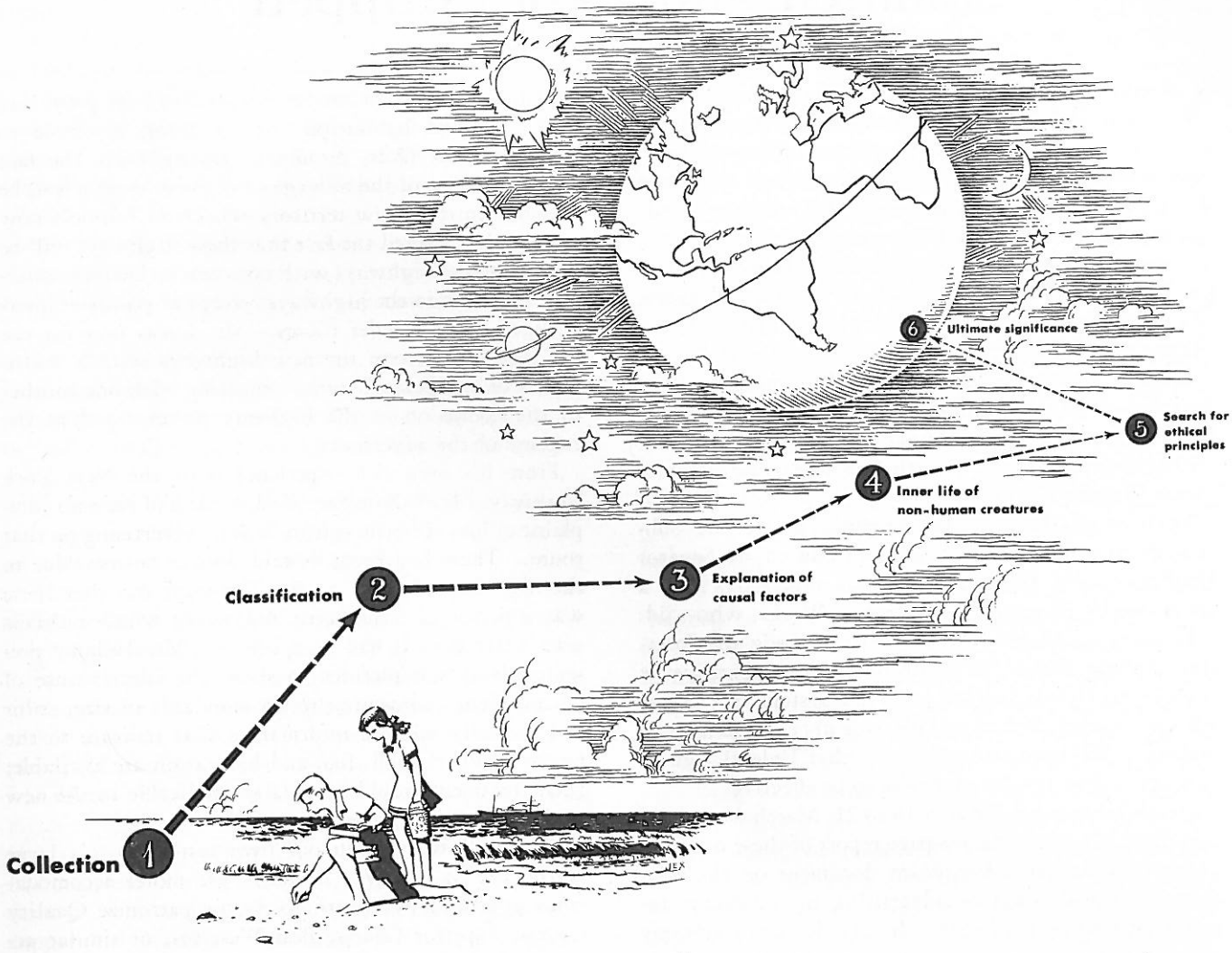

Many a career in the natural sciences has had its inception in the human tendency to pick up and save unusual or colorful objects like pebbles, feathers, flowers or shells.

The Naturalist's Progress

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Probably the majority of those who take more than a casual interest in Nature began their careers as collectors. Delighted by the beautiful or strange objects on which their eyes fell as they wandered through woodland and meadow, they wished to clutch and retain them. A glittering pebble, a colorful moulted feather, a brilliant flower, or a curious shell has started many a boy and girl along the naturalist's long road. The desire to possess shining objects is not peculiar to mankind, but a number of birds, especially in the crow family, display it in high degree.

At this earliest stage of collecting, among crows, jays, children and even many adults, little attention is paid to the wholeness of the specimen. It is not as an example of a certain class of natural productions but as a brilliant or curious trinket that the attractive object is acquired. In the forested parts of tropical America, one often sees the bright yellow breast of a toucan, or its huge and curiously colored bill, cut from the bird and stuck up as an ornament on the wall of a cabin. The first skins of birds of paradise to reach Europe were prepared without legs by the natives of New Guinea, who evidently thought that the whole value of the specimen lay in the gorgeous plumage, from whose beauty the quite com-

monplace legs and feet only detracted. This naive approach to the study of Nature is responsible for the name that Linneaus gave to one of these mutilated specimens of brilliant plumaged birds, *Paradisea apoda*, "the footless bird of paradise." Similarly, when children and amateurs collect flowering herbs they preserve only the blossoms, with perhaps a bit of stem and a few leaves, neglecting the roots, which add nothing to the beauty of their specimens, although they tell much about the character of the plant.

With those who become earnest naturalists, this sort of collecting is a transient phase, leading to a more mature interest in natural objects as wholes, all of whose parts are significant. If collecting is long and strenuously pursued, so many specimens accumulate that some system for arranging them becomes imperative. This brings us to the second stage in the naturalist's progress, the effort to classify the productions of Nature. But to do this intelligently, one must pay attention to the structure of the objects to be classified; the more detailed and intimate our knowledge of their structure, the sounder our system of classification will become. It is also helpful to trace the development of the animals or plants in question, for often a study of their earlier stages reveals relationships that are masked when they become mature. The investigation of the mode of functioning of the organism, its chemical constitution, and its behavior also contributes greatly to understanding its relationship. Thus anatomy, histology, embryology, physiology, biochemistry and ethology are pressed into the service of taxonomy, or the science of classification. Many researches in these fields have been instigated by the desire to improve or substantiate a scheme of classification.

An amateur collector is likely to retain only the parts of a specimen that please him best, with little thought for the whole. Thus, natives of tropical America often cut the bright yellow breast or huge bill from the toucan, while the first skins of the bird of paradise to reach Europe from New Guinea arrived without legs or feet, which the natives thought detracted from the beauty of the specimen.

As the naturalist continues his long journey through the vast and infinitely varied realm of Nature, he becomes increasingly curious about the reasons for the endless array of forms and colors that it presents to him. No longer content with admiring, possessing or even classifying the productions of Nature, he wishes to account for them. This brings him to the third stage in his progress, the search for explanations in terms of causal factors or of utility.

Every child and savage can see that the toucan's bill is extraordinarily large and brilliantly colored, but what is its significance? How does this bird of the tropical forest happen to have a beak so much bigger and more conspicuous than that of its neighbors of whatever size? How does it help him fill his vital needs—or is it actually a hindrance to the bird, an evolutionary freak that natural selection somehow failed to eliminate? And by what course, in response to what needs, and by the action of what agents of selection, did the birds of paradise acquire their gorgeous plumage?

From asking these questions in respect to some of the more striking of the structures and colors of organisms, we proceed to ask about those that are less obtrusive. We wish to know, perchance, what is the function of a little hook on the tip of a small bird's bill, or of certain curious outgrowths on the legs of a bee, or why a certain moth's wings are mottled with shades of gray rather than being as brilliant as the wings of some other moths. The attempt to answer a few of these multitudinous questions may occupy us agreeably for many years and exercise our intelligence to its limit.

In forming his collection, or in trying to answer some of the questions that occur to him, the naturalist commonly treats living things as though they had no will or purpose of their own, and often he deals with them as though they were wholly devoid of sentience. But occasionally a more sensitive and thoughtful naturalist stops to wonder about the inner life of the creatures he studies. How do *they* look upon the world? What feelings and thoughts might they have? Do they observe us while we watch them? He may be led to such questionings at an early age by a sort of natural sympathy, or he may be more tardily brought to them by some of the investigations he has been pursuing.

Thus the most probable explanation of the origin of the bright colors and ornamental plumes of birds of paradise and many other beautiful animals of diverse orders is that they were acquired by the process known as sexual selection. If the females of any species mated with slightly more brilliant males in preference to duller ones, this would lead in the course of generations to ever greater beauty and grace. But this explanation makes certain assumptions about the psychic life of

the animals in question, for it attributes to them esthetic appreciation, or something very like it, and thereby introduces us to that vast, unexplored realm, the inner life of non-human creatures. The effort to enter this realm, whether by the bold exercise of imaginative sympathy or by groping analysis, constitutes the fourth stage in the naturalist's progress.

When we have come to suspect that non-human animals may have feelings and thoughts, volitions and purposes of their own, we have reached by the long, circuitous path of the naturalist, who began his career by regarding them merely as potential specimens, the attitude of every untutored child and primitive man, who never doubts that birds and beasts, and perhaps even trees and shrubs, enjoy an inner life not greatly different from his own. And when he reflects that his acts may affect their happiness, bringing them pleasure or pain, joy or sorrow, the morally mature man begins to ask how he must govern his dealings with them. How should he conduct his life in order to bring the minimum of pain, or the maximum of happiness, to these other sentient lives which encompass him? He desires ethical guidance, a code of morals that will direct his dealings, not merely with other members of his own society or of his own species, but with all those beings which may be somehow benefitted or harmed by his deeds.

Obviously, moral problems, complicated enough even within the narrow context of human society, become vastly more difficult to solve when extended to cover the whole living community. Nevertheless, no thoughtful and compassionate person can contemplate man's relations with the rest of the living world without desiring their improvement, and perhaps detecting a number of ways in which this might be effected. This desire to be moral in our dealings with all living creatures, this searching for ethical principles to govern our treatment of them, marks the fifth stage in the naturalist's progress; it follows directly and almost inevitably from the fourth stage, in which the naturalist begins to wonder about the quality of consciousness in the animals he observes. Certain other cultures reached this point millenia ago, and by a route very different from that which we have traced; but Western civilization, with its own peculiar background, seems most likely to attain it by the roundabout course of the naturalist.

Of the many who take the first steps along the naturalist's long road, only a few persevere until they come to the fifth stage, and even fewer reach the sixth, which we enter when we ask: "What is the significance to me of this so varied world in which I find myself?" This, of course, is the supreme question that religion and philosophy have long striven to answer, each in its own manner, and hence it cannot be regarded as one peculiar to the naturalist.

But it seems to acquire a vaster breadth and depth when one reaches it along the route of the naturalist, who was first attracted by the beauty and strangeness of Nature's productions, who laboriously collected and tried to classify them, who endeavored to explain the function and mode of origin of some of them, who began to speculate on the inner life of the creatures that display such infinite variety of forms and colors, who thence became concerned about his treatment of them as affecting their own welfare. Far more than the philosopher, whose life has been passed in academic cloisters, far more than the mystic, who has striven to reach the Godhead by averting his gaze from the external world and sinking into the inmost depths of his own being, the student of Nature is aware of the endless diversity of creation, of the intricate interactions among its myriad forms, of the startling contrasts between supreme beauty and unspeakable ugliness, between tender love and violent rage, between beneficent growth and destructive fury, which this baffling world presents.

He wishes to know for what purpose, if any, he has been thrust into its midst, what ultimate significance is to be found in his presence here, to what end the whole vast and confusing pageant is moving. This last question seems to include in its wide scope many of the earlier questions, so that if we could answer it with clarity, we also might know the answers to them. If, for example, one knew the significance of his own existence, he could better understand its meaning for other creatures.

These final questions, of course, lead us far beyond the "scientific" study of Nature. We often forget that science is the deliberate attempt to solve certain limited problems by limited means. The scientist investigates the phenomena manifest to his five external senses, and he has decided to employ in his researches only the data that these five senses yield to him. In the attempt to understand the relationships between these phenomena, this has proved to be an efficient method; and the scientist's success in his self-appointed task proves the wisdom of the limitations he has imposed upon himself. Yet these same limitations have placed vast segments of reality beyond the reach of the scientific method, and no one is more poignantly aware of this than the naturalist, who follows his chosen path as far as he can.