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THE WRITINGS OF

JOHN BURROUGHS

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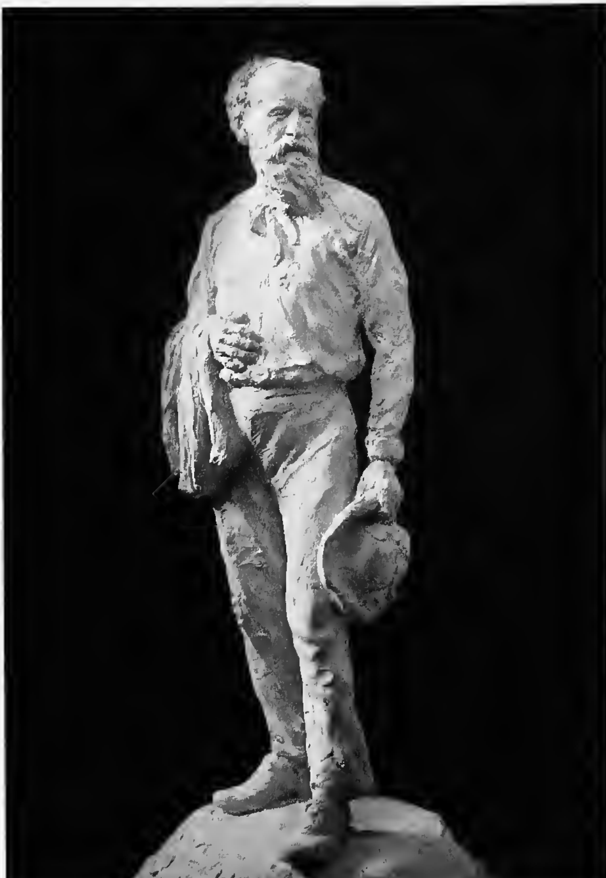

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JOHN BURROUGHS

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HOUGHTON MIFFLIN COMPANY

UNDER THE APPLE-TREES

BY

JOHN BURROUGHS

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PREFACE

I AM quite certain that the majority of my readers would have me always stick to natural history themes. I sympathize with them. I am myself never so well pleased as when I can bring them a fresh bit of natural history, or give them a day with me in the fields and woods or along the murmuring streams. Birds and squirrels come home to us all in a way that speculative ideas do not. While writing my more philosophical dissertations, my mind often turns longingly toward the simple outdoor subjects which have engaged me so many years, and doubtless the mind of my reader does also when he is perusing them. But one cannot always choose at such times. Natural history is a matter of observation; it is a harvest which you gather when and where you find it growing. Birds and squirrels and flowers are not always in season, but philosophy we have always with us. It is a crop which we can grow and reap at all times and in all places, and it has its own value and brings its own satisfaction.

We are all philosophers, we all delight in finding the reason of things and in tracing the relation of things, and to know, for instance, what part chance plays in our lives, and what part is played by rigid law, is a worthy and engaging problem. I do not flatter myself that I can resolve it, or any other similar question, but I find the effort stimulating, and now and then I get a gleam of light.

We live in a wonderful world, and the wonders of the world without us are matched and more than matched by the wonders of the world within us. This interior world has its natural history also, and to observe and record any of its facts and incidents, or trace any of its natural processes, is well worthy of our best moments.

I have given the name of the initial chapter, "Under the Apple-Trees," to the whole collection, because most of the essays were written in my camp under the trees, in the old orchard where I gathered apples as a farm-boy. The wild life about me appealed to my love of natural history, while thoughts and suggestions from beyond the horizon occupied my more philosophical meditations.

John Burroughs.

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UNDER THE APPLE-TREES

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UNDER THE APPLE-TREES

Part I

THERE are few places on the farm where there is so much live natural history to be gathered as in the orchard. All the wild creatures seem to feel the friendly and congenial atmosphere of the orchard. The trees bear a crop of birds, if not of apples, every season. Few are the winged visitors from distant climes that do not, sooner or later, tarry a bit in the orchard. Many birds, such as the robin, the chippy, the hummingbird, the cedar-bird, the goldfinch, and some of the flycatchers, nest there. The great crested flycatcher loves the old hollow limbs, and the little red owl often lives in a cavity in the trunk. The jays visit the orchard on their piratical excursions in quest of birds' eggs, and now and then they discover the owl in his retreat and set up a great hue and cry over their discovery. On such occasions they will take turns in looking into the dim cavity and crying, "Thief, thief!" most vociferously, the culprit meanwhile, apparently, sitting wrapped in utter oblivion.

In May and June the cuckoo comes to the orchard for tent caterpillars, and the woodpeckers come at all seasons — the downy and the hairy to the good of the trees, the yellow-bellied often to their injury. The two former search for the eggs and the larvæ of the insects that infest the trees, as do the nuthatches and the chickadees, which come quite as regularly; but the yellow-bellied comes for the life-blood of the trees themselves. He is popularly known as the "sapsucker," and a sapsucker he is. Many apple-trees in every orchard are pock-marked by his bill, and occasionally a branch is evidently killed by his many and broad drillings. As I write these lines, on September the 26th, in my bush tent in one of the home orchards, a sapsucker is busy on a veteran apple-tree whose fruit has often gone to school with me in my pockets during my boyhood days on the farm. He goes about his work systematically, visiting now one of the large branches and then a portion of the trunk, and drilling his holes in rows about a quarter of an inch apart. Every square foot of the trunk contains from three hundred to four hundred holes, new and old, cut through into the inner, vital cambium layer. The holes are about the size of the end of a rye-straw, and run in rings around the tree, the rings being about a half an inch apart. The newly cut ones quickly fill with sap, which, to my tongue, has a rather insipid taste, but which is evidently relished by the woodpecker. He drills two or three holes, then pauses a moment, and when they are filled sips his apple-tree tipple leisurely. The drain upon the vitality of the tree at any one time, by this tapping, cannot be very serious, but in the course of years must certainly affect its vigor considerably. I have seen it stated in print, by a writer who evidently draws upon his fancy for his facts, that in making these holes the bird is setting a trap for insects, and that these are what it feeds upon. But the bird is a sapsucker; there are no insects at his wells to-day; he visits them very regularly, and is constantly drilling new ones.

His mate, or at least a female, comes, and I overhear the two in soft, gentle conversation. When I appear upon the scene, the female scurries away in alarm, calling as she retreats, as if for the male to follow; but he does not. He eyes me for a moment, and then sidles round behind the trunk of the tree, and as I go back to my table I hear his hammer again. Very soon the female is back and I hear their conversation going on as before. Day after day the male is here tapping the trees. His blows are soft and can be heard only a few yards away. He evidently has his favorites. In this orchard of twenty or more trees, only two are worked now, and only three have ever been worked much. The two favorites bear hard, sour fruit. The bark of a sweet apple-tree does not show a single hole. A grafted tree shows no holes on the original stock, but many punctures on the graft. One day I saw the bird frequently leave his drilling on one tree and go to another, drilling into a small red apple which had lodged among some twigs on a horizontal branch; he ate the pulp, and had made quite a large hole in the apple, when it became dislodged and fell to the ground. It is plain, therefore, that the sapsucker likes the juice of the apple, and of the tree that bears the apple. He is the only orchard bird who is a tippler. Among the forest trees, he sucks the sap of the sugar maples in spring, and I have seen evidence of his having drilled into small white pines, cutting out an oblong section from the bark, apparently to get at the soft cambium layer.

It is a pleasant experience to sit in my orchard camp of a still morning and hear an apple drop here and there — "indolent ripe," as Whitman says, in the fullness of time, or prematurely ripe from a worm at its heart. The worm finds its account in getting down to the ground where it can pupate, and in both cases the tree has finished a bit of its work and is getting ready for its winter sleep; and in both cases the squirrels and the woodchucks profit by the fall. But September woodchucks are few; most of them retire to their holes for the long winter sleep during this month; the harvest apples that fall in August hit them at the right moment; but the red squirrels are alert for the apple-seeds during both months, and they chip up many apples for these delicate morsels. They also love the hollow branches and trunks of the trees, in which they make their homes.

Little currents of wild life hourly flow about me. Yesterday, amid the slow rain and mist and general obscurity, there was suddenly an influx of birds in all the old apple-trees about me. Robins appeared by twos and threes in some choke-cherry bushes a few yards below me, and with much cackling and fluttering helped themselves to the fruit. A hermit thrush perched on a dry limb in front of my tent and in many different postures surveyed me in my canvas cavern, uttering a low note which I took to be his comments upon me. You may always know the hermit thrush from the other thrushes by that peculiar, soft, breathing motion of its tail. A male redstart came and flitted and flashed about the apple-branches without heeding me at all. Whitman asks:—

> "Do you take it I would astonish?
> Does the daylight astonish? does the early redstart
>   twittering through the woods?
> Do I astonish more than they?"

The redstart, with his black-and-orange suit, and his quick, lively motions, does not astonish, but few birds give the eye more pleasure. How gay and festive he looks, darting and flashing amid the gnarled and scaly branches of the decaying apple-trees! It seems as if all his motions were designed to show off his plumage to the best advantage.

With tail slightly raised and spread, and wings a little drooping, he springs and swoops here and there in the trees — a bit of black holding and momentarily revealing a flame of orange. Redstart is a good name for him, as we see his colors only when he is in motion. Note our other black-and-orange bird, the Baltimore oriole; its color is conspicuous while the bird is at rest. Another brilliantly colored bird, the scarlet tanager, is seen from afar when quietly perched. He shows amid the green leaves like a burning coal; and his motions are all slow and deliberate when contrasted with those of the redstart. The latter is a fly-catcher, or insect-catcher, and his movements are necessarily sudden and rapid.

The birds are quite likely to go in troops in late summer or early fall, different species apparently being drawn along by a common impulse.

While the robins and the hermit thrush are among the choke-cherries, a family of indigo-birds, five or six of them, all of the brown color of the mother bird, are grouped around the mother on a flat stone for half a minute, being fed. It is a pretty little tableau. The father bird with his bright plumage is not in evidence. In one of the trees another warbler which I cannot identify, with an olive back and a yellow front, is in a great hurry about its own business. One little olive-green warbler, doubtless a young bird, comes and perches on the edge of my table, and, quite oblivious of my presence, looks my papers and books over for the insect tidbit which he does not find. How round and brilliant and eager are his eyes! If he is looking for a bookworm, he fails to find it.

A phœbe-bird perches here and there and makes sudden swoops to the ground for the insects which she cannot find on the wing. Phœbe hunts by sight at long range. Her eye seems telescopic, rather than microscopic like the warbler's. She explores the air and the ground and sees her game from afar. At all hours of the day she perches on the brown dead branches of the apple-trees, and waits for her prey to appear, her straight, stiff tail hingeing up and down at her rump.

At present my favorite denizen of the orchard is the chipmunk. He, too, likes the apple-seeds, but he is not given to chipping up the apples as much as is the red squirrel. He waits till the apples are ripe and then nibbles the pulp. He also likes the orchard because it veils his movements; when making his trips to and fro, if danger threatens, the trunk of every tree is a house of refuge.

As I write these lines in my leafy tent, a chipmunk comes in, foraging for his winter supplies. I have brought him cherry-pits and peach-pits and cracked wheat, from time to time, and now he calls on me several times a day. His den is in the orchard but a few yards from me, and I enjoy having him for so near a neighbor. He has at last become so familiar that he climbs to my lap, then to the table, then to my shoulder and head, looking for the kernels of popcorn that he is convinced have some perennial source of supply near me or about me. He clears up every kernel, and then on his return, in a few minutes, there they are again! I might think him a good deal puzzled by the prompt renewal of the supply if I were to read my own thoughts into his little noddle, but I see he is only eager to gather his harvest while it is plentiful and so near at hand. No, he is not influenced even by that consideration; he does not consider at all, in fact, but just goes for the corn in nervous eagerness and haste. Yet, if he does not reflect, he certainly has a wisdom and foresight of his own. This morning I mixed kernels of fresh-cut green corn with a handful of the dry, hard popcorn upon the floor. At first he began to eat the soft sweet corn, but, finding the small, dry kernels of the popcorn, he at once began to stuff his cheek pockets with them, and when they were full he hastened off to his den. Back he came in about three minutes and he kept on doing this till the popcorn was all gone; then he proceeded to make his breakfast off the green corn. When this was exhausted, he began to strip some choke-cherries (which I had also placed among the corn) of their skins and pulp, and to fill his pockets with the pits, thus carrying no perishable food to his den. He acted exactly as if he knew that the green corn and the choke-cherries would spoil in his underground retreat, and that the hard, dry kind, and the cherry-pits, would keep. He did know it, but not as you and I know it, by experience; he knew it, as all the wild creatures know how to get on in the world, by the wisdom that pervades nature, and is much older than we or they are.

My chipmunk knows corn, cherry-pits, buckwheat, beech-nuts, apple-seeds, and probably several other foods, at sight; but peach-pits, hickory-nuts, dried sweet corn, he at first passed by, and peanuts I could not tempt him to touch at all. He was at first indifferent to the rice, but, on nibbling at it and finding it toothsome, he began to fill his pockets with it. Amid the rice I scattered puffed wheat. This he repeatedly took up and chipped into, attracted probably by the odor, but, finding it hollow, or at least very spongy and unsubstantial in its interior, he quickly dropped it. It was not solid enough to get into his winter stores. After I had cracked a few hickory-nuts he became very eager for them, and it was amusing to see him, as he sat on my table, struggle to force the larger ones into his pockets, supplementing the contractile power of his cheek muscles with his paws. When he failed to pocket one, he would take it in his teeth and make off. I offered him some peach-pits also, but he only carried one of them up on the stone wall and handled it awhile, then looked it over and left it. But after I had cracked a few of them and had thus given him a taste of what was in them, he began to carry them to his den.

It is interesting to see how well these wild creatures are groomed — every hair in its place and shining as if it had just been polished. The tail of my chipmunk is simply perfect — not a hair missing or soiled or worn. In fact, the whole animal looks as new and fresh as a coin just minted, or a flower just opened. His underground habits leave no mark or stain upon him, and his daily labors do not ruffle a hair. This is true of nearly all the wild creatures. Domestication changes all this; domestic animals become dirty and unkempt. The half-tame gray squirrels in the parks have little of the wild grace and beauty of the squirrels in the woods. Especially do their tails deteriorate, and their sylvan airiness and delicacy disappear.

The whole character of the squirrel culminates and finds expression in its tail — all its nervous restlessness and wild beauty, all its jauntiness, archness, and suspicion, and every change of emotion, seem to ripple out along this appendage.

How furtive and nervous my chipmunk is, rushing about by little jerks incessantly, not stopping for anything! His bright, unwinking eyes, his palpitating body, his sudden spasmodic movements, his eagerness, his industry, his sleekness and cleanliness — what a picture he makes! Apparently he does not know me from a stump or a clothes-horse. His cold paws on my warm hand, on my arm, or on my head give him no hint of danger; no odors from my body, or look from my eyes, disturb him; the sound of my voice does not alarm him; but any movement on my part, and he is off. It is *moving* things — cats, weasels, hawks, foxes — that mean danger to him. In the little circuit of his life — gathering his winter stores and his daily subsistence, spinning along the fences, threading the woods and bushes, his eye and his ear are evidently his main dependence; odors and still objects concern him little, but moving things very much. I once saw a chipmunk rush to his den in the side of a bank with great precipitation, and in a moment, like a flash, a shrike darted down and hovered over the entrance.

I can talk to my chipmunk in low, slow tones and he heeds me not, but any unusual sound outside the camp, and he is alertness itself. One day when he was on my table a crow flew over and called sharply and loudly; the squirrel sat up and took notice instantly; with his paws upon his breast he listened and looked intently for a few seconds, and then resumed his foraging. At another time the sharp call of a red squirrel in a tree near by made him still more nervous. With one raised paw he looked and listened for two or three minutes. The red squirrel hazes him on all occasions, and, I think, often robs him of his stores.

No doubt the chipmunk has many narrow escapes from hawks. A hunter told me recently of a hawk-and-chipmunk incident that he had witnessed the day before in the woods on the mountain. He was standing still listening to the baying of his hound on the trail of a fox. Suddenly there was a rush and clatter of wings in the maple-trees near him, and he saw a large hawk in pursuit of a chipmunk coming down, close to the trunk of a tree, like a thunderbolt. As the hawk struck the ground, the hunter shot him dead. He had the squirrel in his claw as in a trap, and the hunter had to pry the talon open to free the victim, which was alive and able to run away. From the description I guessed the hawk to be a goshawk. What the chipmunk was doing up that tree is a mystery to me, since he seldom ventures far from the ground; but the truth of the incident is unquestioned.

When the chipmunk is in the open, the sense of danger is never absent from him. He is always on the alert. In his excursions along the fences to collect wild buckwheat, wild cherries, and various grains, he is watchfulness itself. In every trip to his den with his supplies, his manner is like that of the baseball-player in running the bases — he makes a dash from my study, leaping high over the grass and weeds, to an apple-tree ten yards away; here he pauses a few seconds and nervously surveys his course ahead; then he makes another sprint to a second apple-tree, and pauses as before, quickly glancing round; then in a few leaps he is at home, and in his den. Returning, he usually pursues the same course. He leaves no trail, and is never off his guard. No baseball runner was ever more watchful. Apparently while in the open he does not draw one breath free from a keen sense of danger. I have tempted him to search my coat pockets for the nuts or cherry-pits that I have placed there, and, when he does so, he seems to appreciate at what a disadvantage his enemy might find him — his eyes are for the moment covered, his rear is exposed, his whole situation is very insecure; hence he seizes a nut and reverses his position in a twinkling; his body palpitates; his eyes bulge; then he dives in again and seizes another nut as before, acting as if he thought each moment might be his last. When he goes into the tin cocoa-box for the cherry-pits, he does it with the hurry of fear; his eyes are above the rim every second or two; he does not stop to clean the pits as he does when on my table, but scoops them up with the greatest precipitation, as if he feared I might clap on the lid at any moment and make him prisoner. In all the hundred and one trips he has made from my camp to his den he has not for one moment forgotten himself; he runs all the bases with the same alertness and precaution. Coming back, he emerges from his hole, sits up, washes his face, then looks swiftly about, and is off for the base of supplies.

One day I went by a roundabout course and stood three paces from his hole. In the mean time he had loaded up, and he came running over the course in his usual style, but before he left the second base he saw me, or an apparition that was not there before, and became very nervous. He jumped about; he sat up on his haunches and looked; crouched by a woodchuck's hole and eyed me, his cheeks protruding; changed his attitude a dozen times; then, as the apparition changed not, he started and came one third of the way; then his heart failed him and he rushed back. More posing and scrutinizing, when he made a second dash that brought him two thirds of the way; then his fears overcame him again, and he again rushed to cover. Repeating his former behavior for a few moments, he made a third dash and reached the home base in safety. How carefully he seems to carry his tail on entering his hole, so as not to let it touch the sides! He is out again in less than a minute, and, erect upon his haunches, looks me squarely in the eye. He is greatly agitated; he has not had that experience before. What does it mean? Erect on his hind legs, he stands almost motionless and eyes me. I stand motionless, too, with a half-eaten apple in my hand. I wink and breathe; so does he. For ten minutes we confront each other in this fashion, then he turns his back upon me and drops down. He looks toward the camp; he remembers the nuts and corn awaiting him there; he stirs uneasily; he changes his position; he looks at my motionless figure again, then toward the source of supplies, and is off, leaving me at his threshold. In two minutes he is back again with protruding pockets, and now makes the home run without a pause. He emerges again from his den, washes his face three times, his mouth first, then his nose and cheeks, then is off for another load. I return to my chair and soon he is again on my lap and table, or sitting in the hollow of my hand, loading up as before. The apparition in the chair has no terrors for him.

I would not say that he is burdened with a conscious sense of danger; rather is his fear instinctive and unconscious. It is in his blood — born with him and a part of his life. His race has been the prey of various animals and birds for untold ages, and it has survived by reason of an instinctive watchfulness that has been pushed to the highest degree of development. He is on the lookout for danger as constantly as he is on the lookout for food, and he takes no more thought about the one than about the other. His life is keyed to the fear pitch all the time. His heart beats as fast as the ticking of a watch, and all his movements are as abrupt and spasmodic as if they were born of alarm. His behavior is an excellent illustration of the unconscious fear that pervades a large part of the animal kingdom.

All creatures that are preyed upon by others lead this life of fear. I don't know that the crow is ever preyed upon by any other creature, so he apparently has a pretty good time. He is social and noisy and in the picnicking mood all the day long. Hawks apparently are afraid of man only. Hence their lives must be comparatively free from harassing fear. Even fish in the streams are not exempt from fear. They are preyed upon by large fish, and by minks and otters, and by the fish hawk. If the weasel has a natural enemy, I don't know what it is. He is the boldest of the bold. He might be captured by a hawk or an eagle, but such occurrences are probably very rare, as a weasel can dodge almost anything but a gun.

Of all our wild creatures the rabbit has the most enemies; weasels, minks, foxes, wildcats, and owls are hovering about poor Bunnie at all times. No wonder she never closes her eyes, even in sleep. To compensate in a measure for all this, nature has made her very fleet of foot and very prolific, so that the race of rabbits is in full tide, notwithstanding its many enemies.

Such animals as the skunk and the porcupine show little fear, because their natural enemies, if they have any, would go by on the other side. There is evidence that the skunk is sometimes preyed upon by the fox and the eagle and the horned owl, and the porcupine by the lynx and the wolf, but these must be exceptional occurrences. The lion probably fears nothing but man. Little wonder that he looks calm and majestic and always at his ease! But I am getting away from my apple-trees.

The arch-enemy of the chipmunk is the small red weasel, and I wonder if it is to hide from him that he usually digs his den away from the fences and other cover, in clean open ground, leaving no clue whatever as to its whereabouts. He carries away all the soil, and either makes a pile of it some feet away, or else hides it completely. The den of my little neighbor is in the open grassy space between the rows of apple-trees, thirty or more yards from either fence. All that is visible of it is a small round hole in the ground nearly concealed by the overhanging grass. I had to watch him in order to find it.

His chamber is about three feet below the surface of the ground, and has but one entrance, through a long crooked passage eight or ten feet long. If his arch-enemy were to find it, there would be no escape. There is no back door, and there are no secret passages. Probably many a tragedy is enacted in those little earth-chambers. The weasel himself fears nothing; he is the incarnation of bloodthirstiness, and his victims seem so horrified at the discovery that he is pursuing them that they become paralyzed. Even the fleet-footed rabbit in the open woods or fields falls an easy prey.

One day last summer as I sat at the table in my hay-barn study, there boldly entered through the open door this arch-enemy of our small rodents — brown of back and white of belly. He rushed in as if on very hurrying business, and all my efforts to detain him, by squeaking like a mouse, and chirping like a bird, proved unavailing. He thrust out his impudent snake-like head and neck from an opening in the wall, and fixed his intense, beady eyes upon me for a moment, and was gone. I feared he was on the trail of the chipmunk that had just carried away the cherry-pits I had placed for him on a stone near by; but the little rodent appeared a half-hour later, as sleek as ever, but with a touch of something suspicious and anxious in his manner, as if he had at least had tidings that his deadly enemy was in the neighborhood.

After I had cracked some hickory-nuts for my little friend this morning, and he had got a taste of the sweet morsel inside, he quickly began to stuff the whole nuts into his pockets and carry them to his storehouse. It was amusing to see him struggle with the larger nuts, first moistening them with his tongue, to force them into those secret and apparently inadequate pockets. The smooth, trim cheeks would suddenly assume the appearance of enormous wens, extending well down on the sides of the neck. The pouches are not merely passive receptacles; they evidently possess some power of muscular action, like the throat muscles, which enables them to force the grain and nuts along their whole course.

As the little squirrel picks the corn from the floor you can see the pouches swell, first on the one side, then on the other. He seems to pick up the kernels and swallow them. What part the tongue plays in the process, one cannot see. In forcing a whole or a half hickory-nut into them, the chipmunk uses his paws. The pouches are doubtless emptied by muscular movements similar to those by which they were filled — a self-acting piece of machinery, a pocket that can fill and empty itself.

I see my little hermit making frequent visits to my study in the morning before I am seated there, exploring the floor, the chair, the table, to see if the miracle of the corn manna has not again happened. He is anxious to be on hand as soon as it occurs. He is no discriminator of persons. One morning a woman friend took her seat in my chair with corn in her lap and under her arched hand on the table, and waited. Presently the little forager appeared and climbed to her lap, and pushed under her hand, as he had under mine. Another woman sat on the cot a few feet away, and the two conversed in low tones. The squirrel gave little heed to them, but any movement of their hands or feet startled him. One day I shifted my position from the table to near the cot, with my extended feet near the entrance. The squirrel was in the act of coming in when I made some slight movement. With that characteristic chippering of his, he retreated hastily to the first apple-tree twenty feet away, and, perched upon its leaning trunk, sounded his little alarm, "Chuck, chuck," for fifteen minutes or more. Apparently he had but just discovered me. After a time he came slyly back and resumed his foraging.

The activity of the chipmunk when he is out of his den is almost incessant. Like the honey-bee, he seems filled with a raging impulse to lay up his winter stores. When he finds an ever-renewed supply, as in my orchard camp, his eagerness and industry are delightful to see. The more nuts I place for him, the more eager he becomes, as most of us do when we strike a rich lead of the things we are in quest of. Will his greed carry him to the point of filling his den so full that there remains no room for himself in it? Will he let the god of plenty turn him out of doors? Last summer I had seen a chipmunk's hole filled up with choke-cherries to within three inches of the top. ("Naturally, being choke-cherries," says a friend, looking over my shoulder.)

From previous experience I calculated the capacity of his chamber to be not more than four or five quarts. One day I gave him all I thought he could manage, — enough, I fancied, to fill his chamber full, — two quarts of hickory-nuts and some corn. How he responded to the invitation! How he flew over the course from my den to his! He fairly panted. The day might prove too short for him, or some other chipmunk might discover the pile of treasures. Three, and often four, nuts at a time, went into his pockets. If one of them was too large to go in readily, he would take it between his teeth. He would first bite off the sharp point from the nut to keep it from pricking or irritating his pouches. I do not think he feared a puncture. I renewed the pile of nuts from time to time, and looked on with interest. The day was cloudy and wet, but he ran his express train all day. His feet soon became muddy, and it was amusing to see him wash his face with those soiled paws every time he emerged from his hole. It was striking to see how much like a machine he behaved, going through the same motions at the same points, as regularly as a clock. He disappeared into his hole each time with a peculiarly graceful movement which seemed to find expression in the sweep of his tail. It was to the eye what melodious sounds are to the ear, and contrasted strangely with the sudden impulsive movements of his usual behavior. When he emerged, the top of his head and eyes first appeared, then a moment's pause, then the head and neck arose, then the whole body shot up in the erect posture with the paws folded and hanging down on the white breast. The face-washing was the next move, first the mouth, then the nose and cheeks. Then, after a swift glance around, off he goes, with tail well up in the air, for another load.

As the day declined, and the pile of nuts was ever renewed, I thought I saw signs that he was either getting discouraged or else that his den was getting too full. At five o'clock he began to carry the nuts out from my camp and conceal them here and there under the leaves and dry grass. His manner seemed undecided. He did not return to his den again while I waited near it. After some delay I saw him go to the stone wall and follow it till he was lost from sight under the hill. I concluded that his greed had at last really turned him out of doors and that he had gone off to spend the night with a neighbor. But my inference was wrong. The next day he was back again, carrying away a fresh supply of nuts as eagerly as ever. Two more quarts disappeared before night. The next day was rainy, and though other chipmunks were hurrying about, my little miser rested from his labors. A day later a fresh supply of nuts arrived — two quarts of chestnuts and one of hickory-nuts, and the greed of the little squirrel rose to the occasion. He made his trips as frequently as ever.

My enforced absence for a few days prevented me from witnessing all that happened, but a friend took notes for me. He tried to fool the chipmunk with a light-colored marble placed among the nuts. The squirrel picked it up, but quickly dropped it. Watching his opportunity, my friend rubbed the marble with the meat of a hickory-nut. The chipmunk smelled it; then put it in his pocket; then took it out, held it in his paws a moment and looked at it, and returned it to his pocket. Three times he did this before rejecting it. Evidently his sense of taste discredited his sense of smell.

On my return at the end of the week, the enthusiasm of the chipmunk had greatly abated. He was seldom out of his den. A nut or two placed at its entrance disappeared, but he visited me no more in my camp. Other chipmunks were active on all sides, but his solicitude about the winter had passed, or rather his hoarding instinct had been sated. His cellar was full. The rumor that right here was a land of plenty seemed to have gone abroad upon the air, and other chipmunks appeared upon the scene. Red squirrels and gray squirrels came, but we wasted no nuts upon them. A female chipmunk that came and occupied an old den at my doorstep was encouraged, however. She soon became as familiar as my first acquaintance, climbing to my table, taking nuts from my hand, and nipping my fingers spitefully when I held on to the nuts. Her behavior was as nearly like that of the other as two peas are alike. I gave her a fair supply of winter stores, but did not put her greed to the test.

So far as I have observed, the two sexes do not winter together, and there seems to be no sort of *camaraderie* between them. One day, earlier in this history, I saw my male neighbor chase a smaller chipmunk, which I have little doubt was this female, out of the camp and off into the stone wall, with great spitefulness. All-the-year-round love among the wild creatures is very rare, if it occurs at all. Love is seasonal and brief among most of them. My little recluse has ample supplies for quite a family, but I am certain he will spend the winter alone there in the darkness of his subterranean dwelling. He must have at least a peck of nuts that we gave him, besides all the supplies that he carried in from his foraging about the orchard and the fields earlier in the season. The temptation to dig down and uncover his treasures is very great, but my curiosity might lead to his undoing, at least to his serious discomfort, so I shall forbear, resting content in the thought that at least one fellow mortal has got all that his heart desires.

As our lives have touched here at my writing-table, each working out his life-problems, I have thought of what a gulf divides my little friend and me; yet he is as earnestly solving his problems as I am mine; though, of course, he does not worry over them, or take thought of them, as I do. I cannot even say that something not himself takes thought for him; there is no thought in the matter; there is what we have to call impulse, instinct, inherited habit, and the like, though these are only terms for mysteries. He, too, shares in this wonderful something we call life. The evolutionary struggle and unfolding was for him as well as for me. He, too, is a tiny bubble on the vast current of animate nature, whose beginning is beyond our ken in the dim past, and whose ending is equally beyond our ken in the dim future. He goes his pretty ways, gathers his precarious harvest, has his adventures, his hair-breadth escapes, his summer activity, his autumn plenty, his winter solitude and gloom, and his spring awakening and gladness. He has made himself a home here in the old orchard; he knows how deep to go into the ground to get beyond the frost-line; he is a pensioner upon the great bounty upon which we all draw, and probably lives up to the standard of the chipmunk life more nearly than most of us live up to the best standards of human life. May he so continue to live, and may we yet meet for many summers under the apple-boughs.

Part II

When the spring came I was seized with a curiosity to know how much of his stores my little friend had disposed of, and which of his various assortment of nuts and grain had proved his favorites. To settle these points there was only one course to pursue: we must dig him out. So one April day we proceeded to do so. We at once discovered a new hole or entrance, only a few inches from the other, and apparently more in use than it was. We found his chamber about three feet below the surface with its usual nest of dry leaves and grass, and a few shells of hickory-nuts and cherry-pits, but, dig as we would, we could not find any recess or granary large enough to hold the peck or more of nuts that I had seen him carry in. We searched carefully for side chambers into which he might have stored the surplus of his unexpected harvest, but we found none. He would not have prepared in advance for such a contingency, as he could have had no hint of the bounty which a designing and near-by Providence was to bestow upon him.

The shells we found accounted for only a small fraction of those with which we had supplied him. Not a chestnut or a peach-pit or a hickory-nut did we find, nor any corn, nor wild seeds of any sort. I was much puzzled, and am still, as to just what had happened. The chipmunk either had been plundered by his neighbors, or else had freely distributed his supplies among them. What did the new hole signify? The old one was ample, and led to the same chamber. We did not find the chipmunk in his den, nor any convincing evidence that he had recently been there. Although I spent the following summer in the same bush camp, I am not certain that I ever saw my little neighbor that season. But the next following season, he or another was again my neighbor under the apple-trees, and disclosed to me a refreshing bit of natural history — that of a chipmunk digging his hole. He came and dug it in broad daylight within a few yards of my bush camp under the apple-trees, and gave me daily opportunities to watch the proceedings.

I have never known any one who has been so fortunate in this respect, nor have I ever seen in print any account of the little rodent's proceedings on such an occasion. For several years I have been an observer and an investigator of their little mounds of freshly dug earth along the margin of the highways or the woody borders of the fields, but until now have never caught one of the little miners at work. I had fancied that the digging was done at night, and that the earth was carried out to the dumping-place in the cheek pouches. But such is not the case. My little neighbor worked by day, and his cheek pockets were never used in transporting the earth from his hole to the dumping-place. I had often found the pile of fresh earth two or three yards from the hole out of which it came, with never a grain of soil littering the grass between the two, and no sign of a trail. I had also been fairly bewildered by finding stones in the pile of fresh soil so large that they could not be forced back into the hole out of which I was sure they had come. On three occasions I had found such freshly dug stones, and they were all too big for the opening that led to the chipmunk's den. By what magic had he got them out? From what I had seen one November, after the earth had been frozen and then thawed once or twice, I concluded that the little engineer had made a niche in the side of his hole just deep enough to make room for the passage of these broad, flat stones, and then had packed it full of earth again. In one case where a red squirrel had apparently been trying to force an entrance, such a niche was disclosed, as if the softer earth there had dropped out. Yet, as I had found other holes the rims of which had evidently never been tampered with, and the dump of which held one or more stones larger than its diameter, I was hopelessly puzzled. I had found still other holes that had no dump at all — not a grain of fresh earth anywhere in their neighborhood. There is one by the roadside in front of Woodchuck Lodge now, eight feet from the stone fence, into which the chipmunk is daily carrying his winter stores, but which has not the slightest vestige of an earth-mound anywhere in its vicinity. If the squirrel ever carried the dirt away in his cheek pockets, I might conclude that he had scattered it along the roadway. This mystery of the holes that have no visible dumping-place I have not yet cleared up. Were there a woodchuck-hole near any of them I might think that the loosened soil had been shot into that. As the problem stands with me now, it is an insoluble mystery. A friend suggests that, like the Irishman, he probably digs another hole to put the earth in, which reminds me of an old story about two countrymen who tried to "stump" each other with questions, it being stipulated that no question should be asked that could not be answered by the propounder.

"How is it," said one, "that a chipmunk digs a hole without throwing out any dirt?"

"You can't answer that yourself," said the other.

"I can; he begins at the other end of the hole," replied the first.

"How does he get to the other end?" asked the second.

"You must n't ask any question that you can't answer yourself."

It is certainly true that in such cases the chipmunk did begin at the other end of his hole, but that end must be somewhere on the surface of the ground. In all cases, whether there is a pile of earth or not, the hole is cut up through the turf from beneath, and hence all the soil must have been removed back along the tunnel and out at the entrance. We often see the same thing in the procedure of the woodchucks — the large pile of earth at the mouth of the main entrance and another hole a few yards away which has been cut up through the turf from below. The woodchuck makes no effort at concealment as does the chipmunk, but apparently aims only at convenience and safety. But how the squirrel can dispose of a bushel of soil and leave no trace is a problem. The mystery of the large stones was soon made clear; they did not come out of the neat, round hole in the turf through which the squirrel enters or leaves his finished den, but out of the larger work-hole through which the soil was removed, and which is finally stopped up and obliterated.

I happened to discover my chipmunk probably the second day after he had begun to dig. Some people were calling on me at my bush camp when, as they turned to go, one of them said, "See that chipmunk!" I looked and saw him sitting up amid a little fresh earth, washing his face. His face certainly needed washing; it was so soiled it looked comical. Presently I investigated the spot and found a rude hole a few inches deep, with the loosened earth in front of it. "Evidently a greenhorn," I said; "a pretty dooryard he will have by the time he finishes, with a hole big enough to admit a red squirrel!"

Next morning there was more fresh earth in front of the hole; indeed, the grass was full of it a foot or more away, and a dump-pile had just been begun. From the hole to this pile there was a deep, wide groove in the loose soil, which I soon saw was made by the squirrel shoving the loosened earth from the hole to the dump, using his nose as a shovel. Day after day, for nearly a week thereafter, I saw him at work, digging and pushing the soil up to the mouth of his hole, and then pushing it along this groove or channel to the dump-heap. His movements were so quick and energetic that, at the final stroke, the soil, a half-teaspoonful or more, would shoot from his nose four or five inches. As he turned back along his roadway he would rapidly paw the earth behind him, and then, before entering his hole, would take a quick look all around. He was never for a moment off guard; the sense of danger was ever present with him. As he entered his hole, a succession of quick jets of earth, forming little parabolas in the air, would shoot up behind him. Then all would be still for from three to four minutes, when he would again emerge, shoving the soil before him and continuing to butt it, quickly glancing right and left the while, till he shot it upon his dump.

This was his invariable procedure. Every motion was repeated like clockwork, the forward shoving, the retreating pawing, and the flying spray of earth as he disappeared in his hole.

I fancied him there underground loosening the soil with his paws, for two or three minutes, then either kicking it up toward the exit or else shoving it in front of him. When at work he was intensely preoccupied; only one other feeling seemed to possess him — that of impending danger. One day while he was mining beneath the surface, I sprinkled some corn and pumpkin-seeds along his highway and in the mouth of his hole, but when he came to the surface with his burden of soil he heeded them not; he shoveled or pawed them along with his soil, and buried them beneath it. The incident reminded me of the hound I once intercepted, hot on the trail of a fox; I offered her my lunch and, holding her, even put it in her mouth, but she threw it disdainfully from her, and rushed on along that steaming trail. She had but one thought or sense at that moment: she was beside herself about that fox, and her attention could not be diverted from it. My chipmunk when at work was alike obsessed; he knew nothing but his work and the danger from his enemies.

Day by day the mound of fresh earth grew and spread back more and more toward the hole out of which it came, till it seemed about to cover it. At times the squirrel either worked at night or else very early in the morning before I was on the scene. But later he was not on his job till past mid-forenoon. For two or three days he promptly appeared at eleven o'clock. He would come leaping over the grass from some point behind my camp and quickly resume his excavating. Once he found some fresh peach-pits upon his mound; these arrested his attention; he seized them one by one, nibbled off the bits of pulp that were still clinging to them, then dropped them and took up his task. He usually knocked off work by or before two in the afternoon.

Evidently he has no partner and will spend the winter in his subterranean retreat alone. I think this is an established chipmunk custom, rendered necessary, it may be, by the scant supply of air in such close quarters, three feet underground, and maybe under three or more feet of snow in addition. At any rate, the chipmunk, male or female, is a hermit, and there is no coöperation or true sociability among them. They are wonderfully provident and industrious, beginning to store up their winter food in midsummer, or as early as the farmer does his. When the nut-crop fails them, as it has this present season, they scour about the neighborhood, gathering all sorts of wild seeds and grains, and wild-cherry pits, working almost as steadily as do the ants and the bees. In the mean time they feed on insects and berries and various green things, but only cured grains and nuts go into their winter stores.

The wild creatures rarely make an economic blunder. We are told on excellent authority that the coney, or least hare, in the Rocky Mountains spreads its newly cut grass and other green food on the rocks in the sun, and dries it as carefully as the farmer dries his hay before storing it up for winter use. I think we are safe in saying that it is not the coney's individual wisdom or experience that prompts him to do this, but the wisdom of something much older than he is. It is the wisdom of nature, inherent and active as instinct.

One day, when I paused before my little neighbor's mound of earth, I saw that the hole was nearly stopped up, and, while I was looking, the closure was completed from within. Loose earth was being shoved up from below and pressed into the opening; the movement of the soil could be seen. It flashed upon me at once that here was the key to the secret that had so puzzled me — he would obliterate that ugly and irregular work-hole and the littered dooryard, bury them beneath his mound of earth, and, working from within, would make a new and neater outlet somewhere through the turf near by. He was probably carrying out that scheme at that moment, and was disposing of the loose earth in the way I had observed. The next day the mound of earth had been extended over the place where the hole had been, and the chipmunk was still active beneath it, pushing up fresh earth like a ground-mole. At intervals of a few moments, the fresh soil would slowly heave or boil up, as it does when a hidden crayfish or mole is at work. Twice while I looked the head of the digger came through the thin screen of earth, as if by accident; he winked and blinked as the dirt slid off his head and over his eyes, then ducked beneath it and proceeded with his work. I began to look in the turf around me for the new entrance which I knew would soon be, if it were not already, made. I did not that day find it, but the next morning there it was, not more than four inches from the edge of the dump-heap — a little round shadow under the grass-blades and wild-strawberry leaves, about half the size of the work-hole, with no stain of the soil about it, and having such a look of neatness and privacy as could not have been given to it if it had been made from without. How furtive and secretive it looked! Still the little miner kept at work, still the fresh earth boiled up above the old entrance. He is excavating his chamber, I thought; he requires a den or vault down there, of several quarts' capacity, in which to build his nest and store his food. Whether or not he was then excavating his chamber and storeroom, the next day I found two more new holes in the turf, one a foot or more from the first one, and the other three or more feet away in another direction — both of them having the same shy, elusive character. Why all these extra holes? I asked. I have never before known of a chipmunk's den with so many back or front doors. Are they only for means of escape if robbers or murderers gain an entrance? If so, they afford another proof of the provident cunning of our little striped friend. It happened in this case that the squirrel brought to the surface no stones too large for the new entrance, but his work-hole was so large and irregular that he might easily have done so.

My chipmunk was engaged for nearly three weeks in his excavations. I knew when he had finished by his boldly coming into my camp one morning, a minute or two after he had seen me enter it. Looking intently up in my face for a few seconds, he proceeded to stuff his mouth with the dry leaves most to his liking that my bushy walls afforded. He did not try to pack the leaves in his cheek pouches, but crammed four or five into his mouth and then made off to his den. He was furnishing his house. Many mouthfuls of dry leaves and fine grass doubtless went to the furnishing, though I chanced to witness only this one. His bedroom is his granary; his winter stores are packed all around and under his nest. Some of his neighbors have been carrying in their supplies since July, just what I could not find out; probably wild seeds of some kind. As there are no beech-nuts this season, and no buckwheat or oat-fields near by, I am wondering what my little neighbor is counting on to carry him over the winter. He may have some source of supply that I know not of. I gave him cherry-pits and plum-pits from time to time before his den was finished, and he seemed to have some place to store them. I hope he is not counting too confidently upon the continuance of this bounty.

In my walks I have many times come across chipmunk-holes with a pile of earth before them, and a general look of carelessness and disorder all about, and I have said, "That squirrel is a bungler; he is not equal to his task." The present season I have seen three such holes while walking less than a mile along the highway. They appeared to have been abandoned. Now I know they were only beginnings, and that had the owners finished their mansions, they would have presented a far different appearance. That ugly work-hole, with its belittered dooryard, would have been completely covered up, and the real entrance deftly concealed.

It is highly improbable that every individual chipmunk has a way peculiar to himself, as we humans so often have. Their dens and modes of procedure in digging them are as near alike as two peas, or as two chipmunks themselves. Yet there remains the mystery of an occasional hole without any pile of earth anywhere in sight. I find several such each season, and I can offer no plausible explanation of them.

I have found two weasels' dens on the margin of a muck swamp in the woods that presented the same insoluble problem — what had become of the bushel or more of earth that must have been brought to the surface? Both the weasel and the chipmunk have several galleries and one or more large chambers or dining-halls, and how each manages to hide or obliterate all the loose soil that must have been removed is a question which has long puzzled me. If we had an American Fabre, or a man who would give himself up to the study of the life-histories of our rodents, with the same patience and enthusiasm that the wonderful Frenchman has had for the life-histories of the insects, he would doubtless soon solve the mystery for me.

I used to think that the chipmunk carried away the soil in his cheek pockets, and have so stated in one of my books, but I am now very certain that he does not — only his food-stores are thus carried. In the present case I measured the excavated earth and found it a plump bushel.

From the point of view of modern scientific philosophy, — namely, that the needs of the organism beget the organ, and a change of use modifies it, — it is interesting to note to what novel use the chipmunk puts his nose in digging his den, apparently without changing or impairing it as an organ of smell. If he has been doing this through biological ages, using it as a kind of scoop and pusher, is it not remarkable that it has not undergone some modification that would make it better suited for these purposes? Note the shovel-footed mole, with his huge, muscular fore paws with which he forces his way through the soil and heaves it up to the surface, or the pig with his nose so well adapted to rooting. The nose of the chipmunk does not perceptibly differ from that of the other squirrels, which do no underground work. Are we not forced to the conclusion that the life-habits of the chipmunk have been much changed since the country has been so largely denuded of its forests, thus forcing him to become a dweller in the open? In the primitive woods, with the thick coating of leaves and of snow upon the ground, he would not have needed to penetrate the earth so deeply. The wood frogs go barely a few inches under the leaves and leaf-mould, where they remain unfrozen all winter. Our beech-woods to-day, when there is a crop of nuts, fairly swarm with chipmunks, and all of them have holes, but rarely is there any sign of freshly dug earth.

None of our wild creatures have as yet become much modified, either in form or color, as a result of the change in their environment by the disappearance of the forests. They have changed in habits, but the habits have not as yet set their stamp upon the organism. Is it not probable that if the chipmunk goes on scooping and packing soil with his nose for long ages, his anatomy will in time become better adapted to this new use?

I fancy that in time the woodchuck, which from a wood-dweller has now so commonly become a denizen of the fields, will change in color, at least. How his form now stands out on the smooth surface of the green fields! His enemies can see him from afar. Is this the reason that while feeding he momentarily rises up on his hind legs and takes an observation? He is instinctively uneasy under his give-away color. As a wood-dweller his colors were assimilative and therefore protective, but now they advertise him to every enemy in the landscape. In the course of ages he should become a much lighter brown or gray — that is, if our theories as to assimilative coloration are well founded. But there is no doubt but that use and wont as well as environment do in time leave their stamp upon every living creature.

II

THE FRIENDLY ROCKS

I FIND there is enough of the troglodyte in most persons to make them love the rocks and the caves and ledges that the air and the rains have carved out of them.

The rocks are not so close akin to us as the soil; they are one more remove from us; but they lie back of all, and are the final source of all. I do not suppose they attract us on this account, but on quite other grounds. Rocks do not recommend the land to the tiller of the soil, but they recommend it to those who reap a harvest of another sort — the artist, the poet, the walker, the student and lover of all primitive open-air things.

Time, geologic time, looks out at us from the rocks as from no other objects in the landscape. Geologic time! How the striking of the great clock, whose hours are millions of years, reverberates out of the abyss of the past! Mountains fall, and the foundations of the earth shift, as it beats out the moments of terrestrial history. Rocks have literally come down to us from a foreworld. The youth of the earth is in the soil and in the trees and verdure that springs from it; its age is in the rocks; in the great stone book of the geologic strata its history is written. Even if we do not know our geology, there is something in the face of a cliff and in the look of a granite boulder that gives us pause and draws us thitherward in our walk. We linger beneath the cliff, or muse and dream amid its ruins as amid the ruins of some earth temple; we pause beside the huge boulder, or rest upon it and survey the landscape from its coign of vantage; we lay our hand upon it as upon some curious relic from a world that we know not of. The elemental, the primordial, the silence of ages, the hush and repose of a measureless antiquity look out upon us from the face of the rocks. "The menacing might of the globe" is in the cliffs and the crags; its ease and contentment are in the slumbering boulders. One might have a worse fate than to have his lot cast in a rockless country — a treeless country would be still worse: but how the emigrant from New England or New York to the prairie States or to the cotton States, must miss his paternal rocks and ledges! A prairie farm has no past, no history looks out of it, no battle of the elemental forces has been fought there, and only a very tame, bloodless battle of the human forces.

A landscape without rocks lacks something. Without the outcropping ledge, the faces of the hills lack eyebrows; without a drift boulder here and there, the fields lack the rugged elemental touch. Next to the trees, rocks are points of interest in the landscape. Slumbering here and there upon the turf, they enhance the sense of repose. How expressionless and uninteresting the landscape in one of the prairie States, or in one of the Southern States, contrasted with a New England or a New York farm! The grazing or ruminating cattle add a picturesque feature, but the gray granite boulders have been lying there chewing their stony cuds vastly longer. How meditative and contented they look, dreaming the centuries away!

The rocks have a history; gray and weather-worn, they are veterans of many battles; they have most of them marched in the ranks of vast stone brigades during the ice age; they have been torn from the hills, recruited from the mountain-tops, and marshaled on the plains and in the valleys; and now the elemental war is over, there they lie waging a gentle but incessant warfare with time, and slowly, oh, so slowly, yielding to its attacks! I say they lie there, but some of them are still in motion, creeping down the slopes, or out from the clay-banks, nudged and urged along by the frosts and the rains, and the sun. It is hard even for the rocks to keep still in this world of motion, but it takes the hour-hand of many years to mark their progress. What in my childhood we called "the old pennyroyal rock," because pennyroyal always grew beside it, has, in my time, crept out of the bank by the roadside three or four feet. When a rock, loosened from its ties in the hills, once becomes a wanderer, it is restless ever after, and stirs in its sleep. Heat and cold expand and contract it, and make it creep down an incline. Hitch your rock to a sunbeam, and come back in a hundred years, and see how much it has moved. I know a great platform of rock weighing hundreds of tons, and large enough to build a house upon, that has slid down the hill from the ledges above, and that is pushing a roll of turf before it as a boat pushes a wave, but stand there till you are gray, and you will see no motion; return in a century, and you will doubtless find that the great rock raft has progressed a few inches. What a sense of leisure such things give us hurrying mortals!

One of my favorite pastimes from boyhood up, when in my home country in the Catskills, has been to prowl about under the ledges of the dark gray shelving rocks that jut out from the sides of the hills and mountains, often forming a roof over one's head many feet in extent, and now and then sheltering a cool, sweet spring, and more often sheltering the exquisite moss-covered nest of the phœbe-bird. These ledges appealed to the wild and adventurous in the boy. The primitive cave-dweller in me, which is barely skin-deep in most boys, found something congenial there; the air smelled good; it seemed fresher and more primitive than the outside air; it was the breath of the rocks and of the everlasting hills; the home feeling which I had amid such scenes doubtless dated back to the time when our rude forebears were cave-dwellers in very earnest. The little niches and miniature recesses in the rocks at the side were so pretty and suggestive, and would have been so useful to a real troglodyte. Of a hot summer Sunday one found the coolness of the heart of the hills in these rocky cells, and in winter one found the air tempered by warmth from the same source. To get down on one's hands and knees and creep through an opening in the rocks where bears and Indians have doubtless crept, or to kindle a fire where one fancies prehistoric fires have burned, or to eat black birch and wintergreens, or a lunch of wild strawberries and bread where Indians had probably often supped on roots or game — what more welcome to a boy than that?

As a man I love still to loiter about these open doors of the hills, playing the geologist and the naturalist, or half-playing them, and half-dreaming in the spirit of my youthful days. Phœbe-birds' nests may be found any day under these rocks, but on one of my recent visits to them I found an unusual nest on the face of the rocks such I had never before seen. At the first glance, from its mossy exterior, I took it for a phœbe's nest, but close inspection showed it to be a mouse's nest — the most delicate and artistic bit of mouse architecture I ever saw — a regular mouse palace; dome-shaped, covered with long moss that grew where the water had issued from the rocks a few yards away, and set upon a little shelf as if it had grown there. There was a hole on one side that led to the soft and warm interior, but when my forefinger called, the tiny aristocrat was not in. Whether he or she belonged to the tribe of the white-footed mouse, or to that of the jumping mouse, I could not tell. Was the device of the mossy exterior learned from the phœbe? Of course not; both had been to the same great school of Dame Nature.

Through the eyes of the geologist I see what the agents of erosion have done, how the tooth of time has eaten out the layers of the soft old red sandstone, and left the harder layers of the superimposed Catskill rock to project unsupported many feet. I see these soft red layers running through under the mountains from valley to valley, level as a floor, and lending themselves to the formation of the beautiful waterfalls that are found here and there in the trout brooks of that region. At one such waterfall, a mile or more from the old schoolhouse, we used to go, when I was a boy, for our slate pencils, looking for the softer green streaks in the crumbling slaty sandstone, and trying them on our teeth to see whether or not they were likely to scratch our precious slates. In imagination I follow this slaty layer through under the mountains and see where it is cut into by other waterfalls that I know, ten, twenty, thirty miles away. At those falls the water usually makes a sheer leap the whole distance, — twenty, thirty, or fifty feet, as the case may be, — the harder rock at the top always holding out while the softer layers retreat beneath it, forming in this respect miniature Niagaras. When near one of these falls I seldom miss the opportunity to climb the side of the gorge under the overhanging rock and inspect its under surface, and feel it with my hand. The elements have here separated the leaves of the great stone book and one may read some of the history written there. When I pass my hand over the bottom side of the superincumbent rock, I know I am passing it over the contours, the little depressions and unevennesses of surface, of the mud of the old lake or inland sea bottom, upon which the material of the harder rock was laid down more than fifty millions of years ago. There are here and there little protuberances, the size of peas and beans, which probably mark where little gas bubbles were in the old mud bottom.

One thing that arrests attention in such a place is the abruptness of the change from one species of rock to another, as marked and sudden as a change in a piece of masonry from brick to stone, or from stone to iron. The two meet but do not mingle. Nature seems suddenly to have turned over a new leaf, and to have begun a new chapter in her great stone book. What happened? There is no evidence in this region of crustal disturbance since the original plateau out of which the mountains were carved was first lifted up in Palæozoic times, when the earth was in her teens. The indications are that on some quiet day the peaceful waters became suddenly charged with new material and the streams or rivers from some unknown land in the vicinity poured it into the old Devonian lakes where it hardened into rock. The changes indicated by these streaks of soft red sandstone suddenly alternating with the hard laminated Catskill formation, well up the mountain-sides, with a sharp dividing line between them, occurred many times during the Devonian Age. During one geologic day the earth-building forces brought one kind of material, and the next day material of quite another kind, and this alternation without any change of character seems to have kept up for millions of years. How curious, how interesting! Both from near-by land surfaces, and yet so different from each other! How difficult to form any mental picture of the condition of things in those remote geologic ages! It is as if one day it had snowed something like brick-dust to a depth of many feet, and the next day it had snowed a dark-gray dust of an entirely different character, and that this alternation of storms had kept up for ages. Long before we reach the tops of the mountains, or at about a thousand feet above the river valley, the red soft strata cease, and the hard dark, cross-bedded gray rock continues to the top.

In the higher peaks of the southern Catskills another kind of rock begins to appear before the summit is reached — a conglomerate. The storm of dark snow has turned to a storm of white hail. As you go up, you seem to be climbing into a shower of quartz pebbles. Presently you begin to see here and there a pebble embedded in the rocks; then, as you go on, you see more of them, and still more; it is like the first sprinkle of rain that precedes the shower, till, long before you reach the summit, the regular downpour begins, the rocks become solid masses of pebbles embedded in a gray hard matrix; there are many hundreds of feet of them. On the top the soil is mainly sand and coarse gravel from the disintegrated rock.

The streams at the foot of the mountains abound in fragments of this pudding-stone or conglomerate, and in the hard, liberated quartz pebbles. These pebbles were rolled on an ancient sea-beach incalculable ages ago, and now they are being rolled and worn again by the limpid waters of the Catskill trout-brooks. What varied fortune the whirligig of time brings to quartz pebbles as well as to men!

Of course the Catskills were under water when this conglomerate was laid down upon them. The coal age was near at hand, and a conglomerate akin to this of the tops of the Catskills underlies the coal measures. The Catskill plateau was lifted up before Carboniferous times began, so that there is no coal in this region. We should have to look overhead for it instead of underfoot. When the Catskill plateau rose above the waters, Pennsylvania and most of the continent to the west was under the sea, receiving additional deposits, thousands of feet thick in many places, and in due time supporting a vegetation that gave us our vast deposits of coal.

The geologic tornado that brought this hailstorm of quartz pebbles, so marked in the conglomerate that caps the highest Catskills, seems to have been a general storm over a large part of the northern hemisphere, as this conglomerate underlies the coal measures, both in this country and in Europe. It must have occurred in late Devonian or early Carboniferous times. On the top of Lookout Mountain, in Tennessee, I gathered a handful of pebbles that had weathered out of the Carboniferous sandstone that the ages have exposed on the summit.

An earlier storm of quartz pebbles occurred in Silurian times, which formed the Oneida conglomerate in central New York, and the Shawangunk range in southern New York. This latter range is a vast windrow made up of small pebbles varying in size from peas to large beans, cemented together by quartz sand. It is several hundred feet thick and runs southwest through Pennsylvania into Virginia, affording another proof of the abundance of quartz rock in those early geologic ages. Dana thinks this conglomerate gives us an idea of the seashore work of that period. Only on a seashore could the crushed material have been sorted and distributed in this way.

According to the published views of a natural philosopher on the Pacific Coast, this rain of rock material from the heavens is no myth. He believes that the earth in its early history was surrounded by a series of numerous concentric rings of floating cosmic matter, like the rings of Saturn, and that from time to time these rings collapsed and their material fell to earth helping to make up the vast series of stratified rocks. This theory certainly simplifies some of the problems of the geologist. My Catskills did not have to go down under the sea to get this coat of mail of quartz pebbles, or these alternate layers of red and gray sandstone, and the question of the abrupt ending and beginning of the different series is easily solved; as is also the larger question of where all the diverse material of our enormous system of stratified rock, reckoned by some geologists to be not less than twenty miles thick in North America, came from. In some parts of Scotland, the old red sandstone, according to Geikie, is twenty thousand feet thick. This explanation of the California theorist gives us all this material, and gives it in the original packages. I wish I could believe it true — and be thankful that there are no more rings to collapse!

How one would like to know the history of this conglomerate that caps the higher Catskills! What stone-crusher reduced the quartz rock and sorted the fragments so evenly? The stone-crushing plant that turned out the material for most of the other rocks ground "exceeding fine," but in this instance they turned out a very coarse product, though a very uniform one. On the shores of some Palæozoic sea have these pebbles been rolled and worn. Only upon one sea-beach have I seen pebbles of this size in lieu of sand, and that was upon Dover beach, on the coast of England. Instead of the hissing of the sands when the breakers come in, there rises the sound of the multitudinous rattling of these myriads of pebbles. Some old Devonian seashore has sent up a like sound where these Catskill pebbles were washed by the waves.

The rock-crushing plants must have been very busy in the early geologic ages, and quartz rock must have been a drug in the market. We see no natural forces at work now reducing rocks to coarse gravel on any scale comparable to that which must have taken place in Silurian times when the Shawangunk rocks and the Oneida conglomerate were laid down. In any case, where were the quartz mountains from which they came, and where were the forces that ground them up? "From lands to the eastward," geologists think, but of such lands there are no traces now.

On the Pacific Coast of southern California I saw a strip of country nearly a hundred miles long and from fifteen to twenty miles wide that was mainly made up of large quartz pebbles. The land was thrown into gentle hills and ridges which became higher as they approached the mountains. Near its inland margin I heard of a search for oil that had been made there, the drill going through nine hundred feet of pebbles and striking the granite rock — an unlikely place for oil. But think of the quartz mountains that must have been broken up and put through the mill of the Pacific to form all the vast banks of water-worn pebbles!

In South America Darwin saw hills and mountains of pure quartz. Not far from Buenos Ayres they formed tablelands or mesas, without cleavage or stratification. On the Falkland Islands he found the hills of quartz and the valleys filled with "streams of stone" — huge fragments of quartz rock varying in size from a few feet in diameter "to ten or even more than twenty times as much." Darwin thinks that these streams of quartz stones may have had their origin in streams of white lava that had flowed from many parts of the mountains into the valleys, and then, when solidified, were rent by some enormous convulsion into myriads of fragments. Some such titanic force of nature must have been the stone-crusher that converted vast hills of quartz into the fragments that make up the

Shawangunk Mountains, the Oneida conglomerate, and the conglomerate on the tops of the Catskills.

In our Northern States there are two classes of rocks: the place rocks, and the wanderers, or drift boulders. The boulders are in some ways the more interesting; they have a story to tell which the place rock has not; they have drifted about upon a sea of change, slow and unwilling voyagers from the North many tens of thousands of years ago; now they lie here in the fields and on the hills, shipwrecked mariners, in some cases hundreds of miles from home. But usually they have been plucked from the neighboring ledges or mountains, and shoved or transported to where they now lie. In nearly all cases the sharp points and angles have been rubbed down, as with most travelers, and they lie about the fields like cattle ruminating upon the ground.

"The shadow of a great rock in a weary land" is pretty sure to be the shadow of a drift boulder. The rock about which, and on which, we played as children was doubtless a drift boulder; the rocks beneath which the woodchucks and the foxes burrow are drift boulders; the rock under the spreading maples where the picnickers eat their lunch is a drift boulder; the rock that makes the deep pool in the trout-stream of your boyhood is a drift boulder; the rocks which you helped your father pry up from the fields and haul to their place for the "rock bottom" of the stone wall, in the old days on the farm, were all drift boulders. How sod-bound many of them were, and how the old oxen used to settle into their bows with rigid muscles in pulling them from their beds! If you had looked on their under sides you would have seen how smoothed and worn most of them were. They had been hauled across the land by oxen of another kind long before yours were heard of.

The rocks that give the eyebrows to the faces of the hills are place rocks — the cropping-out of the original strata. The place rock gives the contour to the landscape; it forms the ledges and cliffs; it thrusts a huge rocky fist up through the turf here and there, or it exposes a broad smooth surface where you may see the grooves and scratches of the great ice sheet, tens of thousands of years old. The marks of the old ice-plane upon the rocks weather out very slowly. When they are covered with a few inches of soil they are as distinct as those we saw in Alaska under the edges of the retreating glaciers.

One day, on the crest of a hill above my Lodge on the home farm in the Catskills, I used my spade to remove five or six inches of soil from the upper layer of rock in order to prove to some doubting friends that a page of history was written here that they had never suspected. I quickly disclosed the lines and the grooves, nearly as sharp as if made but yesterday, and as straight as if drawn by a rule, running from northeast to southwest. Across the valley, a third of a mile away, I uncovered other rock surfaces on the same level, that showed a continuation of the same lines. The great jack-plane had been shoved across the valley and over the mountain-tops and had taken off rocky shavings of unknown thickness.

The drift boulders are not found beyond the southern limit of the great ice-sheet — an irregular line starting a little south of New York and running westward to the Rocky Mountains, but in southern California I saw huge granite boulders that looked singularly like New England drift boulders. They cover the hill called Rubidoux at Riverside. I overheard a tourist explaining to his companions how the old glaciers had brought them there, apparently ignorant of the fact that they were far beyond the southern limit of the old ice-sheet. It is quite evident that they were harder masses that had weathered out of the place rock and had slowly tumbled about and crept down the hill under the expansive power of the sun's rays. But I saw one drift boulder in southern California that was a puzzle; it was a water-worn mass of metamorphic rock, nearly as high as my head, at the end of a valley, several miles in among the hills, with no kindred rocks or stones near it. It was evidently far from home, but what its means of transportation had been I could only conjecture.

Amid the flock of gray and brown boulders that dot my native fields, there is here and there a black sheep — a rough-coated rock much darker than the rest, which the farmers call firestone, mainly, I suppose, because it does not break or explode in the fire. It is a kind of conglomerate, probably what the geologists call breccia, made up of the consolidated smaller fragments of older crushed rocks. The material of which it is composed is of unequal hardness, so that it weathers very rough, presenting a surface deeply pitted and worm-eaten, which does not offer an inviting seat. These rocks wear a darker coat of moss and lichens than the others and seem like interlopers in the family of field boulders. But they really belong here; they have weathered out of the place strata. Here and there one may find their dark worm-eaten fronts in the outcropping ledges. They were probably formed of the coarser material — a miscellaneous assortment of small thin water-worn fragments of rocks and mud and coarse sand — that accumulated about the mouths of the streams and rivers which flowed into the old Devonian lakes and seas. They are not made up of thin sheets like the other rocks, and seem as if made at a single cast. They are as rough-coated as alligators, and do not, to me, look as friendly as their brother rocks. They stand the fire better than other stone. The huge stone arch in my father's sugar bush, in which the great iron kettles were hung, was largely built of these stones. I think the early settlers used them to line the open fireplaces in their stone chimneys. Along the Hudson they used slate, which is also nearly fireproof.

I know a huge iron-stone rock lying at the foot of a hill, from beneath which issues one of the coldest and sweetest springs in the neighborhood. How the haymakers love to go there to drink, and the grazing cattle also! Of course, the relation of the rock to the spring is accidental. The rocks help make the history of the fields, especially the natural history. The woodchucks burrow beneath them, and trees and plants take root beside them. The delightful pools they often form in a trout-stream every angler remembers. Their immobility makes the mobile water dissolve and excavate the soil around and beneath them, and afford lairs for the big trout. I know of a large one that stood on the edge of the road where it snubbed the wagon-wheels as they came along. For generations it had defied the road-menders, till one June day a farmer of more pluck and endurance than usual tackled it with a heavy crowbar, and, after a prolonged effort, split off a huge slab from its top, making it, as the path-master said, "haul in its horns." When a boy I saw my elder brother drill a hole in one with a churn drill, and with a charge of powder blast it into four pieces, which were used in the foundation of a wall by the roadside. As I pass along that road now, after sixty-five years, I see the square faces of that rock with a section of the drill-hole on the corner of each, and think of my brother. It was before the time of fuses, and I remember he primed the blast by the spindle method, and then laid a train of powder with a fragment of paper at the end of it. A lighted match was touched to the paper, and then we ran to a safe distance as fast as our legs could carry us.

How geologic time looks out from the ledges and walls of gray rocks unmindful of us human ephemera that pass! It has seen the mountains decay and the hills grow old. The huge drift boulders rest on the margin of meadows and fields, or stand sentry to the woods, and though races and kingdoms pass, scarcely the change of a wrinkle disturbs their calm stone faces. Yet time gets the better of them also. The frowning ledge melts as inevitably as a snowbank.

Geologic time is the most potent of the gods of change. He wields an invisible hammer beside which the hammer of Thor is a child's toy. Its slow, silent blows break in through granite rocks as big as a house. The traveler sees them along the road when he enters Yosemite; he may see them in New England; he may see them on Lake Mohonk, or on the Shawangunk Mountains in New York — sheer cleavage of rock-masses from fifty to one hundred feet through — a clean break while the huge fragment of the mountain is lying where it fell. It is as if the sunbeams or starbeams did it, as if the snows of winter and the dews of summer had the force of dynamite.

When I get especially rock-hungry, and the troglodyte in me gets restless, as he is apt to in all of us, I take a walk to the ledges on Pine Hill, or on Hemlock Ridge, and prowl about their caverns and loiter under their overhanging strata, putting my hand in the little niches and pockets where I kept my trinkets and choice possessions when I was a troglodyte, inspecting the phœbe's mossy nest on a little shelf where the four-footed beasts cannot reach it, cleaning out the spring that shows like a small eye under the rocky eyebrow, creeping through what we boys called the "Indian oven."

When you want to read a stirring and heroic chapter in the great rock volume of the earth, the very Iliad or Odyssey of the rocks, go to the Grand Cañon of the Colorado, or to Yosemite. As you gaze, a sentence from Job may come to your mind as it did to a friend of mine — "Where wast thou when I laid the foundations of the earth?"

All through the Southwest the great book of geologic Revelation lies open to the traveler in an astonishing manner. Its massive but torn and crumpled leaves of limestone, sandstone, and basalt lie spread out before him all through Colorado, New Mexico, and Arizona, and he may read snatches of the long geologic record from the flying train.

I myself need not go so far to see what time can do with the rocks. On the Shawangunk range of mountains in my own State are scenes that suggest a rocky Apocalypse. It is as if the trumpet of the last day had sounded here in some past geologic time. The vast rock-strata of coarse conglomerate, hundreds of feet thick, has trembled and separated into huge blocks, often showing a straight, smooth cleavage like the side of a cathedral. As a matter of fact, I suppose there was no voice of the thunder or of earthquake that wrought this ruin, but the still small voice of heat and cold and rain and snow. There is no wild turmoil or look of decrepitude, but a look of repose and tranquillity. The enormous four-square fragments of the mountain stand a few feet apart, as if carefully quarried for a tower to reach the skies. In classic simplicity and strength, in harmony and majesty of outline, in dignity and serenity of aspect, I do not know their equal. They are truly Greek in their composure and restraint — impressive, like a tragedy of Æschylus, in their naked grandeur. No confusion of tumbled and piled fragments, no sublimity of wreckage and disorder, but the beauty of simplicity, the impressiveness of power in repose.

What a diverse family is this of the stratified rocks! Never did the members of the human family — Caucasian, Negro, Jew, Japanese, Indian, Eskimo, Mongolian — differ more from one another than do the successive geological formations. White and black, hard and soft, coarse and fine, red and gray, yet all in the same line of descent — all dating back to the same old Adam rock of the Azoic period. Time and circumstance, conditions of water and air, of sea and land, seem to have made the difference. As the races of men were modified and stamped by their environment, so the diverse family of rocks reflects the influence of both local and general conditions. When analyzed, their constituents do not differ so much. As in the different races of men we find the same old flesh and blood and bones, so in the rocks we find the same quartz sand and compounds of lime and iron and potash and magnesia and feldspar, yet in quantity and character what a world of difference! How differently they are bedded, how differently they weather, how differently they submit to the hammer and chisel of the mason and the stonecutter! Some rocks seem feminine, smooth, fine-grained, fragile, the product of deep, still water; others are more masculine, coarse, tough, the product of waters more or less turbid or shallow.

The purity of the strain of the different breeds of rocks is remarkable; about as little crossing or mingling among the different systems as there is among the different species of animals: considering the blind warring and chaos of the elements out of which they came, one can but wonder at the homogeneity of the different kinds. They are usually as uniform as if their production had been carefully watched over by some expert in the business,—which is, indeed, the case. This expert is water. Was there ever such a sorter and sifter? See the vast clay-banks, as uniform in quality and texture as a snow-bank, slowly built up in the privacy of deep, still rivers or lakes during hundreds or thousands of years, implying a kind of secrecy and seclusion of nature. Mountains of granite have been ground down or disintegrated, and the clay washed out and carried in suspension by the currents, till it was impounded in some lake or basin, and then slowly dropped. The great clay-banks and sand-banks of the Hudson River Valley doubtless date from the primary rocks of the Adirondack region. Much of the quartz sand is still in the soil of that region, and much of it is piled up along the river-banks, but most of the clay has gone downstream and been finally deposited in the great river terraces that are now being uncovered and worked by the brickmakers. The sand and the clay rarely get mixed; the great hydraulic machine turns out a pretty pure product. The occasional mingling of sand and gravel shows that at times the workmen nodded, but the wonder is that, on the whole, the two should be so thoroughly separated, and so carefully deposited, each by itself. Flowing water drops its coarser material first, the sand next, and the mud and silt last. Hence the coarser-grained rocks and conglomerates are built up in shallow water near shore, the sandstones in deeper water, and the slates and argillaceous rocks in deeper still. The limestone rocks, which are of animal origin, also imply deep, calm seas during periods that embrace hundreds and thousands of centuries. It is, then, the long ages of peace and tranquillity in the processes of the earth-building forces that have contributed to the homogeneity of the different systems of secondary rocks. What peace must have brooded over that great inland sea when those vast beds of Indiana limestone and sandstone were being laid down! A depth of thousands of feet of each without a flaw. Vast stretches of Cambrian and Silurian and Devonian time were apparently as free from violent movements and warrings of the elements as in our own day.

Occasionally in a system of rocks one may see a change of color over a considerable area, as from gray or brown to red, with small fragments of older and redder rocks embedded in them. I fancy such streaks were caused by a sudden flood or freshet that carried new material worn from a distant land-surface into the sea or into the impounded waters.

It would seem to require as distinctly an evolutionary process to derive our sedimentary rocks from the original igneous rocks as to derive the vertebrate from the invertebrate, or the mammal from the reptile. Of course, it could not be done by a mechanical process alone. It has been largely a chemical process and, no doubt, to a certain extent, a vital process also. The making of a loaf of bread is, up to a certain point, a mechanical process; then higher and finer processes set in. And all the cake and pastry and loaves in the bakeshop do not differ from the original bin of wheat any more than the great family of secondary rocks differs from the unmilled harvest of the earth's original crust. And the increase in bulk seems to have been quite as great as that which the bin of wheat undergoes in passing from the kernel to the loaf or the roll. The leaven that went to the making of our shale and sandstone loaves seems to have been contributed by the sea when the batch was mixed and baked. Little doubt that the bulk of the material of the sedimentary rocks came through the process of erosion and deposition from the original igneous rocks, but how has it expanded and augmented during the process! It seems to have swelled almost as the inorganic swells in passing into the organic.

III
THE MASTER INSTINCT

FROM the naturalist's point of view, the sole purpose of all forms of life in this world, man included, is to beget more life, and secure the perpetuity of the species. The master instinct in every living creature is to increase and multiply and fill the world with its progeny. Our dream that every living thing was made to serve some namable purpose apart from itself, or was designed in some way to serve man, is a notion that has survived from the childhood of the race.

Many forms, in both the animal and the vegetable worlds, are the enemies of man and the enemies of one another. Other forms play into one another's hands, but only to help forward the scheme of propagation of one or both sides, as when vines and trees incase their seeds in tempting fruit-pulps which the animals eat and thus drop the undigested germs far and near. All our fruits, from the apple down to the wild berries, are plotting to get their seeds scattered and planted, and they offer edible morsels as a wage to any creature that will perform this service. In many cases the wage is a very small one, as with the red cedar, the hardhack (*Celtis*), the sumac, the poison-ivy, and the like; but it serves the purpose; the hungry birds are quick to lend a hand. If the plants and vines and trees had minds and could answer our question as to what is passing in them, they would say: "We are thinking how best to perpetuate our species — how to attract the insects to visit the flowers, and thus secure a hardier race by cross-fertilization; how to tempt the birds and four-footed creatures to come and sow our seeds; how to protect these seeds and nuts till they are ripe and ready to pass along the precious heritage of life; hence some of us trust to the winds and the waters to secure fertilization, in which cases we do not need to develop bright or showy flowers, but a superabundance of pollen; for sowing our seeds, some of us devise wings and balloons; others devise hooks and hands that seize upon passing animals; others make use of the tension of springs and other mechanical devices. We heavy-nut-bearing trees enter into partnership with squirrels and crows and jays; they carry our nuts to distant woods and fields; some they carelessly drop by the way, some they hide under the leaves or in the grass, and we find our account in each. They unwittingly plant more oaks and chestnuts and hickory-trees."

Nearly all the animal orders below man are equally obsessed with the idea of perpetuating their species; for this they live, for this they die. It is a kind of madness; it leads to all kinds of excesses and extravagances: bizarre colors and ornaments, grotesque forms and weapons, fantastic rites and ceremonies. The sexual instinct emboldens the timid, and spurs the sluggard; it sharpens the senses, it quickens the wits, it makes even the frogs and toads musical, and gives new life to the turtle. In fact, the drama of all life revolves around the breeding-instinct. It is this that fills the world with music, color, perfume. The nuptials of the vegetable world are celebrated with lovely forms, brilliant hues, and sweet incense. With the birds they are attended by joyous songs, gay plumes, dances and festive reunions, and striking, if at times grotesque, forms. With the insects, music and gay colors mark the day; with the human race, how much of our song and art and pursuit of beauty has grown out of the instinct to please and win the opposite sex! Without this incentive — the mating instinct, the love of children, and of home and fireside — could we ever have attained to our present civilization?

What is the meaning of the spring and summer chorus of bird-songs — the ecstasy of larks and finches, the madness of nightingales, the melody of thrushes, the intoxication of bobolinks and mocking-birds — the jewels in the plumage, the fantastic in behavior — but sexuality, the innate desire for off-spring? How Nature surrounds this passion with the gay, the festive, the hilarious! how she aids it with color and form! how she lavishes upon it all her arts to charm and persuade and entice! Her creatures forget their staid and quiet ways; there is a sound of music and gayety on the one hand, and a noise of strife and battle on the other. The stag bugles and tosses his horns, the bull bellows and tears and paws the earth, the grouse drums and booms, the woodpecker beats a spring reveille on a dry limb, the insects fiddle and shuffle and snap their wings — indeed, nearly all forms of life assume new activity and intensity.

It is the sex principle that gives the beard to the man, the antlers to the stag, the mane to the lion, the spurs and comb to the cock, and the strange fashions and coloration to the male birds. Reproduction is the one thing Nature has most at heart and is intent on securing at all hazards — at the hazard of pain, hunger, strife, and self-destruction.

Just to keep up the game of life, to keep the measure full to overflowing — has Nature any other purpose than this? Think of the swarms of the living that come and go, especially in the insect world, and leave no trace behind! Yes, and at times, in the higher-animal world. Think of the hordes of lemmings that at intervals appear in northern Europe, and move through the land devastating the farmers' crops, till they reach the sea, into which they plunge and are drowned. Ships are said to sail at times through miles of lemmings, swimming they know not whither.

Behold the birds building their nests in spring; how absorbed, how persistent they are! How almost impossible it is to defeat or discourage them! Any one who has tried to prevent English sparrows from breeding on his premises soon learns what a difficult task he has undertaken. Equally, any one who charges himself to see to it that no burdocks or red-root, or other troublesome weeds, mature their seeds on his farm or about his grounds, finds out what enterprise and hardihood he is trying to thwart. Cut the plebeian burdock down within a few inches of the ground and keep it cut down, shorn of all its big leaves, and yet in August or September, without the support of any foliage, it will push out and develop burs in the axils of its old leaves. I have seen masses of burs thus form about the stem half as large as one's fist. The plant was making a last and supreme effort to perpetuate itself. Most garden weeds behave in the same way. As the summer nears its end, and their earlier efforts to form seeds have been thwarted, they seem to become alarmed, and to make a last heroic effort, probably drawing upon the last grain of material stored in the root and stalk to develop the precious germ.

Fruit-trees, starved or in an unhealthy condition, seem to be seized with the same alarm and overload themselves with small, inferior fruit. Is it not notorious that men and women suffering from certain slow, wasting diseases are exceptionally prolific? On the other hand, plants and animals overfed or exceptionally prosperous seem to forget the primal command.

The birds, I repeat, are not easily discouraged. In April of the past year a pair of phœbe-birds built their exquisite mossy nest in a niche in the rocks at the entrance to my natural cellar at Slabsides. It was a nest in the best style of the phœbe's art, built unhurriedly, as all first nests of the season usually are. Like the plant, the bird does not hurry till the season gets late. One snow-white egg was laid, when, on a visit to me of some schoolboys, the nest accidentally came to grief; it was detached from the rock upon which the bird had so carefully masoned it. I replaced the nest, but its foundations had been loosened, and the winds dislodged it. The phœbes then began a nest on a timber under the little shed. One day I found this dislodged and its material pulled apart on the ground beneath. Who or what Vandal or Hun of the woods did it, whether a red squirrel or an owl or other violator of its neighbor's rights, I know not. But the phœbes did not lose heart. When I discovered the second calamity that had befallen them, they were already at work building the third nest, and — what was very unusual — were using the material of the nest just destroyed. Bit by bit the mother bird was gathering it up and reconstructing her "procreant cradle." I hoped a third disaster would not befall the pair, and it did not, but if it had, not later than June, they would probably have built still another nest. The phœbes usually rear two broods in a season when all goes well with them. It is to build the nest and rear the young that they have made the long and hazardous journey from our Southland, or even from Central America, and it is this that will cause them to make it every spring as long as they live. It is this that impels myriads of other small birds and water-fowl to make the same trip from the Far South, braving storms and winds and other perils by land and sea. To beget progeny that will in time reproduce themselves is the unconscious and unquenchable motive that actuates them all. This same motive impels the golden plover to make its marvelous flight from the plains of Patagonia to the Arctic Circle in Alaska, a distance of nearly half the circumference of the globe, crossing oceans without a rest. It sends the European migrants across the Mediterranean from Africa to France, many of them so fatigued on reaching land that they fall an easy prey to man and beast.

It is the impelling force of this motive or instinct that sends the fish up the streams and rivers in the spring, making the waters alive with denizens from the sea, impelling the salmon to leap falls, or, failing to scale them, to keep up the effort till they die from exhaustion. The breeding-instinct is the ruler of life. It asks no questions, it requires no guarantee, it pauses at no obstacles. It sends races of men and animals to seek new lands; it fills nations with the desire for expansion, kindles in them the earth-hunger, and is often the chief factor in devastating wars.

In man the sexual passion is stronger than all others; it rules his life, it has made his history. Consciously or unconsciously, he lives for his posterity. He wages wars to plant colonies or to conquer territory from his enemies, in which his race may expand and increase. His eye is ever on the future; he is looking out for his children and his children's children. Nine tenths of the life of woman centres around the idea of making herself attractive to the opposite sex. This is the meaning of all the modes and fashions — of the monstrous hats, the hobble-skirts, the preposterous shoes, the paint, the jewelry, the feathers, the frippery and the furbelows, the immodest exposures, the exaggerations and accentuations, and all the bewildering arts and devices by which woman seeks to enhance her feminine charms.

The social dances, old and new, though the participants may be all unconscious of it, are as literally sexual, and have as direct reference to the old command to be fruitful and multiply and replenish the earth, as do the dances and aerial evolutions of the birds and the wild fowl. Fine clothes, like fine feathers, all point in the same direction. Male pride and female pride do not differ in their genesis or natural history from the pride displayed in barnyards and in the fields and woods — it is all the outcome of the old command to increase and multiply — it is the masterful desire of one sex to make itself attractive to the opposite.

A great number of insect forms die as soon as they have fulfilled the Biblical injunction. This is true of all the ephemera, and at least one form of vertebrates, the lampreys; these perish as soon as they have spawned.

The cockchafer dies in a month after completing its metamorphosis. The seventeen-year locusts and the grasshoppers live but a short time after they have deposited their eggs. Nature has no further use for them. Many of the moths deposit their eggs within twenty-four hours after they escape from the chrysalis-case, and then very soon die. Many kinds of flies live only four or five hours — just long enough to lay their eggs. As soon as a drone of the hive-bee has fertilized the queen, the swarm has no further use for the whole tribe of drones and they are mercilessly killed or expelled from the hive. Nature displays the same superabundance of the fertilizing principle in such cases that she does in the trees and plants that cast their pollen upon the wind. This is to offset the element of chance. The services of only one drone is required, but the swarm develops scores of them to make sure that at least one male may meet the queen while she is coursing at random on her nuptial flight through the upper air.

Speaking of the queen of the hive-bee reminds me how literally the life of the hive revolves around *her*. The queen's moral support of the swarm, so to speak, is vital. If any accident befall her, in the case of a new swarm before it has established itself, the whole mass of worker bees instantly becomes demoralized; the swarm loses heart, and gradually perishes without making any attempt to start a new colony. The members seem to know instinctively that there can be no increase, and that their own lives are worthless.

I have seen the whole swarm, when it was suddenly discovered that the queen was missing, show the greatest agitation, every individual insect rushing about with quivering body and wings, in a panic of alarm. What one bee knew and felt, apparently the whole swarm knew and felt simultaneously.

It is worthy of note that though it costs the drone his life to fertilize the queen, dozens of them course through the air during the period that the mating-flight of the queen is due to take place, ready to sacrifice themselves in performing this duty. Alike with drone, worker, queen, the paramount instinct is the perpetuity of the race.

So careless of the male of most species is Nature, so solicitous for the well-being of the female! The function of the male is a brief one, that of the female a long and hazardous one. Among birds of prey the female is the larger, the bolder, and the more active. The parental instinct seems much stronger in her than in the male.

The breeding-instinct has developed among the birds, especially among the ground-builders, one of the most surprising traits or practices to be found in all animate nature. I refer to the tricks and the make-believe that birds will resort to in order to decoy one away from their nests or their young — feigning lameness, paralysis, suffocation, anything to fix the attention of the intruder upon the mother and lure him away from her precious eggs or young. I can recall nothing else so extraordinary in the whole range of animal instinct. The bird suddenly becomes a consummate actor and plays a rôle she probably never played before, and plays it in the best style of the art. Her behavior looks like the outcome of a sudden process of reasoning. "This creature," it seems to say, "wants my brood, but I will make him want me, and forget the brood. To do so, I have only to throw myself in his way and offer him an easy victim. By my feigned disablement I can draw him on and on, while my young hide, or the clue to my nest is lost."

Last spring in a low, wooded bottom in Georgia, my friend and I started a woodcock from her nest, in which were three eggs. The bird flew a few yards, at a height of ten feet or more, and then suddenly doubled up and fell fluttering to the ground, precisely as if she had been shot. It was a surprising performance. It is highly probable that it was the first time she ever did the trick, but she did it to perfection. Had we followed her, doubtless she would have given us another exhibition of her art of make-believe.

Strange to say, after all her concern for the safety of her eggs, the bird deserted her nest. My friend suggested that it was because we touched one of her eggs; but, as birds have little or no powers of smell, this reason seems inadequate. Rather am I inclined to believe that some accident befell the bird.

Equally surprising is it to see this stupid-looking mud-prober transformed into an ecstatic song-bird under the influence of the mating-instinct. Whoever has witnessed its hurried spiral flight in the March and April twilights, and heard its curious smacking, gurgling notes rain down out of the obscurity of a couple of hundred feet of air, has been present at one of the surprising incidents in the life of this bird.

Love not only makes the songless woodcock vocal; it puts a new song into the throats of many of our birds. The oven-bird, the meadowlark, the purple finch, the goldfinch, and certain of the sparrows and warblers are keyed up to the point where the flight-song, or song of ecstasy, is the natural expression of the bird soul. The jays and crows also become musical, and the woodpeckers drum in varying keys on the resonant limbs. This marked contrast between their ordinary tones and their love-songs reminds one of Browning's lines: —

> "God be thanked, the meanest of his creatures
> Boasts two soul-sides, one to face the world with,
> One to show a woman when he loves her!"

In the vegetable world the males of diœcious plants perish as soon as the period of bloom of the females, or pistillate plants, has passed. Our spring plant called mouse-ear and everlasting (*Antennaria*) is a familiar example. The two sexes are in separate groups, and show a marked difference in their appearance. The pistillate plants have a feminine look, they are more slender and graceful, and show more color; they differ in looks from the males as much as the queen bees differ from the drones. The males are short, stubby, freckled, and after they have shed their pollen they wither and perish, while the females continue to develop and grow in grace and beauty till their seeds are matured. The same is true with all shrubs and trees — hazels, chestnuts, oaks, beeches — which develop their pollen in catkins or aments; as soon as the pollen is shed upon the inconspicuous flowers the catkins wither and fall.

There is no case of love and mating among the plants more pleasing to me than that of our Indian corn. When I see the male blossom push its panicle up out of the top of the stalk, bold, rigid, conspicuous, rustic-looking, — "topping out," as the farmers say, — and then, following down the stalk with my eye, see among the leaves the female blossom timidly putting out her delicate silk fringe, like a lock of greenish-golden hair, — one tender thread for each kernel of corn that is to be, — and awaiting the caresses through the agency of the wind of her suitor above, I am witnessing one of the most pleasing illustrations of Nature's great law that is to be seen in our fields and gardens.

In the case of no other tree in our Northern forests does the male principle assert itself so conspicuously as in the chestnut — a tree that now, alas! seems in danger of extinction from some obscure fungus disease attacking its inner bark. In early summer its masses of creamy-white staminate flowers make the top of the woods gay, while its small, modest, greenish female flowers are seen only by him who closely searches for them. But the gala day of the males is brief, while the obscure mother-bloom goes forward and develops her polished triple nuts of autumn.

The odors of the blooming corn and blooming chestnut in some way suggest fruition and the sex passion.

In the hazel, masculine and feminine contrast in the same way as in the chestnut. The long, showy, pollen-yielding tassels are seen from afar, but the minute crimson stars of the nut-producing flowers you will not see without close inspection. Thus do sex characteristics run throughout organic nature. Whitman speaks of the sexuality of the earth, having in mind, no doubt, its fertility and the passive feminine relation it sustains to the orbs above.

Truly the breeding-instinct, with the whole train of subsidiary instincts that go with it, is close to Nature's heart, closer than the instinct of self-preservation. Life is conserved only that it may produce more life. In the insect world, certain forms utterly exhaust themselves in the art of reproduction; others in the act of providing housing and food for their unborn offspring. The May-fly develops into winged liberty, experiences the love-festival, deposits its eggs, when both sexes die, all within the compass of a few hours. Of some species of thread-worms it is said that "the young live at the expense of the mother till she is reduced to a mere husk." Fabre tells us of a species of dung-beetle the male of which scours the fields for food for the young, which he carries home and, with his trident, reduces to a powder, till, after the labor of months, without nourishment himself, he becomes utterly exhausted and dies.

In eating up her lover after he has served her purpose, the female spider seems to be carrying domestic economy to unwarranted lengths. Yet generation after generation of male spiders court the female, though often with obvious signs of hesitancy and trepidation. Love overcomes the lover's fear of the ferocious jaws of his mistress. The same is true of the praying-mantis and the scorpion, as portrayed by the inimitable Fabre. After hours or days of love and nuptial bliss, the female turns and slays her lover, and makes a meal off him. The human, or, rather, inhuman, Bluebeard is matched on the other side of the house. Love and martyrdom go hand in hand with honey-bees, spiders, and scorpions. Eating up your mate is certainly a simple and primitive way out of matrimonial difficulties.

Is it not probable that in all such cases the female obtains some nutritive element, maybe in minute quantities, from the body of the male that is necessary for the complete development of her young? The purpose of Nature must be served in some way in such a tragedy, as it is when certain species eat the placenta and when the toad devours his cast-off skin.

Weismann has suggested that the bodies of animals are but appendages to the immortal chain of sex cells — they are only the vessels in which the precious germs are nourished and conveyed, the body bearing the relation to them of host to parasite.

So solicitous is Nature for the well-being of the offspring that she will rob the mother's body, if insufficiently nourished, to feed the baby she is carrying in her womb. If the laying hen is not properly supplied with lime material, Nature will draw it from the bones of the hen herself to build the shell of the egg. The offspring is first always, and has the right of way over all else. In short, the struggle to live in the whole organic world resolves itself into the struggle to have and to rear offspring. This is

> "the one divine event
> Toward which the whole creation moves."

IV

DAME NATURE AND HER CHILDREN

WHEN I saw a chipmunk going by my door, busily storing up his winter supplies in his den in the bank a few yards below, I thought how curious it is that these wild creatures, thrown entirely upon their own resources in the great merciless world of wild nature, with no one to care for them or advise them, should get on so well, and apparently have such a good time of it. I was, of course, looking at the subject from the human point of view; and I could not help thinking how many appliances, how much science, how much coöperation, and what laws and government, and the like we all require in order to live out our lives as successfully as the wild creatures do.

In summer and winter, in storm and cold, in all seasons and in all places, by night as by day, without organization, or power of reason, or supervision, or leaders, or defenders, or government, or schools, or churches, there they go, well and happy, equal to all, or nearly all, emergencies, and making fewer mistakes than we human beings do. Think of our elaborate helps and conveniences; of our machinery for taking us abroad, or for preserving us at home;

of our laid-up stores; and then think how unequipped are the wild creatures in comparison.

Look at the snow buntings in winter, so triumphant over storm and cold, or the tiny chickadees in the frozen winter woods. They know where to look for their food, what to do by day, and where to go by night. They know their enemies; they know where and how to build their nests, and how to rear their young; they know all they have to know in order to live their lives.

When I see a chickadee or a kinglet come to the bit of suet that I put out on the trunk of the old maple in front of my window in December, I say, "See that infant! How can he face all alone the season of scarcity and cold?" But he does not need coaching from me; he avails himself of my suet, but he would get on without it. He is wise in his own economies. I doubt that our winter birds ever freeze or starve, unless in extraordinary circumstances.

When I see a band of robins in late October disporting in my vineyards, filled with holiday cheer and hilarity, calling, singing, squealing, pursuing one another like children in some sort of game, apparently not at all disturbed by the approach of the inclement season and the failure of their food-supplies, I almost envy them their felicity. They are wise without reason, happy without forethought, secure without rulers or safeguards of any sort.

When a Cooper's hawk makes a dash among them, their mirth turns to terror, but they are usually equal to the emergency, and by darting through the vines they manage to escape him.

It is said that when a flock of mallards, or of black ducks, while feeding upon the water, see an eagle, or a certain large hawk coming, they take to wing, knowing that they can outdistance their enemy, but that when they see a duck hawk coming, they hug the water the closer, knowing well that their safety is not in flight, but in diving beneath the surface.

What ages upon ages of schooling in the fierce struggle for existence it must have taken the wild creatures to get their wisdom into their very blood and bones! Yet we cannot think of them as existing without it; we cannot go back in thought to the time when they did not have it; to be without it would be to cease to exist. What, then, is its genesis? We cannot think of man as existing without his reason, his tools, his artificial aids of one kind and another; yet there was a time when he did exist without them, just as the monkeys and anthropoid apes exist without them. Sufficient for the day is the wisdom thereof. Every stage and phase of animal life is wise in those things necessary for its continuance, but whether that wisdom comes from experience or inheritance, or is one phase of the wisdom that pervades the whole economy of nature, — that makes the heart beat and the eye see, and that adapts every organism to its environment, — who can tell?

The plants are all wise in their own way; they have to be, or cease to exist. The cultivated ones cannot shift for themselves like the weeds and wild growths; they have been too long dependent upon the care and culture of man for that; thrown upon their own resources, they perish, or else revert to the habits of their wild ancestors, as the animals do.

I suppose it is impossible for us to conceive of the discipline, the struggle, the schooling, the selection, that all species of animals and plants have gone through in the course of biologic time, and that has given them the hardiness, the hold upon life, that they now possess. The strongest, the cleverest, the fittest have always had the best chance to survive. Natural competition has constantly weeded out the feeble, and still does so; but it does not do it so thoroughly among men as among mice, because mice have no medicine, no surgery, no hospitals, no altruism.

Different species of animals and plants differ greatly in their power to get on in the world. The ruffed grouse, for example, has a much deeper hold upon life than his cousin the quail, mainly because he is a more miscellaneous feeder. In deep snows the quail is in danger of perishing for want of food, but the grouse takes to the tree-tops and subsists upon the buds of the birch, the apple, and other trees.

The flicker will thrive where other woodpeckers would starve, because he is a ground-pecker as well, and lives upon ants and other ground insects.

In the struggle for existence the red squirrel is more than a match for his big brother, the gray, because he is more energetic, and has a wider range of diet. When hard put, he will come to your orchard and garden and chip up the unripe apples and pears for the immature seeds in them; he will cut out the germ from the green elm-flakes; he will rob birds' nests of eggs and of young; he will find or cut his way into your house and barn, and will take toll of your crops in a way that the gray squirrel will not do; on the other hand, his lesser brother the chipmunk will survive him, because he regularly lays up winter stores in his den in the ground, and is snug and warm with a full larder, while the red squirrel is picking up a precarious subsistence in the cold, snow-choked woods. The bear lasts after the wolf is gone, because he is a miscellaneous feeder, and is rarely reduced to extremities. For the same reason the hawk starves where the crow thrives. If the crow cannot get flesh, he will put up with fruit, and grain, and nuts.

The flycatchers among our birds are far less numerous than the fruit- and seed-eaters, and the herbivorous and graminivorous mammals greatly exceed in numbers the flesh-eaters; they can get their food more easily, for they do not have to use speed, wit, strength, or prowess in order to obtain it. How rare are the weasels, compared with their prey of rats and mice and birds and squirrels and rabbits! Yet the weasels have goodly families each season. If man had not been a miscellaneous feeder, could he have overspread the earth as he has done? If an animal can eat only fish, it must keep near the water; if it can eat only nuts, it must keep near the woods; if it subsists upon mosquitoes, it must live near the marshes; if grass is its only diet, its range is limited to certain zones and certain seasons.

The farmer finds it much more difficult to check or exterminate certain plants or weeds than others. The common milkweed and the Canada thistle defy his plough because the parent roots are beyond its reach; they creep horizontally through the soil, and send up their shoots at short intervals. To exterminate the plants, you must remove the parent roots. Looked at in the light of the doctrine of natural selection, it would seem as if these two plants had learned through experience to avoid the plough by diving deeper into the soil and establishing permanent parent roots there. This method or habit baffles the plough completely. What other enemy or circumstance could have so driven them into the ground? In a region unvisited by the plough, would they not succeed just as well nearer the surface, or with only a tap-root like most other plants? This habit is doubtless much older than the plough, and it is very doubtful if the explanation can be found in the theory of natural selection. Quack-grass is baffling for the same reason; there is a family root that travels horizontally under the soil and sends up shoots all along its course; dig out a yard of it, and yet if you have left an inch, the plant renews itself. The chickweed is a wonderfully enterprising plant. It is one of the very first to start in business in the spring; it begins to bloom in March or April; it matures its seeds rapidly, and keeps on blooming and seeding nearly all summer, so that it outwits the most industrious hoe or plough that I have yet seen. Unless you catch it in the first blooming, it gets ahead of you.

The field veronica is an innocent weed, but its ability to get on in life is remarkable. It stole into our vineyards like a thief in the night; where it came from I have no knowledge; for twenty years there was no vestige of it; then suddenly it appeared, and rapidly overspread the surface of the ground. It blooms in April, and by the time the plough starts, a sheet of delicate blue hovers over all the vineyard-slopes. It is a low plant, only an inch or two high, and the plough wipes it out completely; but the next spring there it is again, thicker than ever, painting the ground in the most delicate cerulean tints; it matures some of its seeds each spring before the plough starts, and so is secure.

Sooner or later animals and plants learn to play the game of life well; if they fail to do so, they ultimately become extinct.

V

OLD FRIENDS IN NEW PLACES

LAST winter and early spring in central Georgia I had great pleasure in the little glimpses of wild life, mostly bird-life, that I got from the windows of the cabin study which my friend built for me in one corner of an old unused building situated in a secluded place near a bushy spring run and a grove of pine- and oak-trees. Many of our more northern birds — such as song sparrows, bluebirds, juncoes, and white-throats — winter in Georgia and impart a sort of spring air to the more secluded places at all times. The mockingbird, the brown thrasher, the cardinal, the meadowlark, the crested titmouse, the Carolina wren, the blue jay, the downy woodpecker, and a few others are there the year round.

February in Georgia is like April in New York or New England, and March has many of the features of early May. In late February or early March the red maples are humming with honey-bees and the elms are beginning to unpack their floral budgets.

The sparrows — white-throats and song sparrows — were at home in the weedy and bushy ground around my little hermitage, and I soon encouraged them to come under my window by a plentiful sprinkling of finely cracked corn and bird-seed. They were always very shy, but they soon learned to associate me with the free lunch, so that, very soon after my appearance, — about nine o'clock in the morning, — they would begin to gather from the near-by coverts, one to two dozen white-throats, with four or five song sparrows, and now and then a female chewink. The chewinks remain there the year round, but the song sparrows and the white-throats, like myself, were only there for a season.

By easy stages from one covert to another, traveling mostly at night, the birds were soon to begin the return journey northward. I think the same birds lingered with me day after day, though one cannot be sure in such a matter. The individual units in a stream of slowly passing birds of the same species do not differ from one another in appearance any more than do the separate ripples in a stream of flowing water. Outside of man's influence, the individuals of a species of wild creatures or wild flowers do not seem to differ from one another by as much as one hair or one feather or one petal. They are like coin stamped with the same die, and the wonder of it is that each and all, among the birds, at least, seem like new coin — not one blurred or imperfect impression. This fact always strikes one in gazing upon a flock of wild birds of any kind in the fall or in the spring. The wear and tear of life seems to leave no mark upon them. Take a hundred snow buntings in winter, or robins or bluebirds in the spring, and each individual seems up to the standard of its kind. Indeed, Nature has standardized them all.

Among the song sparrows and white-throats that gathered for their daily lunch under my window, I noted differences between male and female and between old and young, yet each individual seemed at the top of its condition. How free from spot or blemish they were, not one disheveled or unkempt, not one vagabond or unfortunate among them. How neatly groomed they were, every feather perfect and every feather in its place. How bright and distinct the pencilings of the song sparrows' backs! The surplices of the white-throats had just come from the laundry. Among all the wild creatures it is the same. Nature deals evenly and impartially with them. They differ markedly in this respect from birds and mammals under domestication. A brood of newly hatched chickens are fresh and clean enough, but they very soon deteriorate in appearance; but a brood of young grouse or quail keep as clean and bright as shells upon the beach. Then consider the chipmunks and red squirrels — how rarely is one of them below the standard of its kind! how rarely one shows any indication of hard luck, or a loss of standing among his fellows! None are poor; all are equally prosperous. Success is written on every one of them. Rarely is a single hair out of place.

How wise the white-throats are about cracked corn, taking nothing above a certain size! They pick up the larger pieces and test them with their beaks and drop them, then pick them up and feel them again to be quite sure they have made no mistake. Their little gizzards cannot grind the flinty corn except when taken in very small bits. The fruit- and insect-eating birds that sometimes come about your door in winter or spring with the white-throats will examine the seeds and bits of corn, but will not eat them. One February a flock of white-throats and juncoes came daily to the dooryard of a friend of mine near New York City. She sprinkled the ground with rolled oats and hominy grits and her visitors made the most of her bounty. One morning there was a newcomer — a thrush evidently hard put for food. He hopped about amid the feeding sparrows with drooping wings, picking up the seeds and grains and dropping them again, apparently wondering what the others found that was so appetizing. The bird was in desperate straits; he ate the snow, but I fancy it only aggravated his hunger.

The newcomer turned out to be a hermit thrush. I told my friend to take any dried fruit she happened to have — raisins, dried currants, dried cherries, or dried berries, and cut them up and sprinkle them among the seeds. She did so, and it was not long before the thrush began to examine them and taste them doubtingly, but very soon he was eating them. That afternoon his drooping wings were getting back to their normal place, and in a day or two he was a changed bird, brisk and bold, domineering over the other birds, — in a very courteous way, however, — and very much set up in life.

A bird never appears emaciated; it will starve and retain its plump appearance. Robins will famish amid a world of seeds and grains. They must have fruit or worms. Three years ago, while spending the winter in Georgia, I had evidence that a vast number of robins starved to death in March. People picked them up in their yards and in the fields and along the edge of the woods. They seem to have started north from Florida and the Gulf States too soon. A sudden cold snap kept the worms and insects below the surface of the ground, and there was no fruit but the white, dry china-berries, and these appear to poison or to paralyze the robins when they eat them. In my walk one morning I picked up a cock robin that was unable to fly. As it did not appear to have been injured in any way, and was of very light weight, I concluded it was starving. I took it into the house and let it perch on the back of a chair in the study. It showed little signs of fear and made no effort to escape. I dug a handful of earthworms, and dangled one of them before its beak. After eyeing it a moment it opened its beak and I dropped the worm into its mouth. Others soon followed, and still others. The bird began to wake up and come to itself. In a little while it was taking the food eagerly and without any signs of fear. I could stroke it with one hand while I fed it with the other. It would sit on my knee or arm and take the food that was offered it. I was kept pretty busy supplying its wants till in the afternoon it began to fly and to run about the room and utter its call-note. Before night it had become so active and so clamorous for its freedom that we opened the window. With a dash and a cry it was out of the house and on the wing to a near-by tree. I trust, with the boost I had given it, it was soon safely on its northward journey.

The incident shows how extreme hunger in a wild creature banishes fear. One March day, when I was a boy, I found a raccoon wandering about the meadow so famished that he allowed me to pick him up by the tail and carry him to the house. He ate ravenously the food I offered him.

The struggle for life among the birds and other wild creatures is so severe that the feeble and malformed, or the handicapped in any way, quickly drop out. Probably none of them ever die from old age. They are cut off in their prime. A weeding-out process goes on from the time they leave the nest. A full measure of life, the perfection of every quill and feather, and unerring instinct carry them along. They are always in the enemy's country; they are always on the firing-line; eternal vigilance and ceaseless activity are the price of life with them. The natural length of life of our smaller birds is probably eight or ten years, but I doubt if one in a thousand reaches that age. Not half a dozen times in my life have I found the body of a dead bird that did not show some marks of violence.

Next to the trim, prosperous, well-dressed appearance of a flock of wild birds, one is struck with their caution and watchfulness, not to say nervousness, at all times, especially when feeding in the open. My band of sparrows were apprehensive of danger every moment. Here are some notes made on the spot: —

Now there are over two dozen sparrows, among them a solitary female chewink, feeding on the ground in front of my window. An ever-present fear possesses every one of them. They pick up the seeds hurriedly, looking up every few seconds. Suddenly they all stop, and, crouching, look toward the near-by weeds and bushes. Some vague alarm has seized them. Then two of them dart away; then the whole flock rushes to cover. I see no cause for the panic; there is none; the strain has become too great to be longer borne. Though no danger is near, yet their instinct, developed and sharpened by the experiences of untold generations, tells them danger might be near — a hawk, a cat, or other enemy — and that safety demands a frequent rush to cover. After a few minutes they return, one by one, flying from weed-stalk to weed-stalk, and dropping upon the ground where the seed is scattered, with many a suspicious flip of wing and flirt of tail. A dozen or more are soon hurriedly feeding again, now and then running spitefully at one another, as if the aggressors felt a prior claim, but not actually coming to blows.

When the dry grass and weeds cover the seed a song sparrow may be seen now and then executing a quick movement upon it with both feet, a short double jump forwards and backwards. This is the way the sparrow scratches — a crude and awkward way, certainly. She has not yet learned to stand alternately upon one foot and scratch with the other, as do the hen and all other true scratchers, and she probably never will. The sparrows, and many other birds, move the two feet together. They are hoppers, and not walkers or runners. Such birds make a poor show of scratching. The chewink scratches in the same way, but being a much larger bird, she rakes or kicks obtruding weeds about quite successfully.

In less than two minutes the birds again take the alarm and dart away to their weedy refuge.

This is the habit of all birds that feed in numbers in this way in open places. Snow buntings, juncoes, sparrows, reed-birds, blackbirds — all are haunted by a vague sense of impending danger when they are feeding, and are given to sudden flights to cover, or to circling in the air.

I remember that the flocks of passenger pigeons that I used to see in my youth would burst up from the ground when they were feeding, at short intervals, in the same sudden, alarmed way. It is easy to see how the fear of all ground-feeders has become so developed and fixed. Hawks are doubtless the main cause of it. The hawk comes suddenly and strikes quickly, and is doubtless as old an enemy as the birds have. For ages he had been wont to swoop down from the air or from the cover of a tree, or has skimmed over the hill and in a twinkling snatched a feeding bird. I have seen the sharp-shinned hawk in winter sweep over a garden fence and snatch an English sparrow from a flock feeding in the street. I have seen one of the smaller hawks pick up a high-hole feeding in the fields in the same way. Birds feeding singly are less easily alarmed than when feeding in flocks, just as you and I would be. Fear is contagious, and a bird feeding alone has no alarms or suspicions but its own to disturb it.

Since these birds left Canada and northern New England last October they have probably traveled over two thousand miles, beset by their natural enemies at all times and places — in fields and marshes and woods; in danger of hawks and shrikes and cats by day, and of owls and other prowlers by night; compelled to hustle for food at all times, and to expose themselves to a thousand dangers. Is it any wonder that they are nervous and watchful?

In returning they will be exposed to the same dangers. Their traveling is mostly done by night and it is probably by easy stages. But just how long any single flight is we have no accurate means of knowing. It would be interesting to know if the song sparrows and juncoes traveled in company with the white-throats, as they are usually found together by day. If they do, the song sparrows would begin to drop out of the procession by the time they reached the Potomac, and continue dropping out more and more all through New York and New England, but some of them keeping on well into Canada. The juncoes would begin to drop out in the Catskills, where they breed, and a few white-throats may do so likewise, as I have found them in midsummer in some of the higher regions of these mountains.

Fear and suspicion are almost constant companions of most of the wild creatures. Even the crow, who has no natural enemies that I know of, is the very embodiment of caution and cunning. That peculiar wing-gesture when he alights or walks about the fields — how expressive it is! It is a little flash or twinkle of black plumes that tells you how alert and on his guard he is. It is a difficult problem to settle why the crow is so suspicious and cunning, since he has few or no natural enemies. No creature seems to want his flesh, tough and unsavory as it evidently is, and we can hardly attribute it to his contact with man, as we can the wildness of the hawk, because, on the whole, mankind is rather friendly to the crow. His suspicion seems ingrained, and probably involves some factor or factors in his biological history that we are ignorant of.

On the whole, it is only the birds and animals which are preyed upon that show excessive caution and fear. One can well understand how the constant danger of being eaten does not contribute to the ease and composure of any creature, and why these which are so beset are in a state of what we call nervousness most of the time. Behold the small rodents — rats, mice, squirrels, rabbits, woodchucks, and the like; they act as if they felt the eyes of the mink or the weasel or the cat or the hawk upon them all the time.

Among the birds some are much more nervous and "panicky" than others. The woodpeckers are less so than the thrushes and finches; the jays less than the starlings and the game-birds. The seed-eaters and fruit-eaters are probably preyed upon much more than the purely insectivorous birds, because doubtless their flesh is sweeter.

Birds of prey have few enemies apart from man. Among the land animals we ourselves prefer the flesh of the vegetable-eaters, and the carnivora do the same. We all want to get as near to the vegetable as we can, even in our meat-eating.

The birds, even the prettiest of them, are little savages. In watching from my window the feeding white-throats and song sparrows, I cannot help noticing how ungenerously they behave toward one another — apparently not one of them willing to share the feast with another. Each seems to think the food his or her special discovery and that the others are trespassers. They charge spitefully upon one another, but rarely come to blows. Just what makes one give way so readily before another, without any test of strength, is a puzzle. Is the authority in the eye, in the bearing, or is it just a matter of audacity and self-assertion? There may be timid and retiring souls among the birds as well as among other folk. I am inclined to think that usually it is the males bullying the females. Occasionally two males, known by their more conspicuous markings, confront each other and rise in the air a yard or two, beak to beak, and then separate.

During the mating season there is mutual aid and coöperation between the sexes, the male bird often feeding the female. But at other times there is little friendliness, certainly no gallantry. The downy woodpecker in winter will drive the female spitefully away from the bone or the suet on the tree in front of my window till he is first served. I have never seen crows quarrel or strive with one another over their food. On the contrary, if the crow discovers food in winter, he seems glad to be joined by a companion or several of them. The crow is a generous bird; he has the true social instinct. He will watch while his fellow feeds; he cheerfully shares his last morsel with a comrade. How different from any of the hawk tribe! A farm-boy living near me brought up four young sparrow hawks in a cage. They were as jealous of one another over their food as cats are, and when they were nearly full-grown, and the food was insufficient, they proceeded to devour one another. I kept two of the survivors a few days, but they were so utterly cruel and savage that I was glad to let them escape.

Most of our rodents are as free from guile as our birds; they have none of the subtlety and cunning of their enemies the fox and the wolf; they are simply wild and shy. The rabbit has little wit, yet she manages to run the gantlet of her numerous enemies. Some of her arts of concealment are as old as mankind — the art of hiding where no one would think of looking — concealment where there is little to conceal her. One March day I started a rabbit from her form in a broad, open cultivated field. She had excavated a little place in the soft ground just deep enough to admit the hind part of her body and there she crouched in the open sunlight with only a little dry grass partly screening her. When I was within two paces of her she bounded away like the wind and directed her course toward a bushy ravine several hundred yards away. The advantage of her position was that she commanded all approaches; nothing could steal a march upon her, and she could flee in any direction. In a tangle of weeds or bushes she would have been where every one of her natural enemies prowl or beat about, and where concealment would have been more or less confinement. A few yards farther along I came upon another vacant form — the perfection of art without any art. When the rabbit builds her nest and has her young she does not seek out a dense cover, but comes right out into the clear open spaces where you would never think of looking. She excavates a little cradle in the ground, gathers some dry grass, weaves a little blanket of dry grass and fur from her own body, just large enough to cover it, and her secret is well kept — most hidden when hidden the least. Quail and grouse know something of the same art, and never make their nests in a thick tangle. I have seen a quail's nest with twenty eggs in it on the edge of a public highway. The brooding bird allowed me almost to touch her with my hand before she flew away.

If every bushy and weedy spring run in Georgia embracing not more than an acre or two of ground has two dozen sparrows, to say nothing of a pair or two of cardinals, Carolina wrens, and mockingbirds, one can get some idea of what a vast number of birds such a large State — over three hundred miles long and two hundred miles wide — holds. With two pairs of birds to the acre, a fair estimate, it would count up to over seventy millions. The farm of about one hundred and thirty acres upon which I passed February and March probably held several dozen sparrows and as many juncoes, a score or two blue jays, and two or three dozen meadowlarks, a pair each of cardinals, Carolina wrens, and brown thrashers, besides other birds. In one ploughed field I saw, day after day, ten or fifteen killdee plovers. Their wild cries, their silver sides glancing in the sun, and their long powerful wings were always a welcome sight and sound.

Probably more kinds of birds feed on insects than upon seeds and fruits, though the seed- and fruit-eaters are the more numerous, and abide with us more months in the year. It is true also that the seed-eaters nearly all eat insects at times, and start their young in life upon insect food. One can easily see, then, what an inevitable part the birds play in keeping down the insect pests that might otherwise overwhelm us.

VI
THE STILL SMALL VOICE

ONE summer day, while I was walking along the country road on the farm where I was born, a section of the stone wall opposite me, and not more than three or four yards distant, suddenly fell down. Amid the general stillness and immobility about me, the effect was quite startling. The question at once arose in my mind as to just what happened to that bit of stone wall at that particular moment to cause it to fall. Maybe the slight vibration imparted to the ground by my tread caused the minute shifting of forces that brought it down. But the time was ripe; a long, slow, silent process of decay and disintegration, or a shifting of the points of bearing amid the fragments of stone by the action of the weather, culminated at that instant, and the wall fell. It was the sudden summing-up of half a century or more of atomic changes in the material of the wall. A grain or two of sand yielded to the pressure of long years, and gravity did the rest. It was as when the keystone of an arch crumbles or weakens to the last particle, and the arch suddenly collapses.

The same thing happened in the case of the large spruce-tree that fell as our steamer passed near the shore in Alaskan waters, or when the campers in the forest heard a tree fall in the stillness of the night. In both cases the tree's hour had come; the balance of forces was suddenly broken by the yielding of some small particle in the woody tissues of the tree, and down it came. In all such cases there must be a moment of time when the upholding and down-pulling forces are just balanced; then the yielding of one grain more gives the victory to gravity. The slow minute changes in the tree, and in the stone wall, that precede their downfall, we do not see or hear; the sudden culmination and collapse alone arrest our attention. An earthquake is doubtless the result of the sudden release of forces that have been in stress and strain for years or ages; some point at last gives way, and the earth trembles or the mountains fall.

It is the slow insensible changes in the equipoise of the elements about us that, in the course of long periods of time, put a new face upon the aspect of the earth. Rapid and noisy changes over large areas, which may have occurred during the geologic ages, we do not now see except in the case of an earthquake. It is the ceaseless activity, both chemical and physical, in the bodies about us, of which we take no note, that transforms the world. Atom by atom the face of the immobile rocks changes. The terrible demonstrative forces, such as electric discharges during a storm, which seem competent to level mountains or blot out landscapes, usually make but slight impression upon the fields and hills.

In the ordinary course of nature, the great beneficent changes come slowly and silently. The noisy changes, for the most part, mean violence and disruption. The roar of storms and tornadoes, the explosions of volcanoes, the crash of the thunder, are the result of a sudden break in the equipoise of the elements; from a condition of comparative repose and silence they become fearfully swift and audible. The still small voice is the voice of life and growth and perpetuity. In the stillness of a bright summer day what work is being accomplished! what processes are being consummated! When the tornado comes, how quickly much of it may be brought to naught! In the history of a nation it is the same. The terrible war that is now devastating Europe is the tornado that comes in the peace and fruitful repose of a summer's day. As living nature in time recovers from the destructive effects of the mad warring of the inorganic elements, so the nations will eventually recover from the blight and waste of this war. But the gains and the benefits can never offset the losses and the agony. The discipline and agony of war only fit a people for more war. If war is to be the business of mankind, then the more of it we have the better; if there is no true growth or expansion for a people, save through blood and fire, then let the blood and fire come to all of us, the more the better. The German gospel of war, so assiduously preached and so heroically practiced in our day, is based upon the conviction that there is no true growth for a nation except by the sword, that the still small voice of love and good will must give place to the brazen trumpet that sounds the onset of hostile and destroying legions.

Are the arts of peace seductive, and do they hasten the mortal ripening of a people's character? Must the ploughshares now be forged into swords and the swords used to spill our neighbors' blood? The current gospel of war is the gospel of hate and reprisal, of broken treaties and burned cities, of murdered women and children, and devastated homes.

What a noise politics makes in the world, our politics especially! But some silent thinker in his study, or some inventor in his laboratory, is starting currents that will make or unmake politics for generations to come. How noiseless is the light, yet what power dwells in the sunbeams — mechanical power at one end of the spectrum, in the red and infra-red rays, and chemical power at the other or violet and ultra-violet end! It is the mechanical forces — the winds, the rains, the movements of ponderable bodies — that fill the world with noise; the chemical changes that disintegrate the rocks and set the currents of life going are silent. The great loom in which is woven all the living textures that clothe the world with verdure and people it with animated forms makes no sound. Think of the still small voice of radio-activity — so still and small that only molecular science is aware of it, yet physicists believe it to be the mainspring of the universe.

The vast ice-engine that we call a glacier is almost as silent as the slumbering rocks, and, to all but the eye of science, nearly as immobile, save where it discharges into the sea. It is noisy in its dying, but in the height of its power it is as still as the falling snow of which it is made. Yet give it time enough, and it scoops out the valleys and grinds down the mountains and turns the courses of rivers, or makes new ones.

We split the rocks and level the hills with our powder and dynamite and fill the world with noise; but behold the vast cleavage of the rocks which the slow, noiseless forces of sun and frost bring about! In the Shawangunk Mountains one may see enormous masses of conglomerate that have been split down from the main range, showing as clean a cleavage over vast surfaces as the quarryman can produce on small blocks with his drills and wedges. One has to pause and speculate on the character of the forces that achieved such results and left no mark of sudden violence behind. The forces that cleft them asunder were the noiseless sunbeams. The unequal stress and strain imparted by varying temperatures clove the mountains from top to bottom as with a stroke of the earthquake's hammer.

In and about Yosemite Valley one sees granite blocks of the size of houses and churches split in two where they lie in their beds, as if it had been done in their sleep and without awakening them. This silent quarrying and reducing of the rocks never ceases to surprise one. Amid the petrified forests of Arizona one marvels to see the stone trunks of the huge trees lying about in yard lengths as squarely and cleanly severed as if done with a saw. Assault them with sledge and bar and you may reduce them to irregular fragments, but you cannot divide the blocks neatly and regularly as time has done it.

The unknown, the inaudible forces that make for good in every state and community — the gentle word, the kind act, the forgiving look, the quiet demeanor, the silent thinkers and workers, the cheerful and unwearied toilers, the scholar in his study, the scientist in his laboratory — how much more we owe to these things than to the clamorous and discordant voices of the world of politics and the newspaper! Art, literature, philosophy, all speak with the still small voice. How much more potent the voice that speaks out of a great solitude and reverence than the noisy, acrimonious, and disputatious voice! Strong conviction and firm resolution are usually chary of words. Depth of feeling and parsimony of expression go well together.

The mills of the gods upon the earth's surface grind exceeding slow, and exceeding still. They are grinding up the rocks everywhere — pulverizing the granite, the limestone, the sandstone, the basalt, between the upper and nether millstones of air and water to make the soil, but we hear no sound and mark no change; only in geologic time are the results recorded. In still waters we get the rich deposits that add to the fat of the land, and in peaceful, untroubled times is humanity enriched, and the foundations are laid upon which the permanent institutions of a nation are built.

We all know what can be said in favor of turmoil, agitation, war; we all know, as Goethe said, that a man comes to know himself, not in thought, but in action; and the same is true of a nation. Equally do we know the value of repose, and the slow, silent activities both in the soul of man and in the processes of nature. The most potent and beneficent forces are stillest. The strength of a sentence is not in its adjectives, but in its verbs and nouns, and the strength of men and of nations is in their calm, sane, meditative moments. In a time of noise and hurry and materialism like ours, the gospel of the still small voice is always seasonable.

VII

NATURE LEAVES

I. IN WARBLER TIME

THIS early May morning, as I walked through the fields, the west wind brought to me a sweet, fresh odor, like that of our little white sweet violet (*Viola blanda*). It came probably from sugar maples, just shaking out their fringelike blossoms, and from the blooming elms. For a few hours, when these trees first bloom, they shed a decided perfume. It was the first breath of May, and very welcome. April has her odors, too, very delicate and suggestive, but seldom is the wind perfumed with the breath of actual bloom before May. I said, It is warbler time; the first arrivals of the pretty little migrants should be noted now. Hardly had my thought defined itself, when before me, in a little hemlock, I caught the flash of a blue, white-barred wing; then glimpses of a yellow breast and a yellow crown. I approached cautiously, and in a moment more had a full view of one of our rarer warblers, the blue-winged yellow warbler. Very pretty he was, too, the yellow cap, the yellow breast, and the black streak through the eye being conspicuous features. He would not stand to be looked at long, but soon disappeared in a near-by tree.

The ruby-crowned kinglet was piping in an evergreen tree not far away, but him I had been hearing for several days. With me the kinglets come before the first warblers, and may be known to the attentive eye by their quick, nervous movements, and small, olive-gray forms, and to the discerning ear by their hurried, musical, piping strains. How soft, how rapid, how joyous and lyrical their songs are! Very few country people, I imagine, either see them or hear them. The powers of observation of country people are seldom fine enough and trained enough. They see and hear coarsely. An object must be big and a sound loud, to attract their attention. Have you seen and heard the kinglet? If not, the finer inner world of nature is a sealed book to you. When your senses take in the kinglet they will take in a thousand other objects that now escape you.

My first warbler in the spring is usually the yellow redpoll, which I see in April. It is not a bird of the trees and woods, but of low bushes in the open, often alighting upon the ground in quest of food. I sometimes see it on the lawn. The last one I saw was one April day, when I went over to the creek to see if the suckers were yet running up. The bird was flitting amid the low bushes, now and then dropping down to the gravelly bank of the stream. Its chestnut crown and yellow under parts were noticeable.

The past season I saw for the first time the golden-winged warbler — a shy bird, that eluded me a long time in an old clearing that had grown up with low bushes. The song first attracted my attention, it is so like in form to that of the black-throated green-back, but in quality so inferior. The first distant glimpse of the bird, too, suggested the green-back, so for a time I deceived myself with the notion that it was the green-back with some defect in its vocal organs. A day or two later I heard two of them, and then concluded my inference was a hasty one. Following one of the birds up, I caught sight of its yellow crown, which is much more conspicuous than its yellow wing-bars. Its song is like this, *'n-'n de de de*, with a peculiar reedy quality, but not at all musical, falling far short of the clear, sweet, lyrical song of the green-back. Nehrling sees in it a resemblance to that of the Maryland yellow-throat, but I fail to see any resemblance whatever.

One appreciates how bright and gay the plumage of many of our warblers is when he sees one of them alight upon the ground. While passing along a wood road in June, a male black-throated green came down out of the hemlocks and sat for a moment on the ground before me. How out of place he looked, like a bit of ribbon or millinery just dropped there! The throat of this warbler always suggests the finest black velvet. Not long after I saw the chestnut-sided warbler do the same thing. We were trying to make it out in a tree by the roadside, when it dropped down quickly to the ground in pursuit of an insect, and sat a moment upon the brown surface, giving us a vivid sense of its bright new plumage.

When the leaves of the trees are just unfolding, or, as Tennyson says,

> "When all the woods stand in a mist of green,
> And nothing perfect,"

the tide of migrating warblers is at its height. They come in the night, and in the morning the trees are alive with them. The apple-trees are just showing the pink, and how closely the birds inspect them in their eager quest for insect food! One cold, rainy day at this season Wilson's black-cap — a bird that is said to go north nearly to the Arctic Circle — explored an apple-tree in front of my window. It came down within two feet of my face, as I stood by the pane, and paused a moment in its hurry and peered in at me, giving me an admirable view of its form and markings. It was wet and hungry, and it had a long journey before it. What a small body to cover such a distance!

The black-poll warbler, which one may see about the same time, is a much larger bird and of slower movement, and is colored much like the black and white creeping warbler with a black cap on its head. The song of this bird is the finest in volume and most insectlike of that of any warbler known to me. It is the song of the black and white creeper reduced, high and swelling in the middle and low and faint at its beginning and ending. When one has learned to note and discriminate the warblers, he has made a good beginning in his ornithological studies.

II. A SHORT WALK

One midsummer afternoon I went up to "Scotland" and prowled about amid the raspberry-bushes, finding a little fruit, black and red, here and there, and letting my eyes wander to the distant farms and mountains. The wild but familiar prospect dilated and rested me. As I lingered near the torn edge of the woods in a tangle of raspberry-bushes, I caught a glimpse of some large bird dropping suddenly to the ground from a tall basswood that stood in the edge of the open, where it was hidden from my view. Was it a crow or a hawk? A hawk, I guessed, from its manner of descent. I threw a stone after waiting some moments for it to reappear, but it made no sign. Then I moved slowly toward the spot, and presently up sprang a hen-hawk and, uttering its characteristic squeal, circled around near me and then alighted not far off. A young hawk, I saw it was, and quite unsophisticated. Presently, as I made my way along, just touching the edge of the woods, a covey of nearly full-grown partridges burst up out of the berry-bushes, ten or twelve of them, and went humming up into the denser woods, some of them alighting in the trees, whence they stretched their necks to watch me as I passed along. The dust flew from their plumage as they jumped up, as if they had been earthing their wings.

My next adventure was with a young but fully grown bluebird, which crawled and fluttered away from my feet as I came upon it in the open. It could not fly, and I easily picked it up. Its plumage showed the mingled blue and speckled brown of the immature bird. I looked it over, but could see no mark or sign of injury to wing or body. Its plumage was unruffled and its eye bright, but its movements were feeble. Was it ill or starved? I could not tell which, probably the latter. It may have got lost from the brood and was not yet able to forage for itself. I left it under the edge of a rock, where the fresh blue of the ends of its wings and tail held my eye a moment as I turned to go.

Farther along, under some shelving rocks, I came upon two empty phœbes' nests — a relic of bird-life that always gives a touch to the rocks that I delight in. I find none of these nests placed lower than three feet from the ground, and always in places that seem to be carefully chosen with reference to enemies that can reach and climb.

Two or three woodchucks, which I bagged with my eye, completed my afternoon's adventures.

III. IN SOUTHERN CALIFORNIA

In southern California the seasons all go hand in hand, and dance around one like a ring of girls, first one season, then another in front of you, — Spring, Summer, Autumn, Winter. Now in March I see January on Mt. San Antonio, with wraiths of snow blowing over his white summit against the blue sky. In the valley I see them harvesting oranges and planting their gardens. The camphor-trees are shedding their leaves, and the eucalyptus and other trees are blooming. The oak-trees are shaking out their catkins and resound with the hum of bees. I see calla lilies in bloom four feet high, and wild flowers an inch high just opening. Along the road the wild sunflowers and other tall plants are in bloom, as in August in the Atlantic States. June is in the knee-high grass and oats and blooming white clover, and April in the bursting apple-tree buds and pink peach- and almond-trees, — yes, and in the new furrow and the early planting, — autumn in the golden orange-orchards, and the red berries of the pepper-trees, and the black berries of the camphor-trees. The birds are nesting, the shad are running, and swallows are in the air, midsummer butterflies dance by, and house-flies tease you indoors. I see and hear the white-crowned sparrow that at home I see in May. Spring, Summer, Autumn, and Winter, I say, all nudge you, and claim your attention at once.

During the last ten days of March there were heavy rains with four feet of snow in the near-by mountains. The air was like cold spring-water — full of just melted frost.

"Yesterday friends took us to Claremont, a ride of thirty miles, in their automobile. The day was all sun and sky above, and all fresh green earth below, with a line of snow-white peaks behind dark near-by mountain barriers on the horizon. After a week or more of cloud and rain, how we enjoyed the brightness and the sunshine! Especially did that line of white peaks cut off by that dark mountain wall in front of them draw and hold my eye. Over the top of the highest one, San Antonio, we could see the snow lifted by the west wind and carried high in the air over on the east side. It was like a thin, white flame, swaying, flickering, sinking and falling, but clinging tenaciously to the mountain-peak. Thus have I seen this frost flame stalk across my native hills in midwinter. All the time we were speeding through orange-groves yellow with fruit, along improved lands red with the new furrow, and past wild, unclaimed places spotted with the bloom of many flowers.

I think the bird I most want to take home with me, and establish in our towns and villages, is the blackbird, — Brewer's blackbird, — one of the best-mannered, best-dressed, best-groomed birds I ever saw. He is like a bit of polished ebony moving quietly over your lawn. His coat has the same rich iridescent hues as that of our crow blackbird, and he has the same yellow eye, but he is much less in size and much more graceful in form and movement, and much softer-voiced. Besides, he is a bird of the streets and dooryards, very noticeable everywhere, and, so far as I can learn, has no tastes or habits that incur the enmity of the farmer or the fruit-grower. I pass within a few feet of him and his duller-colored mate walking about the smooth lawns, picking some minute insects from the ends of the grass-blades. This seems to be his chief occupation. Like all blackbirds, these are social and gregarious, and at times, when in flocks, their musical instincts are stimulated. I have heard a band of them in the later afternoon discourse a wild, pleasing music much superior to the crude, harsh cackle and split whistles of the related species with us.

The birds here are abundant both in kinds and in numbers. The white-crowned sparrows are familiar about the houses and the gardens, and they sing most sweetly, but the song is not quite equal to the song they sing along the Hudson for a brief day or two in May. Here they sing for weeks.

The mockingbirds are as common as robins are at home — all about the lawns and gardens and streets, flitting, flirting, attitudinizing, and singing — on the housetops, on the telegraph and telephone wires, on the curbstones, on the lawn. In the face of this bird's great fame as a songster, I wonder why I am so indifferent to it. It pleases me less than do its cousins, the catbird and the brown thrasher. I detect little or no music — sweet tones — in it. It is a series of disjointed quirks and calls, quite surprising as vocal feats, but, to my ear, entirely destitute of real bird melody. It is a performance, the tricks of a vocal acrobat, and not in any sense a serious, unified song. The bird has much less music in its soul, less of the spirit of self-forgetting joy and praise, than has our little song sparrow. I would rather have one robin, or one song sparrow, about my place than any number of "mockers." Indeed, the more "mockers" there were, the less welcome they would be. It is a polyglot, but not a songster.

The mockingbird is a theatrical creature, both in manners and delivery. I have heard it in Jamaica, in Florida, and now in southern California, and I have heard it by night and by day, and I have no good word to say for it. It is a Southern bird and has more the quality of the Southern races than our birds have. Northern birds are quieter, sweeter-tempered, softer-voiced, and more religious in tone.

IV. ARE THERE COUNTERFEITS IN NATURE?

One day my son killed a duck on the river that an old gunner told him was a mock duck. It looked like a duck, it acted and quacked like a duck, but when it came upon the table it mocked us. I now recall that it was a "coot," a species of duck not usually eaten.

The incident led me to thinking whether or not there were really any mock things — any counterfeits in nature — known to me. Some of our wild flowers are named "false" this and that, as false indigo, false Solomon's-seal, false mitrewort, and others; but in designating them thus we are simply slandering Nature and exposing our own ignorance. Other things come to mind that are not what they seem, or what they are popularly called; "cedar plums," for instance, — those yellow fungous growths upon the branches of the red cedar which suddenly develop with the rain and warmth of May or June, and that look like ripe fruit upon the tree. In sun and dryness they soon shrink and wither; on the return of a wet day they are again clammy gelatinous masses. Later in the season they disappear entirely. They are not the work of an insect, but the result of some disease like black-knot on our plum- and cherry-trees. They can scarcely be called counterfeit fruit. The so-called oak-apple bears a somewhat closer resemblance to a genuine fruit. Its stringy texture might be taken for the skeleton of the pulp of the apple. It is a gall caused by the sting of an insect. The oak is made to grow the cell or house in which the young of the insect is hatched and developed. The May apples which children gather from the wild azalea and eat with much relish are also a sham fruit — the work of an insect.

Can we call the infertile flowers of certain plants, like those of the fringed polygala, shams or counterfeits? They seem to exist for show merely, while the fertile flowers are small and upon the roots hidden beneath the surface. What purpose the showy infertile flowers serve in the economy of the plant I am unable to say.

In the Southern States the plough sometimes turns out of the soil a curious vegetable product called "Tuckahoe," or "Indian loaf," that suggests a counterfeit of some sort. It is a brown roundish mass, the size of a cocoanut or larger, whitish within, with a characteristic odor, and it is said to be useful and nutritious in diseases of the bowels. It is thought that the Indians used it as a kind of bread. Its origin is shrouded in mystery. What it springs from, what conditions favor its growth, are all unknown. It is not a fungus, like the truffle, nor a normal vegetable product. It has no cellular structure, as has the potato, for instance, and it contains no starch, but is composed mainly of pectin, which for the most part makes up the jellies of fruit. It is probably the result of degeneration in the roots of some plant.

Among animals shams and imitations are not uncommon. The marsh wren, for instance, often builds several sham, or cock, nests in the reeds surrounding the real nest. These nests seem like the mere bubbling over or surplusage of the breeding-instinct in the male. Many birds, especially ground-builders, feign lameness or paralysis to draw attention to themselves and lure the intruder away from their nests. They know to perfection the art of make-believe. The males of bumblebees and wasps when caught will imitate perfectly the action of a bee when it thrusts its stinger into your hand.

The look of frightfulness which certain caterpillars take on often, in the shape of two fierce counterfeit eyes, is only a mask to scare the unsophisticated birds. At least experiment seems to prove that this is the case. The caterpillars of some of the hawk-moths wear this frightful mask. These insects can so retract their heads and front segments as to give an increased look of fearfulness. Weismann found that certain small birds were afraid of them.

When one insect mimics another for the purpose of protection, as is now generally believed to be the case among a number of butterflies, such insect is sailing under false colors. There is perhaps more masquerading in nature than we wot of, and yet it is all natural.

VIII
THE PRIMAL MIND

I

ONE of my problems is how to reconcile the unity of creation with the fact, or apparent fact, that while the vast mass of the visible universe is governed by purely physical laws, a comparatively small part of it is dominated by laws of another order, and is the abode of life and intelligence. How these two parts or phases of the cosmos are related, how we can ascribe purpose and intelligence to living matter, and deny them to the non-living, without doing violence to our sense of the oneness of universal nature, is the problem. Are we to believe that the universe is part rational and part irrational? — that mind is operative in the grass, the trees, the animals, and not in the stars and sidereal systems?

Emerson celebrates

> "the primal mind
> That flows in streams, that breathes in wind."

But unless we identify mind with cosmic or solar energy, Emerson's lines do not seem especially happy. Is it possible to think of mind, or anything like intelligence, as we know it in this world, as active in streams or winds or tides, or in any of the blind mechanical forces? All these things go their appointed ways and their ways are not as our ways; they are void of purpose, void of will, void of any suggestion of a rational principle; they are ruled by irrefragable law.

Mind as we know it, and can only know it, is associated with life. Not the caressing winds, nor the sparkling currents, nor the beauty of crystals and precious stones, nor the glory and the majesty of the heavens, suggest mind; they suggest power and measureless energy. The midnight skies fill us with awe, they overwhelm us with a sense of our own insignificance, but do we see anything akin to ourselves in them? Do we not rather see that which leaves us out of the account entirely? An infinity of celestial bodies ruled by rigidly mechanical laws, going their inevitable rounds at the risk of cosmic collisions and disruptions in which suns and systems are at times shipwrecked, unutterably sublime and awe-inspiring, but lifeless, mindless, unhuman. In all the vast depths of sidereal space, strewn with celestial bodies as a June meadow with clover blossoms, we see but the dance and whirl of dead matter. The heavens declare the glory of a god who hath not one attribute akin to our own. What shall we say, then? What can we say but that this astronomic background of cosmic matter and energy seems but a vast theatre upon which a small fraction of the whole, clothed with new powers and purposes, plays the drama of organic nature? Who can say that it even seems designed for this purpose? On the contrary, from our human point of view, how casual and uncertain the drama appears! Inside of this stupendous carnival of the physicochemical forces — at far removed points, and doubtless at vast intervals of time, flickering here and there in the cosmic darkness like a dim taper — appears this mysterious change, this light which we call life and mind, appears and disappears, like the lamps of the fireflies of a summer night, confined to a very narrow range of thermal and physical conditions, and, in its higher manifestations on our planet, at least, limited to a very narrow period of time.

In our solar family of nine planets (considering the asteroids as fragments of an exploded body between Mars and Jupiter) only one is unmistakably the abode of life, with a strong probability in favor of Mars. Our earth is the seventh child of the Sun in point of time, and on it life is clearly as yet in the heyday of youth. But what an enormous preponderance of lifeless matter the other planets present! Though the superior planets are æons older and thousands of times larger, it is evident that they have never been the abode of life, and doubtful if they ever can be. As the planets are all made of one stuff, and the same physical and chemical laws are operative in all, it is evident that the conditions of life must everywhere be essentially the same, and hence that life is not possible on the major and minor planets unless, or until, conditions upon them are similar to those upon the earth. But what astronomic significance would the fact have if life never appeared upon any of the other planets, nor upon any of the bodies that swarm in celestial space? None whatever. The vast celestial mechanism would know it not. Doubtless there are untold worlds where life has never appeared and never will appear, and other untold worlds upon which it has appeared and has run its course, or is now in full career.

The natural philosophers tell us that under a certain size a planet cannot retain an atmosphere; it drifts away to the larger and more powerful bodies. Probably our moon has never had an atmosphere. They also tell us that a world with a very small particle of radium in its rocky interior, — two parts in a million million parts, — like our earth, must inevitably, in the course of time or of eternity, explode. This may be what happened to the body of which the four hundred asteroids are fragments.

What a comfort, a sort of cosmic comfort, it would be to us dwellers upon this astronomic mote, to have positive proof that there were beings like ourselves upon other astronomic motes in the heavens around us, even if we had to know that millions of them were trying desperately to exterminate each other, as they are at this moment upon this war-scarred planet! Astronomy and geology grind away at their everlasting tasks, but biology is as a flower that cometh in a day and on the morrow is cut down. Our greedy anthropomorphism sees the whole universe travailing in pain to bring forth man — sees him as the sum and purpose of it all; but clearly the cosmic gods have taken very little thought about him; if his patrimony is this vast sidereal province, he is likely to come into possession of a very small part of it. He is of secondary importance, as are all forms of life, though he alone can assign each god his rank and sit in judgment in the council-chamber of the Infinite.

I am only trying to see with modern eyes, and in the light of modern science, what the old Hebrew seers and prophets saw so long ago — the littleness of man, and his brief, uncertain foothold in the total scheme of things. His glory is that he is a part, an infinitesimal part, of this total scheme, and that with his finite mind he can to some extent grasp and measure it. The secret of his relation to it, the closeness of his kinship with it, whether he came out of it through the inevitable operation of natural laws, or was grafted upon it by an omnipotent power external to it, is a question that opens up a line of inquiry of which he never tires.

Is it possible to reconcile the revelations of astronomy, of geology, of palæontology, — the waste, the delays, the cosmic cataclysms, the indifference to life, a universe sown with dead worlds and with extinct suns, the mindless depths, the supremacy of mechanical laws, the unconscionable energy, — all this and more, with our ideas of a beneficent, omnipotent being gòverning all, of whose love and concern for man this universe is the expression?

The universe as the theatre of mechanical laws — the action and interaction of matter and energy — is godless; neither human nor divine attributes are displayed there. It is only as the theatre of biological laws that we can recognize in it the sources of our own lives or get any glimpse of what we call mind. The source and fountain of life in the universe is clearly no more intent upon man than upon any other form of life, even the humblest. All life is cheap in the presence of the material forces. The tempest and the earthquake blot out human communities as unhesitatingly as they blot out communities of ants and mice. Fire, flood, gravity, and chemical affinity respect nothing that lives. The organizing tendency in matter, whatever be its source, works as if it knew what it wanted when not interfered with; it builds up its predetermined forms and hands the secret of the craft down to succeeding generations unerringly, so long as nothing diverts or confuses it, or imposes foreign purpose upon it, as do the many parasites of the animal and vegetable world. An insect stings a leaf or a stalk and thus diverts the life-energies of the plant to its own purpose. In the case of malignant tumors, the life-energy of the body consumes itself. The hostile germs destroy the body by the use of the vital energy which the body furnishes. The body can be made to destroy itself, to eat itself up.

II

Interfere with the normal currents and course of life in the mother's body, and her womb grows a monstrosity or hideous deformity; the cells go on building blindly; the push of life is not abated, but it has lost its way or forgotten its plan; it wanders aimlessly. Now, what gives it a plan, or guided it through all its vagaries and wanderings in the lowly or monstrous forms of the foreworld, till it built up man from the ape, and the bird from the fish or reptile? Natural selection, the Darwinians say. But there must be a variety to select from, and some scheme or purpose in the selecting agent. Mechanical laws may select the strongest, or the largest, or the smallest, as the case may be, but not the fittest. The fittest implies a scheme, implies progression. The survival of the fittest implies the push of life, the aspiration, as it were, toward higher forms. How could the gift of mind be brought about by mechanical means, unless there was incipient mind — a tendency to mind — in the struggling forms? The physicochemical forces are not creative; they bring about startling changes, but have their cycles; they go their rounds over and over, and can never depart from them. Oxygen and hydrogen unite to form water, sodium and chlorine unite to form salt, but their formulas do not vary, and they lose nothing in the cycle of change; their elements can be separated and reunited any number of times. Not so with any living thing.

Intelligence, then, seems inseparable from life. Wherever we see adaptation as opposed to mere time-induced adjustment, and purposive forms and movements as contrasted with mechanical and accidental forms and movements, we recognize the action of mind; do we not? The use of specific means to specific ends indicates what we have no name for but intelligence. It is obvious that the hairs on plants, the varnish on leaves, the wax on buds, the hooks, wings, balloons, on seeds, all have a specific purpose; that is, these things are true devices, and not merely chance combinations or fortuitous occurrences. The ingenious devices of certain plants to insure cross-fertilization are, to me, just as much an evidence of what we must call mind, though of mind of a vastly different order from our own, as any model or device in our patent offices, while the forms of the rocks, the hills, the shore, the streams, the rivers, are in no sense purposive.

If man, with all his powers and attributes, is a part of nature, — and the naturalist can regard him in no other light, — if the sun is his father and the earth his mother as literally as they are the parents of all other forms of life, then all that he is or can be is latent or potential in nature; then is his humanity, his reverence, his love as much a part of nature as are the instincts and the cunning of animals a part of nature; then is his literature, his philosophy, his art, his religion a part of nature; then is he as amenable to biological laws and as truly a subject for the natural historian as are the animals; then also are all his follies, sins, shortcomings, superstitions, cruelties, ingratitudes, and the rest a part of what we call nature. If not so, then of what are they a part? Man is not separated from nature by his body; he is dependent upon the material elements and forces — upon the air, the water, the soil — to the same extent and by virtue of the same organs and relations as are all other forms of life. He is begotten and nourished like all other animals, and he dies as they do. He differs from all others in his mental and spiritual equipment, but in view of his humble remote ancestry, as seen in the light of palæontology, and the gradations of intelligence and complexity of organization between him and them, can there be any doubt that these gifts also come out of nature? Can there be any doubt that what we must call mind pervades at least all organic matter, and, potentially, all other forms?

Where would you have man's mind come from?

The supernatural? Then let us name it the natural-supernatural, as Carlyle did? Let us annex all the territory that adjoins us; let us put a circle around every reality we can conceive of, and regard the universe as one, and not as two or three. Carlyle's idea of the natural-supernatural still permitted him to look upon nature as the "Time-vesture of God, which reveals him to the wise, and hides him from the foolish"; but the notion of vesture or clothes suggests an arbitrary and artificial relation which is more in consonance with theology than with science or with life. Goethe's expression "the living garment of God" is less misleading, but Pope's familiar couplet, —

> "All are but parts of one stupendous whole,
> Whose body Nature is, and God, the soul," —

is the least objectionable of all, as this restores the vital unity which must exist.

If Nature be half God and half demon, it is all the more easy to believe that man arose out of her, since these terms fitly describe him also. We say that the fountain cannot rise above its source, but surely the source is usually above the fountain, and if we choose to conceive of this God-nature as much above man, there is still room for a broad ground of relationship between them. Nature is cruel and blundering and irrational, and does not the present world-war exhibit man as her legitimate offspring? How the gods on Olympus must smile and chuckle and say, "Surely they are our children, bone of our bone, and flesh of our flesh"!

A recent critic says that my principal mistake is in considering life and mind as concrete realities when, in fact, they are only abstract terms, indicating conditions of matter. In the act of denying mind do we not affirm mind? What is it but mind that makes that statement denying all reality to mind? Is not the assertion self-destructive? If we affirm that the only concrete reality is matter, what are we going to do about our minds that make this affirmation? Are they unreal or nonentities? Can a nonentity grasp and weigh an entity? We cannot use our eyes to prove that there are no eyes in the universe, nor our reason to dethrone reason. Science cannot cut the ground from under its own feet. Huxley was convinced that there were three realities in the universe — matter, energy, and consciousness. How could he affirm the reality of matter and energy if he denied the reality of that which affirmed it? If we are not sure of our own existence as knowing, reasoning beings, how can we be sure of this uncertainty? Our light is self-extinguished; mind, or consciousness, belongs to a different order of reality than do matter and energy. We know mind only as a subjective reality, whereas we know matter and energy as objective realities. Destroy all life and consciousness in the world of matter, and energy still exists. Of course, this assertion is also self-contradictory, as we postulate ourselves as still being witnesses of the existence of matter and energy. Blot out life and mind, and, so far as we are concerned, there is nothing left. We cannot get rid of ourselves without turning the universe topsy-turvy, and even then we are on hand to bear witness that it is topsy-turvy. In my youth I once heard an old Methodist preacher say that we could not conceive of annihilation without thinking of our unannihilated selves as looking on.

The modern, rigidly scientific mind, in considering this question of life, gets right down to the ground and denies everything we call spirit, mind, soul, creative energy, and the like. Man is a machine and only a machine, it says, run by the physicochemical forces. His brain is only a photochemical mirror, his thoughts only molecular activities.

Mind, or our mental states, is only a name for complex physicochemical processes in the brain-substance. But what is it that understands and names these processes? Can a physicochemical process write a poem, or paint a picture, or weigh the stars?

Modern biophysics sees no more evidence of mind in living processes than in non-living. Intelligence is only a sequence of physical states caused by physical stimuli. The brain is no more creative than is the prism when it divides a ray of light into the component colors of the spectrum. The division of a drop of water into two drops or the union of two drops into one by chemical changes inside them involves the same forces that cell-division involves, and cell-division is a no more mysterious process. Life is nothing but chemistry and physics; mind, soul, consciousness, only a sequence of chemical and physical changes in the brain-substance. But what about the living brain-substance? Do these same changes beget mind or soul when controlled in the laboratory? Does the compound in your retort think, and speculate about itself? Is there not something in living beings that science does not take account of?

Mankind has long believed in a spiritual order of reality, and in so doing it is only affirming the reality of that which distinguishes it from stocks and stones. The psychic world is as much a matter of fact to us as is the world of matter and energy; because the first fact is consciousness of self, it is that which recognizes the world of matter and energy. The I is the pillar that upholds the very heavens; it is the veritable creator of the world and of all the gods that rule over it. But to what extent, if any, it is independent of matter and energy, or has been in the past, or may be in the future, is a question. (How contradictory all these questions are! The only realities to us are our varying states of consciousness. To the dead in their graves there is no death; death is real only to the living.)

All living things *know;* they know what they want, they know how to multiply, they know how to fit themselves to their environment. We cannot in the same sense ascribe intelligence to any of the motions of inert matter; they are blind, fateful, stereotyped. The cell is an intelligent being; through the chemicophysical forces it builds up a man and fits him with a brain and all his wonderful organs and powers. It builds the flower, the seed, the leaf, the stalk, the root, and through the mystery of inheritance keeps up the succession of its kind. Back of the cell is unorganized protoplasm, back of that must lie still lower conditions of matter, and so down till we come to the inorganic. But what is it that sets the process of organization going and keeps it up and pushes on and on through the biologic ages, from lower to higher till man is reached? Darwin says natural selection. But clearly natural selection is a secondary process; there must be a primeval onward impulse, something that profits by selection, something that knows in a blind way what it wants; that struggles, that gains and loses, and that has a goal. The weak, the unfit, drop out; that is natural rejection. The strong, the fit, press on; that is natural selection. But if there were no plan or purpose, no urge from behind, no end to be achieved, there would be neither selection nor rejection. Live things would progress no more than do the pebbles on the beach. Do we not have to postulate a primal impulse toward development? Is it all pure mechanics?

Of course, in saying all this we are ascribing our intelligence to nature, and we cannot do otherwise. We can think of degrees of intelligence, but not of kinds. Evolution in the inorganic world has been a purely chemicomechanical process, but in the organic there has been a new factor, supermechanical and superchemical. We are forced to think of it in those terms.

Think of the blind, irrational, or, at least, *un*-rational forces that are careering over the earth at this moment, and every moment, — in the winds, the tides, the rains, the storms, the floods, the river and ocean currents, — changing its surface, pulling down, building up, transporting; sleeping here, raging there; one moment fostering life, the next, destroying it; malignant or benevolent according as we place ourselves in relation to them; and all, from our point of view, without intelligent guidance. No engineer has planned the drainage-system of the globe, and yet see how surely the waters find their way to the sea.

I can see nothing in the operations of inorganic nature analogous to human intelligence or human benevolence, or, I may add, analogous to human malevolence. Human intelligence would go more directly to its goal and avoid the waste, the delay, the suffering, the failures, that we see about us. We do not plant our forests or sow our seed or trim our trees, or drain our land, as Nature does; we abbreviate, and select, and take short cuts, and do in a season what Nature takes years to accomplish. Her forests get planted, her trees get trimmed, her canals get dug, but think how modern business methods would improve her processes. We see what we call intelligence in organic nature, — adaptation, selection, the use of means to an end, — but it is all a kind of blind, groping, experimenting intelligence, like that of man in a new and strange field, when he feels his way, tries and tries again, and reaches his end after many delays and failures.

If our minds only knew all that our bodies know, or knew how our bodies come to know the things they seem to know, then we should have the secret of organization, of inheritance, of adaptation, and of many other things. The body knows how to build itself up from single cells, how to preserve its form, how to run itself, how to repair and reproduce itself, and many other things. But it does not know how to combat certain enemies that attack it as well as we know how. We can aid it in many of its functions, and relieve it in many of its obstructions.

What I know, and what my body knows, are two different things. We can separate the mind from the body in this way, and we can and do separate man from physical nature in the same way, but the truth is that the mind and the body are one, and man and the universe are one. Yet the body seems to know things which the mind does not know, as there is a wisdom in the universe that man cannot compass. We separate ourselves in thought from our bodies, on the one hand, and from the universe, on the other, while in reality the unity in both cases is complete.

I think the knowledge the animal seems to possess is of the same kind and degree as the knowledge its body seems to possess, and which enables it to discharge all its functions and build itself up and reproduce itself. But man transcends his body, he knows more than it does, more than outward nature about him does. It is as if he had eyes while they had only the sense of touch. His reason is his mind's eye; man sees, but his dog, as it were, goes by touch.

IX

"FATED TO BE FREE"

I

THE question of fate and free will is hoary with age. In touching upon the subject here, I have little hope that I can put a youthful face upon it. But it seems to me that the question has been discussed mainly on religious and metaphysical grounds. I have in mind to see what light can be thrown upon the subject from the consideration of our relation to the natural world around us and within us. The moment we think of ourselves as a part of this natural world, with its laws and forces vital within us and an innate part of our essential being, the problem takes on a new aspect. The necessity that rules us is no longer foreign to us, but is the essence of our own wills. Our sense of freedom is as clear and secure as our own eyesight.

The phrase "fated to be free," is Emerson's, and well expresses the kind of contradiction and marriage of opposites that we find everywhere in nature and in life. "Man is fated to be free." The determinism of the nature within him and without him does not blunt or abridge his sense of absolute freedom of choice. He always feels himself free to choose between two objects or two courses of action, no matter how much in reality he may be in the grip of the necessity that rules in the sequence of cause and effect.

Our relation to the atmosphere well illustrates the principle of fate and free will. We live at the bottom of a great atmospheric sea in which we move with the utmost freedom, but which yet presses upon us with the force of many tons' weight. We are not conscious of this enormous pressure because our organizations are adapted to it; we are born and grow up under its influence as do the fish in the bottom of the sea under water pressure. It is not the pressure of a burden; our freedom is unhampered; the frailest bubble is not affected by it, because the pressure from within neutralizes the pressure from without. Herein we see the fatalism of nature, which presses upon us so heavily from all sides and yet leaves us with a sense of perfect freedom and spontaneity because it acts within us as well as without — in the mechanism of our bodies and in our inherited traits and dispositions, as well as in the external forces that constantly play upon us. The fatalism of nature working within us does not hamper us because, I repeat, it is a part of our very selves. We are always free to do what we like, because we never like to do what is contrary to the nature within us. In one sense, therefore, we are not free at all, because we are a part of that nature which is greater than we are, and which works over us and through us. In another sense we are absolutely free, because that nature is vital within us and is the pith and marrow of our own wills. We cannot separate ourselves from the world of forces that surround us, and set up on our own account as independent centres of energy, but what we call our wills give us power in a measure to direct and modify the very nature of which we form a part.

Nature works us cunningly as a machine is worked by external forces, and yet we know it not. How sure we are, for instance, that we draw the air into our lungs when we breathe, as literally as we put the food into our mouths! The universal mechanical principle involved, in other words, the involuntary nature of our breathing, we never suspect. Can we not breathe fast or slow, deeply or superficially, practice abdominal breathing or chest breathing, or even inhibit breathing for a minute or more? How free the act seems to be, and yet the chest is a bellows over which our wills have but slight control. Our freedom in breathing, as in many other acts, is freedom inside of a stern necessity. We are free inside of the iron circle of fate; or, to use a still better image, we are free to move inside the ship, or on the train that is carrying us along. We are free to obey our natures, our spontaneous promptings, but all these things are rings of fate around us. They bear us along, but we can move a little in other directions while, at the same time, we are moving with these currents. By an effort of will we can deny ourselves this or that, inhibit for a time this or that tendency, but no effort of will can make us wise, or happy, or angry, or in love, or hungry, or sad, nor can it make one temperament as calm, as patient, as sanguine as another.

We are more conscious of the pull of gravity because that is in one direction only; but we do not know that the force which our body exerts through its various complex movements is the force of gravity which the earth gives us. We overcome gravity with every step we take, only by using gravity. If our bodies were devoid of weight, how could we exert force? We are strong by that which opposes us, and which will crush us if we give it a chance. We are fitted into the complex of forces which runs this universe in such a subtle way that we are run by it without being aware of the fact. We do not know that the air is forced into our lungs when we breathe, the water into our mouths when we drink, and the force of gravity into our limbs when we walk. Life is that mysterious something which alone uses and rises above the material forces in this manner. Life makes servants of the energy of the non-living. It is a part of the fate which it triumphs over. It turns the material forces against themselves; it defeats gravity by the aid of gravity; it fights fire with fire; it outwits the wind by the aid of the wind. The organism is built up by the same chemical reactions that would pull it down; its strength is the strength of the forces it has overcome. Life has no capital but that which it draws from the non-living. The *modus operandi* of this drawing science may analyze and explain, but the secret of life itself — that impulse which lifts this wave of matter up into these myriads of living forms — is beyond the reach of scientific analysis.

Our breathing and drinking, I have said, are on the principle of the bellows, but the bellows implies the man working it. So our breathing implies the life-principle working the respiratory apparatus; but working from within, not from without, sustaining a vital and not merely a mechanical relation to it. Of this we have no parallel in our mechanical contrivances. The nearest we can come to it is in the electromagnetic world, where the active and potent principle is inseparable from the ponderable body which it animates.

A man may repeat the type of character of his father or grandfather — the main course of his life may be determined by his unconscious inheritances, or by his race, and the nation of which he forms a part, and yet have the utmost sense of freedom, because these things do not act as external or foreign forces, but form the body and substance of his inmost personality; his identity is one with them.

How can we separate the energy that acts within us, giving power to our muscles and all our movements, that is the source of our weight and the strength of our hands, from the energy that acts without us, that checks or restrains all our movements? They are both one and the same. We overcome gravity with gravity. We break its pull whenever we lift our feet, or hurl a weight, or raise any object from the ground. The cyclone that lifts your house from its foundations, and levels forests, and heaps up the waves could do nothing without the weight which gravity imparts to the air. The force that sets the air in motion — thermic or electric, a steep gradient of temperature or an electromagnetic strain — is probably not of gravitational origin. In vegetable life what we used to call a vital force lifts matter up in opposition to gravity — lifts tons of water up into the trees, and tons of lime and potash and other earth salts, but does it by mechanical and chemical means.

The vital and the physical are inseparably united, and play into each other's hands. In animal life, mechanical and chemical principles are equally active in all living bodies. In the higher forms a psychic principle comes into play. The will of man through mechanical means reverses or controls the action of gravitation and directs chemical reactions — in every instance two contraries work together and make one whole.

II

Life and nature and philosophy are full of contradictions. The globe upon which we live presents the first great contradiction. It has no under or upper side; it is all outside. Go around it from east to west, or from north to south, and you find no bottom or top such as you see on the globe in your study, or as you apparently see on the moon and the sun in the heavens. A fly at the South Pole of the schoolroom globe is in a reversed position, but the discoverers of the South Pole on our earth did not find themselves in a reversed position on their arrival there, or in danger of falling off. The sphere is a perpetual contradiction. It is the harmonization of opposites. Our minds are adjusted to planes and to right lines, to up and down, to over and under. Our action upon things is linear. Curves and circles baffle us. My mind cannot adjust itself to the condition of free empty space.

Transport yourself in imagination away from the earth to the vacancy of the interstellar regions. Can you convince yourself that there would be no over and no under, no east and no west, no north and no south? Would one not look down to one's feet, and lift one's hand to one's head? What could one do? — no horizontal, no vertical — just the negation of all motion and direction. If one rode upon a meteorite rushing toward the earth, would one have the sensation of falling? Could one have any sensation of motion at all in absolutely vacant space — no matter at what speed with reference to the stars one might be moving? To have a sense of motion must we not have also a sense of something not in motion? In your boat on the river, carried by the tide or the current, you have no sense of motion till you look shoreward. With your eye upon the water all is at rest. The balloonist floats in an absolute calm. The wind does not buffet him because he goes with it. But he looks down and sees objects beneath him, and he looks up and sees clouds or stars above him. Fancy him continuing his journey on into space till he leaves the earth behind him — on and on till the earth appears like another moon. Would he look up or down to see it? Would he have a sense of rising or of falling? If he threw out ballast, would it drop or soar, or would it refuse to leave him?

Such speculations show how relative our sense standards are, how the law of the sphere upon which we live dominates and stamps our mental concepts. Away from the earth, in free space, and we are lost; we cannot find ourselves; we are stripped of everything but ourselves; we are stripped of night and day, of up and down, of east and west, of north and south, of time and space, of motion and rest, of weight and direction. Just what our predicament would be, who can fancy?

The belief in free will is like the belief that the earth is a plane instead of a sphere. For all practical purposes the earth is a plane — a plane which has no boundaries; and for all practical purposes the will is free. We feel at liberty to do what we like, to go here or to stay there, to vote for this candidate or to vote for that. We live our lives without any sense of the sphericity of the globe, and without any sense that our power of choice is not absolutely free.

But it is as easy to prove that the will is not free as to prove that the earth is round. In the realm of material things fatalism abounds. Everything is held in the iron law of cause and effect. Only life is spontaneous. We speak justly of the spontaneity of the great poets, of the great orators, of our own best acts, while yet we do not take into account the subtle and hidden physical forces at work. The flower blooms spontaneously, but not independently of the long chain of forces at work there in the soil, in the air, in the sun. Heroic deeds and poetic thoughts are spontaneous in the same sense. Without thought or calculation heroic deeds flash out in the lives of men, noble thoughts are born in our minds and hearts, as spontaneous as the rain or the dew, — and no more so; which is to say that they are the result of an intricate complex of causes at work in unison with the creative force of Life.

Something cannot come from nothing. Some force in the man impelled him to the heroic act. All that had gone to the making of his character up to that hour impelled him to it. Something in the poet bloomed or flashed out in his lyrical burst, but perhaps if he had had a headache, or had just lost a friend, the lyric would not have come.

In terms of science every effect has its cause, and there is no life except from antecedent life. When we fix our attention upon matter, and the laws of matter, the belief in free will is impossible. We are in the land of fatalism. We are not here by our own will. We are not of this type or family or race by our own will. We are hardly more of this or that political or religious creed by our own will. We did not choose to have red hair or black hair, blue eyes or gray eyes. We have no power of choice in the main things of our lives and fortunes. And yet to us it seems that our wills are free. When we appeal to the natural scientific order, we are held in the iron bonds of necessity or determinism. The natural order is inviolable. The river is free to flow where gravity directs or pulls it, or rather, where its inherent mobility allows it to flow. Each thing is free to obey the laws of its own nature, which means it is not really free at all. "Free as the air" we say, but the air always behaves the same under the same conditions; it is controlled by its own laws. The wind does not blow where it listeth, but where its laws decree that it shall blow. Human nature is free in the same way — a vastly more complex affair than the air, yet it cannot transcend its own limitations. You and I are free to act according to our natures, modified by our training and by the times in which we live. This modification is not voluntary, at least only in part. Our times, our environment, our proclivities, shape us insensibly and involuntarily. How, then, is the will free?

A scientific analysis shows that it is not free when looked at objectively, but free when looked at subjectively. We do not ordinarily feel the bonds of our own natures. In the moral order we are free; we are unconscious of restraint or control. In our own thought we seem to do what we like, though what we like has been determined by forces or conditions far older than we are. What we like and dislike are inherent in our own natures, and with our own natures — our mental and spiritual constitutions — we have had little to do. With our physical natures likewise we have had little to do, and how closely our mental and spiritual make-ups are dependent upon the physical, we are coming more and more to realize.

We like a fine day because we thrive best on a fine day, but all fine days would grow monotonous, and we should sigh for cloud and storm. We like kindness, gentleness, good nature, a cheerful spirit, because these things are conducive to our well-being. We prefer truth to falsehood, because our nature demands it.

We are not free in the physical order; how, then, are we free in the moral order? We cannot be wise at will, or always choose the best course, or always speak the right word, but we are free because we feel that we are free. We have moral freedom. We are willing to be held responsible for the choice we make, though that choice be in reality not so much a matter of our wills as a matter of our characters — a vague, non-scientific term with a very uncertain content.

The big man who marries the little woman, and the little woman who accepts the big man, both feel that they had perfect freedom of choice, yet is it not clear that there is a law in such matters? In fact, is it not clear that most marriages are complementary, — black eyes with blue, slowness with quickness, weakness with strength, — though the contracting parties yielded, as it seemed to them, to the utmost freedom of choice? Their wills were free — to do what Nature wanted them to do. Her purpose was deeper than theirs.

A man is free to elect heaven or hell, if heaven or hell have a mortgage upon him. But if it have, he never will know it, and will credit himself with absolute power of choice. Hence, we say the will is free, though freedom only means the absence of any conscious restraint.

In the pride of our wills we boast that we are masters of our fate, and so we are in a very limited sense. In a large way human history is under the same law as natural history or biological history; is subject to the same haphazard, hit-and-miss process, the same waste, delays, failures. The only sure thing in either case is the law of progress — evolution in a general broadcast way. We do not know that the great historical characters appeared when most needed. When they did appear, they did their work, filled their places, but how many epochs have come and gone without their redeemers and leaders! In how many cases the great leader and savior may have been there, though conditions and events have not favored his appearance! Grant would have died unknown had not events brought him out. So would Washington and Lincoln and Lee. Opportunity is half of life.

We cannot jump off the sphere; no more can we free ourselves of the idea of a final cause. This idea of causation is developed in us by our experience in life; if we forget it, we speedily come to grief. But it does not help us in dealing with the final mystery. We can find no end to the causal sequence. We simply rest in First Cause.

Two opposites may make a whole. There is often the larger truth with the lesser truth inside it. The larger truth is the law of causation; the lesser truth is the freedom of the will. Fate is true and, within limits, freedom of choice is true. If my temperament, or that complex of forces and tendencies which I call my disposition, impels me to act thus and not otherwise, if my Irish blood, or my Dutch blood, or my English blood, if my maternal or my paternal grandfather, if my small brain or my large brain, rule the destinies of my life, I am still free, *because these things and influences are my very self.* They are not something external which lays a guiding and restraining hand upon me; they are the *me.* Hence, with the utmost sense of freedom I go my way in life.

Gravity makes the stream flow, the lay of the land determines its course, but if the water were conscious, would it feel that it did not flow where it had a mind to? It has a mind to flow where gravity and the lay of the land permit it to flow.

The joy of free choice is in us all because the forces that choose for us are a part of our very selves.

In choosing our way of life we are controlled by many factors, but these are all vital in our characters. In choosing our wives, we unconsciously choose a woman who is mainly complementary to us, and yet, she is the choice of the heart — the heart chooses in obedience to this law of nature; in choosing our bosom friends, we are in the same way guided by influences we wot not of. In choosing our walk in life, we are guided by our talent, our attractions, and the like. The father chooses the profession of his son through his blood. Our constitutions play a part in all we do or think or choose, and our constitutions are complexes of forces that date from the past as much as, or more than, they date from the present.

Determinism is only a name; free will is only a name; the reality is our joyful and conscious obedience to the promptings of our own natures. That our individual natures are a part of the general nature, and subject to its laws, is the fact above all.

At times we are conscious of struggling against a tendency in us, but this struggle also has its natural history. We are pulled two ways, and the stronger pull wins. We yield to it because it is the strongest.

Freedom of will means freedom to lift the arm, to open the eyes, to close the mouth, but not freedom to lift the hair, or to close the nose or the ears, or to abolish hunger, or any of the other things we might enumerate as against nature. All the little but fundamental acts of our lives, all the movements of our bodies, are immediately under the control of what we call our wills. But the movements of our spirits, the promptings of our character, our temper, our dispositions, are not in the same sense under the control of our wills.

Only so much of a man knows itself and is under the control of the conscious will as is necessary to his dealing successfully with outward things. By far the larger part of every one of us is the subconscious self. The body runs itself. Our minds have but little to say about it. All the physical functions are so important that they could not be left to the hazards of the forgetful and sleep-indulging mind. In health the body does not forget to breathe, or the heart to beat, or the stomach to digest.

III

In all our human relations and enterprises we are no doubt under the influence of general, impersonal laws to a much larger extent than we ever suspect. Our destinies are shaped more or less by the geography of the country, by its geology, by its climate. A great river, a great lake, the coastline, a mountain-range — all set their stamp upon our lives. We are independent of our environment only within very narrow limits. The mountains beget one type of character, the plains another, the sea another. These influences work over and beyond our power of choice. Men in masses and tribes are subject to influences and courses of action that the individual members composing them are exempt from. There is a rule of the multitude, and a rule of the individual. Men collectively will be guilty of deeds and crimes that the separate units would not stoop to. In a crowd we escape the feeling of individual responsibility. In mobs man reverts to more primitive and savage conditions; he becomes more like the irrational forces of nature. Is there any ground of hope that international morality will ever reach the standard of individual morality? — that the nation will ever be as unselfish and fair-minded as the individuals composing it? The experience of most of us with individual Germans has been of the most satisfactory kind — an honest, sober-minded, fair-dealing, humane people is our verdict; but the nation embattled and fired with the thirst of conquest and in the grip of a military despotism, reverts to the temper of the original Hun: the atrocities their government and armies are guilty of shock mankind. The history of all other nations shows similar contrasts, but not, in our time, to the same degree.

The streams and rivers all find their way to the sea; the conditions and influences that shape their courses are few and constant; but once they are united in the ocean, a new set of influences is called into play: the tides appear and the vast ocean currents begin to flow and modify the climates of the globe. The laws of water are not changed, but new laws or forces, that have their sources beyond the earth, at once begin to operate. An application, not too precise and literal, of this fact to the nations of the earth may throw some light upon their behavior.

X

SCIENTIFIC FAITH ONCE MORE

I

SCIENTIFIC faith is no more smooth sailing than is theological faith. One involves about as many mysteries, as many unthinkable truths, as the other. It is unthinkable that a particle of matter can be so small that it cannot be made smaller, yet the atomic theory of matter involves this contradiction. The luminiferous ether, the most dense and at the same time the most attenuated body in the universe, which science has invented to account for the action of bodies upon other bodies at a distance, is unthinkable; but with all the contradictions which it involves, we are compelled to assume its reality in order to account for things as we know them.

How many things may be affirmed of the visible, ponderable bodies on the earth's surface which are just the opposite of what is true of the invisible, imponderable bodies of the interior world of matter, and which also do not hold among the bodies of celestial space! Thus all inanimate bodies on the earth's surface are at rest until some force exterior to themselves acts upon them. In the world of molecular physics the molecules and atoms and electrons are self-moved, and are in perpetual motion. If the Brunonian movement extended to visible ponderable bodies, the earth would be uninhabitable; we should behold a sight such as we have never yet beheld. Spontaneous motion never takes place among inanimate bodies, while it is the rule among the atoms of which they are composed. Gravity and friction bind the bodies on the surface of the earth, but these laws are inoperative in the world of atoms and electrons. On the other hand, when we reach the astronomic world, or the sidereal universe, we find the same condition that prevails in the world of the infinitely little: perpetual motion goes on, friction is abolished, and nothing is at rest; there are collisions and disruptions just as there are in the world of atoms. Height and depth, upper and under, east and west, north and south, weight and inertia, as we experience them, have vanished. There are no boundaries, no ending and no beginning, no centre and no circumference; the infinite cannot have any of these. Rest and motion are relative terms. The sun is at rest with reference to the earth, but in motion with reference to some larger system, which is again at rest when tried by the sun. Motion implies something which is not in motion. The bodies we know have weight with reference to the earth, as the earth has with reference to some larger body, and this again with reference to some other still larger, and so on; but the universe as a whole can have no weight. A body at the centre of the earth can have no weight. If unsupported, would it move up or down? The infinitely little and infinitely vast alike baffle the understanding, developed as it is by our concrete finite life. Creation is typified by the sphere. A circle is a straight line that at every point ceases to be a straight line, and the earth's surface is a plane that every moment ceases to be a plane. Following the surface of the earth does not carry us to the under side, because there is no more an under side than there is an upper side — there is only a boundless surface. But if it were possible for us to build a globe upon the earth of any conceivable dimensions would it not have an upper and an under side?

II

The mysteries of religion are of a different order from those of science; they are parts of an arbitrary system of man's own creation; they contradict our reason and our experience, while the mysteries of science are revealed by our reason, and transcend our experience. One implies the supernatural, while the other implies inscrutable processes or forces in the natural. That man is of animal origin is a deduction of reason, but the fact so far transcends our experience that it puts a great strain upon our scientific faith.

The miracles of our theology do violence to our understanding, but it is a part of our faith to accept them. The miracle of the loaves and the fishes, and of the turning of water into wine, have their parallels in chemical reactions, as in the conversion of starch into sugar, or of sugar into an acid; the mystery is that of chemical transformations, and occurs in the everyday processes of nature, while the biblical miracles are exceptional occurrences, and are never repeated.

The miracles of religion are to be discredited, not because we cannot conceive of them, but because they run counter to all the rest of our knowledge; while the mysteries of science, such as chemical affinity, the conservation of energy, the indivisibility of the atom, the change of the non-living into the living, and the like, extend the boundaries of our knowledge, though the *modus operandi* of these changes remains idden.

We do not know how the food we eat is transformed into the thoughts we think; in other words, the connection of the physical with the mental baffles us; but our familiarity with the phenomena causes us to look upon them as a matter of course. In fact, while most of the mysteries and marvels of the prescientific ages only served to measure the depth of the mental darkness of those ages, the mysteries and the marvels of modern science serve to measure the depths to which we have penetrated into the hidden processes of natural law.

The scientific faith which triumphs over all obstacles is not common. The late Alfred Russel Wallace was an eminent scientist and naturalist, co-laborer with Darwin in sustaining the theory of the origin of species by natural selection; but he could not accept the whole of Darwinism. The break in his scientific faith is seen in his failure to accept completely the animal origin of man; he looked upon man's spiritual nature as a miraculous addition to his animal inheritance. Natural science owes a great debt to Agassiz, but he, too, faltered before the problem of the origin of species through natural descent. He belonged to an age that had not fully emancipated itself from the dogmas of the church. He saw an incarnated thought of the Creator in every species of animal and plant. The great majority of mankind still see a dualist world — half natural and half supernatural. But the strict scientist knows only the natural. Even the origin of life is to him only a problem of the inherent potency of matter.

Darwin's scientific faith was not quite able to stand alone; it had to lean upon teleological props. He could not accept the whole proposition of the natural origin of man and of other forms of life; his theory of descent had to start with a few forms, animal and vegetable, three or four, miraculously brought into the world by the creative power of an omnipotent being; these few original forms, through the action of natural selection, working upon chance variation, gave rise to all the infinite diversity of forms that now people the earth. Darwin's scientific faith was strong where that of Wallace was weak, inasmuch as he had no more difficulty in accounting for the mind of man by the theory of descent, than he had in accounting for the body of man. Both were an evolution of lower forms. His was a type of mind much more steady and consistent than was the mind of Wallace. Darwin's mind was of the planetary order, while Wallace's was more cometary. The later works of Wallace are a curious mixture of scientific data and theological moonshine.

Darwin's conviction of the origin of species through descent was so deep and whole-hearted that one wonders why it did not carry him back into the problem of the very beginning of life upon the globe. If natural law is adequate to account for the wonderful diversity of vegetable and animal forms, including the body and the soul of man, why should it not be adequate to account for the origin of the first primordial forms? If we are to believe that the mentality and spirituality of man as we know him to-day could arise from the blind, unreasoning lower orders, should we have any trouble in believing that living matter could arise or be evolved from the non-living? The change is no greater in the latter case than in the former.

Are we to look upon the universe as half natural and half supernatural? Must it not be entirely one or the other to be a *uni*verse? Is it any easier to believe that God planted the germs of evolution in a few forms, created out of hand, so to speak, than it is to believe that He kindled the evolutionary impulse in matter itself? If we believe that one species was brought into being by a special act of creative energy, are we not bound to believe that all species were? It is the old story of our fathers: that the Creator is active in nature at certain times and places, and is passive at others. The processes of creation being miraculously started, they then continue under the guidance of natural law.

This break in Darwin's scientific faith does not at all detract from the immense value of his work. I only point to it as showing how difficult it was for even his mind to commit itself unreservedly to the full guidance of natural science. Tyndall, whose scientific faith was more consistent, saw the "promise and the potency" of all terrestrial life in matter itself, but he wrote matter with a big M, and declared that at bottom it was essentially mysterious and transcendental; and Bruno, in declaring that matter was the mother of us all, brought the Creator near us in the same way. Such views simply show the creative energy as always immanent in the universe. They free our minds of the notion that creation is a miracle at one end, and ordinary development at the other; that a primary cause sets the machine going, then turns it over to secondary causes. How is it possible to conceive of so-called secondary causes, except as phases of the First Cause? When we use the phrase, the idea of delegated power, drawn from our civic experience, seems to be in our minds. But I doubt if the universe is run on this plan, though our ecclesiasticism has made much of this idea. Our idea of cause, anyhow, is drawn entirely from our experience with material bodies and forces. In living nature, and in the brain of man, cause and effect meet and become one. There is no up and no down, no east and no west, no north and no south, in the depths of sidereal space; neither do any other of our mundane notions of primary and secondary causes apply to the universe as a whole.

The rain causes the grass to grow, and the sun causes the snow to melt, but we cannot apply the idea of cause, in this sense, to nature as a whole, but only to parts of nature. Gravitation caused Newton's apple to fall, but what causes the earth to fall forever and ever, and never to fall upon the body that is said to attract it?

Huxley's scientific faith was more radical and uncompromising than Darwin's. It never went into partnership with the old teleological notions of creation. Huxley not only accepted the development theory, with all that it implies, but, so far as I can make out, he accepted the theory of the physicochemical origin of life itself. He found no more place for miracle at the beginning than at the end of evolution, yet he repudiated materialism as emphatically as he rejected what he calls spiritualism, — declaring that the latter was only the former turned bottom-side up. While recognizing that "the logical methods of physical science are of universal applicability," he saw clearly enough that many subjects of thought and emotion — doubtless he would say, many forms of truth — lie entirely outside the province of physical science. He recognized three forms of reality in the universe, — matter, energy, and consciousness, — and that the last-named was no conceivable modification of either of the others. Whether he assigned to consciousness the same cosmic rank as to matter and energy, does not appear. It is quite certain that matter and energy existed before consciousness appeared, and will continue to exist after it disappears. But, in making this statement, are we projecting our consciousness into the past, and into the future?

I note one weakness in Huxley's faith: it seems to have balked at accepting the reality of things it could not conceive of. While looking upon the theory of the atomic constitution of matter as a valuable working hypothesis, it balked at the objective existence of the atom, — a point of matter which occupied space and had form and weight, and yet was indivisible. This was beyond his power of conception, as it is beyond the power of conception of the best of us. Yet we have to accept the atom on the demonstrations of experimental science. The helium atom has been proved to be an objective entity as truly as is the sun in heaven. The apparent contradiction of an indivisible body is involved in our habits of thought formed by our dealings with ponderable bodies; we are introduced to the world of chemical reactions. We cannot conceive or picture to ourselves just what takes place when two gases unite chemically, as when hydrogen and oxygen unite to form water. Our only resource is to apply to the process mechanical images; our experience affords us no other.

We fancy that the difference between two compounds with the same chemical formula, but with widely different properties, — say alcohol and ether, — consists in the different arrangement of the particles. Arranged in one order, they produce one compound; arranged in a different order, they result in a compound with different properties. Yet every particle of these gases is supposed to be exactly like every other particle. How hard, then, to conceive of any mere spatial arrangement of them as resulting in such widely different products. One has to think of each atom or electron as a little world in itself, containing different stores of energy or vibrating at a different rate of speed, in order to see substances of such different properties arising out of the different orders in which the atoms are arranged in the molecule, and the molecules in the mass. If the atoms of carbon or oxygen or hydrogen are each as unique and individual as men and women are, one can see that the order in which they join hands or select their partners may be fraught with important consequences. Or if the atoms are vibrating each with a different degree of energy, or carry different charges of electricity, then one can see that the different orders in which they stand to each other would be significant. But no mechanical image, nor the action and interaction of ponderable bodies in time and space, afford us a key to chemical combination.

How can we figure to ourselves any sort of spatial disposition of the ultimate particles of the invisible gases of oxygen and hydrogen that shall result in a product so unlike either as water? How impossible it all is in the light of our experience with visible bodies! Each atom or electron seems to get inside the other. But how can an indivisible particle of matter have either an inside or an outside, or place, or weight, or any other property that we ascribe to the bodies that we see and feel? What a world of the imagination it all is! It introduces us to some of the unthinkable truths of science — truths beyond our power to grasp, yet which experimental science verifies. It is unthinkable that matter and motion can exist without friction; that two bodies can occupy the same space at the same time; that a particle can be so small that it might not be smaller, or so large that it might not be larger; that space is without limits, creation without beginning; that at the centre of the earth there is no up and no down, on its surface no under and no over. Two waves of sound may interfere with each other and produce a silence, and two waves of light produce a darkness.

Molecular physics has made great strides since Huxley's time. With all the phenomena of electricity before him, he could not conceive of electricity as a positive entity; he seems to have regarded it as only a mode of motion, like heat. How shall we think of dematerialized substance, of disembodied energy, of a fluid as elusive and ubiquitous as thought itself, or of the transformation of one form of energy into another, as of electrical energy into mechanical? Electricity disappears in matter beyond the reach of any analysis to reveal; it is summoned again from matter as by the wave of a wand. In a thunderstorm we see it rend the heavens and disappear again into its impossible lair as quick as thought — energy which is not energy. Yet we know the reality of all these things, and the atomic theory of electricity is securely established. This gross matter with which life struggles, and which we conceive of as at enmity with spirit, is far more wonderful stuff than we have ever dreamed of, and the step from the clod to the brain of man is not so impossible as it seems. There is deep beneath deep all around us. Gross matter has its interior in the molecule; the molecule has its interior in the atom; the atom has its interior in the electron; and the electron is matter in its fourth or its ethereal estate. We easily conceive of matter in the three states, — the solid, the liquid, the gaseous, — because experience is our guide; but how are we to figure to ourselves matter in the ethereal estate? In other words, how are we to grasp the electric constitution of matter?

III

In Sir Oliver Lodge we have an example of a thoroughly trained and equipped scientific mind which yet, to account for things as we find them in this world, has to postulate another world of a different order — the world of spiritual reality — interpenetrating and interacting with the visible and tangible world about us. In doing this, Sir Oliver takes an extra-scientific step and lays himself open to the same criticism that has been visited upon Alfred Russel Wallace.

Our Professor Loeb would account for all our gods through physical and chemical changes in matter, and would probably look as much askance upon Huxley's "consciousness" as belonging to the trinity of cosmic realities, as upon Sir Oliver Lodge's hierarchy of spirits. Huxley's coat of mail is his agnosticism: he does not know, and sees no way of knowing, the truth of many things about which some of his fellows are so certain.

Haeckel's faith is so robust that he has no trouble in seeing life arise from lifeless matter by easy natural processes. But it is extraordinary matter that he starts with — unorganized matter charged with such potency that it goes forward from step to step up the ladder, from compound to compound, each step a nearer approach to life, till what he names the *monera*, an organism without organs, is reached, then organized protoplasm, then the cell, then the functioning organism. The first bit of unicellular life is charged with such possibilities of development that the whole world of living things lies folded in it: man and all that lies below him, all the orders and suborders and species of the animal and vegetable kingdoms, are latent in the first bit of life-stuff that Haeckel invokes by the magic of words from inert matter.

For his start Haeckel goes back to the first hardening of the earth's crust, the formation of water in a fluid condition, and great changes in the carbonic-laden atmosphere. Under these conditions a series of complicated nitrogenous carbon compounds was formed, and these first produced albumen or protein. The molecules of albumen arranged themselves in a certain way, according to their unstable chemical attractions, in larger groups of molecules; and these combined to form still larger aggregates, and thus produced homogeneous plasma-granules. As these grew they divided, to form still larger plasma-granules of a homogeneous character, and the result is what he calls the *monera*, — the first bit of living unorganized matter, a cell without nuclei.

Out of this *monera*, by surface strain and chemical differentiation and other obscure processes, that wonder, the nuclear cell, arose — the architect of all living things on the globe. Our bodies, and the bodies of all other living beings, are simply multiplications of cells, all fundamentally the same, — the work of a complex microscopic mechanism that seems to know from the start the part it is to play in the world, and proceeds to build all the diversities of living forms that we know; but why, in the one case, it builds a flea, or a cat, or a monkey, or a man, and in another a flower, or a pine, or an oak, Haeckel's exposition does not help us to understand.

Do we know of anything in the laws of matter and force, as we see them in the non-living world, that would lead us to expect such novel results? Why the cell should build anything, since the colony of living cells that Dr. Carrel has kept going for a year or more builds nothing, but only multiplies its units, is a question which Haeckel's chemistry and physics will never be able to answer.

"The organs of a living body," he says, "perform their functions chiefly by virtue of their chemical composition." Undoubtedly, but what made it a living body and gave it organs? Of course the functioning of any bodily organ involves chemical processes, but do the processes determine the function? Do they assign one function to the liver, another to the kidneys, another to the heart? In other words, is the organizing effort that awakens in matter the result of chemistry and physics?

Do we not need to go outside of the material constituents of a living body to account for its purposive organization? Can we deduce an eye or an ear or a brain from any of the known chemical properties or their material elements? Does any living thing necessarily follow from its known chemical composition? Do the material constituents of the different parts of a machine determine the purpose and function of that machine? The function of an organ and the organ itself are the result of some unknown but intelligent power in the body as a whole.

I have no purpose to discredit Haeckel's science or his philosophy, but only to show how great is his scientific faith, — how much it presupposes, and what a burden it throws upon chemistry and physics. Like all the later philosophical biologists, he reaches a point in his argument when chemistry and physics become creative, while he fails to see that they differ at all in their activities from the chemistry and physics of inorganic matter. To be consistent he is forced to believe in the possibility of the artificial production of life. He helps himself out by endowing all matter with sensation and purpose, and thus its passage from one condition to another higher in the scale is easily accomplished.

Haeckel's manipulation of matter to get life will to many persons seem like a sleight-of-hand trick. One thing disappears, and at a word another entirely different takes its place. Now we see the solid lifeless crust of the earth, then we see water and carbon dioxide, then nitrogenous carbon compounds, then, presto! we have albumen or protoplasm, the physical basis of life. Out of protoplasm by a deft use of words comes the *monera;* another flourish of his pen and there is that marvel, the living cell, with its nucleus, its chromosome, its centrosome, and all its complicated, intelligent, and self-directed activities. This may be the road the creative energy traveled, since we have to have creative energy whether in matter or apart from it; but our scientific faith hesitates until these steps can be repeated in the laboratory and life appear at the behest of chemical reactions.

The scientific faith of mankind — faith in the universality of natural causation — is greatly on the increase; it is waxing in proportion as theological faith is waning; and if love of truth is to be our form of love of God, and if the conservation of human life and the amelioration of its conditions are to be our form of brotherly love, then the religion of a scientific age certainly has some redeeming features.

XI

LITERATURE AND SCIENCE

I

IT is not in the act of seeing things or apprehending facts that we differ so much from one another, as in the act of interpreting what we see or apprehend. Interpretation opens the door to the play of temperament and imagination, and to the bias of personality, and is therefore within the sphere of literature. A mind that has a lively fancy and a sense of mystery will interpret phenomena quite differently from a mind in which these things are absent. The poetic, the religious, the ethical mind will never be satisfied with the interpretation of the physical universe given us by the scientific mind. To these mental types such an interpretation seems hard and barren; it leaves a large part of our human nature unsatisfied. If a man of science were to explain to a mother all the physical properties, functions, and powers of her baby, and all its natural history, would the mother see her baby in such a portraiture? Would he have told her why she loves it? It is the province of literature and art to tell her why she loves it, and to make her love it more; of science, to tell her how she came by it, and how to secure its physical well-being. Literature interprets life and nature in terms of our sentiments and emotions; science interprets them in terms of our understanding.

The habit of mind begotten by the contemplation of Nature, and by our emotional intercourse with her, is in many ways at enmity with the habit of mind begotten by the scientific study of Nature. The former has given us literature, art, religion; out of the latter has come our material civilization. Out of it has also come our enlarged conception of the physical universe, and a true insight as to our relations with it, albeit this gain seems to have been purchased, more or less, at the expense of that state of mind that in the past has given us the great poets and prophets and religious teachers and inspirers.

The saying of Coleridge, that the real antithesis to poetry is not prose but science, is of permanent value. When we look upon nature and life as the poet does, or as does an emotional, imaginative being, we see quite a different world from the one we see when, armed with chemistry and physics, we go forth to analyze it and appraise it in terms of exact knowledge. Science is cold and calculating, and can only deal with verifiable fact. And by far the larger part of nature and of life is unverifiable, and therefore beyond the province of science. Science strips Nature to her bare bones; literature and philosophy clothe the bones with something analogous to flesh and blood and warmth and color.

The sensitive, imaginative mind cares only for that scientific truth which points to something beyond science — to large, ideal views. Unless science makes the world more alive and significant to such a mind, unless its truths have ideal values and can in some measure be made into the bread of literature, it does not permanently interest it. The hard, literal facts of physical science, unless one can synthesize them and thus in a measure escape from them, are barren and tasteless to the artistic mind.

In the great sciences, like astronomy and geology, one gets wholes; the imagination has play-room. The cosmic laws launch him upon a shoreless sea. One is blown upon by a breeze from eternity. The same with biology in the light of evolution.

The humanistic view and the scientific view of the universe supplement each other; science corrects and guides sense, humanism enlarges and colors and vitalizes science. After science has unveiled the heavens, our human emotions play about them; after it has revealed to us the history of the earth and of man, emotion and imagination have fresh material to work upon. Science is exact fact; literature is liberal truth.

The universe of science is the real world; the union of literature and art shows what we make of it — our interpretation of it, or humanization of it. Literature is plastic, flowing, suggestive; science is exact, uncompromising, inflexible. If you want to know the exact condition of the weather, consult the thermometer and the barometer and the hygrometer, but if you want to know the quality of the day, or the subtle difference between spring and fall, and the morning and the evening, or between one day and another, consult your senses. The body will tell you what the instruments will not — the character of the day — its balminess, softness, sweetness; but it will not tell you the exact temperature, or the amount of moisture in the air, or the degree of pressure. The result of our sense impressions gives us the material of literature; the thermometer and the barometer give us science, exact knowledge, knowledge shorn of its fringe of poetry. The body and the mind sympathize with surrounding conditions; implements of precision do not.

Science reveals things as they are in and of themselves; literature, as they stand related to our mental and emotional condition and edification. One is not true and the other false; both are true in their own sphere, true as fact, and true as emotion and idea. Science explains the rainbow, but literature sees it as a symbol and a promise. So with the sunset or the sunrise. Science knows all about the diamond, but knows not why it is so prized by us. It explains the pearl, but not the pearl necklace.

Science analyzes all the life-processes, and knows all the mechanism of living beings; but it cannot find the secret of life. Life, as such, it knows not; it only knows its material elements. Literature alone can grasp and interpret life; it names a vital force at which science scoffs; it names spirit, but spirit does not fall within the categories of science. The latest biological science names a new force, "biotic energy," — an old friend with a new name; and it names a new substance, "plasmogen," which it has not yet found, and which is just as hypothetical as vital force.

The scientific interpretation of the universe repels a great many minds because it lays the emphasis upon matter itself instead of upon something supermaterial. It hesitates to name a creative energy, but makes matter itself creative, and does not try to help it out with teleological conception. Science sees man arise out of the earth, as literally as it sees the plants and the trees arise, and it is convinced that if a moving picture could be had of man's long and wonderful line of descent through the geologic ages, we should see his development or growth from unorganized matter up through hundreds of changing living forms during the geological ages, till we behold him as he is to-day. Condense his history, cut out the element of time, as the moving-picture machine cuts it out of the changes in the growing plant, and behold the protozoa mount and unfold, putting on and off form after form, till man appears at the end of the series.

This is the ministry of physical science, to reveal to us the divinity that lurks in the ground underfoot. We do not so much need its services to point out the glory and grandeur overhead. In all ages man has been aware of this; but the soil he treads, the bodies that impede his way, he has spurned with his foot; they were anathema to him. They were the antithesis of spirit, and his enemy. The heavens declared the glory of God because they were so far off; near at hand, they were of the earth, earthy. Science teaches us that the earth is a celestial body also, and that there is no better or finer stuff in the heavens above than in the earth beneath, and Whitman's lines indicate this fact —

> "Underneath, the divine soil,
> Overhead, the sun."

But the moral and religious import of this stupendous truth has not yet influenced our habits of thought; we are still the prisoners of the old dualism.

II

As I have said, the two types of mind, the scientific and the artistic, the analytic and the synthetic, look upon nature and life with quite different eyes. Wordsworth said of his poet that he was quite "contented to enjoy what others understood." When Whitman, as he records in one of his poems, fled from the lecture-hall where the "learned astronomer" was discoursing about the stars, and in silence gazed up at the sky gemmed with them, he showed clearly to which type he belonged. Tyndall said that men of warm feelings, with minds open to the elevating impressions produced by nature as a whole, whose satisfaction therefore is rather ethical than logical, lean to the synthetic side, while the analytic harmonizes best with the more precise and more mechanical bias which seeks the satisfaction of the understanding. Tyndall said of Goethe that while his discipline as a poet went well with his natural history studies, it hindered his approach to the physical and mechanical sciences. Tyndall, himself, was a notable blending of the two types of mind; to his proficiency in analytical and experimental science he joined literary gifts of a high order. It is these gifts that make his work rank high in the literature of science.

Tyndall was wont to explain his mechanistic views of creation to Carlyle, whom he greatly revered. But Carlyle did not take kindly to them. This was one of the phases of physical science which repelled him. Carlyle revolted at the idea that the sun was the physical basis of life. He could not endure any teaching that savored of materialism. He would not think of the universe as a machine, but as an organism. Yggdrasill, the Tree of Life, was his favorite image. Considering how the concrete forces of the universe circulate and pull together, he found no similitude so true as that of the tree. "Beautiful, altogether beautiful and great," said he. "The Machine of the universe — alas! to think of that in contrast!"

Carlyle was a poet and a prophet and saw the world through his moral and spiritual nature, and not through his logical faculties. He revolted at the conception of the mystery we name life being the outcome of physical and chemical forces alone.

Literature, art, and religion are not only not fostered by the scientific spirit, but this spirit, it seems to me, is almost fatal to them, at least so far as it banishes mystery and illusion, and checks or inhibits our anthropomorphic tendencies. Literature and art have their genesis in love, joy, admiration, speculation, and not in the exact knowledge which is the foundation of science. Our creative faculties may profit by exact knowledge of material things, but they can hardly be inspired by it. Inspiration is from within, but scientific knowledge is from without.

There is no literature or art without love and contemplation. We can make literature out of science only when we descend upon it with love, or with some degree of emotional enjoyment. Natural history, geology, biology, astronomy, yield literary material only to the man of emotion and imagination. Into the material gathered from outward nature the creative artist puts himself, as the bee puts herself into the nectar she gathers from the flowers to make it into honey. Honey is the nectar plus the bee; and a poem, or other work of art, is fact and observation plus the man. In so far as scientific knowledge checks our tendency to humanize nature, and to infuse ourselves into it, and give to it the hues of our own spirits, it is the enemy of literature and art. In so far as it gives us a wider and truer conception of the material universe, which it certainly has done in every great science, it ought to be their friend and benefactor. Our best growth is attained when we match knowledge with love, insight with reverence, understanding with sympathy and enjoyment; else the machine becomes more and more, and the man less and less.

Fear, superstition, misconception, have played a great part in the literature and religion of the past; they have given it reality, picturesqueness, and power; it remains to be seen if love, knowledge, democracy, and human brotherhood can do as well.

III

The literary treatment of scientific matter is naturally of much more interest to the general reader than to the man of science. By literary treatment I do not mean taking liberties with facts, but treating them so as to give the reader a lively and imaginative realization of them — a sense of their æsthetic and intellectual values. The creative mind can quicken a dead fact and make it mean something in the emotional sphere.

When we humanize things, we are beyond the sphere of science and in the sphere of literature. We may still be dealing with truths, but not with facts. Tyndall, in his "Fragments," very often rises from the sphere of science into that of literature. He does so, for instance, in considering the question of personal identity in relation to that of molecular change in the body. He asks: —

> How is the sense of personal identity maintained across this flight of the molecules that goes on incessantly in our bodies, so that while our physical being, after a certain number of years, is entirely renewed, our consciousness exhibits no solution of continuity? Like changing sentinels, the oxygen, hydrogen, and carbon that depart seem to whisper their secret to their comrades that arrive, and thus, while the Non-ego shifts, the Ego remains the same. Constancy of form in the grouping of the molecules, and not constancy of the molecules themselves, is the correlative of this constancy of perception. Life is a *wave* which in no two consecutive moments of existence is composed of the same particles.

Tyndall has here stated a scientific fact in the picturesque and poetic manner of literature. Henri Bergson does this on nearly every page. When his subject-matter is scientific, his treatment of it is literary. Indeed, the secret of the charm and power of his "Creative Evolution" is the rare fusion and absorption of its scientific and philosophical material, by the literary and artistic spirit.

How vividly present Huxley is in everything he writes or speaks, the man shining through his sentences as if the sword were to shine through its scabbard! — a different type from Tyndall, more controversial. A lover of combat, he sniffs the battle afar; he is less poetical than Tyndall, less given to rhetoric, but more a part of what he says, and having a more absolutely transparent style. How he charged the foes of Darwin, and cleared the field of them in a hurry! His sentences went through their arguments as steel through lead.

As a sample of fine and eloquent literary statement I have always greatly admired that closing passage in his essay on "Science and Morals" in which he defends physical science against the attacks of Mr. Lilly, who, armed with the weapons of both theology and philosophy, denounced it as the evil genius of modern days: —

> If the diseases of society [says Huxley] consist in the weakness of its faith in the existence of the God of the theologians, in a future state, and in uncaused volitions, the indication, as the doctors say, is to suppress Theology and Philosophy, whose bickerings about things of which they know nothing have been the prime cause and continual sustenance of that evil skepticism which is the Nemesis of meddling with the unknowable.
>
> Cinderella is modestly conscious of her ignorance of these high matters. She lights the fire, sweeps the house,

and provides the dinner; and is rewarded by being told that she is a base creature, devoted to low and material interests. But in her garret she has fairy visions out of the ken of the pair of shrews who are quarreling downstairs. She sees the order which pervades the seeming disorder of the world; the great drama of evolution, with its full share of pity and terror, but also with abundant goodness and beauty, unrolls itself before her eyes; and she learns in her heart of hearts the lesson, that the foundation of morality is to have done, once and for all, with lying; to give up pretending to believe that for which there is no evidence, and repeating unintelligible propositions about things beyond the possibilities of knowledge.

She knows that the safety of morality lies neither in the adoption of this or that theological creed, but in a real and living belief in that fixed order of nature which sends social disorganization upon the track of immorality as surely as it sends physical disease after physical trespasses. And of that firm and lively faith it is her high mission to be the priestess.

Although Tyndall and Huxley possessed fine literary equipments, making them masters of the art of eloquent and effective statement, they were nevertheless on their guard against any anthropomorphic tendencies. They were not unaware of the emotion of the beautiful, the sublime, the mysterious, but as men of science they could interpret evolution only in terms of matter and energy. Most of their writings are good literature, not because the authors humanize the subject-matter and read themselves into Nature's script, but because they are masters of the art of expression, and give us a lively sense of the workings of their own minds.

Herbert Spencer, so far as I have read him, never breathes the air of pure literature. "Life," says Spencer, "is a continuous adjustment of internal relations to external relations." In other words, without air, water, and food our bodies would cease to function and life would end. Spencer's definition is, of course, true so far as it goes, but it is of no more interest than any other statement of mere fact. It is like opaque and inert matter. Tyndall's free characterization of life as a "wave which in no two consecutive moments of existence is composed of the same particles" pleases much more, because the wave is a beautiful and suggestive object. The mind is at once started upon the inquiry, What is it that lifts the water up in the form of a wave and travels on, while the water stays behind? It is a force imparted by the wind, but where did the wind get it, and what is the force? The impulse we call life lifts the particles of the inorganic up into the organic, into the myriad forms of life, — plant, tree, bird, animal, — and, when it has run its course, lets them drop back again into their original elements.

Spencer was foreordained to the mechanistic view of life. His mind moves in the geometric plane. It is a military and engineering intellect applied to the problems of organic nature. How smoothly and orderly his intellect runs, with what force and precision, turning out its closely woven philosophical fabric as great looms turn out square miles of textiles, without a break or a flaw in the process. Never was a mind of such power so little inspired; never was an imagination of such compass so completely tamed and broken into the service of the reasoning intellect. There is no more aerial perspective in his pages than there is in a modern manufacturing-plant, and no hint whatever of "the light that never was on sea or land." We feel the machine-like run of his sentences, each one coming round with the regularity and precision of the revolving arms of a patent harvester, making a clean sweep and a smooth cut; the homogeneous and the heterogeneous, the external and the internal, the inductive and the deductive processes, alternating in a sort of rhythmic beat like the throb of an engine. Spencer had a prodigious mind crammed with a prodigious number of facts, but a more juiceless, soulless system of philosophy has probably never emanated from the human intellect.

IV

The tendency to get out of the sphere of science — the sphere of the verifiable — into the sphere of literature, or of theology, or of philosophy, is pronounced, even in many scientific minds. It is pronounced in Sir Oliver Lodge, as seen in his book on

"Science and Immortality." It is very pronounced in Alfred Russel Wallace; in fact, in his later work his anthropomorphism is rampant. He has cut more fantastic tricks before the high heaven of science than any other man of our time of equal scientific attainments. What a contrast to the sane, patient, and truth-loving mind of Darwin! Yet Darwin, it seems to me, humanized his birds when he endowed the females with human femininity, attributing to them love of ornament and of fine plumage, and making this love of ornamentation the basis of his theory of sexual selection. It seems as though in that case he could not find the key to his problem, and so proceeded to make one — a trick to which we are all prone.

Since science dehumanizes nature, its progress as science is in proportion as it triumphs over the anthropomorphic character which our hopes, our fears, our partialities, in short, our innate humanism, has bestowed upon the outward world. Literature, on the other hand, reverses this process, and humanizes everything it looks upon; its products are the fruit of the human personality playing upon the things of life and nature, making everything redolent of human qualities, and speaking to the heart and to the imagination. Science divests nature of all human attributes and speaks to impersonal reason alone. For science to be anthropomorphic is to cease to be science; and for literature to be anything else is to fail as literature. Accordingly, the poet is poet by virtue of his power to make himself the centre and focus of the things about him, but the scientific mind is such by virtue of its power to emancipate itself from human and personal consideration, and rest with the naked fact. There is no art without the play of personality, and there is no science till we have escaped from personality, and from all forms of the anthropomorphism that doth so easily beset us. It is not that science restricts the imagination; it is that it sterilizes nature, so to speak, reducing it to inorganic or non-human elements. This is why the world as science sees it is to so many minds a dead world.

When we find fault with science, and accuse it of leading us to a blank wall of material things, or of deadening our æsthetic sensibilities, we are finding fault with it because it looks upon the universe in the light of cold reason, and not through that of the emotions. But our physical well-being demands the dehumanization of the physical world; until we see our true relation to the forces amid which we live and move, — our concrete bodily relations, — we are like children playing with fire, or with edged tools, or with explosives. Man made no headway against disease, against plague and pestilence, till he outgrew his humanistic views, dissociated them from evil spirits and offended deities, and looked upon them as within the pale of natural causation.

Early man saw and felt and heard spirits on all sides of him — in fire, in water, in air; but he controlled and used these things only so far as he was practically scientific. To catch the wind in his sails he had to put himself in right physical relation to it. If he stayed the ravages of flood or fire, he was compelled to cease to propitiate these powers as offended deities, and fight them with non-human forces, as he does to-day. And the man of to-day may have any number of superstitions about his relations to the things around him, and about theirs to him, but he is successful in dealing with them only when he forgets his superstitions and approaches things on rational grounds.

Our fathers who held that every event of their lives was fixed and unalterable, according to the decrees of an omnipotent being, could not have survived had their daily conduct been in harmony with their beliefs. But when ill, they sent for the doctor; if the house got afire, they tried to put the fire out; if crops failed, they improved their husbandry. They slowly learned that better sanitation lessened the death-rate; that temperate habits prolonged life; that signs and wonders in the heavens and in the earth had no human significance; that wars abated as men grew more just and reasonable. We come to grief the moment that we forget that Nature is neither for nor against us. We can master her forces only when we see them as they are in and of themselves, and realize that they make no exception in our behalf.

The superstitious ages, the ages of religious wars and persecutions, the ages of famine and pestilence, were the ages when man's humanization of Nature was at its height; and they were the ages of the great literature and art, because, as we have seen, these things thrive best in such an atmosphere. Take the gods and devils, the good and bad spirits, fate, and foreknowledge, and the whole supernatural hierarchy out of the literature and art of the past, and what have we left? Take them out of Homer and Æschylus and Virgil and Dante and Milton, and we come pretty near to making ashes of them. In modern literature, or the literature of a scientific age, these things play an insignificant part. Take them out of Shakespeare, and the main things are left; take them out of Tennyson, and the best remains; take them out of Whitman, and the effect is hardly appreciable. Whitman's anthropomorphism is very active. The whole universe is directed to Whitman, to you, to me; but Whitman makes little or no use of the old stock material of the poets. He seeks to draw into himself and to assimilate and imbue with the human spirit the entire huge materialism of the modern democratic world. He gives the first honors to science, but its facts, he says, are not his dwelling; —

"I but enter by them to an area of my dwelling."

Being a poet, he must live in the world of the emotions, the intuitions, the imagination, — the world of love, fellowship, beauty, religion, the super-scientific world. As practical beings with need of food, shelter, transportation, we have to deal with the facts within the sphere of physical science; as social, moral, and æsthetic beings, we live in the super-scientific world. Our house of life has upper stories that look off to the sky and the stars. We are less as men than our fathers, have less power of character, but are more as tools and vehicles of the scientific intellect.

Man lives in his emotions, his hopes and fears, his loves and sympathies, his predilections and his affinities, more than in his reason. Hence, as we have more and more science, we must have less and less great literature; less and less religion; less and less superstition, and should have less and less racial and political antagonisms, and more and more freedom and fellowship in all fields and with all peoples. Science tends to unify the nations and make one family of them.

The antique world produced great literature and great art, but much of its science was childish. We produce great science, but much of our literature and art is feeble and imitative.

Science, as such, neither fears, nor dreads, nor wonders, nor trembles, nor scoffs, nor scorns; is not puffed up; thinketh no evil; has no prejudices; turns aside for nothing. Though all our gods totter and fall, it must go its way. It dispels our illusions because it clears our vision. It kills superstition because it banishes our irrational fears.

Mathematical and scientific truths are fixed and stable quantities; they are like the inorganic compounds; but the truths of literature, of art, of religion, of philosophy, are in perpetual flux and transformation, like the same compounds in the stream of life.

How much of the power and the charm of the poetic treatment of nature lies in the fact that the poet reads himself into the objects he portrays, and thus makes everything alive and full of human interest! He sees —

> "The jocund day
> Stand tip-toe on the misty mountain-top";

he sees the highest peak of the mountain range to be—

> "The last to parley with the setting sun";

he sees —

> "The white arms out in the breakers tirelessly tossing";

while the power and the value of science is to free itself from these tendencies, and see things in the white light of reason. Science is the enemy of our myth-making tendency, but it is the friend of our physical well-being.

Every material thing and process has its physics, which, in most cases, seem utterly inadequate to account for the thing as it stands to us. Life is a flower, and the analysis of it does not tell us why we are so moved by it. The moral, the æsthetic, the spiritual values which we find in life and in nature are utterly beyond the range of physical science, and I suppose it is because the physicochemical explanation of the phenomenon of life takes no account, and can take no account, of these, that it leaves us cold and uninterested. Spencer with his irrefragable mechanistic theories leaves us indifferent, while Bergson, with his "Creative Evolution," sets mind and spirit all aglow. One interprets organic nature in terms of matter and motion, the other interprets it in terms of life and spirit.

Science is the critic and doctor of life, but never its inspirer. It enlarges the field of literature, but its aims are unliterary. The scientific explanation of the great problems — life, mind, consciousness — seems strangely inadequate; they are like the scientific definition of light as vibrations or electric oscillations in the ether of space, which would not give a blind man much idea of light. The scientific method is supreme in its own sphere, but that sphere is not commensurate with the whole of human life. Life flowers in the subjective world of our sentiments, emotions, and aspirations, and to this world literature, art, and religion alone have the key.

XII

"A PROPHET OF THE SOUL"

I

IN taking this line from Emerson for the title of an essay on Henri Bergson, I would indicate at once the aspect of his philosophy that most appeals to me. The overarching conception in his writings is the immanence and the potency of spirit or consciousness in matter, and his "Creative Evolution" is the unfolding of the drama, as he conceives it, of the struggles of this spirit with the opposition which it encounters in the material world, and its triumphs over it. Arnold said that Emerson was the friend and aider of those who would live in the spirit; we may say of Bergson that he is the friend and aider of those who would see with the spirit and enter into the mystery of creation through intellectual sympathy or intuition, instead of making the vain attempt to do so through the logical and scientific understanding. The true inwardness of living things, or of the creative movement, cannot be reached through the practical intellect, available as it is only for our action upon concrete bodies and forces.

I am not familiar with all of Professor Bergson's published works. I have read the essay on the

"Philosophy of Laughter," the "Introduction to Metaphysics," and the "Creative Evolution," his masterpiece. It was also my privilege to hear some of his lectures at Columbia University in the winter of 1912, and to meet him personally.

A view of the man always seems to bring one nearer to an understanding of his work. In person Bergson is a small, slender, rather shy man, with a wonderfully beautiful and symmetrical head — a large brain, filled out and rounded on all sides; face smooth and thin, with a close-cropped mustache; prominent, finely chiseled aquiline nose; small, expressive eyes in deep sockets overhung by heavy, mobile eyebrows — an Emersonian type of face with more than the Emersonian size and beauty of brain, lacking only the powerful Emersonian mouth.

His lectures in French were delivered without notes, in an animated conversational style, his hands, within a narrow circle, being as active as his mind. Not an imposing figure on the platform or off, nor an aggressive and dominating personality, but a gentle, winsome man, the significant beauty of whose head one cannot easily forget. Those who were fortunate enough to hear him may well have felt that they were seeing and hearing a modern Plato or Kant or Hegel, for surely his work is destined to make as distinct an epoch in the history of philosophy as did theirs.

His essay on laughter is undoubtedly the most convincing and satisfactory exposition of the subject that has yet been made. One phase of its central idea, — namely, that we laugh at inanimate objects when they behave like human beings and *vice versa*, — I saw illustrated at a farmhouse in the Catskills last summer. The water from a spring on the hill was brought to the house in a pipe which discharged into a half-barrel near the kitchen door. Into the end of a pipe a plug had been driven with a good sized gimlet-hole in the end of it. Out of this hole a jet of water came with great force, striking the water in the tub a few inches from the rim, at an angle of about forty-five degrees, and driving deeply into it. One day I was washing some apples in the tub, and while they were floating about I noticed that they all tended to line up on the west side of the barrel and then move up in a slow, hesitating manner to a point just behind the jet of water. I became an interested spectator. Slowly the apples in procession in close line turned toward the little vortex made by the jet. The one in the lead seemed to hesitate just on the edge of the danger-line, as if it would fain draw back; then, while you were looking, it would so suddenly disappear beneath the plunging jet that the eye could not trace its movements; its hesitation was followed by such a lightning-like plunge that it astonished one. One fancied he could almost see tiny heels flash in the air as the apple went down.

Then it came bobbing up in the boiling water on the other side of the tub in a very hilarious manner, and slowly took its place at the rear end of the line, while the apple next in the ranks approached the jet in the same coy, doubtful manner, and made the instantaneous plunge. Then the next and the next, till an endless procession of apparently demure, but fun-loving apples was established that kept up the circus day and night.

I was wont to take my callers out to the tub, without any explanation, to let them see my apple performers. Invariably every one of them, after they had gazed a moment, broke out into a hearty laugh. "What are you laughing at?" I would inquire. "Why, it is so funny; see how those apples behave, like little people."

If I looked at them every hour in the day I was bound to laugh. My little granddaughter, seven years old, "a moody child, but wildly wise," spent hours watching the antics of those apples. She would replace them with others to see if they would all behave in the same way, and then would take them all out and lay them in the sun as if to rest and warm them. After some days the apples began to have a bruised and overworked look, and one felt instinctively like taking them out. On the whole it was one of the most human performances I ever saw inanimate objects engage in, and confirmed Bergson's philosophy of laughter completely.

II

The reception of Bergson's philosophy by different types of mind has, of course, been very diverse. He conquers easily the higher class of his general readers — the lovers of good literature — because of the superb literary style of his work; his philosophical readers do not succumb quite so readily, though many of these are enthusiastic, and all are interested; but he has a hard fight with many of his scientific readers. I have noted but one man of science, the eminent physicist Sir Oliver Lodge, who is in accord with the main drift of his work. It is probably the philosophical, not to say theological, strain in Sir Oliver, and his love of good literature, that make him respond so cordially to Bergson, especially to his conception of life as a primordial creative impulse pervading matter. He declares that the work is "peculiarly acceptable and interesting to men of science."

Professor Poulton disputes his doctrine of instinct as a form of sympathy, and argues forcibly and fairly against it. Sir Edwin Ray Lankester, an eminent Darwinian biologist, in introducing and endorsing H. S. R. Elliott's attack upon "Creative Evolution," expresses his dissent with angry and insulting epithets. Mr. Balfour and our own William James express deep sympathy and admiration for the work of the French philosopher. Most of our university philosophers fight shy of it, I hear, probably because it discredits or limits pure intellectualism as giving us the key to the real inwardness of life; we enter into this mystery only through spirit, — real sympathy or intuition, — and not through our logical faculties. Men who attack the problem of living matter with the same tools which they use upon the problem of dead matter, — namely, our logical understanding, — will not, according to Bergson, get very far.

The flexible, sympathetic, and intuitive type of mind, the type that finds expression in art, in literature, in religion, and in all creative work, will take more naturally and kindly to Bergson than the rigidly scientific and logical mind.

In this shining stream of ideas and images that flows through Professor Bergson's pages, or from his mouth in the lecture-room, the strictly scientific man will probably find little to interest him. He may approve of it as literature and philosophy, but he is pretty sure to feel that unwarranted liberties have been taken with scientific conclusions. He will deny the validity of the principal actor in the Bergsonian drama of evolution; the cosmic spirit, as something apart from and independent of cosmic matter, has no place in his categories; matter and the laws of matter are all-sufficient for his purpose. He must keep on the solid ground of the verifiable. Apparently, to Huxley consciousness is as strictly a physical phenomenon as the lamp of the glow-worm, or the sound of a clock when it strikes; and the tremendous psychic effort which Bergson sees in organic evolution would probably have appeared to him and to others of the mechanistic school as only a poetic dream.

It is a philosophy that goes well with living things. It is a living philosophy. In my own case it joins on to my interest in outdoor life, in bird, in flower, in tree. It is an interpretation of biology and natural history in terms of the ideal. In reading it I am in the concrete world of life, bathed in the light of the highest heaven of thought. It exhilarates me like a bath in the stream, or a walk on the hills.

Those who go to Bergson for strictly scientific conclusions will find bread where they were looking for a stone; but those who go to him in the spirit of life will find life — will see him work a change in scientific facts like that which life works in inorganic matter. His method is always that of the literary artist; and looking at the processes of organic evolution through his eyes is like looking into the mental and spiritual processes of a great creative artist. Mr. Balfour mildly objects that the vital impulse as Bergson reveals it has "no goal more definite than that of acquiring an ever fuller volume of free creative activity." Sir Oliver Lodge replies that that is a good enough goal. "Is it not the goal of every great artist?"

III

To some readers "Creative Evolution" has opened a new world. To open a new world to a man is only within the power of unique and original genius. I think we may say that Bergson is a distinct species. He is *sui generis*. He has the quality of mind which we call genius. One cannot read far in his book without feeling that here at last is an inspired philosopher, and inspiration always carries the mind through into the poetic and the romantic.

The new world which Bergson opens to his reader is the world of organic nature seen for the first time through the creative imagination of a great literary artist and philosopher combined. Bergson recreates this world for his competent reader by showing it like a living stream issuing from the primal cosmic energy; and it is reflected in his pages with a morning freshness and promise. The novelty of his thought, the beauty and vitality of his style, and the telling picturesqueness of his imagery make the reading of his book a new experience to the student of philosophical literature.

It is as if one were to open a gate or a door, expecting to be admitted to the closed-in air of academic halls, or the dim light of monastic aisles, and were to see before him instead a wide prospect with moving currents and growing things and changing forms of earth and sky. It is doubtless this quality of Bergson's work that led William James to say of it that it was "like a breath of the morning and the singing of birds."

I think we may say that no new world can be opened to a man unless that world is already in him in embryo at least; then the poet, the seer, the inspired teacher, like Bergson, can open it for him. Wordsworth opened up a new world to John Stuart Mill, Goethe opened up a new world to Carlyle, Emerson and Whitman have been world-openers in our own land and times. The world-opening to which I here refer, is almost a sacrament; it implies a spiritual illumination and exaltation that does not and cannot come to every mind. It means the opening of a door that our logical faculties cannot open. Positive science, of course, opens its own new worlds of facts and relations, and speculative philosophy opens its new world of ideas and concepts; but only the inspired, the creative works, admit us to the high heaven of spiritual freedom itself. We do not merely admire such writers as Goethe, Carlyle, Emerson, Whitman; we experience them, and they enter into our lives. I think this is in a measure true of Bergson. With more method and system than any of the others I have named, he yet possesses the same liberating power, the same imaginative lift, and begets in one a similar spiritual exaltation.

Bergson is first and foremost a great literary artist occupying himself with problems of science and philosophy. The creative literary artist in him is always paramount. His method is essentially that of literature — the visualizing, image-forming, analogy-seeking method. He thinks in symbols and pictures drawn from the world of concrete objects and forces. Probably no system of philosophy was ever before put forth in language so steeped and dyed in the colors with which the spirit paints this world. His style illustrates his theme; it is never static or merely intellectual; it is all movement and flexibility.

Open his book anywhere and your mind is caught in a flowing stream of lucid, felicitous thoughts that seem of the very quality of life itself. He visualizes mental and emotional processes. He sees spirit and matter as two currents — two reverse currents — one up, one down. He sees life struggling with matter, stemming its tide, seeking to overcome and use it; he sees it defeated and turned aside many times, its triumph complete. Life or spirit is freedom. Matter is the seat of necessity; it proceeds mechanically; it is obdurate, unwilling, automatic. Life humbles itself, makes itself very small and very insinuating in order to enter into and overcome the resistance of inert matter. It "bends to physical and chemical forces, consenting even to go part of the way with them, like the switch that adopts for a while the direction of the rail it is endeavoring to leave." "Life had to enter thus into the habits of inert matter in order to draw it little by little, magnetized, as it were, to another track." "Ages of effort and prodigies of subtlety were probably necessary for life to get past this new obstacle" — the tendency of organized matter to reach the limits of its expansion.

Thus on every page does Bergson visualize and materialize his ideas. He envisages the process of evolution of the whole organic world. He sees one tremendous effort pervading it from bottom to top. He sees thought or life caught in the net of matter.

> It becomes a prisoner of the mechanism by which it has climbed. From the humblest of organic beings to the highest vertebrates which just antecede man we are watching an endeavor always missing success, always re-undertaken with an increasingly wise art. Man has triumphed — but with difficulty, and so partially that it needs only a moment of relaxation or inattention for automatism to recapture him.

The creative impulse does not itself know the next step it will take, or the next form that will arise, any more than the creative artist determines beforehand all the thoughts and forms his inventive genius will bring forth. He has the impulse or the inspiration to do a certain thing, to let himself go in a certain direction, but just the precise form his creation will take is as unknown to him as to you and me. Some stubbornness or obduracy in his material, or some accident of time or place, may make it quite different from what he had hoped or vaguely planned. He does not know what thought or incident or character he is looking for till he has found it, till he has risen above his mental horizon. So far as he is inspired, so far as he is spontaneous, just so far is the world with which he deals plastic and fluid and indeterminate and ready to take any form his medium of expression — words, colors, tones — affords him. He may surprise himself, excel himself; he has surrendered himself to a power beyond the control of his will or knowledge.

We must remember that man is a part of the universe — a part of the stream of life that flows through organic nature, and not something separated from it. But he alone among living beings has come to self-consciousness and is capable of the creative act. Is it not, therefore, entirely reasonable that the method of nature should be reflected in his mind — that he should be a god, too, though a puny one? So far as he knows his own powers, so far as he knows those of the Infinite, so far as he is a creator, his method mirrors that of his Creator.

The vital impulse is finite, it cannot overcome all obstacles. The movement it starts is sometimes turned aside, sometimes divided, always opposed, and the evolution of the organized world is the unrolling of this conflict. Contingency enters into the course of evolution at every point. "Contingent the arrests and set-backs; contingent, in large measure, the adaptations." Contingent, he thinks, the way life obtains the solar energy from the sun, namely through the carbon of carbonic acid. It might have obtained it through other chemical elements than oxygen and carbon. In this case the element characteristic of the plastic substances would probably have been other than nitrogen, and the chemistry of living bodies would have been radically different from what it is, resulting in living forms without any analogy to those we know, whose anatomy would have been different, whose physiology also would have been different.

It is therefore probable that life goes on in other planets, in other solar systems also, under forms of which we have no idea, in physical conditions to which it seems to us, from the point of view of our physiology, to be absolutely opposed. All life requires is slow accumulation of solar energy and its sudden release in action, and this accumulation may take place in other systems by a chemism quite unlike ours, in which the carbon of carbonic acid is fixed and stored up by the chlorophyllian function of plants. Life releases this energy by an act analogous to the pulling of a trigger, and the resultant explosive is the power living bodies exert. How figurative and yet concrete and seeable it all is! Though man seems to be the aim and crown of evolution, yet we cannot say that it was all for him. It is abundantly evident that nature is not solely for the sake of man; we struggle like the other species, we have struggled against other species; moreover, if the evolution of life had encountered other accidents in its course, if thereby the current of life had been otherwise divided, we should have been physically and morally far different from what we are.

We aim to look upon a problem of science or mathematics understandingly; we try to regard a work of art — a novel, poem, painting, symphony — appreciatively, to enter into its spirit, to become one with it, to possess ourselves of its point of view, in short, to have an emotional experience with it. The understanding is less concerned than our taste, our æsthetic perceptions, our sympathy with beautiful forms, and our plasticity of mind. We do not know a work of art in the same way in which we know a work of science, or any product of analytical reasoning; we know it as we know those we love and are in sympathy with; it does not define itself to our intellect, it melts into our souls. Descriptive science is powerless to portray for me the bird or the flower or the friend I love; only art and literature can do that. Science deals with fixed concepts, art with fluid concepts.

This is Bergson's position as I understand it. Living nature is like a work of art, and our descriptive science fails to render its true meaning, or grasp the nature of the evolutionary movement. The feelings, the perception, and the spiritual insight that go to the making and the appreciating of a creative work are alone equal to the task.

Resolve all the processes of organic nature into their mechanical and chemical elements, and you have not got the secret of living bodies any more than you have got the secret and meaning of a fine painting by resolving it into its original pigments and oils, or of a poem by cutting up the words into the letters with which it is composed.

Bergson's attitude of mind in "Creative Evolution" is foreshadowed in a passage in Royce's "Spirit of Modern Philosophy." Royce is speaking of the series of purely physical events which our descriptive science shows us in evolution: —

> Look upon all these things descriptively, and you shall see nothing but matter moving instant after instant, each instant containing in its full description the necessity of passing over into the next. Nowhere will there be, for descriptive science, any genuine novelty or any discontinuity admissible. But look at the whole appreciatively, historically, synthetically, as a musician listens to a symphony, as a spectator watches a drama. Now you shall seem to have seen, in phenomenal form, a story. Passionate interests will have been realized.

Bergson reads this story of organic evolution in the creative and sympathetic way. He does not deal with it solely through his equipment as a man of science, but primarily through his equipment as a great creative artist and inspired seer. Not intellectual analysis, but intellectual sympathy, gives him the key to the problem of life. Intuition is his method, which he opposes to the analytical method of science.

Science sees the process of evolution from the outside, as one might a train of cars going by, and resolves it into the physical and mechanical elements, without getting any nearer the reason of its going by, or the point of its departure or destination. Intuition seeks to put itself inside the process, and to go the whole way with it, witnessing its vicissitudes and viewing the world in the light of its mobility and in determinateness.

All the engineering and architectural and mechanical features of the railway and its train of coaches do not throw any light upon the real significance of railways. This significance must be looked for in the brains of the people inside the coaches and in the push of the civilization of which they are some of the expressions. In like manner when we have reduced biological processes to their mechanical and chemical equivalents, we are as far as ever from the true nature and significance of biology.

Organic evolution is something more than an illustration of the working of the laws of dead matter. A living body is the sum of its physicochemical factors, plus something else. The dead automatic forces of the earth went their round of ceaseless change for untold ages without escaping from the grip of mechanical necessity in which they were held; then there came a time when the spell was broken and the current of life arose. We have to speak of the event in this anthropomorphic way, as if it were an event, as if there were discontinuity somewhere, as if the creative spirit began its work as we begin ours. But evidently life did not begin in our human, practical sense, any more than the line we call a circle begins, or any more than the sphere has ends and boundaries. Our logical faculties, cast in the moulds of our experience, fail to grasp these problems. Life *is*, and, in some inscrutable way, always has been, and always will be, because it is one with the cosmic spirit.

IV

One phase of this new world which Bergson's "Creative Evolution" opens to us is this play and interplay of spirit and matter, or this struggle for the mastery, or shall I say for the union between them, of which organic evolution is the drama — a real drama unfolding throughout the biologic ages, with vicissitudes, failures, and successes. We see the current of life, spirit, consciousness, making its way through matter, struggling with it, hampered and retarded by it, as a stream wearing its channel through the soil wastes itself and is delayed, divided, but ever onward flowing by reason of its essential mobility. The branchings and the unfoldings of life in the process of evolution have been contingent and indeterminate in the same way — inevitable, but plastic, yielding, accommodating, taking what they could get and ever reaching out for more. Life has succeeded, but its triumph has not been complete. It has been very human and fallible. Indeed, it is the complete humanization of life that makes Bergson's conception so pleasing and stimulating. It is the taking of it out of the realm of mechanical necessity or fatality, and the surrounding of it with the atmosphere of the humanly finite and contingent, that is new in philosophy. I hardly know why we should wish to believe that what we have always called God should have its problems and difficulties and setbacks, as we do, unless it helps us the better to understand the failures and imperfections in the world — the condition of struggle and unrealized ideals that is the common lot of mankind, and, in a measure, of all that lives. The soul dreams of perfection, but it is hampered and defeated by the body it animates; so did, or does, the Cosmic Spirit, but the obduracy of the matter through which it works makes it fall short of the perfection at which it aims.

There are two short sentences in Bergson which hold the key to his philosophy. "Living nature," he says, "is more and better than a plan in course of realization"; and again, "Everything is obscure in the idea of creation if we think of *things* that are created, and a *thing* that creates." Such views are the work of our practical intellect. When we see a house we think of the builder, when we see a watch we infer the maker, and this attribute of mind is necessary to our successful dealing with concrete things; but in organic nature the house and the watch are always being made, and every day is a day of creation; the forms of life are like the clouds in the summer sky, ever and never the same; the vital currents flow forever, and we rise to the surface like changing, iridescent bubbles that dance and play for a moment, and are succeeded by others, and ever others. The vital impulse absorbs Bergson's attention, "not things made, but things in the making; not self-maintaining states, but only changing states. Rest is never more than apparent, or, rather, relative." This is the way Bergson gets rid of the old conception of design and finalism in nature. He thinks of the creative impulse or tendency in terms of the mobile, the incalculable, the ever-changing.

Life hovers forever between the stable and the unstable. We cannot describe it in terms of the fixed, the geometric. Motion is not in place, it is in transition — neither here nor there, but forever between the two. Our bodies are like the clouds, ever and never the same. Hence our conception of life seems a contradiction, or two contraries united, which seems one absurdity; an ascending and a descending current balanced, a perpetual explosion, integration and disintegration going hand in hand.

The effort of matter and force in the inorganic world is to find a stable equilibrium; their effort in the organic world is to find an unstable equilibrium, to hang forever, as it were, on the pitch of the torrent, suspended between mobility and immobility, constantly passing from one to the other. Life is an interchange of the two, the perpetual translation and transformation of the immobile into the mobile. The effort of the inorganic forces to find a stable equilibrium gives us all the forms of mechanical energy and shapes the surface of the globe; the efforts of the organic to find and hold a state of unstable equilibrium give us all the forms of life. Gravity rules in one. What rules in and determines the other?

One may think of Bergson's conception of a living body under various images. I am reminded of it when I see at the fountain a little ball dancing in the air at the top of a slender column of water — the upward push just balancing the downward pull of gravity, and the ball playing and hovering perpetually. It is mobility and stability equalized. Diminish the force of the upward current and the ball sinks and sinks till it lies motionless at the bottom. So, when the pressure of life goes down, the living body fails and fails, overcome by the opposite tendency, till death ensues.

One may think of it under the image of the bow in the clouds, so frail and fugitive, yet apparently so permanent. It is not involved in the fate of the raindrops through which it is manifested. They fall but it does not. It is ceaselessly renewed; it hangs forever on the verge of dissolution. If the sun is veiled it is gone; if the rain ceases it is gone. Its source is not in the rain, but is inseparable from it. So matter is only the seat of life, not its source. Its final source is in the *élan vital,* as the source of the rainbow is in the sun. The sunbeams still pour through space whether they encounter raindrops or not.

Bergson thinks that consciousness, or the soul, is not involved in the fate of the brain, though momentarily dependent upon it. The true way in which to regard the life of the body is to postulate that it is on the road which leads to the life of the spirit. Souls, he says, are continually being created, which nevertheless, in a certain sense, preëxisted in the cosmic spirits as the bow preëxisted in the sun.

V

In a limited sense Darwin was a creative evolutionist also; in his view nothing in animal life was fixed or stereotyped; ceaseless change, ceaseless development marked its whole course through the geologic ages; his animal series is as mobile, or as much a flowing current, as Bergson's; species give rise to other species through the accumulation of insensible variations, but Darwin looked upon the whole process as mechanical and fortuitous. He did not hit upon any adequate reason for variation itself.

It has been aptly said that while natural selection may account for the survival of the fittest, it does not account for the arrival of the fittest. In Darwin's scheme, Nature was always blindly experimenting and then profiting by her lucky strokes, but why she should experiment, why she should try to improve upon her old models, what it was and is in the evolutionary process that struggles and aspires and pushes on and on, did not enter into Darwin's scheme. He did not share the Bergsonian conception of life as a primordial creative impulse flowing through matter. This were to transcend the sphere of legitimate scientific inquiry to which he applied himself. As living forms had to begin somewhere, somehow, Darwin starts with the act of the Creator breathing the breath of life into one or into a few forms, and then through the operation of the laws which the same Creator impressed upon matter, the whole drama of organic evolution follows. Secondary causes, by which he seems to mean the laws of matter and force, complete the work begun by the Creator.

After all, the differences between Darwin's and Bergson's views of evolution are not fundamental. They conceive of the creative energy under different symbols, and as working in different ways, but it is finally, in both cases, the same energy. Whether living beings are evolved as the result of laws impressed upon matter at the first, or whether they arise by the ceaseless activity of a psychic principle launched into matter, at a definite time and place, as Bergson teaches, is mainly a difference in the use of terms. Both theories start from the same centre; they diverge only as they are worked out toward the periphery. Darwin conceives of primary and secondary causes, Bergson conceives of an original creative spirit, ceaselessly struggling to evolve living forms out of inert matter. Creation as a special event is a past history with Darwin; it is an ever-present event with Bergson. New species are accidental with Darwin, they are contingent and unforeseeable with Bergson; the creative impulse, like the genius of the creative artist, does not know the form it is looking for till it has found it; on other planets, amid other conditions, evolution may result in quite other forms.

When I try to conceive of Darwin's laws impressed upon matter, I can see only the creative energy immanent in matter. I see the *élan vital* of Bergson framed in another concept. When I recall the famous utterance of Tyndall in his Belfast address of over thirty years ago, — namely, that in matter itself he saw the promise and the potency of all terrestrial life, — I see, in another guise, Bergson's principle of creative evolution. How matter came to have this power, Tyndall says he never ventures to inquire. Elsewhere he speaks of the primeval union between spirit and matter. The scientific mind, like Tyndall's, so conversant, with the protean forms hidden in matter, and so moulded by the method of verification, hesitates to take the step which the more philosophical and imaginative mind, like Bergson's, takes readily and boldly. But whether we conceive of the final mystery of life as hidden in the molecular mechanics of Tyndall and Huxley, or in the entelechy of Driesch, or in the *élan vital* of Bergson, it seems to me makes little difference. Life is a species of activity set up by something in inert substance, as unique and individual as that set up by heat or electricity, or chemical affinity, and far less amenable to our analysis. As so many of its phenomena, such as metabolism, reproduction, assimilation, adaptation, elude all interpretation in terms of exact science, we can only appeal to philosophy or to teleology — to the light that never was on sea or land — for an explanation. And when we invoke the light that never was on sea or land, positive science turns its back and will have none of it. Things not on sea or land have no place in its categories. But Bergson is full of this light, it radiates from nearly every page, and this is one great source of his charm, and of his power to quicken the spirit. It is his art, his vision, the witchery of his style, the freedom and elasticity of his thought, and not the net result of his philosophical speculations, that carry him, as a prophet and an interpreter of nature, so much beyond the sphere of Darwin and Spencer and Tyndall.

Thus at the centre of their conceptions, at the point from which they start, our natural philosophers do not seem to differ radically. They all begin with life in some form, hidden somewhere in matter. There is no dead matter.

All our philosophers look to the sun as the source of the energy which the organism uses and manifests. But M. Bergson fixes his attention upon life as something working in the organism and releasing at will the energy which the organism has stored up. There is always in his scheme this free agent or being, called Life or Consciousness, which works its will upon matter, while with Tyndall and Huxley and Haeckel attention is fixed upon this mysterious force which they conceive of as potential in the ultimate particles of matter itself. Out of this force comes life; vitality is in some way identified with molecular physics, matter has no forward impulse or current as Bergson conceives it, but the phenomena of life appear when the atoms and corpuscles are compounded in certain proportions and in a certain order. One sees a psychic principle launched into matter where the other sees mechanical and chemical principles; one humanizes a force, and makes it of the order "willed"; the other dehumanizes it, and makes it of the order "automatic." Both deal with mysteries, but one is a human or spiritual mystery, the other a scientific mystery; one puts a Creator behind nature, the other finds a creator in nature, but calls it molecular attraction and repulsion. Tyndall pays homage to the mystery that lies back of all, M. Bergson pays homage to the freedom and plasticity, the creative activity of all. A mechanical movement is translation, a vital movement is transformation. In Bergson's scheme every living thing is creating itself continually; this creation of self by self for self is what separates living matter from the non-living by a gulf. The life-process is indivisible, it is whole every moment. It is symbolized by the curve, which returns forever into itself, and a curve is no more made up of straight lines than life is made of physicochemical elements. The intellect working through science can only explain the genesis of life in terms of physics and chemistry. "Analysis will undoubtedly resolve the process of organic creation into an ever-growing number of physicochemical phenomena, and chemists and physicists will have to do, of course, with nothing but these. But it does not follow that chemistry and physics will ever give us the key of life." To get a correct notion of life we must break with scientific habits of thought, we must "go counter to the natural bent of the intellect."

Is one's own apprehension of the truth of these distinctions of M. Bergson's intuitional or logical? In my own case I feel that it would be hard to give logical reasons why I believe that we are nearer the truth when we think of life under the image of a curve, than under the image of a right line; or why I see that nature's method is an all-round method, like the circle, while man's is a direct method like a straight line. We seem driven to the conclusion that all transcendental truth — truth that transcends our reason and experience — comes by way of the intuitions. The daring affirmations of a writer like Emerson — the very electricity of thought — are intuitional. The great truths in Whitman, shining like beacon lights all through his rugged lines, cosmic truths of the moral nature, — one may call them glimpses into the depths profound of the moral universe, — he never came at by any logical or ratiocinative process. "Logic and sermons never convince," he says. "The damp of the night drives deeper into my soul." They are truths of the intuitions. M. Bergson's conceptions of life seem to transcend logic and reason in the same way.

VI

Probably never before was there so successful an attempt to reconcile contradictions, to make the difficult, not to say the impossible, the easier way. It is so easy to prove determinism, fatalism; so difficult to see the road to free will, liberty, and the ascendancy of the spirit. The weight of the whole material world is on the side of determinism. All our intellectual and logical faculties are trained in this school; we can act successfully upon matter only when we regard it as held in the leash of irrefragable law; through the conceptions of geometry and mechanics we conquer and use the material world. Our civilization is the product of these conceptions. Any indeterminism, any inexactness, in measurements and calculations, any of the freedom of life admitted into our dealings with matter and force, and we come or may come to grief. If we built our houses as we often build our arguments, they would fall upon our heads. But Bergson's philosophy does not fall upon our heads, because it is buoyant with spirit; it is not a mere framework of logical concepts; it is a living and not a dead philosophy; it is more like a tree rooted in the soil, not a framework of inert ideas. It is Gothic rather than classic; its symbols and suggestions are in living things.

I can fancy how like a dream or the shadow of a dream all this may seem to the rigidly scientific mind — the mind that has always dealt with the solid facts and the measurable forces of the mechanical world. And science, as such, can deal with no other. Its analysis necessarily kills living matter, and when it deals with the living animal none of its vital functions fall within the sphere of the mechanical and chemical categories. When it tries to formulate the psychic, it finds itself dealing with the vague, the unforeseeable. What is true of the psychosis of one animal is not always true of another of the same species. As soon as we enter the sphere of life, we enter the sphere of the variable, the incalculable, the supra-mechanical; and when we enter the sphere of mind, the doors of the unstable and unpredictable are thrown still wider open.

In theory Bergson says it is a kind of absurdity to try to know otherwise than by intelligence or reason. How can intelligence go beyond intelligence? Is not all this step of setting bonds to intelligence taken by the aid of the very faculty to which we prescribe limits? By life alone is the contradiction solved. As in swimming, action, the fearless plunge, cuts the knot; and we swim by the same members we walk with. A man can lift himself over the fence if he uses the fence as a fulcrum, and life can overcome matter when it enters into it and uses it.

Our scientific faculties will carry us through the inorganic world and unfold for us the processes of inorganic evolution, the foundation of all suns and systems, and they will account for the present state of the earth on physical and chemical principles, and can with reasonable confidence forecast its state or condition in the far distant future. But when it comes to the living world, those faculties are baffled; when they pass from the astronomic and the geologic to the biologic, their mathematics and their physics do not go very far. They can analyze many of the life-processes and unlock many secrets with their mechanical and chemical principles, but they cannot account for life itself, they cannot reduce vital functions to scientific categories; they cannot account for the mind, for consciousness, nor show us the relation of thought to matter. Here some sort of philosophy is necessary, and here arise the scientific philosophers, like Spencer and others, and offer us their guesses or interpretations. Each and all take a leap in the dark; their science fails them and their philosophy comes to their aid. Many of the physical objects of life can be dealt with by science, but its psychic aspects cannot be so dealt with; a science of psychology is impossible. Biophysics are not the same as geophysics; there is a new, unknown factor to be dealt with. Evolution is not a mere process; it is a progress; it is not a circle, but a spiral.

"Creative Evolution" is likely to live as literature even though it should be discredited as philosophy. Attacked its philosophy of course will be, and has been. But vitalized by such a style and humanized by such a spirit so in fellowship with the highest emotions and aspirations of the soul, Bergson's philosophy, I think, stands a better chance of surviving than any other system of our time. It is a proclamation of emancipation to minds in the bondage of materialism and mechanism. It makes free as the spirit alone can make free. Coming to his work from the dry, arid pages of Spencer, for example, is like coming from the atmosphere of a great manufacturing-plant to the air of the summer hilltops. It leavens what to many minds is the heavy world of scientific matter with the leaven of the spirit. Bergson is an inspired man, and he begets in us that inward joy and exultation which is the gift alone of "a prophet of the soul."

XIII

LIFE AND CHANCE

I

CHANCE, as we commonly use the word, plays an important part in all our lives and in the lives of all other creatures. According to a recent writer it plays an important part in the present great European war, or in Great Britain's relation to it. "Chance," he says, "located nearly all the available harbors on the English side of the Channel. Chance made it necessary for sailing ships to hug the English coast and to utilize English harbors in case of storm; chance provided winds and currents so variable that large fleets seldom found conditions favorable for the crossing of the Channel, the result being that only three of about fifty attempts to invade England succeeded." Chance in this sense has been one of the prime factors in all history and is a prime factor in our individual lives. So much that we are and do is contingent upon outward conditions over which we have no control. Where the laws and movements of inorganic nature come into play, our power of choice is negatived. We apply the word "chance" to these things, because they are not purposive, they serve no special end, they are the result of the action of irrefragable law. Hence chance in the physical world is but another name for fatalism.

The non-living, material bodies are in the grip of irrefragable laws. Toss a stone from your hand, and if we knew all the forces acting upon it, we could tell the precise point where it would strike the earth; we may say that it was foreordained from the foundations of the world just where it should fall. "Lawless as snowflakes" is a phrase used by Rousseau and then by Whitman, but snowflakes in their formation obey their own law of crystallization, and, in their descent to the ground, obey the forces of the air acting upon them. They are lawless to us because we do not see the forces that control them. The same fate or necessity rules throughout all inorganic nature, and it rules in the world of living bodies, so far as those bodies are in the grip of physical laws. What seems more lawless than the falling leaves of autumn, or the grains of pollen which the flowering trees and plants cast upon the air? But they are all as strictly under the control of physical forces as are the snowflakes, or the driving drops of rain, or the breaking waves upon the beach. When two celestial bodies collide, as now and then happens, it seems from our point of view purely accidental, as much so as when two persons collide upon the sidewalk. In the former case, if the astronomer knew all the forces at work, he could figure out just where and when the collision would occur, as accurately as he calculates when an eclipse of the sun or the moon will occur, and where upon the earth's surface it will be visible. But in the case of the two persons colliding upon the sidewalk, are any data possible that would enable us to anticipate such a collision? If we knew their past lives to the minutest detail, and their present occupations and their temperaments and dispositions, could we foresee when and where the encounter would take place? Huxley, who in his philosophy was a fatalist, and thought that if we had all the data that entered into the problem, purely human events could be forecast as accurately as could physical events, would say yes. M. Bergson and his school, who hold that life adds to matter a psychological principle, — something indeterminate and incalculable that frees it from the fatalism of mechanical laws, — would say no. In human life the material is, in a measure, under the control of the psychical, and the psychical is not bound by the rigid law of causation, as is the physical. This conclusion involves a super-scientific step which the rigidly scientific mind hesitates to take. But Sir Oliver Lodge does not hesitate to take it, though he is one of the leading physicists of his day. Indeed, Sir Oliver takes so many steps in that direction — such tremendous strides, one may say — that he is seriously discredited among his scientific brethren. His conception of a hierarchy of spirits that govern the universe savors of the remote prescientific ages. But the belief that the mystery of life involves other forces than the purely material ones — forces whose action cannot be foreseen or measured — is a proposition that exact science has not rendered and probably never can render incredible.

The more by searching we find out the true inwardness of matter, the nearer we find ourselves to the borderland of the unknowable, the transcendental, the incalculable. It appears more and more as if we might still be men of science and yet keep the words "soul," "spirit," "creation," "spontaneity," and the like as standing for real truths in the total scheme of things. I do not think those persons overcredulous who hold that human life in its most material aspects is not entirely a matter of chemical reactions and mechanical transpositions.

We apply the word "chance" to those events or happenings in our lives that were not designed or foreseen. In our good luck and bad luck our wills are not consciously concerned. The famous apple that fell upon Newton's head was a chance hit, though its falling was the result of the action of immutable law; but Newton's position in the line of the apple's fall was, so far as his will was concerned, a matter of chance. Here a new factor comes in, the incalculable behavior of a living body. We cannot bring its activities to book as we can the movements of a non-living body. Yet up to a certain point living matter is in the grip of the same physical laws as the non-living — inertia, gravity, friction, mechanical and chemical principles play the same part. There are not two sets of physical laws, one for the living and one for the non-living, but into the movements of the former, even the humblest, there enters another principle which is not in the same sense amenable to physical law. A purposive act may use gravity, but its genesis is above and beyond gravity. I cannot walk across the room without the aid of gravity, but gravity has nothing to do with the motive that sets me moving. The chemical reactions in my body are the same as those outside my body, only there are far more of them, and they are of greater complexity, but the purposeful organs and activities in the living are unknown in the non-living world.

We call that fortuitous or accidental in which we see no purpose or design. The shape of the rocks, the lines of the hills, the course of the streams, are matters of chance. They are not purposive. The whole earth's surface, the distribution of land and water, of mountain and plain, is in this sense accidental, though the result of the action and interaction of unimpeachable physical laws. Given the conditions and the forces at work, these things could not have been otherwise, though being otherwise would have made no difference in the total result. (Of course, a different distribution of the land and water upon the globe would have made a vast difference in the distribution of life upon the globe, but not to the non-living bodies.) A natural bridge in the rocky strata, the rude architectural and monumental forms in the rocks of the Southwest, are purely matters of chance, in the sense in which I am using the word. But the forms of vegetation and of animal life are not in the same sense accidental; they are purposive. All the parts of a living body are subordinated to the whole. Hence it possesses a unity in the sense that a non-living body does not. The unity and subordination of parts of a machine are given to it by the builder, and are not an evolution from within.

The question whether the beginning of life upon the globe was itself accidental — a fortuitous chemical reaction — is a question upon which our natural philosophers are divided. In this whole problem the accidental and the purposive seem so blended that it is a difficult matter to find our way between them. The mechanistic conception of life, which is winning more and more acceptance among scientific men, looks upon it as accidental, as truly so as are the sparks struck out by two colliding bodies. In this view man himself is as much the result of the action of the blind, irrational forces which we see in the inorganic realm about us as are the rains and the dews, the winds and the tides. Given the elements and the physical laws about us and these things are inevitable. Is life inevitable in the same sense? Was it predetermined in the constitution of matter and its laws? One cannot say that the profile in the rocks was predetermined in this sense — only the possibility of it. The conjunction of circumstances that gave life to the globe, the mechanists would say was a matter of chance; this specific conjunction might never have happened, or might have been vastly delayed, or accelerated, as maybe it was. But the law of probability would sooner or later have brought it about. The law of probability will in time, or in eternity, throw our earth into the arms of a comet, and our sun against another sun coursing in space. If celestial bodies collide once, then they will collide twice, and thrice, and ten thousand times; so if the conjunction of matter that resulted in life happened once, it will happen again, and may have happened any number of times in the past history of the cosmos.

It is quite certain that there could have been no man and none of the higher forms of vertebrate life, had not the land risen above the sea. There is enough water on the globe to cover all the land-areas at a depth of two miles. With the continents thus submerged, of course the present forms of terrestrial life could not have developed, and if we look upon this elevation of the land above the sea as a matter of chance, — the result of the hit-and-miss warring of the purely mechanical forces, — then is man to that extent involved in these contingencies. In this sense I think all terrestrial life is accidental. The working of the same physical and mechanical forces lies far back of him in the depths of the astronomic ages. Physical laws, so far as all forms of life are concerned, work irrespective of them. If the winds or the tides bear the shipwrecked mariner to safety, we say it was accidental; likewise where the air-currents will drop the winged seed is a matter of chance. The same chance, or law of probability in regard to living things, prevails as to where the thunderbolt will strike the earth. It is more probable that it will strike certain kinds of trees in the landscape than certain other kinds; in a wood of mixed hemlock, pine, oak, maple, beech, the chances seem to be that the pines and the hemlocks are in the greatest danger. Physical laws determine these things, as they do when buildings and persons are struck. In the human sense Nature does not select. In her garden there is nothing that takes the place of man who selects one of two, or favors one and suppresses the other, and takes a short cut to specific ends. Nature does not guard against waste or delay. All time and all matter are hers, and her losses and gains are all one.

The forests get planted and trimmed, and a certain sort of order and unity prevails among them — the pines in one place, the spruce in another, the beech, the maple, the oak, the cedars in still others. Some species, such as the ash, the maple, the elm, the linden, give their seeds wings, or devices to hold gravity in abeyance, and the wind scatters them. The cedars, the oaks, and all the nut- and fruit-bearers depend upon living creatures who feed upon their fruit to scatter their seeds. In all cases the element of chance plays an important part.

Life is such a mysterious thing, — if it be a thing, or an entity, at all, which so many later biologists dispute, — its goings and comings are so incalculable; it is so involved in the material forces, and yet seems so superior to them; it plays such a small part in the totality of the cosmos, and yet appears to be the one event upon which all things wait.

If we use the word "chance" as opposed to "design," or "law" as opposed to "intelligence," — which to me amounts to the same thing, — then, in the last analysis at least, the conditions of life were a matter of chance.

There could be no life as we know it till the earth was ripe for it, till the waters were gathered together with the air swimming above them, and the crust of the earth cooled and became comparatively stable. And all these things were the result of the operation of irrefragable physical laws — not of the order or relation of parts that result from intelligent design, but of the equipoise and adjustment that come from the conflict of blind, irrational material forces. This introduces us to the world of chance or of fate, just as we choose to regard it—chance as being void of thought or purpose and fate as being in the grip of immutable laws.

The law of chance and of probability is competent to account for all the particular forms which bodies assume in inorganic nature — a natural bridge, a profile in the rocks, obelisks, architectural forms, brought out by erosion, etc.; but can it account for the forms of living things? The forms of living things are purposeful; the forms of non-living things serve no purpose, there is no particular end to be served by them. The forms of crystals are not haphazard, they are predetermined, and yet they serve no purpose. The exquisite and mathematical forms of the snowflakes serve no purpose; such things are the result of a particular activity in matter, and seem in some way to bridge the gulf between the organic and the inorganic. Chemical activity foreshadows vital activity, and is the parent of it. Though life arises out of chemical reactions, yet a philosophy of life expressed in terms of chemical reactions is barren or unsatisfactory.

Can the ocean tides be defined and accounted for in terms of the mobility of water? The water in the pond has the same mobility, but it has no tide. To account for the tides we must look beyond the mere fluidity of water, though without this fluidity there would be no tides. No more can life be defined and accounted for in terms of its chemical and physical changes, though these are inseparable from life.

Behold the great tidal impulse rolling around the world, heaping up the waters on this shore and on that, and nullifying its tendency for the moment to a dead equilibrium. In like manner behold the organic impulse flowing through matter and lifting it up into myriads of novel and beautiful forms and defeating its tendency to settle back into a dead equilibrium.

I would not say in the case of life that there is anything analogous to the lunar and solar attractions, but would only suggest that there is some primordial and inexplicable impulse in matter that is not explained by its chemical and physical processes.

Chance plays a greater part in vegetable life than in animal life, and it plays a greater part in the lower forms of life than in the higher. The fertilization of plants is mostly brought about through the agency of winds and insects, which are chance happenings, contingent upon many things. The fertilization of certain lower forms of animal life, such as fishes, is brought about by the agency of water or outward forces, and hence chance enters largely into the problem.

II

It may help us to get nearer the truth of this question of chance in its relation to the origin of life if we consider the fortuitous and the accidental, not as they occur in a world of mechanical movements, but as they occur in a world of chemical reactions. The fortuitous among chemical bodies is quite a different thing from the fortuitous among ponderable bodies. We might shake together the parts of a watch for all eternity and not get that adjustment of the wheels and springs that makes a watch. If a thousand of brick are dumped upon the ground, is there any probability that they will take the form of a house? Or if the letters of the alphabet are shaken up together in a bag, is there the slightest chance that they will arrange themselves into words and that the words will arrange themselves into intelligent sentences? In all these things the parts have no attraction for one another, but among chemical compounds, out of which living bodies are built up, there rules the selective force of chemical affinity. The elements select their partners. It is a marriage in which two literally become one. Chemistry is on the road to life; chemical transformations lead up to the transformations we call vital. The physical forces transport and transpose and seek a state of rest; they sort and sift the sands and gravels and clays of the soil, depositing them in a regular series, but they never get beyond the realm of mere chance. The clouds are ever changing, but they never change into living forms. The waves shift and pile the sands endlessly upon the shore, but the shore is always essentially the same. Gravity is the ruling force. But among chemical bodies a new force appears; chemical affinity is here the determining factor. The law of probability plays a secondary part. Spontaneous combustion, for instance, is a molecular accident only in a limited sense. The antecedent conditions may be in a measure accidental, but the chemical reactions that bring about the rise of temperature to the point of combustion are not accidental; they inhere in the constitution of the elements. Life may be of spontaneous and fortuitous origin in the same sense; not a mere chance happening among unrelated bodies, but the continuation of long-antecedent conditions brought about by that mysterious force we call chemical attraction. This force, as it were, gives the elements eyes, and hands, and feet, and power of choice, and determines the line of their activities. Liquid water, without which life could not exist, was contingent upon the chemical union in fixed properties of the two gases, oxygen and hydrogen; accident may have played a part in the meeting of those two gases, but, once met, under the proper conditions, water was bound to appear. The chemical union of oxygen and silica, which forms so large a part of the earth's surface, was predetermined by the nature of the substances, but the forms of the landscape and the size and the shape of the continents were not in the same sense predetermined. An entirely different disposition of the land surfaces of the globe than the one we behold might have occurred.

Life has its roots in the ground. Everywhere in the inorganic world are movements that foreshadow the organic; inanimate nature is dreaming of the animate. If the worm, as Emerson says, "is striving to be man," the clod is no less striving to be worm. The crystal prepares the way for the cell. The flowing currents of air and water are forerunners of the flowing currents of the living body. Solutions, precipitations, chemical reactions, oxidation, osmotic pressure, assimilation, disassimilation, catalytic power, all antedate and apparently lead up to the movement in matter that we call vital. Life had a large capital to begin on. Its house was well furnished, and its servants awaited its call. It was dowered with the air, the water, the soil, the warmth, the light. The four estates of matter — the solid, the fluid, the gaseous, the ethereal — were its special inheritance. They furnished the conditions. The colloids mothered it, the catalyses fathered it. Electricity, radio-activity, chemical transformations, are parts of its assets. The forces of life are only the forces of inert matter imbued with a new purpose. In the living body we see the same old chemistry and physics working to higher ends. The chemical transformation of the two substances into a body totally unlike either is a forerunner of the magical changes in the conditions of matter wrought by life. The scientific philosophers find no tendency or activity in living matter that they cannot match in the non-living; hence to them there is no difference between the two that experimental science can grasp. But behold the difference to our consciousness! The difference lies in the purposive activities of one that are absent from the other. There is no purpose in the facets of a crystal in the sense that there is purpose in the forms and structures of living bodies. The hinge of a bivalve has purpose that is determined by the needs of the organism; but what purpose have the lines of cleavage in the rocks, or the contours of the hills, or the courses of the streams? All these things may serve man's purpose, but they are meaningless when regarded in their own light. There is no significance in the whistle of the wind about your house, but a whistle of another kind there in the darkness would startle you. The sounds of inanimate nature mean nothing, but all sounds that proceed from living, moving things are significant. The rainbow is an optical phenomenon, and, though a beautiful symbol to us mortals, it is not purposive; it plays no part in the physics of the storm. There is no purpose in the glint of the dewdrop nor in the sparkle of the diamond, but there is purpose in the flash of the firefly and in the beam of the glow-worm. The gay plumage of certain birds has a deep significance that does not attach to the brilliant hues of precious stones.

All the movements of nature may be divided into rational and irrational. The movements of living things are rational; they serve a purpose in meeting the needs of those things; but non-living things have no needs, hence their movements are fortuitous and irrational.

The collisions and disruptions that take place in the vast depths of sidereal space show that chance takes a hand in the game even there, though the universal law of gravitation is not annulled.

III

Though one has trouble in reconciling the hit-and-miss method of Nature which one sees all about him — her blind, groping, experimental ways — with the obvious purpose and order which one sees in all living bodies, yet the reconciliation somehow exists. Here life appears and here it goes on amid accidents, delays, waste, failures; at war with itself, at war with the physical forces; rooted in the inorganic, but perpetually crushed and destroyed by it; the long evolutionary process crowned by man as if he were the end of it all, yet man beset by a thousand enemies, internal and external; his history marked by war, pestilence, famine, suffering, injustice, the monstrous and the abnormal; the methods and aims of intelligence seen everywhere in the organic world, yet intelligence hampered by matter and struggling to be free; chance taking a hand in every game in life, and only life itself seeming superior to the clash of conflicting forces.

We have at once to look upon the organic and the inorganic as occupying two different planes. In the world of inert matter one sees only the operation of fixed laws: things cannot be otherwise than as they are; fate rules; the balance of forces is fatefully kept. But when we reach the world of living things all this is changed: the books are never balanced; there is purpose, flexibility, indeterminateness, a shaping of means to an end, an ever-changing fixity, movement which perpetually defeats the tendency in matter to a dead equilibrium. In life matter takes on a new behavior, enters into new combinations, builds up new forms, and in a measure escapes from the law of necessity that rules inanimate bodies.

Life is like those figures which the sculptor sometimes carves when he shows us the form of a youth or a maiden partly freed from the shapeless block of marble — the flowing and delicate lines of life are quickly lost in the ragged and broken lines of the insensate stone. Life is hampered and bound by the fatality of matter in the same way; the organic is still in bonds to the inorganic; it is half one and half the other, and is constantly struggling for mere freedom. This struggle is the drama of evolution, and the drama and tragedy of human history. Its very condition is the union of two opposing elements — fate and freedom wedded in one movement. Life without that which hampers and holds it would not be life; it would have no reality, no expression. The struggle and the antagonism give it body and power. It also opens the door to chance, or fortune, as the ancients called it.

The living has to adapt itself to the non-living. The latter is uncompromising; it goes its own way if all life perishes. But life is plastic, inventive, compromising; it takes what it can get; under the pressure of outward conditions it is perpetually changing; it flows on like a stream, taking the form that external conditions impose upon it, but ever flowing. It would not be life without this inherent movement.

All life asks is opportunity; it takes its chances in the clash of opposing forces; it loses at one point and gains at another; the hazards of time and change modify it, hindering or helping it, but do not extinguish it.

Forms grow old, but the life-impulse does not grow old. The animal brain suddenly began to increase in size in Tertiary times. Why? To account for evolution, as I see it, I have to substitute something like the creative impulse of Bergson for the mechanical and fortuitous selection of Darwin. The process of evolution would have stopped, or never have begun, had there not been the inherent tendency of life to struggle up to higher and more complex forms. Mechanical forces seek rest; life forces seek action and change. A static equilibrium is the tendency of the one; a dynamic disequilibrium is the aim of the other. The boy's hoop stands up as long as he keeps it running; it does not have time to fall, gravity is defeated every moment. This is a type of living matter; the life impulse keeps it from stopping and falling down.

It is easy to see that chance, or the law of probability, would have brought the world of dead matter where it is, but the living world presents a different problem. Here we strike the world of organization, parts fitted to parts, and parts subordinated to parts, the many organized into the one. Still there is the same hit-and-miss method of the action and interaction of bodies upon one another, the blind inorganic forces taking a hand in the game of life; the seeds are sown by the chance action of the winds and the floods, the forests are planted and trimmed by chance; the chance actions of squirrels and jays and crows plant the heavy nuts, the grazing cows plant the apple and red-thorn seeds, the fruit-eating birds scatter and drop the many small fruits; there is chance in the planting and trimming and weeding of Nature's garden, and in its locality, but is there chance in the production of her living gardener, in life itself? It is in the reciprocal action of the living and the non-living that life goes on. Chance, inside of mechanical and chemical laws, rules in the one; chance, limited and subordinated to specific ends, rules in the other. Fate and freedom each play a part in life. The plants that spread by runners are free to spread in all directions, but they are fated to run; the vines that climb by tendrils are free to reach out in all directions, and their tendrils react to whatever they touch, and cling there; the fate of their organization limits them to this mode of getting up in the sun and air. Were there not something fixed and upright, the tendriled vines and plants could not get on in the world. Every tree and every plant has its typical form, but what variations inside that pattern or form! The pines and spruces must throw out their branches in whorls at regular intervals, with one central shoot leading the ranks upward; this is the fixed or stereotyped form, but kill the central shoot, and the tree is free to promote one of the lateral shoots to take the place of the lost leader. The maple-leaves, the oak-leaves, are of fixed patterns, but how hard to find two leaves of the same tree that are exactly alike! The mating of the queen bee and the drones in the air of a summer's day is a chance meeting; the mating of men and women from which marriages result is largely a chance meeting; the fertilization of flowers through the agency of insects is largely a chance occurrence; if the weather is bad for a number of consecutive days, the fertilization does not take place. Chance enters into life in this way. As the inorganic forces are blind and haphazard, and the wind bloweth where it listeth, the success of the organic forces, so far as they draw upon these things, is fortuitous also. Aristotle seems to think that organisms are under the same rule of necessity as prevails in the inorganic world. The rain, he says, does not fall in order to make the corn grow any more than it falls to spoil the corn when it is threshed out in the field. This is the modern scientific view. The weather-system is indifferent to crops; the rain falls by reason of the laws of physics, which always acts the same under the same conditions. The rain is not designed for the corn, but the corn avails itself of the rain because it has organic needs. The rain has no needs; inert matter has no needs; it is ruled by necessity, but living things are ruled by a different order of necessity — the necessity arising from their internal spontaneity, of which Aristotle speaks. Aristotle thinks that the teeth and other organs of an animal have a merely accidental relation to its body, and to all the parts to which we attribute design; they continue, and are perfected because they are useful. This is natural selection before Darwin. But it is more in agreement with the thought of to-day to regard all the parts of a living body as the result of an inherent demand of the organism — the "internal spontaneity" which Aristotle had in mind. All parts of living bodies are appropriately constituted, but the word "appropriate" does not apply in the same sense to winds and clouds.

IV

Contingency attends all forms of life, but determinism rules throughout the realm of insensate matter. The pulp of all fruits is purposeful; it is a wage for any animal that will come and sow this seed, but behold how largely chance enters into this bargain! The heavy nuts have neither hooks nor springs nor wings, but they are toothsome to birds and beasts which supply feet and wings, hence they get scattered. Every part and organ of a living body is purposeful, and not the result of chance as we use the term, but its lot is cast in a world of unorganized material forces, which go their endless rounds from one static condition to another, bound in the iron law of causality.

Nature makes her knives and shears and drills and chisels and augers and hammers a part of a living organism, while with man they are but the mechanical extension of his hand and brain. The parts of a watch are no more purposeful than are the parts of the human body, and are no more the result of a "fortuitous concourse of atoms"; but there is no mystery about a watch; it can all be explained in terms of mechanics plus the mind of man. A living body cannot be so explained; the mystery is in the organizing principle which defies all analysis and all attempts at reproduction. "Natural philosophy," says Professor Soddy, of Glasgow University, "may explain a rainbow, but not a rabbit." We can produce a rainbow at will, but only rabbits can produce rabbits. Yet Professor Soddy seems to think it is not improbable that the time will come when the chemist will be "able to synthesize foodstuffs apart from the life-process." If he means directly from the inorganic elements, I do not see why it would not be as easy to synthesize a rabbit as to synthesize a peach, or a kernel of wheat, or a beefsteak, or an egg, "apart from the life-process."

Fate and freedom play with or against each other in all living things; there is fate in the material conditions of life, and freedom in life itself; their interaction opens the door to chance; freedom of choice in us makes all our mistakes and failures possible. Life is plastic, fluid, a flowing metamorphosis, ever and never the same.

When the wind snatched my hat off my head the other day, and carried it down the street amid a cloud of dust and dry leaves, whisking it across to the other side and between the feet of a colored man bearing a big bundle of excelsior on his shoulders, the hat was completely in the grip of the fateful material forces. But the colored man who seized it and held it was force of another kind. The wind might have carried him away also had it been stronger, but he would at least have struggled and opposed his strength to it. And it is in this that the freedom of life consists — freedom to struggle, to push on, to overcome obstacles, and to turn the inorganic forces against themselves, thus making life strong by the strength of the obstacle it surmounts. We cannot still the wind, but in our sailboats we can use it.

The extent to which the law of probability rules in the organic world is seen in the fact that the proportion of males to females among all species keeps pretty uniform. In any given city or country there will probably be about the same number of deaths from the various diseases year after year, unless some means of fighting disease are employed. There will be about the same number of weddings and elopements, about the same number of defective persons born, about the same number of persons that reach extreme old age, and of persons above or under the average height. The fluctuations about a common mean in all things will be pretty regular. Indeed, the law of averages plays about as full a part in organic as in inorganic nature. It is probable that just about as many boys will be drowned while skating each winter and while bathing each summer.

In a world of pure mechanics and chemistry all these things would remain about the same, century after century. But the reason and soul of man introduce a new element, and the dice are loaded, at times, at least. Still, the law of probability plays a prominent part in the affairs of men and nations.

Over and above our wills and purposes stream the great cosmic currents which we cannot stem, but which, in a measure, we can and do utilize.

Development is what distinguishes the living from the dead. Friction and collision, warmth and moisture, do not develop the pebbles on the beach.

A variation proves advantageous only to something growing, expanding, and seeking advantages and capable of profiting by them. The tendency of the action of outward physical forces upon a body is to produce uniformity, and if living bodies were shaped by these forces alone they would all be alike. If there was not something in every living form that was *sui generis*, they would all be alike.

The slight variations in the forms of living things are doubtless the result of outward chance occurrences. In passing from the purely mechanical to the vital, we seem to enter a realm where the dice are loaded, chance still plays a part, but a secondary part. The perfect apple on the tree has escaped many mishaps of wind and storm and hostile insect and germ, but it is not a matter of chance that it is an apple, and that it is sweet or sour, red or green, round or flat. That variety of apple is always thus with possible modifications. Soil, climate, exposure, culture, all have their influence.

In all marriages and social relations chance plays a part — a chance meeting, an auspicious moment; but sex and the social instinct are not a matter of chance. There is no chance in the workings of the Mendelian law; it is mathematically exact.

If a hybrid which results from the crossing of two varieties that differ from each other only in one specific character, as in color, or tallness, or shortness, be planted, we know that one fourth of the seeds will take on the character of one grandparent, and one fourth take on the character of the other, and that the other two fourths of them will take on the character of the hybrid, and that this order will repeat itself endlessly. Chance takes no part in the result. The dominant characters are constantly separated from each other in the second generation to the extent of one half, while the other half remains hybrid.

The element of chance enters into all the operations of outward nature. Not a flower blooms, not a fruit forms, not a drop of rain falls, not a child is born, but is more or less contingent upon the changes and fluctuations of the natural currents and forces. But the capacity of matter itself to produce life we cannot think of as accidental; only its development is subject to the law of chance in a world of conflicting forces.

If the seed did not possess an innate tendency to grow and unfold under favoring conditions, the flower, the fruit, could not appear, nor the child be born. And if matter did not possess potential life, life could never have appeared in the world.

I conceive that the appearance of life upon this globe was a matter of chance in the same way that fertilization or impregnation in the vegetable and animal world is a matter of chance. There is the possibility of fertilization to start with, and there is the inherent tendency, but unless conditions favor, — conditions that are contingent upon many things, — it does not take place. In the vegetable world, storms, frosts, rains, floods may prevent fertilization; or the part played by insects may be negatived in some way. In the animal world, external conditions, as well as internal, must also favor, and fortune certainly plays a part in the game. In cold, late springs the first birds' nests contain fewer eggs than the nests do in warm, early seasons. One summer there is an invasion of insect pests — grasshoppers, or tent-caterpillars, or forest-worms; the chance conditions favored them. The next season the country may be quite free from them, the conditions having been reversed. The slow or the rapid increase of the population of a country is contingent upon many things. Economic conditions play a part, climate plays a part, the geography and the geology play a part. What a part the Gulf Stream has played in the life of the British Islands! What a part a great river, an inland sea, or a much broken coastline plays in the life of the countries to which these belong! Life is expansive, tends to push out and develop, but it is at the mercy of external conditions. Environment is either a check or a stimulant.

The origin of life and the many forms it has taken were probably a matter of chance in the same sense that the origin of springs and streams and the formation of rivers were matters of chance. Given our weather-system, and the unequal elevation of land above the sea, and fountains and streams are bound to appear, but they will all be modified and shaped by the chance conditions they encounter. Water will flow, and the tendency of life to push out and on, and organize itself into new forms, is equally inherent. It seems to me we have to take into account this innate expansive or evolutionary force in living matter. To ask whence it comes, how it is related to the matter which it animates, as mankind so long have asked, is at once to get beyond sounding. All forms of life bear the stamp of the environment. Life must adapt itself to its material conditions. And this living adaptation of life to its environment is radically different from a mechanical adjustment. Inanimate bodies adjust themselves, animate bodies adapt themselves. It is this power of adaptation which makes all purely mechanistic conceptions of life so inadequate. The only machine that can fit itself to the medium in which it moves is the living machine. To inquire into the fitness of the environment is to reverse the problem, and leads to confusion; since the environment is uncompromising, and life must adapt itself to it or cease to be. Man can and does alter his environment to a limited extent, but not so radically as his environment alters him. He cannot change the air he breathes, or the water he drinks, or the nature of the food he eats, nor change his vital relations to the physical world. His mechanical relations, to a certain extent, wait upon his will, but his vital relations are forever fixed. The place and the hour leave their mark upon everything — more upon the plastic and adaptive forms of life than upon the rigid and immobile forms of death. If you and I had been born in another month, another season, or in another country than we were, can there be any doubt that we should have been quite other than we are? If Carlyle had come and settled here when Emerson invited him, is it not almost certain that his outlook upon life would have been radically changed, and his literary output different? The currents flow; life moulds itself to the moments as they fly. The almost infinite diversities of types and characters attest the influence of the chance happenings in the environment. The plains beget one type of life; the mountains, the desert, the sea, the wilderness beget others. The professions and occupations beget their types. The general type of a race long adjusted to its environment — the English, the French, the Arabian, the Mongolian — remains fairly constant, but inside this constancy occur the slight local differences owing to differences in environment. No doubt extraordinary men are in a measure the result of happy accident. There are determining or favoring factors — race, climate, family inheritance, and so on — and there are modifying and fortuitous factors in the daily lives and habits of the parents and in the social conditions. The web of human life is so complex, so many influences and inheritances converge and unite in the genesis of every life, that the elements of chance or fortune inevitably play a part. The malformed, the underwitted, the monstrosities, the still-born, all afford evidence of how the plans of Nature are thwarted or marred by accident. This factor of chance invades even the life of the cells, and occasionally some part is absent or defective.

V

The forms and distributions of bodies in inorganic nature are not important; any other scheme or rearrangement would do just as well. The wonderful monumental and architectural rock-forms in the great Southwest are purely a matter of chance — that is, they serve no special purpose, though, given the kind of rock, and the conditions, they are inevitable; they are fated to be thus and not otherwise. But the men and women who make long journeys to view the marvelous spectacle are not in the same way a matter of chance, and their going thither is not a matter of chance; other than physical causes have determined the journey. Their desire to make the journey has its physical basis, but the journey itself was not inevitable like the flow of water down-hill, or like the geometric forms of the rocks themselves. A psychic principle played a part.

Man's freedom is not that of the wind which bloweth where it listeth, but freedom to go against the wind, or to conquer and use the forces that oppose him. There is no movement in inanimate nature that typifies human freedom; only living beings withstand and turn to their own account the forces of dead matter.

Man's work is geometric; he runs to angles and right lines; in other words, to parts and fragments. The circuitous method of Nature — her waste, her delays, her confusion, her endless seeking, her survival of the fittest, her all-around-the-horizon activities — he seeks to avoid, because he is not concerned with the All, but with a part. He aims at victories now and here, and not in the next geologic age. He would eliminate the element of chance. He does not wait for the winds and the floods to sow his seeds or plant his trees, or for the storms to trim and thin his forests; he takes short cuts, he saves time because he has not all time; he selects and abridges and cuts out, and reaches his ends by direct, geometric methods.

The red-thorn in the pasture is constantly cropped back by the cattle; the first shoot is browsed off half its length or more, but the push of life is behind it, and it throws out one or more lateral shoots; the ends of these are nipped, and the shoots that remain again subdivide, thus causing the would-be tree to spread out wider and wider upon the ground. The cropping continues, every new shoot is nipped, and the bush rises slowly as its circle extends farther and farther. Its progress is slow. Every season it goes through the same ordeal; every nip from the cows is met by new subdivisions of the shoots, till the rising bush becomes an impenetrable network of short, thorny branches. The mass is so dense that only the small birds can enter it. I have seen a song sparrow take refuge in it when hotly pursued by a hawk. The hawk flies round and round, unable to reach his victim. As inevitably as fate, the mass rises in the form of a cone, pushing its enemy farther and farther away till it is four or five feet high and as many feet broad at the base. Its triumph is now near at hand. Its top reaches a point where the cattle do not easily reach; they neglect the central twig at the apex of the cone; this shoots up, and having the whole push of the extensive root system of the tree behind it, grows rapidly as if in a race for life. I see such a red-thorn daily in my walks. Last year it won with this central shoot; this year it has made rapid progress, and now it has a stalk two feet high which the cattle cannot again crop. They will continue to crop the cone beneath it as long as fresh shoots are put out, but as the life of the tree is more and more drawn off from this mound at the base, and transferred to the rising top, the base will soon cease to grow and will slowly die. So that in a few years more the tree will assume the shape of an hourglass, the upper half flourishing, the lower half at a standstill or slowly going back. And in a few years more the hourglass form will have faded; only a part of the lower half will remain, and so the tree, after a struggle of many years, will come into shape and drop its fruit to the cattle that were so bent on destroying it, and who, by eating this fruit, will plant more thorn-trees all over the landscape. Not all species of trees possess this power of struggling successfully against their enemies. The linden, for instance, when cropped by the cattle, resorts to no such tactics as do the apple and the red-thorn. In its simplicity it pushes out new shoots each year to be cropped off by the cattle, and it never gets above their reach. The push of life is there, but it is along right lines. There is no manœuvring for advantage, as with the thorn.

The red-thorn in the pasture, struggling to become a tree, is a good type of life. Accident and destiny enter into its problem in due proportion. Accidents are analogous to the grazing cattle, and destiny to the inherent nature of the tree. All life is certainly more or less a struggle against opposing forces, and were it not for the push of life within, living bodies would soon cease to be such; and if the part played by changing fortunes without were greater or less than it is, these bodies might present a far different appearance from that which we now behold.

XIV

LIFE THE TRAVELER

I

WHEN I was a boy and studied astronomy at school I thought of Kepler's *radius vector* as a real thing that played an important part in celestial mechanics. Later, in following Darwin's theory of animal evolution, I found the same tendency in myself and in others to objectify natural selection and regard it as a positive agent or principle that controlled and determined the origin of species.

Darwinians are prone to imply that Nature selects as man selects, by positive interference. Even so great a natural philosopher as Weismann speaks of natural selection as a positive force. He says in so many words that it "is the cause of a great part of the physical evolution of organisms on the earth — the guiding factor of evolution which creates what is new out of the transmissible variations, by ordering and arranging them, selecting them in relation to their number and size, *as the architect does his building stone, so that a particular style may result*"! (The italics are mine.) Natural selection, then, according to this ultra-Darwinian, is something that knows what it wants from the first, as the architect does when he begins his building, or as the breeder does, say, when he sets out to produce a pouter or a tumbler pigeon.

In his work on "Heredity," Weismann proceeds further to illustrate his conception of the positive character of natural selection in originating new species, by comparing it to a traveler on a journey. His traveler proceeds from a certain point on foot by short stages at any given time and in any direction — the direction being determined by the lay of the land, and by its features of mountain, wood, and stream, and other obstacles. He will take the line of least resistance. But if he is a real traveler, and not a vagrant, an aimless wanderer in the wilderness, will he not be going somewhere, aiming at some predetermined goal? Some purpose, and not the lay of the land, set him traveling; he will keep, in a general way, a given direction. His course will be modified more or less by the obstacles he encounters, but these obstacles will not keep him going, nor determine his goal.

Will the organizing impulse, set aimlessly wandering in the wilderness of inert matter, and taking only the line of least resistance, finally attain to all the beautiful and wonderful living forms that people the earth? Will it evolve the fish, the bird, the mammal, and finally man? Do we find anything in the constitution of the primary elements that foreshadows these things? Or in organized matter itself? Could we infer the bird from the reptile? or man from the unreasoning brute?

Even if we accept Weismann's conception of natural selection as like unto a man on a journey in a pathless wilderness, do we not still want some explanation of why he has undertaken the journey and what his ultimate goal may be? A man lost in the woods or in the desert wanders blindly on in a circle and gets nowhere. Could evolution ever have arrived at man, had not man, in some way beyond our power to grasp, been potential in the primal organizing impulse? And so of all other forms? But Weismann's traveler does not know where he is going; he goes where "the most tortuous and winding route leads him." There is no intelligence in the matter, there is only blind groping. Then Weismann's traveler starts on his journey as one of the very low forms of life, and by sheer luck, and by blindly running the gantlet of all the countless hazards of the long geologic ages, he ends as man. Other forms on the same journey, through the law of probability, end as reptiles, or birds, or butterflies, or quadrupeds. It is all a chance throw of the dice. A stream of water starting on the mountainside takes the easiest way and reaches the river or the lake or the sea. It is all a matter of physics. Whether it flow north or south or east or west depends upon the lay of the land. All its loopings and doublings are, in a measure, accidental. But it ends as it began, a stream of water and only that. But the stream of life begins in definite forms, and, as it flows on, changes perpetually and increasingly into higher and more complex forms. Its physics and chemistry are the same as that of the stream of non-living bodies, its elements are the same, but changes and transformations take place of which non-living forms know nothing. Of course the fortuitous plays a part in the course of the living as in that of the non-living, but it plays an entirely secondary part. The seeds that fall upon rocky or barren places do not sprout, and they fall where the chance winds or floods drop them.

We may never be able to make a logical statement about this something here hinted at, but that there is no controlling purpose in organic nature, that the eye, the heart, the brain of man, are mere molecular accidents, like a profile in the rocks, or a face in the clouds, is unthinkable. Natural selection does not work on dead things, and it does not beget life, and in the origin of species it can play only a secondary part. As has been said, it may, in a measure, account for the survival of the fittest, but not for the arrival of the fittest.

Natural selection is only a name for a weeding-out or eliminating process, and were it not for the inherent tendency to development which organisms possess, coupled with the variations that result from environmental influences, natural selection would have nothing to go upon. It is the conflict between the push of life and the obstacles which it encounters that results in the survival of the fittest. The prime factor in the origin of species is this aboriginal push or organizing tendency, the modifying factor is the stress of the environment. Are we not compelled to look upon organic nature as a whole, and to say that it knows from the first what it wants, and the means to obtain it? Could any struggle for life of the lower organisms have resulted in the higher forms had not these forms been in some way predicated in the lower? The German biologist and philosopher makes this struggle creative. It does not merely bring out inherent capabilities, it begets those capabilities *de novo*. Natural selection is all-potent. "No leaves or flowers," he says, "no digestion or system, no lungs, legs, wings, bones, or muscles were present in the primitive forms, and all these must have arisen from them according to the principle of natural selection." Natural selection invented and perfected the wonderful piece of mechanism we know as the human body. The kidneys, the liver, the lungs, the heart, the brain, the eye, the hand, the double circulation, — all the result of chance, or the hit-and-miss method of the blind, irrational physical and chemical forces!

Why these forces left some forms so low down in the animal scale, and carried others so much higher up, does not appear. Natural selection has shown great partiality. Weismann admits that "these primitive forms were in a certain sense predestined to development." The traveler was predestined to get out of the woods and reach his goal, but only in case he had a goal, and knew in what direction it lay.

Does not the plasticity of living forms, their power of adaptation, their capacity to profit by fortuitous circumstances, imply something super-mechanical and super-chemical that natural selection could neither give nor take away?

Behold an army on a forced march; see the weak and incompetent fall out and drop by the wayside. That is natural selection, the survival of the fittest; only the strongest and the least handicapped reach the goal. The only positive things are the plans of the commanding general and the impulse that sends the troops forward. Darwin himself never looked upon natural selection as a cause, or in any sense a directing agent, but as a name for a process — a sifting process that led to the survival of the most fit. Darwinism makes no account of the evolutionary impulse — the constant push of life that lies back of, and makes possible, this drama of creation. Development implies an inward tendency to development, something that profits by development. The myriad of living forms could only arrive under the pressure of an organizing tendency in living matter. Natural selection may trim the tree, but it does not plant it, nor make it grow, nor prescribe one form to the pine and another to the oak. Do we not have to think of all these things as involved in the mystery of the evolutionary impulse itself? What that impulse is, in the terms of the rest of our knowledge, or whence it comes, or how it adheres to matter, is one of the fundamental mysteries.

Biologists who hold to the mechanistic conception of life, or to its explanation in terms of chemistry and physics, lose their reckoning when confronted by the strange power of regeneration which certain low forms of animals possess, and which the higher forms do not possess. The body of the newt has power to grow a new eye to take the place of a lost one, and to reproduce it by a new process, radically different from the process that gave it the first eye. This, and other like phenomena, to my mind can be interpreted only in terms of intelligence. Such a procedure transcends all we know of chemistry and physics. Something in the body knows what it wants, and knows how to proceed to obtain it. The impulse or organizing tendency that certainly had a beginning in geologic time is equally mysterious, and equally beyond the reach of the chemical and physical forces as we know them in the inorganic world. I am compelled to think of this impulse as inherent in matter, and as involved in the physicochemical forces, but I am aware that this form of words throws no light upon the mystery.

The water from the fountain seeks the easiest course to the lake or the river; the river seeks the easiest course to the sea; but the prime cause of its seeking, of its flowing, is the mystery we call gravity. Is there anything in the constitution of water, or in the laws of hydrostatics, from which we could predict or infer the tides, did we not look beyond the tides and beyond the earth itself? Running water selects the sand, the silt, the gravel, from the soil, and deposits each in separate places, but here again the result is the working of the law of gravity. This is natural selection without struggle or competition. Only living things struggle. The living world is always pitted against the non-living, and it is this conflict that constitutes the drama of evolution; the one is flexible, adaptive, compromising; the other is rigid, stereotyped, remorseless. Only in so far as life overcomes and uses the obduracy of matter is it life, and on the road to development. We are thus compelled to speak of life as an entity, as we do of gravity and chemical affinity, when in the one case as in the other we can only mean a specific activity or tendency in matter. Science with its rigid methods cuts the ground from under our feet and we have recourse to philosophy to save ourselves from falling into the bottomless abyss.

II

More than any other man of our era, Charles Darwin has contributed to the tremendous growth which biological science has made in our time. No matter whether his theory of natural selection as an adequate explanation of the origin of species stands the test of time or not, it aroused men's minds to the feasibility of the subject for scientific investigation. The questions Darwin put to Nature were all fruitful and stimulating. Whether he got the right answers or not, he showed men how to question and cross-question her, and showed that she was not so dumb as we had thought. Darwin loosed the whole animal world from its moorings in the theory of the fixity of species, and set it afloat on the sea of change. His solution of the origin of the various forms is bound to be greatly modified, may be negatived altogether, but he did a mighty service to biological science in simply raising the question of their instability, and in calling attention to the natural grounds upon which their stereotyped characters may be questioned. Life is so fluid and elastic, so various and adaptive, that, on *a priori* grounds, one would say that species are not rigid and fixed. Darwin's proof that they are not is overwhelming, and his provisional explanation of how their origin was brought about is stimulating if not convincing. He was a great, honest, patient, penetrating investigator, and his inquiries put biological science in the front ranks of the great sciences, alongside of astronomy and geology, making with them the great trinity of sciences.

Darwin made no attempt to grapple with the question of the nature and origin of life itself, but only with the evolution of the many forms of life. He was not a laboratory naturalist, but a student of the drama of animate nature as it is enacted on the earth's surface. He held to the special and miraculous creation theory of his fathers, but limited it to one or more forms. Out of this beginning he thought, through the fortuitous operation of natural selection, all the myriad forms of life have been evolved. This is Darwinism in its simplest terms — a miraculous beginning of life, but a natural unfolding. Is it not like asking us to credit the immaculate conception, followed by the birth of a normal baby, and its normal development into child and man?

Darwin formed his ideas of natural selection upon artificial selection, but the two are fundamentally unlike. There is an active agent involved in the one case, which has specific and limited ends to attain, and hence which thwarts the tendencies of nature. But what is the active agent corresponding to man, in the other? Natural selection is the name for a process set going and kept going by the evolutionary impulse. It is natural rejection as well. It is not an arbitrary interference with the course of nature, like artificial selection. It is not the name of a force or of an active principle, as seems so often implied, but an explanation of the survival of the fittest, or the best equipped, for the natural competitions of life. Artificial selection is man at the helm guiding the vessel; natural selection, on Darwin's own theory of fortuitous variation, is like a fleet of vessels unequally equipped, all drifting with the wind and tide, and only the most stanch and seaworthy ones by good luck reaching some port.

When Darwin declares that "if organic beings had not possessed an inherent tendency to vary, man could have done nothing" in modifying species or in developing new ones, he unwittingly takes the process of evolution out of the mechanical or automatic series, and places it in another and higher order; he recognizes the original push of life which is the central thought of Bergson's "Creative Evolution." Variability is certainly a characteristic of living bodies to an extent and in a sense that it is not characteristic of non-living. Creative evolution is only the principle of growth illustrated by the whole biological series; there is the inherent tendency to grow, to develop, which is characteristic of all life. It may be true that the initial variation is caused by slight changes in the conditions of life, yet the variations could not be initiated in a non-growing, a non-vital, a non-developing body. Darwin had a vision of spontaneously varying organisms, the form their variations should take determined by outward conditions, or contingent upon them, but the inward push and plasticity of life is implied in his theories. He saw a world of living forms arise and people the earth under the action of natural selection, but natural selection working on an ever-growing, expanding, irrepressible, self-renewing vital impulse. Natural selection can do nothing without variation, and variation springs from an inherent tendency to vary. Outward conditions determine in the same way the course and the form that water from a fountain shall assume, but it plays no part in the pushing and flowing properties of the water itself. Darwin took pains to say that "there is no innate or necessary tendency in each being to its own advancement in the scale of organization," but is not the innate tendency to vary the first step in this advancement?

None of man's ways throw light on Nature's ways. Man works to specific or partial ends. Nature works to universal ends. Artificial selection throws no light on natural selection, because man singles out one or more forms and favors them against all others, whereas Nature favors all forms and multiplies her types endlessly. She has no choice of types, but favors the more perfect of a given type as against the imperfect. The weak and the strong in animal life alike succeed if each is complete, or well equipped of its kind; the mouse gets on as well as the lion, if it is a perfect mouse. The weak, the unfit, fall out because of their scant measure of life-force. Natural selection works to harden and confirm a species, but plays no part in originating it.

If the unfit arrives, it is cut off by the stress of the struggle for life, but it is unfit only so far as it is malformed or feeble; the unfit in any other sense never arrives. I saw a two-headed trout recently in a collection of several hundred thousand fingerlings. It was a year old. It was unfit to survive, and in a state of nature would soon have perished, but it had been isolated and carefully looked after. Artificial selection had preserved it. How long it can preserve it against natural selection is a question. Tumbler and pouter and fan-tailed pigeons are all preserved by artificial selection against the working of natural selection. Nature's interest lies not in such extreme forms, but in forms nearer the mean — the rock dove, the wood pigeon, the band-tailed pigeon, and the like. The myriad forms of fish in the water, of birds and insects in the air, of quadrupeds and bipeds on the land, are all equally fit to survive and do survive, because each has its full measure of life, and finds its place in the total scheme of life. If the invertebrate gave rise to the vertebrate, or the reptile gave rise to the bird, or the lower mammals gave rise to the higher, it was not because the former were unfit to survive; they did survive, and still survive, but because the evolutionary impulse is inherent in the first forms of life, and was stimulated, rather than stamped out, by the vicissitudes of time. "No statement of the universe," says the wise Emerson, "can have any soundness that does not admit of its ascending effort." Is it thinkable that man could have arisen from the manlike apes by the mere clash and friction of an irrational environment alone? Is one man superior to another by reason of outward conditions, and the discipline of life alone? Is the secret of Plato or Paul or Shakespeare or Lincoln in the keeping of pans and pots? Man arose from his humbler ancestors because the manward impulse, in some way beyond our ken, was inherent in the evolutionary impulse. Man was potential in the monkey. He might never have arrived had the race of apes, or some kindred tree-living form, been cut off, say in Oligocene times. But it was not cut off, and here we are, and rather ashamed of our forebears. One has to say that all other forms of life, down to the flea and the cockroach, were also potential in the life-impulse — the enemies of man as well as his friends.

The three-toed woodpecker evidently gets on as well as the four-toed; the downy as well as his larger and more powerful brother, the hairy; the creepers and the nuthatches, with their slender beaks, as well as those with powerful beaks; animals without legs, as snakes, as well as animals with legs; and the bipeds flourish as well as the quadrupeds; birds without the power of flight also flourish; animals with horns succeed no better than animals without horns. Natural selection works in each species, weeding out the weak and the imperfect, but the competition among species has only the effect of clinching and developing the species, not in originating new ones.

The struggle for life, outside of man's disturbing influence, is not so much a struggle of the weak against the strong, or of one form against another, as it is a struggle of the plant or animal with its environment. If there were but one plant, or one animal, or one tree on the earth, the life of that one individual would be a struggle, much more, of course, in some parts of the earth, and in certain climates, than in others, and the severer the struggle within certain limits, the greater the tenacity of life. An oak-tree growing amid the rocks and on a scanty soil has tougher fibre but less size and grace of form than the tree growing on an alluvial plain. A life is made strong by the obstacles it overcomes. We do not feel the force of the wind or the tide when we go with them. The balloonist rides in a profound calm. Life is a struggle always. Only living things struggle; in the organic world alone is there an activity that is an effort. There is activity in all matter, visible and invisible activity, the end of which is to reach an equilibrium.

The key-word of evolution is organic effort, the inherent impetus of life. No conjuring with merely mechanical forces can, in my opinion, account for the upward or aspiring tendency of organic nature. Life struggled out of the fish into the reptile, and out of the reptile into the bird, but left these forms still flourishing behind it. According to natural selection these unfit forms ought all to have gone out. The fish is as fit to survive as the reptile, and the reptile as fit as the bird and the mammal, and the mammal as fit as man; the invertebrate as fit as the vertebrate. The individuals of these species that do not survive are cut off by accident largely, then by reason of low vitality, or a scant measure of life. The competition with other living forms plays only a secondary part. I fancy that all the animals of any and every kind that are well born, that is, with a normal life-endowment, thrive equally well and survive equally well, except so far as accident enters into the problem. If food is scarce, they go hungry together, until those enfeebled by age and other things are eliminated.

The variations which lead up to the formation of a new species are so insensible, they stretch over such a vast period of time, that their survival value from generation to generation is and must be very slight.

Take the case of the horse, for instance. The development of the horse seems to stretch over a period of at least three millions of years, or from the eohippus of Eocene times, an animal less than two feet high, and probably weighing less than one hundred pounds, to the horse of later Tertiary times, the pliohippus, much like the superb creature we know to-day, five feet high, and weighing ten or twelve hundred pounds. If this animal increased in height only one quarter of an inch in ten thousand years, he would be six feet high in less than two million years. So if we allow him three million years to develop in, his increase in height must have been even less than one fourth of an inch in ten thousand years. Think of it! Our horse of to-day might be increasing or diminishing in size at that rate and the fact never be noticed during the whole historic period. In weight the same; one eighth of a pound in one hundred years, and he would weigh fourteen thousand pounds in less than two million years, a rate of increase that our scales would hardly detect in a century of time. The transformations of the other animals have probably been equally slow. Science would feel safe in saying that a flying fish never becomes a bird, but can we conceive how slight the change would have to be in every one thousand years to bring it about in geologic or biologic time?

Where does such an estimate leave natural selection? Of what survival advantage to the eohippus could the gain of an inch in height in forty thousand years, or of one pound of weight in four hundred years, amount to? Such an application of mathematics to the problems of evolution leaves us with the conviction that there is something else at work besides natural selection. Could natural selection work on a capital of a gain of the one one-hundredth of an inch in height in four hundred years? — assuming, of course, that the gain was uniform. Must there not have been an inherent tendency to increase in size and to all the various modifications — a primal push, as Bergson urges? With man it has, no doubt, been the same. His evolution has been so infinitely slow, that the mechanical conception of it is utterly inadequate. It is very certain that his line of descent in Miocene times was through a small animal form probably no larger than a new-born baby.

Or take the case of the elephant. These forms changed and enlarged under the discipline of their environment, the augmenting force or impulse within always meeting and filling the changing needs from without. The size of the channel of the stream kept pace with the increasing size of the stream. The stream branches or divides when some obstacle intervenes; but the obstacle does not account for the new branch, but only for the form it takes and the direction it flows. The four-toed horse was evidently just as fit to survive as the one-toed, as is evinced by the fact that it did survive for millions of years, but it eventuated in a series of progressive forms because of the push of life meeting and utilizing the changing outward conditions.

Life got out of the sea upon the land and developed lungs instead of gills, and legs instead of fins, not because the competition in the sea drove it out, but because of this primal push and aspiration to new forms.

Life is so flexible and adaptive, the table which Nature spreads for her creatures is so varied and bountiful, that the most delicate and minute forms survive as well as the large and powerful, and finally outlast them. Size and strength count in the arena where they are the determining factors. If other things did not count, the vast army of lesser creatures, with man at their head, would not have been here. The early gigantic forms did not prevail. The savage and powerful carnivorous animals do not exterminate the weaker herbivorous. Professor Bailey well says that "the minor things and the weak things are the most numerous, and they have played the greatest part in the polity of nature." "The whole contrivance of Nature is to protect the weak." Rather, I should say, Nature has a thousand contrivances to protect the weak and defenseless.

Henri Bergson's conception of the creative energy as struggling with matter, hampered and delayed, and often defeated by it, subject to what we call chance or contingency, like us mortals, taking half a loaf when it cannot get a whole one, seems to be a fruitful conception in explaining the condition of life as we see it, past and present, on this planet. There has been a steady struggle and progression toward higher forms from the first. The creative energy shows itself to be very human, very fallible, often vacillating and short-sighted. Indeed, man is the image of his maker in this respect. God has gone on with his work very much as man goes on with his — blundering, experimenting, but doing the best he could. I spent an hour in a medical museum recently and was nearly made sick by what I saw there — such failures, such monstrosities, such miscarriages of life, such deformities, such evidence of pain and agony, men no more exempt in this respect than pigs or monkeys, children impotent to be born, or brainless, or with only one eye. What did it all mean? It meant, if it meant anything, that the life-impulse, or life-energy, was subject to the accidents and uncertainties of time and chance, before birth as after, and that we are part of a system of things that seems struggling to a goal, but is delayed in reaching it, and, furthermore, that the goal is not an end in itself. The Eternal seems to indulge creative energy just as an artist does for the sake of self-expression — the joy of creation. The cosmic energy seems to have no other end than this. It fills the world with life just to see it struggle and develop. The earth is a canvas of living pigments, or a page of living words, or a score of living chords, and the picture or the poem or the symphony is for the joy of self-activity. The picture is in high lights and low lights, it is shaded with suffering and pain and failure; the poem halts and is full of dull and prosaic as well as of lyric passages; the symphony is full of discords as well as of harmonies.

III

Nothing is plainer, I think, than that forms of life of the same species begin life with different degrees of vitality, whatever that may be. Of a thousand spears of corn in May, some will stand a frost better than others; nine hundred may be killed and one hundred may live. The same is true of many other plants. Occasionally a severe freeze in May will kill ninety or ninety-five per cent of the young shoots on a grapevine. Expose a thousand babies six months old to the same test, and the result will probably be as variable; a fraction of them will survive a test that would prove fatal to the majority. Of a thousand eggs of any bird or fowl subjected to the same test, a few will pull through when the majority will perish. In a state of nature, of course, the exposure to the cold will be greater in some cases than in others, and the test of endurance will not be equal, but I am thinking of equality of exposure. Or, subject any number of living animals or men to test trials of labor or of cold, or of deprivation of food, and a few of each will distance the majority. Of our various kinds of farm and garden seeds, ninety or more per cent will, under the right conditions of soil, warmth, and moisture, sprout the first season; usually less than fifty per cent, the second season, and a still smaller percentage, the third season; all of which indicates the different degrees of vital power which living things possess. No doubt the secret resides in certain peculiar properties of the somatic cells or of their arrangement — which is past finding out. The races of all forms of life have been tested in some such way by outward conditions for untold ages, and the weaker have been eliminated. The process has resulted in deepening the hold of each upon life, or has increased their hardiness, till life is as we see it to-day. Man interferes with this weeding-out process in his own species; the weak are shielded and preserved, and the fund of vitality of the whole is thus depleted. It is no figure of speech to say of certain men that they have a deep hold upon life, — an abounding, or plus, vitality, — while the opposite is true of others. In a brood of chickens or a litter of pigs or of puppies this inequality of the gift of vitality is often very pronounced; it of course has its prenatal causes, but they are involved in the hidden activities of the cells. The term "a good constitution" has a scientific value, though quite beyond the tests of scientific analysis. The term "constitution" is only a name for a certain totality of physical endowment, as the word "vitality" is only a name for certain activities in matter; but if the latter has no standing in the court of science or of philosophy, neither could the former have standing. Yet how very real both are to us. The diathesis of a person — his predisposition to certain diseases — is a very real factor in his physical life. No doubt by artificial or arbitrary selection a race of very long-lived men might be developed. By allowing only the offspring of long-lived parents to marry, the term of human life could doubtless be greatly lengthened. But Nature does not work on this plan. She constantly crosses these opposite tendencies, because her solicitude is not about the few, the exceptional, but about the many, or the average. Tall men are prone to marry short women, one temperament to unite with its complementary, the robust with the delicate. Robert Browning marries the invalid Elizabeth Barrett. In the human species Nature thus brings up the average, and prevents the too great dominance of any one type.

The struggle of life with life results in deepening the hold of both sides upon life, because it increases effort. It develops cunning, it develops speed, it develops strength, it develops weapons. The weak, those whose measure of life is scant, fail or fall out. It is not this struggle that develops new species; it is this struggle that hardens and perfects species; it eliminates the unfit, but does it hasten the fit? No scientific explanation of this fullness of life, this power of adaptation, is possible. The resistance of the environment, or of outward obstacles, may account for variation, as the obstacles in the way of a stream of water account for the form and changing course of the stream; but it does not account for the onward flow or the constant push of the water — only the inherent nature of water and gravitation account for this. Indeed, the full genesis of the fountain and flowing stream involves the sun, the clouds, the rains, the shape of the land surfaces, and the break in the deadlock of the elements which all these things bring about. Science easily sees through this riddle, but the explanation of the organic effort that seems to pervade nature is, in its final terms, beyond the reach of science. Science can duplicate or repeat the formation of the fountain and the stream, even to the formation of water from its two constituent gases, but it cannot repeat the genesis of living matter without the aid of other living matter. The cows in the pasture crop off the tender shoots of the young red-thorn and apple-trees, and thus increase the struggle of the sapling to become a tree. They do not eliminate it; they retard its growth and add to its toughness.

All these considerations illustrate how living things struggle with and against one another and survive. All the grasses and the herbs of the field struggle in the same way. If they are exterminated, it is usually by fire or by flood, or by protracted drought, or other elemental agencies. But not always. The chestnut blight which has lately attacked our chestnut-trees threatens to exterminate the whole race; the potato-beetle would doubtless, if left alone, exterminate the potato; the currant-worm, exterminate the currant; but these pests would not be factors in developing new species. There would be no survival of the fittest; all would go. With the myriad forms of life that have become extinct during the geologic ages, doubtless similar agents were at work; enemies or unfavorable conditions, or some mysterious failure in the springs of life, have led to their disappearance. Natural selection has played no part. Adaptation implies adaptability — something fluid and mobile — which is characteristic of life. Osborn says that certain characters are adaptive from their first appearance. Are not all characters adaptive from the first? Do not all organs have an inherent tendency to shape themselves for the use of the organism? Does natural selection do any pruning here? The eye, from its first appearance as a pigmented spot in the earliest form, is adapted for seeing, the ear for hearing, the teeth for cutting and grinding. Life knows what it wants from the start. I do not believe that there is any blind groping in the organism. The blind groping begins when the organism begins to live, or to find its way in the world. Then it comes in contact with blind forces whose coöperation it needs, but which heed it not. Then it must fit itself to its environment by the trial-and-error process.

The winds and air-currents do help to explain the winged seeds, but do not help to explain why Nature is so much more solicitous about some seeds than about others. What a beautiful and ingenious device is the delicate parachute of the dandelion-seed, and the balloon of the thistle! but scores of other troublesome plants have no such device.

What possible advantage can it be to the honey-bee that it should lose its sting, and hence its life, in the wound it inflicts — any more than it would be to the advantage of a man to lose his sword in the flesh of his enemy, and have his arm pulled out of the socket into the bargain? The wasps and hornets and bumblebees live to sting another day; why should this cruel fate attend only the honey-bee? Why should the drone fertilize the queen at the cost of his own life? Where is the gain to the swarm? Where does natural selection come in?

When we begin to ask the whys and the wherefores of Nature's doings, our human standards soon fail us. No plummet can sound these depths. Why does one species often destroy another, or why a parasite exterminate its host and thus exterminate itself?

There are no rational checks in Nature — all is left to chance; and the scheme works because Nature has all power and all time. There is no other, no rival. The All can go its own way; to play the game, to win and lose — the stakes are Nature's in any event.

Our little plans and wants are specific, individual, but our activities are hemmed in by general laws which work to no special end. We row and steam against the currents and against the winds; we check or thwart or control the natural forces: this is life as opposed to gravity; but life could not oppose gravity without the aid of gravity. Thus are we a part of that from which we seek to detach ourselves, and are kept going by the force we seek to overcome.

XV

GREAT QUESTIONS IN LITTLE

I. THE ETHER

TO speak of invisible rays of light seems a contradiction of terms, and so it would be were light rays an objective reality instead of an experience of our consciousness. The dark, or heat, rays of the spectrum are as real as the light rays, but we see them not because our eye is not attuned to them, or in their key. It is said that the Leyden jar emits rays that obey all the laws of optics, but the eye is no wiser for it. Light is created in the eye, as sound is born in the ear. Certain vibrations in the ether give us a sensation that we name "light"; certain vibrations in the air give us sensations that we call "sound." All the color in nature is the result of what the vibrations reflected from objects do to the eye, just as all we call sound is the result of what certain mechanical disturbances in the air do to the ear. There is no color in the dark and there is no sound in a vacuum. We can set up a mechanical disturbance in the air, but we cannot set up a mechanical disturbance in the ether, because the ether is not a tangible body. It defies all our definitions of tangible bodies. No device or experiment of man has as yet been able to detect it or prove its existence. It is a metaphysical necessity. We are compelled to assume its existence to account for such phenomena as light, electricity, and gravity. We can produce a vacuum as regards the air, but not as regards the ether. The ether has no mechanical reality. It is the negation of all mechanics, of all matter. The physicists are driven to the necessity of describing matter as a hole in the ether. But how can there be a hole in that which is the negation of matter? It is like trying to think of a hole within a hole, or a nest of holes, like a nest of boxes. But our scientific philosophers are not disturbed by such things. Necessity in science, as in war, knows no law, and our need for the ether is so great that we must have it even if it negatives all the rest of our knowledge. It is, so to speak, the connective tissue of the cosmos, it makes the cosmos one and inseparable. It is the unchangeable, the all-present, the everlasting. It satisfies the needs of the mind for an all-embracing reality, for a primal stuff out of which all things arose, for an immaterial reality which is the parent and master of matter. It is the sea of energy in which the cosmos floats. It affords the key to the well-authenticated cases of mind-reading, telepathy, and all genuine occult phenomena. It gives us a glimpse behind the veil of things; it adds a new chapter of wonders to this universe of wonders

— wonders beneath wonders everywhere; it supplies the missing link between matter and spirit; it helps us to understand the unity of things — that all are of one stuff, that near and remote are the same, that celestial and terrestrial join hands; it helps us to grasp the phenomena of magnetism, of electricity, and of gravity, and of the vital interchange, so to speak, between all the hosts of heaven. "Not a hawthorn blooms," says Victor Hugo, "but is felt at the stars." If the ether is a reality, this may be true. "The divine ship" (the earth), says Whitman, "sails the divine seas." The ether is this shoreless and soundless sea — the sea in which all worlds and systems float like bubbles.

II. NATURAL SELECTION

Darwin could not believe that man was the result of chance, neither can any of us reach that conclusion in the terms in which we at present do our thinking. It is unthinkable. If we suppose that an accidental meeting or a clash of the molecules of inert matter resulted in the lowest forms of life, how are we to get these myriads of living forms from the amœba up to man, out of the aimless struggle and jostling of living cells, unless the cells know what they want, or work according to some plan or purpose? How can there be any progress toward higher forms, any coöperation among these minute living units, such as we actually see, in building up organs and parts more and more complex, till the earth is peopled with intelligent beings? Must there not be some kind of method in the madness of molecular activities, in the chaotic rush and whirl of the atoms and electrons, some purposive arrangement and direction, in order that so wonderful a mechanism as even a flea or a fly may result? What the directing and organizing agent is, or whether or not there is any such agent or power that can be described and referred to in these terms, is one of the fundamental mysteries. According to the terms in which we do our thinking, nothing can create itself, and yet in the concepts of a non-teleological universe, we cannot admit any objective power or influence apart from Nature herself.

An eye, for instance, is a very convenient thing for an animal to have, but how could natural selection, or the mere struggle of life, have brought it about? Nothing is planning an eye, or thinking about it, or feeling the want of it, in the chaos of a world of chance. The organism is jostled about here and there, and yet in due time the eye with all its wonderful powers and adaptation appears. It is of use when developed, but must there not have been a long preliminary stage in its development when it was of no use? It began as a faint pigmented spot in the epidermis. Was this pigmented spot of any service to the organism? Could natural selection favor it or originate it before it began to function? Can we conceive of a blind tendency to variation as hitting upon such an organ as the eye, or the ear, or any other part of an organized body? If we grant the Darwinians the body to start with, how is chance variation going to give it an eye or an ear, or its organs of secretion, and the like? Could any possible number of hit-and-miss variations give it one of these things? And during their incipient stages, of what advantage are they to the organism? How did an eyeless organism chance to vary toward an eye? Who or what said "eye"? What put the organism in mind of it? Its needs? But would it not be very useful sometimes for an animal to be able to live without air or water? Yet they develop no organs that enable them to do it. They have needs only because they are living, developing beings. Natural selection can work only when there is struggle or living competition. It cannot create the current by which it profits.

III. SPECULATION AND EXPERIMENT

There are two ways of attacking a problem, the speculative way and the experimental way. The ancient observers almost invariably chose the former way. This is the way of children and of all primitive peoples, and of the larger part of mankind in our own day. It is the natural way. The birth of science began when men took up the experimental way.

Look into Plutarch's "Morals" and see some of the questions that he and his fellows used to discuss at their debating clubs. They do not actually discuss the question that still survives among country people, "Why does the sunlight put out the fire?"—a deception of the eye merely; but many of their discussions were upon subjects that a little experimentation would have settled at once. Here are some of their questions:—

Why sea-water will not put out fire? Why a deer when it is taken sheds salt tears, and a boar sweet? A wild fig being bound around a garden fig-tree will keep the fruit from falling and promote its ripening. Why does a deer bury its cast-off horns? Why does a goat stop the entire herd by holding a branch of sea-holly in its mouth? Why does dew make fat people lean? Why does a vessel filled with water weigh more in winter than in summer? Why are waters hottest in the bottom of the sea? (Because heat shuns cold and flees to the bottom.) Why is the flesh of sheep bitten by wolves sweeter than that of others?

Such matters of dispute show the childish vagaries of the human mind before the advent of the scientific method. It was largely out of this frame of mind that Christianity arose. The reports of its miracles were accepted without question. When man began to doubt and to ask for proof, then his emancipation from error began.

IV. EARLY MAN

A factor that has, no doubt, played an important part in man's evolution is the much greater swing which the law of variation has in his case than in that of any other animal. The extent of variation in the mental capacity of men has no parallel in any other species in the animal kingdom. The individual differences between animals of the same species, in disposition, in intelligence, is considerable, but in the case of man it is enormous. With this sweep of variation man's development would be rapid. The most gifted led the race forward. Our civilization is the work of a few minds; all progress is the work of a few minds. The rank and file of mankind follow their natural captains and leaders. The law of variation has evidently worked more and more in man the farther he departed from the lower orders, so that he has progressed with accelerated rapidity. Every advance gained made a greater advance possible. The possibilities, say with dogs, are very limited; the possibilities with man are almost infinite.

No doubt the first rude man, or the immediate animal ancestor of man, made himself a nest or a shelter from the storms long before he became a tool-user. The orang makes a platform of branches in a tree, upon which he sleeps, but he has no tools or weapons. When this ancestor used his first tool, — a stone to crack a bone or a nut, or a stick to reach a fruit or to drive off a foe,—that was the beginning of the great change, the great progress, then was the man really born. It is as a tool-user and weapon-user that man's advance over all other animals begins. The more he used them, the more his intelligence was stimulated; the more his hand was trained, the more his brain was developed. Each reacted upon the other. Then, when this creature began to shape and improve his tool — that was the second great step. Wood and bone, at first, no doubt, were the substances used or improved upon. Then came the shaping of stone implements—arrowheads, spears, and axes. When he discovered the use of fire and how to control it — what a step was that! In those two things — the shaping of tools and the use of fire — lay the germ of all his subsequent progress. All this time he must have been a savage wild beast, probably covered with hair, and subsisting upon roots and fruits and smaller animals. His teeth were for rending and his hands for seizing. He was probably a healthy animal, free from the diseases of the housed and clothed man. The nature within him fitted the nature without him. Instinct ruled him. But as his reason began to develop, and to cross Nature, error, or sin and disease, came.

Hence the truth at the bottom of the old myth, that it was by the fall of man came all our diseases. The birth of reason was the fall of man, and only then did error and sin become possible; only when man crosses Nature and seeks to rule her, does disease, as we know it, appear, because only then does error appear. The animals do not err; they go along with Nature; it is a survival of the fittest; but give an animal a tool or a weapon, and the naturally weak may survive over the naturally strong. If we could only know all the steps of man's progress from his nearest animal ancestor!

The third step in man's progress was taken when he tamed and used other animals. His fourth great step was when he began to cultivate the soil, or to plant and reap. At first he was, of course, a hunter and fisherman. He must have evolved some sort of language soon after his emergence from the lower animal state. Writing, of course, came much later.

The greatest step of all will be when man learns to stamp out disease through his more complete knowledge of Nature.

V. ASTRONOMIC GRANDEUR

We humanize the nature we see around us in field and river and wood; we infuse ourselves into it; we fill the lap of earth with treasures not her own; but when we look up to the heavens, when we behold the midnight skies, and ponder upon the truth that science reveals to us there, we are moved in a different way. And when we peer into the vista of the geologic ages our humanizing process does not come into play. In fact, the two great sciences, astronomy and geology, move us without any admixture of the human element; they move us by their grandeur, by the conception of time and space which they force upon us. In these fields science opens up to us views into the universe of non-living matter that not only challenge our reasoning faculties, but also stimulate our imagination, views that overwhelm us with a sense of power and magnitude. We do not see ourselves reflected there — we are swept away from ourselves, and impressed with our own insignificance. Astronomy is pure science. It reveals to us mechanical principles working on such a scale and with such harmony and precision that we get a new conception of these principles. They encompass the universe; they guide the stars in their courses, they are the builders and upholders of suns and systems. The cosmos is automatic, blind physical forces work there with mathematical exactness, but all is on such a scale and involving such an element of time and distance that we never think of it as mechanical. We do not see the wheels go round; we do not see the source or the distribution of the power; all is as fluid and spontaneous as a meadow brook. We do not see matter or motion as we know them upon the earth;

we see light and splendor and eternal repose. But the astronomer knows that the light and splendor are shed by inert matter, obeying the inexorable laws of celestial physics. If the stars sang in their courses, and the whole universe were alive, as some European scientists have audaciously affirmed, the facts would seem more in accord with the impression they give us than does the mechanistic conception of them. But the bare facts of astronomy are beyond our power of humanization; in their naked grandeur they strike us dumb. Whitman gives us a fresh impression of this when he opens his scuttle at night and sees far-sprinkled systems. He does not add to or take from the facts, but by his art he quickens our sense of limitless space and the wild dance and whirl of the heavenly hosts.

Celestial mechanics are certainly the same as terrestrial mechanics, and if we fancy that matter up there is any more spiritual than it is here underfoot, we are giving way to our humanistic tendencies. Starlight does not differ in its nature from lamplight, and the flight to us across the gulf of space has not changed its character. If the stars sing in their courses, then the earth sings in its course; if the celestial bodies thrill with life, the earth, too, thrills with life.

The universe is one, and not two or three. It is not symbolized by a straight line, but by the curve, which goes not in one direction, but in all directions, or, rather, is without direction. It is that enigmatical contradictory thing. We cannot think of the universe as a whole, because a whole has bounds, and we cannot think of it as a part, because we ask where are the other parts?

VI. WHY AND HOW

We are told that the function of science is not to ask why, but how. This is largely true. Philosophy asks why. Science does not ask why we are here, but how we are here and how we stay here — how our food nourishes us, how our physical functions are carried on, how one form of life gives rise to another form, and the like. Science aims to give the reason of things, to trace secondary causes. It is dumb before the question of first causes. We often ask the question "Why" when we are really seeking the "How." Why does a plant lean toward the light, why do the seasons change, why do rain and snow fall, why is the sky blue, why is snow white, why does the tide ebb and flow, when we are really in quest of the reason of these things — the how of them.

We do not know why the sky is blue, or the grass green, that is, for what purpose; or for what purpose the tides ebb and flow, or why a man stops growing at a certain age, or why water expands when it freezes. But we think we know why flowers are sweet-scented, or brightly colored, why some of them have contrivances to secure cross-fertilization, why some seeds have hooks, others wings, and others springs. But all these "whys" are involved in the "hows" of the plants' getting on in the world. Why the child is afraid in the dark, and why the infant has such a strong grip in its hands, have good and sufficient reasons in the past history of the race. If we were to ask why the moon has no atmosphere, what we really want to know is, How happens it that the moon has no atmosphere, how was such a condition brought about?

VII. LIMITATIONS OF SCIENCE

On as sure ground as we know that food nourishes us, and fire warms us, do we not know that the soul is identified with the body, an organic part of it, growing with its growth, decaying with its decay, and dying with its death? Our philosophy or our theology may lead us to a different conclusion, but certainly our science cannot. The touchstone of science is proof or verification, but philosophy lives and moves and has its being in the region of the unverifiable — in the inner world of man's mental life — a world certainly as real as the outer world of his physical life, but of another order, and amenable to other laws.

We may say that the soul lived before the body lived, and will live after the latter is dead, but we cannot affirm it on scientific grounds, that is, on grounds of physical certainty afforded by observation and experience. There are only two kinds of proof, mathematical proof, and experimental or scientific proof. There is not, and cannot be, such a thing as metaphysical proof, because metaphysical truths are unconditioned — they are like a sea without shores or land without boundaries. We may feel them to be real and true, while another man may not feel them so at all. But the truths of science and mathematics are true to all men. To dispute them is to dispute weights and measures. A path through the fields seems a very real thing: see it winding on ahead of us; our feet can find it in the dark, but it is only a phantom, a negation, an absence of something — a result of the attrition of many feet passing and repassing that way. Where are the tracks we made in last year's snow? The snow was real, and still, in some form, exists; and the feet were real, and may still exist; but the track was only a shape in a material thing.

In the printed page the only real things are the paper and the ink; the white spaces play the same part in aiding the eye to take in the meaning of the print as do the black letters. The type was real, and the mind and hands that shaped the type, and the compositor that set it up, were real, and the sense of the print is real to the mind, but not to the body. All this science affirms; what does philosophy affirm?

GREAT QUESTIONS IN LITTLE

VIII. BEGINNINGS

The problem of the beginning of anything when philosophically considered is an elusive problem. Everything and every condition has its antecedents, and these antecedents have their antecedents. In spring the sap begins to mount in the trees, but to draw a line between its state of quiescence and its state of activity could only be done in imagination. It is not like a gun that is ready to go off when the trigger is pulled. It goes off slowly and insensibly. It is "fixing to begin to get ready" to go off all winter, as the old colored woman said about a like matter. The grain begins to sprout in the ground, but the insensible changes in the germ that have preceded the actual sprouting — what about them?

Things in nature begin, but they begin away back, and so gradually and insensibly that we cannot put our finger on the point of actual beginning; we have to imagine such a point. Spencer repudiates the theory of spontaneous generation, or the instantaneous birth of living matter from the non-living, because such a theory admits of no steps or gradations in the process. The theory of generation by evolution is more thinkable — an immeasurably slow transformation of the non-living into the living without any fixed line between them.

If we cannot say that life ever literally begins, can we say that it ever literally ends? It is certainly true that the inorganic is lifted into the organic, and it is as certainly true that the organic falls back again into the inorganic, and the movement we call life ceases. Spencer's position is a sort of philosophical puzzle. It is equivalent to saying that life like matter is infinitely divisible or reducible, so that the mind can never reach the point where life ends and the non-life begins. If in the case of matter we draw the line at the atom, it is an arbitrary line, so in the case of life, any line we may draw is an arbitrary line; life as a constant becoming and a constant ending is like a circle, returning forever into itself; it begins and ends at every imaginary point. The old puzzle that motion is impossible because a body cannot move where it is, nor where it is not, is easily disposed of by taking one step. We are forced to the conclusion that life on the globe did begin, and that it will in time as surely end.

Kindling a fire by friction might symbolize Spencer's idea of the evolution of life. When does the fire begin? Every moment in the process has its antecedent moment back to the original elements and forces that built up the wood in the tree, and the first molecule of smoke that appears can be infinitely divided, yet combustion finally takes place.

As we go down the scale of animal life toward the vegetable, there must be a point where consciousness — the feeling of pleasure and pain — begins.

No matter how minute the gradations, unless we allow our minds to be fooled with the old philosophical puzzle of the infinite divisibility of space, we come to a point in thought where consciousness dawned. (To be and not be in the same moment of time, that is the puzzle.) In like manner, as we go down the scale of the organic toward the inorganic, we must come to a point where one ceased and the other began. By the process of reasoning that proves that Achilles could never overtake the tortoise, we may prove that evolution of life never began, the organic could never overtake the inorganic. But the fact that once it was not here and is here now, shows the fallacy of such reasoning.

The evolution of one animal form from a previously existing form has been an equally gradual process. The horse did not begin as the horse; he has been becoming horse through countless ages. So with all other forms. The descendants of a species which we find in one geologic horizon turn out to be something vastly different in a later geologic horizon. The passage from one species to another actually took place, yet where can you draw the line between them — between the non-man and the man?

The clock begins to strike, the clock itself as a piece of machinery had a beginning, the man who made the clock had a beginning in his mother's womb, but the beginning of the germ cell from whence he sprang — where was that? If we could trace it back to the unicellular life of Cambrian times, could we find its beginning then?

All these questions about the beginning of things return forever into themselves; and their final solution baffles us.

IX. EVOLUTION

We are apt to think the book of evolution closed, the tale finished. But can it be true? The evolution or transformation of the earth's surface certainly is not finished, and never can be finished. As long as the rains continue to fall, and the seasons to change, and vegetation to grow, the land surface of the globe must continue to alter. As long as the secular cooling of the earth goes on, the crust must continue to fold and in places to be lifted up. Geology shows us that millions of years ago it was vastly different from what we now behold it. How will it be as many millions of years hence? How different, too, was the animal life of the globe during the past geologic periods from the animal life of to-day! Will it not differ as much from that of to-day millions of years hence? The changes and transformations will doubtless be slower in the future than in the past, because the globe is older, life is older, the physical forces are less riotous, life is less gross and turbulent; still, radical changes must slowly appear. I cannot believe that the race of man has run its evolutionary course. One cannot see where there is any room for a physical change, but the mental growth may be enormous, incalculable. All our theories of knowledge, all our beliefs, are founded upon the assumption that we have reached the summit of human life. But just as the men of a few centuries ago were children in the arts and sciences, compared with us, so we shall doubtless appear as children when compared with men a few centuries hence. The mental powers of man may not have increased since Aristotle and Plato, but that is only a brief time. Local, and, as it were, accidental, causes may account for that. Wait five or ten thousand years, and then see. It is a long road and it is up and down hill. Man is now armed with the weapons of science as he never has been before, and his conquest over Nature is bound to be more and more complete.

Whole tribes and families of animals have become extinct in the past, and others will probably become extinct in the future, but one can think of the race of man as becoming extinct only on some radical cosmic change in the earth, such as there has been in some of the other planets and in our moon. This change will come, but not in millions of years.

Unless the waste of the fertility of the land into the sea through man's agency is checked, the fertility of the soil in the course of countless ages will no longer support the race, but this as a cause working against the perpetuity of the race can be and doubtless will be checked. The fuel in the earth will be exhausted in a thousand or more years, and its mineral wealth, but man will find substitutes for these in the winds, the waves, the sun's heat, and so forth.

X. AN UNKNOWN FACTOR

How this unknown factor in life, or the vague consciousness of it, hovers in the background of the minds of even the most rigid scientists! It hovered in Darwin's mind when he said he could not look upon man, with all his wonderful powers, as the result of mere chance, though his theories of the origin of species made man the result of fortuitous variations conserved and improved upon by natural selection. It hovered in Tyndall's mind when his physicochemical theory of the origin of life left him on the brink of an abyss, and he contemplated "the mystery and miracle of vitality." It hovered in Huxley's mind when he resented the charge of materialism and gave consciousness a place with matter and energy as one of the three realities in the universe. It hovered in Haeckel's mind when he admitted a psychic principle in the atom. Professor Osborn finds some unknown and unknowable factor in evolution from the fact that some parts or organs are adaptive, or purposeful, from the first, and were fitted to survive when they first appeared.

THE END

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