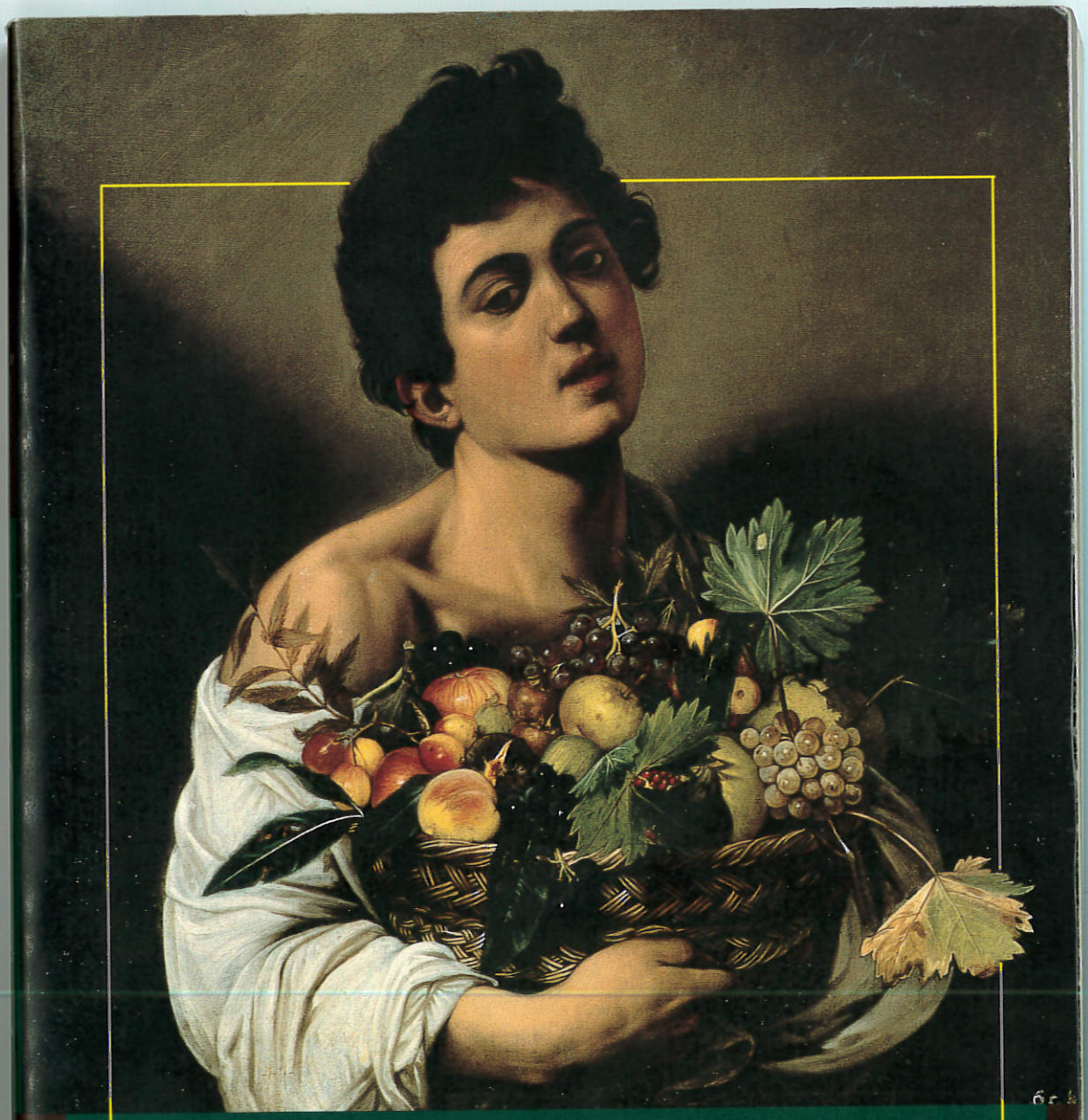

The Hungry Soul

Eating and the Perfecting of Our Nature

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WITH A NEW FOREWORD

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To Amy

1

Food and Nourishing

The Primacy of Form

For of the soul the body form doth take;
for soul is form, and doth the body make.

—Edmund Spenser
"A Hymn in Honour of Beauty," line 90

The whole of nature, as has been said, is a conjugation of the verb to eat, in the active and passive.

—William Ralph Inge
"Confessio Fidei," *Outspoken Essays*

Who says the earth is not the center of the universe? No, not its geometrical or material center; the earth is not even the center of its own solar system, which in turn is nothing like the center of our allegedly boundless universe, by definition incapable of having a spatial center. But, *pace* Copernicus, the earth may still be the vital, and also the intelligent, center of the universe; for it is, as far as we know, the only place in the vast cosmic sea of inorganic stuff and motion that has proved hospitable to life. Only here has the lifeless mud acquired the breath of life; only here has the cosmos through life finally become conscious of itself.

These are not just anthropocentric prejudices; they seem to be cosmic truths. In the waters, on the land, and high aloft before the heavens, the earth teems with living beings, plants and animals, large and small, manifesting and reproducing themselves according to their myriad and distinctive kinds. And we are not the least among them, not least because we *know* that we and all our other terrestrial relations are alive. We, the curious and reflective animals, give names to all our kin—to date to more than 1.4 million species of organisms.

Though plants offer splendid displays for the appreciative eye of the beholder, most people find animals more fascinating. For the animals are the truly animate, because obviously lively, ones. They move around and about and often collide with one another. They hunt and fish and sport and mate and die—as do we. Most of them operate beneath our notice, too small or too hidden to be detected except by the searching zoologist. But the larger ones especially attract a crowd. For notwithstanding their abundant variety and their manifest strangeness, we sense in their movements and expressions that their life is somehow related to our own and that they too experience an inwardness filled with some similar pleasures and pains, desires and fears. About this we are surely not mistaken, at least with respect to the business of staying alive. For every living animal is alike at least in this: It needs, seeks, and takes in food—and so do we. Moreover, being self-conscious eaters, we can sympathize with all that hungers and feeds. Not surprisingly feeding time at the zoo ranks first in popularity with occupants and spectators alike.

Taking food is not a matter of choice. It is a desired necessity, indispensable for all vital activity and sought after by all living animals. Food is needed for growth and development, for maintenance and

repair, for every motion and activity. Show us an animal that is not turning over foodstuff and we shall pronounce him dead. To live is to metabolize; at least for all terrestrial beings, there is no other way. One is only if and because one eats.

Animals seek and find food in their environments. Originally outside and other, food must be brought inside and transformed into same. But what does this really mean, and what is responsible for it? What *is* the sameness that persists despite—indeed, because of—the ceaseless transformations of metabolism, transformations now occurring in every cell of your body even as you sit quietly and read? How do we understand what is responsible both for the transformations and for any persisting sameness? What kind of "world relationships" are entailed by the necessity of finding food? What enables an animal to recognize that which is nourishing? What drives it forward and outward to appropriate its food? What, finally, is the relationship between what one is and what one eats? These are the questions with which we begin our inquiry into eating. Animals, and not especially human beings, are our focus. At stake in the inquiry is the adequacy or sufficiency of a materialistic explanation of metabolism and animal eating, and therewith of life as such.

Let me introduce the question by reflecting grossly on the process by which we—and other multicellular animals—reach our maturity and by considering explicitly the relation between what we are and what we eat.

At first glance there is some reason to believe that one *is* just *what* one eats. We begin life as a single cell, barely visible to the naked eye. To reach our adult size, we must increase our bulk 120 billionfold. We acquire this extra mass entirely from without, by ingestion. In addition, it seems certain that—no matter how diligently we search—we will never find any immaterial something that enters our bodies along with all that stuff. We are, from head to toe, altogether stuff-y. To be sure, we don't *look* like the food we eat. But appearance is deceiving. At bottom we are proteins, carbohydrates, fats, vitamins, minerals, and nucleic acids—and so is our food. No wonder food is so important to survival: Where it goes, there I am; where it goes not, there I am not; what it is, that too am I. We are identical, I and my stuff.

This plausible equation of what I am with what I eat, by means of the intermediate and even more plausible identifications of me and my stuff and of my stuff with my food, requires closer scrutiny. An obvious difficulty confronts us. Chicken embryos digest egg yolk and grow into egg-laying chickens; calves drink milk and grow into milk-giving cows; human children eat egg yolks and drink cows' milk but grow up only human. Yolk taken by the chicken becomes chicken; the same yolk taken by the child is humanized. How can this be, if one is what one eats? If we eat the same, why are we not the same? What is our distinctive being if we are materially the same? What is the relationship between what we eat and what we are?

Let us start again and proceed more slowly, taking nothing for granted. Let us begin simply and with the obvious, with what we—or any animals—eat: with food. What is food?

Food

If we begin grossly, and with the larger animals, food is other living things or their parts and products. Some animals are vegetarian: Frugivores like the squirrel or the cedar waxwing eat acorns or chokecherries, herbivores like the cow or the sheep eat grass, while the koala eats only the leaves of the eucalyptus tree. Up the so-called food chain are the carnivores, who, because they eat animals that in turn eat plants, are at least indirectly omnivores. Flies are food for frogs and phoebes, fish for crocodiles and cormorants, mice for snakes and owls, rabbits for falcons and foxes, zebras for lions and tigers. We omnivorous human beings, who transform much of our food by cooking, mixing, and seasoning it for tastiness or edibility, cannot fully hide from ourselves—or at least from our butchers and meat packers—that we eat cows, sheep, and pigs; chickens, fish, and shellfish; in addition to radishes, rhubarb, radicchio, raspberries, and rice and countless other roots, stems, leaves, fruits, and seeds.

Yet insofar as these other living beings are regarded as food, they cease to be treated as *what* they are, even before they cease to *be* what they are when they are ingested. From the point of view of the disinterested observer, a rabbit is a rabbit and spinach is spinach. Each organism is, in and for itself, a formed and determinate one of a determinate kind. Yet from the viewpoint of a hungry rabbit, spinach is lunch, and for a hungry fox, the well-fed rabbit is dinner. A mate for the zebra is just meat to a lion. The form of the object is finally unimportant to the eater; that it is potential material is all that matters.

It follows that something is *as* food only to another being—one that almost universally belongs to a different species. Food is a relational term. Yet the relation is not superficial: That which is appropriated as food is actually something other but (also and at the same time) potentially the same, at least in part. Strange as it seems and sounds, the zebra, in addition to being in fact a zebra, is also and at the same time capable of becoming (part of) a lion. Like all food it exists in the relation of desired unlike but potential like; through digestion it is transformed by the lion's living body from being something other into being just the same. Between being what it was as formed (and alien) and being what it becomes as formed (and one's own), food passes through the intermediate stage of being more or less formless, homogeneous elementary stuff. What was food to the mouth and the naked eye is unrecognizable when it becomes food to the intestine, as seen under the microscope.

Indeed the microscopic view provides us with additional reasons to think of food more as the *final* product of digestion—the chemical material just before absorption from the intestinal cavity into the bloodstream—rather than as the *initial* object of appetition or ingestion. For the microscope has also introduced us to simpler creatures, ones that lack mouths and intestines but that nevertheless take in food. The simplest organisms, bacteria, selectively absorb the simplest nutriments; for example glucose or other sugars and amino acids. Elegant studies have shown that even bacteria have preferences among foodstuffs—though obviously not conscious ones. For example, they will swim after and absorb glucose as their carbon source until it is exhausted from the medium; only then will they change over to pursuing, absorbing, and metabolizing a less-desirable sugar or some amino acid.

The amoeba, another of the simplest organisms, actually engulfs more complex foodstuffs. As they are engulfed, the food particles enter with some surrounding water to form little bubbles, called vacuoles, contained as discrete entities within the cytoplasm (the living cell substance) of the amoeba. There the food particles are broken down, and the simples (amino acids, simple sugars, fatty acids, and so forth) are absorbed into the cytoplasm across the vacuole wall in a process physically similar to the one that occurs across the intestinal wall in higher animals and men. Indeed the digestive tract of higher animals, though spatially located within the confines of the living body, is nonetheless—analogously to the vacuole—only a captured portion of the outside world, to which it is open at both ends. Topologically and digestively speaking, the bodies of higher animals are, in fact, highly complex variations of a simple plan: a thick-walled solid cylinder built around a hollow tube that runs through its center. In schematic cross-section, the organism is like a doughnut, nourished from its hole, here and there armed with appendages that work either to keep that hole filled or to keep the doughnut from filling some other doughnut's hole.

But the digestive cavity is not only a conduit, it is also a cauldron for transforming its contents. Along the extensive and extensively coiled tube through which the captured foodstuffs flow, the animal's digestive powers operate, so that, by the time the true orifices of ingress, the intestinal cells, are reached, the semipermeable membranes of each intestinal cell will be confronted with a feast of simples, to be absorbed by processes like those functioning in the bacterium or amoeba: diffusion and selective absorption.

Yet this reductive analysis, albeit illuminating, is not the whole story, and if we regard it as such it will prove misleading. True, every cell of multicellular organisms is nourished and is metabolically active in ways remarkably similar to microorganisms—for example the glycolytic and Krebs cycles (the chemical pathways for breaking down sugar) and oxidative phosphorylation (the process of capturing in usable form the energy released by breaking down sugar and other foodstuffs) are universally found. Yet the more complex organisms cannot be understood as mere aggregates or sums of their component cells, even with respect to nourishment: Complexity also brings with it genuine novelty. For example, the specialization required effectively to nourish the higher organisms means, among other things, that some cells and tissues must feed others as well as themselves, and one organ, the mouth, serves as a portal that collects all the fodder. This specialization gives rise to the two different views of food—one relative to the mouth, one relative to the gut (or, ultimately, to the individual cells). Furthermore the organ of ingestion acquires functions and pleasures of its own—biting, chewing, swallowing—as well as its own gustatory predilections and delights, which are logically, physiologically, and experientially separate from

the ultimate goal of nourishment. Because it is such a long way from the taste buds to the true ports of call, food to the mouth need not be foodstuff to the intestine. The tasty or appetizing and the fitting or needful—each at the heart of one of two possible definitions of food—need not be identical, at least not for human beings (a fact to which we shall return). Speaking generally—and as we shall see more clearly later—these intermediate activities that serve to gain survival may become parts of the larger, well-working wholeness that an animal gets to enjoy by surviving. We begin to suspect that the "complex eaters" are not just simple eaters grown large, and that modern science's attempt to explain the activities of living animals in terms of interactions among "dead" chemicals may be not only incomplete but also distorting.

Eating

We began our look at eating by asking about what we eat, about food. But since food turns out to be that which is eaten (to nourish a nourishing being), the meaning of food falls back onto the meaning of eating (and nourishing). This is no illicit circularity. Such correlation of the activity and its object is captured in those languages that contain cognate accusatives for their verbs for eating. The Old English word *foda* and the Teutonic root *fôd*, meaning food, are cognate with the old Teutonic verb *fôdjan*, to feed, to be the source of food. Indeed, English has similar cognates: We feed food; we eat the edibles. Yet such formal correlation does not reveal concretely how activity and object are related, that is, how "feeding food" differs from, say, "smelling smells" or "thinking thoughts." In its transitive sense *to feed* means to give food to another, to supply someone else with fodder. A dog feeds her pups by suckling them; a bird feeds her young by putting food into their mouths; a farmer feeds his cattle by putting them out to graze and feeds his family by supplying them with grain, milk, and meat. Feeding in this sense is an act of nurturing assistance, even of generosity, and not only for human beings. Always a social act, it presupposes some communal relations between feeder and fed.

But reflexively *to feed* also means to take food for oneself. To feed (oneself) is to eat someone (or something) else. This usage is no longer applied, except colloquially, to human beings: animals feed, human beings eat. In the present chapter I shall use the term *eating* to refer to this common activity of both animals and men, the taking of food for oneself. Further on, we will consider the more specifically human features of eating, which distinguish it from mere feeding.

Eating has several aspects, linguistically distinguished. As an intransitive verb, *eating* is an activity of the animal, more precisely, the activity of the animal as eater ("First they eat, then they fall asleep.") Eating as an activity is thus one manifestation of animate being and is part of the animal's "being-at-work." But eating is not a pure and self-contained activity of the agent, like running or swimming or flying; the word *eating* is also, and always, a transitive verb as well. To be eating is necessarily to be eating *something*—something *other* and *in the world*.

Other vital activities also entail an encounter with correlative objects: To be at work thinking is to be thinking the thinkable; to be at work seeing is to be seeing the visible; to be at work copulating is to be fusing with the sexual complement, and so on. Yet the relations among agent, activity, and object in eating differ from all these other cases. In thinking the thinking mind seems to become one with the thing thought; the thinker is possessed by his thoughts, always "changing his mind" as the ideas that "fill it" change. (This, I trust, is now happening to you, in reading.)* In seeing we open our eyes and effortlessly receive the sights that "pour" in, mysteriously filling us with the appearance of visible things even as those same things remain undisturbed and in their place, unaffected by our activity of seeing them. In sexual activity, despite the longing for union, duality is never overcome; the lover does not lose himself in the beloved, the beloved does not become part of the lover, and the two do not become one flesh, except derivatively in the children that may issue from such sexual coupling. But when we are at work on the world in eating, we do not become the something that we eat; rather the edible gets assimilated to what we are.

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*So powerful is this experienced coincidence between minding and the ideas-being-minded that ancient thinkers (like Aristotle) thought that the human so-called mind or intellect is basically a pure openness or receptivity, an immaterial "material," a capacity to be grasped and informed by the intelligibles. On this view mind is actually nothing except when it thinks, and when it thinks it is identical to the active being-at-work of the intelligibles.

Eating something means transforming it, chemically as well as physically. Eating comprises the appropriation, incorporation, and de-formation of a complex other, and its homogenization into simples, in preparation for their transformation into complex same. More precisely, in eating, another becomes one's own through specific stages. First it loses independence when it is seized or plucked or uprooted and grasped by hand or mouth. Next its own distinctive form is destroyed, beginning with ingestion and proceeding through the homogenizing process of digestion. Otherness is ultimately overcome by the incorporation of the homogenized simples that is absorption, followed by their re-formation and assimilation to sameness through biosynthesis. Whereas in seeing, the sight of the viewer is informed by the visible object, in eating, the edible object is thoroughly transformed by and re-formed into the eater.

The transformation is, of course, never complete; some of the ingested materials resist digestive breakdown; some of the simples produced by digestion are rejected for absorption. Even for the healthiest and most fastidious animals, there is digestive waste. A bacterium may absorb only glucose (and salts) and waste virtually none of it, but organisms with digestive tracts necessarily "have eyes bigger than their small intestines," excreting the unusables as solid waste. The conversion of other to same is thus only partial; for any complex organism there is no perfect food, completely incorporated without remainder, immediately active as part of the feeder. A crystal "grows" by addition and "waste-free" incorporation of units already directly identical to its own; an animal only by transmutation of another organism. That such conversion is possible at all is the wonder that is eating and metabolism.

Strange as it may seem, the necessarily wasteful character of metabolism is not necessarily a defect, for the need it creates turns out, as we shall see, to be the deepest cause of the richer forms of being available to living embodied organisms (compared to the "more efficient" crystals). As a thought experiment, one might ask, Why is there need for *new* food? Why does not nature favor the perfect recycling of materials? Why does not animal evolution tend toward the selection of organisms that effectively recycle, that waste less, that need less and less exogenous food? A physicist will point out that perfectly efficient recycling is impossible, a violation of the second law of thermodynamics. A physiologist will point out that the products of metabolic breakdown (like ammonia or carbon dioxide) are often toxic to the animal and therefore need to be expelled. But a philosopher will wonder whether these necessities are not, paradoxically, also *good* for the organism. For lack, experienced as desire, is the spur to all aspiration, to action and awareness, to having a life at all. Bodies as incorruptible as diamonds, or bodies lacking in nothing beyond themselves, would have no impulse or orientation toward the world beyond their borders. Waste makes need, and need makes for everything higher than need. Here, in the germ of hunger, is the origin of all the appetites of the hungry soul.

What Use Is Food?

What happens next to the material absorbed after digestion? What is foodstuff food *for*? Some of it will be used for energy, which in turn is needed for all bodily activities. In this sense food is to the organism what gasoline is to the automobile. No fuel, no performance. But the relationship between the fuel and the fuel-dependent performer differs markedly for an automotive organism and a mechanical automobile. In a car the combustion of fuel releases heat energy that expands the gases in the combustion chamber, and the expanding gases mechanically drive the pistons that, via a series of interconnecting rods, shafts, and gears, make the wheels go around. In the automobile (and the steam engine, the jet airplane, and the atomic-powered submarine) the motion is external to the site of fuel combustion, and the site of combustion is external to the mechanism that moves. The machine, though it houses the fire, is not itself altered or consumed by the combustion of fuel, except to be coated by some fraction of the unexpelled residues. Fuel goes in and combustion wastes go out, but the machine does not participate in the transformations; it remains unaltered, like the fireplace that hosts but escapes the transformation of the fuel-consuming fires.*

*The word "fuel," from the Old French *fowaille*, may be etymologically related to the Latin *focalia*, neuter plural of the adjective *focalis*, related to *focus*, which originally meant "hearth," "fireplace." Thus *focalia* are the things of the hearth.

In contrast the controlled biological combustion (or oxidation) of energy-rich carbohydrates for use in animal locomotion does not work through the use of released heat to expand physically an inert and external mechanism. Rather the chemical energy contained in foodstuff is trapped in the form of concentrated, transportable, and readily usable packets of energy still in chemical form (usually in the high-energy bonds of a carrier known as ATP), which bring about the contraction of the muscles, which in turn move the bones that move the body. Moreover—and this is the more profound difference—the oxidation that enables them to contract is housed (and conducted) by the muscles themselves. In the living animal fuel "burned" to permit motion moves and alters purposively especially the very "hearth" that burns it. (And, as will soon become clearer, the muscles are—indeed the entire organism is—not only moved but moving, actor as well as acted upon, in metabolic combustion as in all other organic activities.)

But animal nourishment differs still more profoundly from machine fueling. Food is, in fact, more than fuel, because it yields more than power. Food is needed also to maintain the "organic machine." All of the organism's constituent materials—that is, the proteins, carbohydrates, lipids, and nucleic acids and the complexes formed from these—are in constant flux, including also the materials that carry out these metabolic transformations. For example, the very enzymes instrumental (as catalysts) in the breakdown of sugar to produce useful energy are themselves regularly broken down and resynthesized from amino acids within the cell. Quite literally the organism that turns over foodstuff is itself constantly turning over its own stuff. No part of the cell is immune. But what is lost to degradation is regenerated by the cell itself, in part from the very foodstuffs brought from without. For the organism, unlike a machine, to nourish means to maintain as well as to fuel, and the organism is self-maintaining and self-repairing.

Organic self-maintenance not only preserves and restores the stuff of living cells; in multicellular organisms it also secures a stable internal fluid environment in which the cells live and function. All living cells and tissues are surrounded and sustained by body fluids, like blood and lymph, that not only bring nutrients and remove wastes but also make possible the optimum functioning of the cells

by keeping roughly constant the physicochemical properties of their immediate habitat. The blood or serum concentrations of, for example, glucose, albumin, fatty acids, and various inorganic salts and ions (like sodium, potassium, calcium, phosphorus, and iron) are stably maintained—along with temperature and pH—within a narrow range. In higher animals elaborate neural and hormonal mechanisms help ensure this homeostasis* of the *milieu intérieur*, but the materials held in balance are constantly being supplied and replenished by nourishment, by food.

Nourishing provides not only for maintenance; it also provides, out of the same foodstuff, for increase and growth. But here a careful distinction is needed between mere increase in size and genuine growth. When a mature, full-grown adult eats more than he needs for activity and maintenance, that surplus stuff is turned into storage, largely as fat. Food is, in this sense, a source of quantity, of increased mass and bulk. Yet this surplus is not in principle essential for life and, except in animals that hibernate, may even be harmful—as we human beings know only too well. But even where spare bulk is useful insurance against a lean year, such an increase in quantity is not genuine growth.

True growth, in contrast, is *in-form-ation*—formation and organization, of and from within—not just increase. It is seen most clearly in the process of maturation. True, as an animal goes from a fertilized egg to a mature adult, as we already observed, its bulk increases enormously. But that increase is in the service of and subordinate to the development and differentiation of the various organs and their maturation to full functional capacity. Not as prospective storage bulk to be saved for the event of famine but as material to be reformed and transformed into the *essential* components of an organic, organized, and active whole is food the material of true growth.

What happens when the foodstuff is incorporated into the feeder? How are we to understand its transformation into the living flesh of the growing and active organism? What, precisely, is the relation between the nutrient part and the organic whole?

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*The term *homeostasis*—meaning "staying the same"—was coined by Walter B. Cannon to describe the internal constancy that permits the remarkable persistence of the organism's bodily structure and function.[1]

Here we need to avoid some careless thinking about the meaning and relation of parts and wholes.* For not everything that is a piece or a hunk of something bigger is properly a part. A part, by its very nature, is always a part *of*. A part of what? A part of a whole. Only true wholes can have true parts. Not every larger entity, comprising subunits, is a whole. Everything depends on how the subunits and the larger unit are related, and on the kind of being each is and has.

The crucial distinction is between a composition and what I shall call a concretion. In a composition the so-called parts or elements are put together (*com+ponere*), "placed with" each other side by side, like bricks in a building or molecules in a crystal, *without losing their individual identity*. By contrast, in a concretion mutual interaction effects a transformation of the original subunits. The elements become "grown-together" (*con+cresco*) into a more intimate union, which submerges their original distinct identities into the larger whole. Curiously, when the elements are truly concretized into the whole, they are no longer *actually* what they were. They exist in the whole only *potentially*; that is to say, the original elements, now transformed and submerged, can be restored only by separation and only *if and when* the larger whole is broken down (as, for example, when a body decays after death or when scientists dissect and analytically destroy its integrity). A true whole is continuous and integral; even the internal so-called boundaries between the organic parts do not exist except as potential sites for future divisions of the whole. When a part is made to stand apart as an actual discrete something—like a hand or a liver or a DNA or protein molecule—it has ceased to be a true part of the functioning whole. A "hand" that cannot handle is in fact not a hand.

When foodstuffs like sugars and fats become material for organic growth, self-maintenance, or self-healing, their identity as discrete

*The philosophical questions of part and whole are among the most interesting and difficult: What is the relation of part and whole? What makes something a one, a unity, an integrity with its own identity, despite the presence of a plurality of parts or subunits? Though a powerful argument can be made that plants and animals are the clearest instances of natural wholes, the issue of part and whole crops up in many other realms: the electron within the atom, hydrogen within water (H_2O), lines within the triangle, notes within a song, bricks within a building, and so on. And then there is the overarching question of the relation of each thing or being to *the* whole. The reader may fruitfully ponder whether these part-whole relationships are all basically the same or whether (and how) they are at once both similar and different.

chemicals is submerged as they are incorporated into the larger units of life: cells, tissues, organs, organ systems, and, finally, the whole organism. (Indeed the identities of each of these progressively larger parts, as discrete entities, are submerged in the next larger organizational level.) True, the elementary foodstuffs are constantly being recycled in metabolic turnover, and they can be recovered as distinct chemicals on analysis. But as they exist when incorporated into the living being they exist concretely, not compositely; they exist grown-together in the integrated whole. This concretization and integration of renewable materials is the work of biosynthesis, a chief, if not *the* chief, use of nourishing.

Nourishing is thus the activity of self-renewal as well as self-fueling, self-maintenance, self-healing, and self-maturation. Its essence: the transformation of materials, from other to selfsame, by the organism itself—indeed by each of its cells, tissues, and organs, in well-coordinated and integrated processes of breakdown, biosynthesis, and concretization—to preserve and to serve the organism as a living, performing whole.

The Cause of Nourishing

Our reflections to this point have hardly broken new ground nor have they been especially controversial. The difficulty begins when we move from description to explanation, from stating the facts of nourishing to finding their cause. Here we begin to probe more deeply into the meaning of eating in relation to the being of animals.

Nourishing not only makes possible and sustains the performing whole; it is itself one of the whole's performances. As the many recent references to "self" imply, an organism feeds and nourishes itself. The impulse to feed, as well as all steps of ingestion, digestion, absorption, and regenerative biosynthesis, is an *accomplishment* of the animal itself. Though sustained by metabolism, an organism seems to be more than metabolism's product. It also appears to be its cause.

What is it *in* the organism that is *responsible* for these activities? This is, of course, the heart of the matter. At issue is the very nature and being of living things, a question once much debated by philosophers, but now virtually neglected even by biologists. Nothing less

than a complete ontology can answer the question, and I am, quite frankly, unequal to the task. Nevertheless an attempt must be made, at least to clarify the question and to suggest the outlines of what seems to me the most reasonable answer.*

We ask "What is responsible?" because we are perplexed by change. Change of all sorts is puzzling, organic change peculiarly so. Organisms come into being and pass away; they grow, mature, metabolize, move, mate, decline, and die. We want to know *why* it happens; we want an "explanation." It is the aspiration of all explanation of change and activity to find something *beneath* the change, itself more stable or fixed, to which we refer, and in terms of which we explain, the activity. We seek, as it were, to arrest or capture the motion by identifying it with something simpler and more regular and predictable, something preferably permanent and immobile (or, if not absolutely unchanging, immobile in the sense that the character and quantity of its motions are not themselves changing). When we ask about responsibility† for metabolism, we are asking about such an under-lying cause, the stable something beneath or behind the flux.

When this question of responsibility or cause was first elaborated in classical antiquity,‡ a variety of meanings were distinguished, for there are many different kinds of responsibility, as many as there are meanings to the question Why? Consider, for example, the chair in

*The ensuing difficult but necessary discussion of causation and of form and material, like that just concluded about part and whole, will be insufficiently rigorous for the sophisticated. Yet I fear it may also be too dry or tedious for those impatient with philosophical argumentation, despite my strenuous efforts to avoid technical terms and jargon. Such readers may derive some comfort from knowing that I too find these matters very hard to sort out; thinking about the true being of familiar things is never easy.

†I deliberately lead with the phrase "what is responsible for" rather than the more common "what is the cause of." For, as will soon emerge in this discussion, the notion of "cause" carries the weight of 2,500 years of philosophical dispute; moreover, in its contemporary use, it generally means at most something like "moving agent," that which propels or pushes the motion or change. Yet there are a variety of answers to the question "why this motion?". What, for example, is responsible for your present activity of reading? Among others, the physical existence of the book, the intelligibility of its contents, your desire to learn, the physiological health of your eyes and brain, and your capacity to receive the units of intelligibility mysteriously carried by the words on the page.

‡The term entered classical philosophy from its ordinary usage in the Greek law courts, where an *aitios* was the guilty party, the one responsible for the crime. Hence *aitia*, cause, became that which bore responsibility for some happening or change or for some being's existence. A cause is that which is "guilty" of and for the deeds—and misdeeds—of Being itself.

which you are sitting: Why is it the way it is? More than one thing is responsible. Responsibility for its being precisely the way it is lies with the carpenter-upholsterer who made it, and also with his art and tools (responsible as source of its coming-into-being); with the wood or springs or cushioning out-of-which it is made (responsible as its material); with the shape or structure it displays (responsible as its form or idea); and also with the use it serves, sitting (responsible as the that-for-the-sake-of-which or purpose-for-which it was made). In short, the from-what, the out-of-what, the what, and the for-what are all modes of responsibility.

With the coming of modern science, the notion of causation shrank to mean only the moving cause or the efficient cause, the source of the effect, that which puts something in motion. In the Newtonian world of inert matter in motion, the true cause would be the force that pushed or pulled from the outside, overcoming inertia to produce a change. Yet it proved easier to describe and quantify these changes than to identify the sought-for underlying substantive cause. (What kind of being, for example, is gravity?) Thus, today, abandoning altogether the search for a true cause or for an underlying being or substance whose properties explain the phenomena, scientists often content themselves with finding instead the regularity and permanence of so-called laws of change and motion, which express descriptively the relations of variables, usually in mathematical terms. Contrary to common opinion, the laws of motion—like Newton's famous expression $f = m \times a$, which defines the quantity of force as a constant product of a body's mass times the acceleration it experiences—do not explain motion or address its cause; they merely relate certain measurable external quantities of the motion and the thing moved, quantities defined in terms of preconceived parameters of space and time.

Nevertheless, despite these epistemological difficulties, scientists are by orientation drawn to materialism, to a belief in the primacy of matter and its necessary movements, to a faith that responsibility for natural phenomena resides ultimately with atoms and molecules and their autonomous attractions and repulsions, unions and divorces. Biologists are no exception. Though there are some nonconformists, nearly all contemporary biologists tend to explain the vital phenomena of feeding, nourishing, and metabolism in terms of the structure,

motions, and relations of the material parts of the organism (and of its food). Not since Descartes broke with his philosophical ancestors to present his doctrine of the "animal machine" and a purely mechanical explanation of vital phenomena has any philosopher or scientist of the first rank thought to argue that some notion of form or soul or purpose was required to understand metabolism or, indeed, any activity of life with the possible exception of consciousness. One can well understand why, for modern biology has made enormous progress precisely by eschewing all such speculation.

Modern biochemists have made great strides in identifying the pathways of intermediary metabolism and biosynthesis, in defining the chemical fates of all absorbed nutriments, in describing the structure and mechanisms of action of the enzymes that catalyze bioorganic reactions, and in working out the genetically controlled regulatory mechanisms that keep the process running smoothly. Physiologists have analyzed the numerous elements of digestion and absorption and have defined the autonomic nervous system's control of these processes. And neurobiologists are presently searching out the "chemical basis" of appetite. In short the whole is treated in terms of its "parts" and the activities of the living being in terms of the motions of inanimate matter, of that underlying stuff more durable, long lasting, and regular than any living thing it frequents. The great successes of our analytic and reductive biology seem to most scientists to vindicate their mechanistic and materialistic presuppositions, not only as heuristic but as ontological hypotheses. Most biologists are, tacitly if not by explicit profession of faith, philosophical (as well as methodological) corporealists, firm believers in the primacy of the material: Understood in this sense, "You are what you eat" might well be their motto.

Against the stream I want here to argue for the necessary supremacy of living form. There is, of course, no doubt that our corporealist science has taught us much that is both illuminating and useful about the *how* of metabolism, but understanding the *what* and the *why* requires attention to organic form and its special properties. For, as we shall see, the relation of living form to its own material differs markedly from the form-material relation in inanimate things. In order to show this, we first need to gain greater clarity about our terms, *form* and *material*.

Form and Material

Every tangible object or being, whether of natural origin or made by human beings, both *is* a something and is *made-out-of* something. Provisionally let us call the latter its "material" and the former its "form." Form and material are, in the first instance, relative and correlative terms: Form *is* the something made of certain materials; materials are, as materials, materials *of* and *for* the thing as formed. In fact to *be* material means to be potential, to be able to receive a certain form or forms, to be capable-of-being-worked-on by some process or operation that would trans-*form* it—that is, form it into that something whose material it then becomes. Wood is, by itself, just wood; marble is marble; cholesterol is cholesterol. But marble becomes also material for Michelangelo only because and when its capacity to be the marble David or Moses is realized through the workings of the sculptor's hand. And cholesterol becomes material for a cholesterol-requiring organism when its capacity to interact intimately with other membrane materials is realized as it is incorporated by the organism as a component of its living cell membrane. Without ceasing altogether to be or to manifest properties of marble or cholesterol, these "things" are transformed and altered by their subordination to the activity of "information." The materials, though following their own nature, are at the same time constrained by their new arrangements, which constitute a nature of a higher order.

Form and material are interdependent not only in definition but usually also in fact; though distinct as ideas and separable in speech, they are, especially in living things, grown-together in the enmattered form or the informed matter that is the given thing; the dog and its flesh, the oak and its roots, no less than the desk and its wood, are each as inseparably related and as mutually interdependent as the concave and the convex. The relativity and interdependence of material and form persist also at multiple levels of organization: The oak wood that is material for the table is itself a special form, say, of xylem and phloem, which are in turn special formations of cells, which are special formations of carbohydrates, lipids, and proteins, and so on and on. At the "lowest level" some least or ultimate material would be reached (if any such there be) that could not be analyzed further into its form and material (and whose parts, if it had parts, would be ho-

mogeneous with the whole). Such an ultimate "material" would be more than material relative to some other form; it would be *matter*. It is, of course, one of the aspirations of a corporealist science to explain the formation, organization, and workings of all complex wholes in terms of the dispositions, motions, and interactions of their parts or materials, and, ultimately, of such ultimate matter. Form, on such an account, would be at all levels but an accident, or at most a result, of the necessitated bumpings and joinings, in stages, of the ultimate matter. It is this view that we are here challenging.

If material is material relative to a form, what then is a form? Form is often connected with shape and figure. But when we think of form with regard to living beings, we mean more than shape or figure, and more than an aggregate of corporeal parts. A pile of rocks has shape but not form; it is a heap, not a whole. Form is what makes a being a unity and a whole, in the world and through time. Form is that order or ordering that makes a one of the many components, giving it an integrity the components by themselves do not have. It is, I confess, extremely difficult to say just what this unifier is (if it is a distinct "what"). It cannot be the outside surface or skin; although the boundary defines the limits of the organism against everything it is not, it does not define what it is. The boundary is not the cause of unity but rather one of its manifestations. We begin to suspect that form is not primarily something visible or tangible—in short, that there is, in this sense, some immaterial "thing" that unites and informs the absolutely corporealized organism—but what it is we cannot define. Yet we may continue to discern its meaning and its work.

Form provides not only unity but also specificity and identity; each being is both a particular *one*—that is, a singular whole being, distinct from all others—and also a one *of* a particular species or kind. Although form is more than its visible aspect, these unifying and specifying properties of form are immediately evident in an organism's surface appearance or *gestalt*.[2] Both the hidden ground of its unity and the distinctive character of its being are attested to by its visible looks. Indeed the word *looks* has been suggested (by the late Jacob Klein) as the best translation of the Greek word *eidos*, central to the thought of Plato and Aristotle, which is usually translated as "form," "idea," or "species." (*Eidos* is derived from a root meaning "to see.") "Looks" preserves the etymological insight that both the *fact* of a thing's wholeness and, more important, the distinctive *kind* of whole that it is are generally evident in its visible appearance. The "invisible looks" or form or nature of an organism is announced eidetically, in the language of visibility. Indeed our word "species," from the Latin *species* (again literally "looks"), also carries this double sense of form: form as contrasted with its own material, and form as distinctive kind, contrasted with other kinds.

This way of approaching animal forms accords well with our ordinary (that is, prescientific) experience of the world. It also fits with human speech, which acknowledges the manifest species character of animal form by the use of such general nouns as *lion*, *tiger*, *cardinal*, or *eagle*. Despite what some critics might say, this recognition of species does not commit us to so-called typological thinking, to a belief in the permanence of species, or to any particular ontological teaching regarding form. In such ordinary speech we do no more than acknowledge what any healthy rabbit recognizes—without metaphysical prejudice and without deception attributable to language and its reliance on general nouns—when it flees from all hounds, finds all carrots to its taste, and mates only with other rabbits. Not philosophers but living nature is responsible for the existence of natural kinds, distinctively and recognizably formed after their kind.

Living things are not only visibly ordered, they are also internally organized. Organization—literally, the division of the whole into instrumentally active parts (the word *organ* means "instrument" or "tool," and *organization* means "the condition of systematic coordination of distinct instrumental parts or organs")—is, in a sense, the distinctive form of organism. Organs are genuine and heterogeneous parts, each with useful activities crucial to the life of the organism as a whole. One organ breaks up the food, another pumps nutrient-carrying blood throughout the body, a third filters the blood of toxic wastes; some organs of sense help locate the food; other organs of motion help capture it. Each organ in its own way contributes something useful to the whole. Indeed the very being and meaning of an organ is always given by its relation to the whole of which it is a useful part; to be useful is, necessarily, to be useful *to* something or someone, in this case to the whole organism. Utility, like the things that are useful, is a subordinate and subservient matter, always pointing to something that is being served.

To be sure, complex machines also have organization and comprise organs. But one of the chief differences between an organism

and a machine is that *organisms are self-organizing*. They are organized—that is, they acquire their organs—developmentally and from within, realizing an innate plan or program. There is a second chief difference: The organized machine serves its owner; the *organized animal, to begin with, "serves" itself*.

Some animals are, of course, more highly formed—that is, intricately organized—than others. It is sometimes difficult, all the more so in lower organisms, to discern the boundary between one organ and another, and organs often have or can acquire more than one useful function. Yet organization, the special and coordinated arrangements of the necessary material, with the coincident emergence of new powers or capacities and new activities or functions, is an indisputable fact. And it is also a fact that many, if not all, of the interesting vital powers and activities of any organism depend absolutely on the arrangement of the suitable materials, rather than on the materials alone.

Our frequent references to animal activity remind us that, in living things, form is not a static notion. The looks of animals are often mobile, like the mobile animals that bear them, and the motions of the looks are generally recognizable and true to form. Most fundamentally, living form *is* generally *functioning* form or organization, that is, form in its work or activity. To be a something, to be a particular animal in the full sense, is to be that animal-at-work: Really to be a squirrel means to be actively engaged in the constellation of activities we can call "squirreling." The true squirrel is a bushy-tailed fellow who not only looks but also acts like a squirrel

> who leaps through the trees with great daring; who gathers, buries, covers but later uncovers and recovers his acorns; who perches out on a limb cracking his nuts, sniffing the air for smells of danger, alert, cautious, with his tail beating rhythmically; who chatters and plays and courts and mates, and rears his young in large improbable-looking homes at the tops of trees; who fights with vigor and forages with cunning; who shows spiritedness, even anger, and more prudence than many human beings.[3]

The dead squirrel or the sleeping squirrel or the squirrel-in-utero do not fully manifest the squirrel form.

Two further observations follow: Form-at-work in all its aspects

can be said to be the distinctive way of life of an animal. And since every way of life is related (or adapted) to a particular place in the "outside" world—not just a geographic or climatic place but one filled also with other life forms—animal form-and-activity often shows itself in, and in turn bears the marks of, active reference to place and to relations beyond its border. The being of animals is not limited by their apparent visible boundaries; they live, thanks to the special powers of their peculiar forms, in and in relation to the larger world, as it were, "outside themselves" (a point to which I will return). Second, form manifests itself inwardly as well as outwardly, not only "spatially" in the internal arrangements of organs but also "psychically" in "inner" experience, that is, in feelings, moods, appetites, and so on. Sometimes, especially in the higher animals, this inwardness manifests itself on the surface, gaining outward expression in the changing patterns of visible form; in the higher animals, facial expressions and gestures make possible genuine communication of mood or emotion from one formed being to another. Form can thus be a conveyer of meaning, including some aspects of what it might *mean* to be *this* particular formed being.*

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*From a philosophical point of view this discussion of form has but scratched the surface. It leaves many large and important questions unaddressed. For example, it ignores the vexing question of the origin or coming-into-being of the forms; for if the forms (or species) of living things change, as evolutionary doctrine teaches us that they do, we face the challenge of understanding how that is possible, especially if we insist that form is not just an accident of matter—that material receives and does not determine form. My discussion also ignores the difficult question of whether the form of an given animal is always the same or whether it can be present more or less. Is the form of the frog embryo the same as the form of the tadpole, and is either of these the same as the form of the mature frog? If form in the emphatic sense means form-at-work, then the early frog embryo does not have the full form of frog; yet it has the form of frog rather than the form of cockroach, it will remain the *same* frog from fertilized egg to full maturity, and the full form of frog is somehow "present" to the embryo as a potentiality toward which its growth is directed. What does it mean to say that the form is "present" in the embryo as a potential? Can the potential form be alone responsible for its own coming into full and actual presence? Since the frog egg does not contain a miniature preformed "froglet" (a "frogunculus"), but does contain the full directions and inclinations for producing such a frog, how exactly is that "absent" frog "present" and efficacious in its own coming-into-being? What is responsible for the emergence of such "emergent form"?

I am aware of these questions and know they cannot be avoided. But they are, I insist, *secondary* questions that arise only after one has discovered the distinction of form and material and, as I shall argue in the next section "The Primacy of Form," once one has discerned the superior responsibility of the form for all the activities of living things, metabolism included. For the purposes of my present inquiry, these secondary questions can be left hanging. My purpose is to begin close to the ground, with the phenomena, and to show why we need notions like *form* and *form-at-work* simply to make sense of what appears before us. I trust my more metaphysically inclined readers will be tolerant of my refusal to tackle here their favorite questions.

The Primacy of Form

After this preliminary exploration of form and material, we are at last prepared to argue that the activity of nourishing is the work more of an organism's form than of its matter. In the course of showing the supremacy of form, we shall necessarily be indicating also the ways in which the relation of living form to its own material differs from the form-material relation in inanimate things.*

Though we are partisans of the primacy of form, we do not reject the importance of material. Matter must be given its due, and one must even acknowledge the initial attractions of materialism. The classical argument for the primacy of matter began from the fact that all living beings die and that, after death, their bodies decay into lifeless stuff. The persistence of matter, against the perishability of life and living things, seemed to attest to its greater causal power. As Adam Schulman has observed:

> From the latter evidence (organic decay into lifeless matter) early Greek thinkers like Empedocles concluded that what truly exists are the materials earth, air, fire, and water, and that organisms and other putative wholes are merely aggregates of these immutable elementary bodies. There are therefore no genuine wholes, but only complex systems, all of whose properties are attributable to the spatial organization of their material components. In such a world nothing is ever truly generated or destroyed, just reorganized. . . . Empedocles said, "Of all mortal things there is no birth nor any end in baneful death, but only a mixing and a separation of things mixed." The Empedoclean viewpoint in physics proved persuasive to Galileo and Newton, and finds modern expression in the eighteenth century's "man the machine," as well as in the implicit reductionism of much of modern natural science.[5]

Yet, paradoxically, it is the activity of metabolism itself that should make it clear that the materials do not *by themselves* even begin to account for the phenomena of life. Yes, the organism is perishable. Yes, the properties of its materials are in part responsible for its workings and character. But, as we ourselves know best from the inside and precisely because of our constant need to eat and to replenish our bodily stuff, the living animal has a unity and a self-identity that in fact outlast its ever-shifting material.

*My argument here is much indebted to the late Hans Jonas's penetrating essay "Is God a Mathematician? The Meaning of Metabolism," in his splendid book, *The Phenomenon of Life: Toward a Philosophical Biology*.[4]

Over the course of a lifetime of metabolizing, the *organism persists, though its materials do not*. Metabolism means the continuous exchange of stuff between inside and out, and no molecule in the organism is immune to turnover. Thus the organism is never the same materially, yet it persists as the same being, and indeed precisely by means of exchanging its materials. But *what*, then, *is* it that persists? Among other things the organism's boundedness and separation from all else beyond its border, and its wholeness and identity (both species-specific and individual) within. Persisting too is the internal organization and the functional harmony among the parts. Most important, persisting are the organic powers and activities, including the powers and the activities of self-persistence (that is, metabolism) itself—maintenance of the self, by the self, and for the self—always exerted and directed against a largely indifferent world of otherness and against the impending negation that is death. In short, what persists is form: integrated, specific, individuated, empowered, and efficacious organization.

Second, the persistence of organization or form, despite and indeed because of the interchange of material, implies a certain independence of the form from its own materials. True, any organism's form is absolutely dependent on, and always inseparable from, material and precisely on such and such kinds of materials, but not on these and these individual molecules. True, the organism is, always, coincident with its materials at any moment, but it is independent of—not tied to—any one collection of stuff over time. Indeed, if organic form ever coincided for any length of time with the exact same collection of molecules, it would have ceased to live. The organism would have become a thing, with exactly the same form-material identity as seen in such inanimate bodies as rocks and crystals.

Third, and most crucial, this "persistence" and "independence" of form or organization is itself an achievement of form. The form of a given organism is a certain organization-in-action, whose first activity is to keep the enmattered organization-in-action (that is, itself) both organized and acting. The organization is not a mere outcome or heap or aggregate *caused* by the motions and joinings of the mate-

rial parts. On the contrary, the joinings and motions of the material parts are caused and governed by the organization. Organization organizes, at each stage guiding the activities of the next. To be sure, the energy for organic activity is chemical energy, trapped in elementary molecules and always transferred from molecule to molecule. And no chemical molecule reacts in the organism contrary to what would be predicted for it by the laws of thermodynamics. But the reactions of the molecules are constrained by their organization in the cell, which in turn is constrained and directed by the overall organization of the animal. Only *as organized* do the materials conduct the orderly and directed metabolic exchange of stuff that provides the cell and the animal with energy, with materials for maintenance and growth, and with the wherewithal to respond to changes in the environment. Even at the cellular level and even in the simplest organisms (for example, a bacterium or an amoeba), the sequence of chemical reactions is ordered and directed by structural and functional arrangements uniquely provided by the living cell: enzymes that catalyze the reactions; highly intricate three-dimensional intracellular structures (organelles), such as mitochondria or endoplasmic reticulum, that link chemical processes together and that channel intermediates in functionally useful directions; positive and negative feedback mechanisms, which regulate the metabolic activity in keeping with the physiological needs of the cell and changes in its external environment; and so on. Moreover, the functional arrangements of molecules—in cell organelles, cells, tissues, organs, and organ systems—is the work not of the molecules as such. The living organization directs the comings and goings of molecules and all their interrelations, as the legislative guides the executive or a musical score the musicians. And organization, legislation, and harmony, I remind you, are not themselves material.*

None of this is altered by the marvelous findings of biochemistry and molecular biology, claims of molecular biologists or biochemists

*Form or organization is, as has been noted, absolutely dependent upon material. One never finds the form of lion separated from its leonine flesh. But, unlike the flesh, the form cannot be held in your hand. Neither can one touch or see the *powers* inherent in living form. One can point to or hold the eyeball, but one cannot point to or hold its power (sight) or its activity (seeing). These aspects of its form are themselves intangible because they are immaterial.

to the contrary notwithstanding. We cannot here present a full argument. But suffice it to say that even DNA—the genetic material, the so-called molecular basis of life—functions *not* as a chemical material but as *information carried by material*. True, the information carried in DNA is borne by its material elements—that is, by the nucleotide bases (adenine, guanine, thymine, cytosine)—though here too the preservation of the same *kind* of base, not of this particular nucleotide molecule, is all that is required. True, the nucleotides of DNA are chemically well suited to act as the coded letters of legislative messages for protein synthesis. But the medium is *not* the message. Call it a plan, a program, organization, whatever—this ruling principle is itself immaterial. Proof: One can hold DNA *molecules* in a bottle, but one cannot physically hold or grasp the *messages* they carry.

We must not allow ourselves to be deceived by the materialistic counter-claims of scientists who, to be blunt, are philosophically rather naive. With a little careful thought we can see through their materialistic interpretations of experiments, which they (wrongly) believe demonstrate that it is the chemical materials that bear primary responsibility for the doings of living things. Such proof they find, for example, in experiments that have achieved the synthesis of fully active DNA—say of a functioning virus—from simple inorganic nucleotide precursors. The synthesis takes place according to chemical principles, of course, and no vitalist ghost jumps into the flask. But form is still dominant and rules over the synthesis. The order in which the chemist adds the nucleotide bases, one to the next, is dictated not by the bases themselves or even by the chemist. It is prescribed by the natural order—that is, by the form—of the virus itself. One might say that here the hands of the chemist substitute for intracellular mechanisms to execute the legislation carried in the sequence of the DNA for replicating the same organized whole. DNA *is* a material molecule, but the *information* it carries as the *genetic* material is no more material than are the meanings of words carried by visible letters. And although the information carried in DNA is in a form utterly different from the visible looks of the mature organism, the developmental and physiological processes DNA directs are orchestrated to generate the organic, self-maintaining whole that appears visibly as just this-here individual and just this-sort of animal.

Fourth—returning to the main argument—because the persistence and independence of form through metabolism are themselves achievements of the form, which guides the animal's traffickings in materials, feeding and metabolism necessarily entail for living things a new and distinctive relation to the world. Unlike nonliving things that persist inertially as what they are—immediately self-identical and without any need to maintain their self-identity through their own efforts—living things must constantly work to maintain both their existence and their self-identity in the face of ever-present dangers of going out of business. Metabolism is a full-time occupation from which only death provides release. The organism's ability to endure as an able-bodied being means that nourishment—newly gathered or retrieved from storage—is a *continuous* necessity. An organism's ability to metabolize is inseparable from its absolute need to do so. The organism's *in*dependence as a self is inseparable from its absolute *de*pendence on what lies beyond its borders.

Thus, with the emergence of life, even in its most elementary forms, comes the emergence of a genuine "self"—a distinct and separate being, potent but perishable, which persists by its own performance in metabolism and self-nourishing—pitted against but in active commerce with a correlative "world," in which, from which, and against which it acts to maintain itself. The neediness of living things, not shared by self-sufficing inanimate matter, drives the organism into genuine relations with its surrounding environment, for which there are no precedents among nonliving things. Indeed, it is only living things that have—and have a relation to—an environment, a world, and not merely contiguous, adjacent, and neutral space. This need-inspired relation to the world entails—necessarily—all the essential powers of life, powers present to an organism here and now but exercised always in relation to what is beyond and not yet. All animals—even the simplest or lowest—possess (even if only as rudiments) the great powers* of action, awareness, and appetite.

*By "power" I mean "ability," "capacity," "potency," "faculty," (in Latin, *potentia*; in Greek, *dynamis*), in all cases, the requisite organized strength and facility for performing a specific activity or activities. An organic power is more than a mere possibility; it is a readied and available capacity that inheres in already existent cells, organs, or organ systems.

The Three Great Powers of Organic Form

The need for outside material means that organisms must be capable of reaching out to obtain it—to find, appropriate, and transform it. They must be able to act in and on the world. In mammals the distance-effacing and world-altering character of chasing, capturing, and devouring are self-evident, as are the innate powers to move, grasp, bite, and crush, which are manifested in these activities. But simpler animals are also agents of change and worldly transformation. Barnacles and other filter feeders do not chase their victims, but they hold and destroy them nonetheless. By means of pseudopodia, an amoeba approaches, surrounds, and then engulfs its food. Even inanimate food can be actively pursued; some species of bacteria propel themselves along concentration gradients, seeking and consuming those sugars (or other carbon sources) that are most efficiently metabolized. Granted, these "actions" are performed and these powers are exercised "automatically," without deliberation or conscious intention; one could argue, rightly, that we do not here have action in the full sense. Still, the doings of living things are spontaneously done, exercising immanent powers adapted for such exercise, and the transformations wrought are real and large—in the aggregate, massive. In order to live every living animal disturbs and alters its surrounding world, each in its own characteristic ways, though it seeks in fact not "world alteration" but only its own persistence.

Actions on the world in food seeking are generally fairly specific; only some parts of the environment are regarded as edible. Discriminate action implies discriminate awareness.* And awareness, too, is present—if in only rudimentary form—even in the simplest forms of life. Specific nutrients are actively transported even in single-celled animals and bacteria. Such active transport involves the presence of specific proteins, located at the cell boundary, that recognize, selectively bind, and carry inside the desired nutrient. And again, even at

*I use the broad, nonspecific term "awareness" to encompass all forms of openness and receptivity and sensitivity, from the barest irritability to the richest intellection. Sensing, perceiving, imaging, cognizing, minding, intellecting—all these are species of awareness. There can also be internal awareness (kinesthesia) and self-awareness. Awareness need not be self-conscious or even conscious to be awareness.

these lowest levels, awareness is awareness of form: Bacterial transport systems can discriminate between D and L stereoisomers (structural mirror images) of the same sugar, which differ not at all in their chemical composition but only in their three-dimensional geometrical form. Biological *trans*formation of the world presupposes *in*formation about the world; powers to alter the outside world necessarily coincide with powers to perceive it, and both are born with life itself.

Needless to say there is enormous structural and functional variation in the means animals use to recognize and to pursue food. Some rely more on sight, others on smell, still others on hearing, whereas animals with less-developed external sense organs locate their food by following, say, temperature gradients or chemical traces given off by the edible object. But of just *how* awareness guides food-securing action, even in the higher animals who hunt by sight, we are still largely ignorant. We know that we human beings depend very much on the visual image of the desired object, and, as we shall see (in Chapter 2), our imagination works with images available to it even when the objects are long absent. But when the fox chases the rabbit, does it follow a visual image? Does such an image depend on the presence—or the very recent presence—of the rabbit? Is there memory of previous chases, and does it function in the present one? That animals learn from experience suggests that some sort of memory plays a role, but, lacking direct access to animal awareness and inner life, we may never really know how. Nevertheless awareness they have, whatever its precise form; they are discriminatingly receptive to the world beyond their borders.

Here, perhaps, it is worth a moment's interruption to note the obvious fact—often overlooked because it is taken for granted—that organic powers of nourishing, including powers for active transformation and receptive information, require complementary possibilities of and in the surrounding world. Animal need is met by the (at least partial) hospitality of the world. The animal's need for food is answered by its availability; his ability to transform other into same is matched by the other's transformability; and his power to sense and to be informed about the world is made possible by the world's articulated, formed, and sensible character. Our

world need not have been thus hospitable—other planets, as we know, cannot support life. It is only a partial explanation to say (correctly) that if the world were not hospitable to life in the first place, living things would not have arisen at all. The world's original receptivity, in a sense reenacted for every new organism that sees the light of day, is itself unexplained, a given—and, to all that lives, an unmerited gift.*

But, to return to the vital powers implicit in metabolism, simple awareness of some outside edible is insufficient to account for the action of self-nourishment. Something must "take an interest in" the perceived edible object; something must energize the animal into action. In short, something like "felt need" or "appetite" is also required. In higher animals awareness of an edible being or object leads to eating only because—and if—hunger or felt lack is present. To be sure, the experience of lack *as* hunger, in the full sense of the term, presupposes a nervous system sufficiently advanced to allow for the self-experience of inner states of being. But the essence of what, in such higher beings, comes to be manifest to feeling or conscious experience is already (unconsciously) present to the simplest forms—albeit unknown to any mind. What moves an organism to feed is not merely the sensed and registered presence or absence of a certain chemical or edible being in its environment but the *inner needy state* of the organism, for which such an absence is a lack, an absence to be overcome or remedied. Bacteria do not measure the concentration of glucose in their environment in the indifferent and detached way of the biochemist who prepared their growth medium. Not the numerical measure itself but the immanent "perception" that it represents a potential fulfillment of a *lack* leads to the activities of "chasing" and selective absorption. "Lack" need not be conscious to be "felt"—to be efficacious. Here we see a refutation of the impoverished and faulty explanation of stimulus-response theory, which attempts a strictly mechanistic account of behavior: The organism would not "respond" to perceived food "stimuli" were it not an "interested" or "appetitive" being, were it not already internally ordered toward the necessary activities of self-nourishing. As with action and awareness, the seeds of appetite are

*I return to this topic in the last chapter.

copresent with life. Indeed the germ of appetite governs, guides, and integrates awareness and action: Appetite or desire, not DNA, is the deepest principle of life.

The attentive reader, reflecting on the immanent powers of appetite, awareness, and action I claim are coextensive with animal form itself, will recognize that we are now speaking about the inner or *psychic* meaning of animal embodiment. To repeat, animal form turns out to be internally capacious, empowered to sense, to move, to want. Somehow—and I would say mysteriously—animal organization means "animation," means "inwardness," means the presence of what the ancients called *psyche* or *anima*, soul. By this they did not mean a disembodied spirit, a ghost in a machine, a vital force superadded to an otherwise "dead" body, a separate being that flees the body on death. Rather, *psyche* referred to and comprised all the integrated vital powers of a naturally organic body, always possessed by such a body while it is alive. Not the property of the materials alone but of the materials as species-specifically formed, the species-specific psyche might be said to be the vital form or ruling-beginning of each animal, when the animal is regarded as a unified center of awareness, action, and appetite. When soul is thus understood, we should not be reluctant or embarrassed to recognize that animals—all animals—indeed have soul.

Thanks to the psychic powers of action and awareness, energized by need and appetite, living things exist in the world differently from nonliving things. All living things in some degree transcend their confinement to the here and the now. Though isolated from and precariously poised in opposition to the world, they live effectively in that larger world. The organism's boundary is open for traffic with the world, in principle with the whole. Organisms are all able to appropriate and transform material beyond their borders. They are all able to receive information from outside themselves and to discriminate among the things received. Just as they impress themselves on their surroundings, so, in varying degrees, aspects of the surrounding world impress themselves upon (and within) living animals. The rudiments of action *in* and *on* the world and of perception *of* the world, born with life itself, give the living being a certain transcendence of the space it physically occupies. The powers of life transform the surrounding territory into "lived space" or "action space,"

which, it should be stressed, is *not* the homogenous, neutral and mathematized space of the physicists.

The animal lives not only beyond the here but also beyond the now. As we have seen, its new world-relations grow out of a self-concern with persistence and are driven by a rudimentary inwardness or subjectivity, which orders present needs to actions that may bring future satisfactions. To be sure, the existence of the present powers of an organism is decisively the result of past performance and successes (especially those of its ancestors from whom these powers are inherited). But when they are actually at work and exercised in the here and now, these powers imply and point forward toward the "not yet." The self-concern of the organism, manifest in appetite, means that the future moment of satisfaction of need is always implicit in the present moment of want and in the activities to which want gives rise. Appetite and its ministerial actions are, by definition, always forward looking and purposive. As Hans Jonas puts it:

> With respect to the organic sphere, the external linear time-pattern of antecedent and sequent, involving the causal dominance of the past, is inadequate: while mere externality is, at least can be presented as, wholly determined by what it was, *life is essentially also what it is going to be and just becoming*: in its case, the extensive order of past and future is intensively reversed.[6]*

This forward-looking character of organic activity is most obvious in the doings of whole animals: the chase points to capture, ingestion points to satisfaction. But the same directedness is manifested at all levels, down to the intracellular. The transcription of a gene into messenger RNA points toward the translation of the message in protein synthesis; the protein as synthesized points toward its subsequent use

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*Jonas also shows how the organism's transcendence of the here follows from the need to transcend the now, and also how biological time and biological space differ from the neutral time and space of modern physics: "[I]t [the organism] faces outward only because, by the necessity of its freedom, it faces forward: so that spatial presence is lighted up as it were by temporal imminence and both merge into [future] fulfillment (or its negative, disappointment). Thus the element of transcendence we discerned in the very nature of metabolizing existence has found its fuller articulation: both horizons into which life continually transcends itself can be traced to the transitory relation of organic form to its own matter. The internal direction toward the next impending phase of a being that has to continue *itself* constitutes biological time; the external direction toward the co-present not-itself which holds the stuff relevant to its continuation constitutes biological space. As the here expands into the there, so the now expands into the future."[7]

in transporting, from without to within, the sugar newly present in the environment; the transport of the sugar derives its meaning from the utilization of the sugar that follows, providing needed energy for all future reactions and activities. Without any trace of conscious intention, in metabolism all organisms face forward in time and engage in self-directed purposive behavior aiming at a future goal. Even lowly metabolism, mindlessly conducted throughout the animal kingdom, is unintelligible save as a purposive, goal-directed activity.

Animals face purposively forward in goal-directed activity not only in the self-interested and self-preserving functions of eating and taking nourishment. They do so in most everything, and nowhere more than in the activity of reproduction. The fact and necessity of reproduction remind us of the intrinsic limit on the future-serving power of eating: No amount of self-preservative feeding can provide the indefinite preservation of the feeder. Eating sustains the life of the living but only for a finite time; sex provides a partial answer to this finitude. But whereas eating serves the good of the being that eats, sexuality—however pleasurable to the animal participants—serves mainly the good of those beings that issue from this sexual union (and, indirectly, the "good of the species"). In sexual activity animals necessarily serve an end that goes beyond them; indeed quite literally so: In the very act of reproducing, animals—even if mindlessly—ratify and acquiesce in the necessity of their own mortality. (Salmon going upstream to spawn and die provide only the most vivid example of what is, in fact, a general truth about all sexually reproducing animals.) Thus, because of built-in limits on the power of metabolism to maintain individual life, animals—unbeknownst to them—live bifurcated and divided lives: Self-servingly they eat to secure their own existence, self-sacrificingly they reproduce—and, with the higher animals, also feed the young—to secure the existence of their descendants.* The complex relations between individual and group well-being, between self-love and other-regard,

*The world-relation of animals that reproduce through sexual union is thus not adequately characterized solely by the distinction between self and nonself, some of which non-self is edible. Certain other "selves"—sexual partners or mates and, in some cases, the young they generate—stand out for the animal and are of special interest. Here is the germ of animal sociality, of that special transcendence of individual isolation that is part and parcel of the necessarily selfish business of staying alive (and of thus facing one's inevitable "self-ish" death).

between independence and sociality, all have their origins in this ubiquitous biological fact.

The Hierarchy of Living Forms

All these essential aspects of life—needful freedom; selfhood set against otherness; relation to the world through the activities of perception, appetite, and reaching-out in action; purposiveness (all present rudimentarily even in bacteria and amoebae)—become more developed and rich as organisms become more complex. To the rudimentary ability to discriminate the shapes of sugars and other chemical nutrients, still retained by individual cells of higher organisms, are added the abilities to perceive the temperature, hardness, shape, color, and motions of outside objects and, relevant to our topic, the looks, sounds, smells, and tastes of the edible ones. To the amoeboid or ciliate motion of single cells, still retained by certain white blood cells in mammals, are added the somatic power and psychic direction for locomotion—for the hunt, the chase, and the capture; and to the catabolic capacities of single cells are added the powers to gnaw, bite, tear, grind, chew, and swallow, as well as elaborate mechanisms for digestion, absorption, and transport of nutrients. The inner perception of lack is gradually transformed into the genuine experience of hunger, which is simply one aspect of the emergence of a more pronounced sense of selfhood. Eventually, consciously felt and even deliberately set purposive actions supervene atop the mute and mindless—but at the same time perfectly rational and intelligible—goal-directed food-gaining behavior of simple organisms. With greater powers of awareness, mobility, dexterity, and self-perception, with greater internal bodily control over the essential conditions of life, and with greater social interaction, higher organisms attain greater freedom and a richer way of life.

The richer life of higher animals is, in a way, implicit in the way they get and take their food. Unlike simple organisms and plants, whose relevant environment is largely only the immediately contiguous, higher animals (including all vertebrates and the higher invertebrates like bees, spiders, and squids) live and meet their needs over greater distances. They both can and must perceive at a distance and move to reach their food. Animal appetite, which entails experiencing a distant object as a goal, persists throughout the time

of absent satisfaction and drives the animal's motion toward his food. Nourishment—calories for the energy bank and materials for biosynthesis, repair, and growth—is still the bottom line, but it is now attained only through intermediate activities. In a bacterium the need for sugar and its proximate availability translate immediately into active transport of sugar into a cell. But in a lion metabolism is detached from, and must await the successful result of, many prior acts: the lion must first see, smell, stalk, chase, attack, and finally conquer the zebra, whose flesh he then tears, tastes, chews, and swallows. All of these activities are *voluntary*: They are performed by the action of striated (voluntary) muscle under the control of the voluntary nervous system, unlike the subsequent digestive processes, which are performed by the action of smooth (involuntary) muscle under the control of the autonomic (involuntary) nervous system. These larger activities of the whole animal are distinct from the metabolic goal they serve; they even have their own inherent pleasures (and pains). Indeed some of the intermediate activities, which were originally adapted to serve nutrition and mere survival, eventually even acquire a life and fulfillment of their own; they become part of the goal—as well as the means—of surviving.

Special kinds of mediated nourishing are found among those higher animals—especially birds and mammals—that feed their own young. Here getting food ceases to be simply self-ish: Not only does one animal (an adult bird, a lactating female mammal) put food into the mouth of another; the food-gathering activity is itself often socialized (for example, the pack-hunting of wolves and lions). In the very special case of mammals, where the young are fed out of the mother's own substance—first, "intravenously" while the young are *in utero*, then after birth by suckling—intimate "social" ties are established around the activity of feeding, with pleasures in those mediating interactions that go beyond the mere satisfaction of hunger, pleasures that anticipate the social enjoyments of human eating-together. In the higher animals, the hungry soul wants more than food.

With regard to our subject of eating, several implications of the mediated nourishing of the higher animals deserve emphasis. First, the feeder, though ultimately interested in the nutritional value of his food, acts seemingly for different reasons. The lion pursues the zebra, as meat to be sure, but the zebra nonetheless. The lion in fact sees and chases and kills—and is by his form empowered to see, chase, and kill—the formed zebra, however much his processes of digestion will then automatically turn zebra into the necessary biochemical simples, themselves to be worked up into lion. Indeed, in most of their voluntary food-gathering activities, higher animals engage other ordered and formed living beings or their products. Though we cannot know what the inner experience of eating feels like or means to the lion, it seems reasonable to suggest—from evidence provided by examining ourselves and by observing animals, including a cat's playing with a captured mouse—that the lion's satisfactions in eating come mainly from the pleasures of capture, tasting, and devouring and from relieving the pains of perceived hunger, not from the restoration of intracellular nitrogen balance or the availability of extra sugar to replenish the glycogen stores. Anyone who has for a time been forced to take nourishment intravenously or via stomach tube, or who has been restricted for a time to pureed foods, knows first-hand how welcome and enjoyable it is at long last to sink one's teeth into something solid and to chew it up. Eating comes to satisfy appetites for more than nutrition, and not only among human beings.

Second, the higher animals—with fully developed powers for living with and over distance, and with intermediate activity in part dissociated from the continuous vegetative activity of metabolism—increasingly display a more comprehensive relation to the world, and this in several aspects. In the realm of awareness, powers of distance perception and locomotion disclose much more of the world; the higher senses—notably sight and the sense of forms—eventually provide an awareness of whole beings in their wholeness and specificity, not merely (as with smell or sound) of their mere presence. The diverse and plentiful forms of life eventually become known to life itself; in fact, by means of facial expressions, postures, and gestures, the looks of the higher social mammals are even capable of communicating something of an animal's inner life to members of the same species.[8] In the realm of action, locomotion and speed also enlarge the animal's arena in which it can act. The travelers, in many cases, are more exposed to risks than, say, the barnacle or clam, which stay put indoors and filter. But they also enjoy many more

possibilities, including possibilities for food. The most varied diets belong mainly to those beings who most vary their place and who can perceive more clearly and accurately the variety of things among the possibly edible. The biggest transformers of the world are generally those who are also most receptive to its many-splendored forms.*

This observation brings us back to that great paradox of life, clearly embodied in the necessity of eating: Living form, to preserve life and form, threatens life and form. Eating is at once form preserving and form deforming. What was distinct and whole gets broken down and homogenized, in order to preserve the distinctness and wholeness of the feeder. In the case of predatory meat eaters, what was alive is killed in order to preserve life. This tension in eating is emblematic of the ambiguous relationship between life and form in general. Although the vital powers of metabolism exist only in specific, formed beings, these powers as exercised threaten the existence of specific, formed beings. Nature manifests both variety and vitality; in living things vitality presupposes, conserves, but also threatens variety.

Life, though an advance over nonlife—indeed, *because* it is an advance over nonlife—is in tension with the articulated character of the world. True enough, on the side of awareness, only animals are capable of recognizing and appreciating the multifarious forms of the ordered world. But at the same time, on the side of action, animals threaten the survival of that order and those forms. Forms that need to transform other forms are, in principle, a threat to the stability of the world—and ultimately even to their own survival. The danger and the glory of living forms is writ large in the fact of eating.

*Several of the points of the last few paragraphs are beautifully made by Hans Jonas in his essay, "To Move and To Feel: On the Animal Soul," in which he defends the hierarchical character of life and demonstrates that survival is an inadequate standard for evaluating life's success:

> If mere assurance of permanence were the point that mattered, life should not have started out in the first place. It is essentially precarious and corruptible being, an adventure in mortality, and in no possible form as assured of enduring as an inorganic body can be. Not duration as such, but "duration of what?" is the question. This is to say that such "means" of survival as perception and emotion are never to be judged as means merely, but also as qualities of the life to be preserved and therefore as aspects of the end. It is one of the paradoxes of life that it employs means which modify the end and themselves become part of it. The feeling animal strives to preserve itself as a feeling, not just a metabolizing entity, i.e., it strives to continue the very activity of feeling: the perceiving animal strives to preserve itself as a perceiving entity—and so on . . . The rift between subject and object, which long-range perception and motility opened and which the keenness of appetite and fear, of satisfaction and disappointment, of pleasure and pain, reflect, was never to be closed again. But in its widening expanse, the freedom of life found room for all those modes of relation—perceptive, active, and emotional—which in spanning the rift justify it and by indirection redeem the lost unity.[9]

Let me summarize the argument to this point:

1. The animal world is articulated into formed and recognizable kinds, distinctive individuals belonging to distinguishable species yet depending for survival on their eating—that is, on their de-forming and homogenizing—other individuals belonging to other kinds. Indeed, the evolutionary differentiation into new kinds—speciation—is in part a consequence of the pursuit of survival through feeding, as mutations giving selective advantage in obtaining food or in avoiding being eaten gradually give rise to new living forms; conversely, new varieties of food appear with the proliferation of new kinds of living beings.
2. Though there is, for every organism, a constant need for new material, what persists despite and indeed as a result of the transformation of material is the selfsame formed organism in its characteristic and recognizable form.
3. The primacy of form is most evident in the fact that the formed organism is not the result of metabolism but rather its cause, for persistence through nourishing is an *achievement* of the organism as *organized*, not of its materials alone. Yet the possibility of success depends on the partial hospitality of the world—namely that food is there to be taken. (In this dialectical relation of power and dependence, we can see the seeds of both pride and gratitude.)
4. Though their neediness makes their being more precarious, living things have "more being" than nonliving things. They *are* more in, and are *in* more of, the world. Because of their need of sustenance from the world, they participate in genuine relationships with the world beyond their borders, in some ways transcending their confinement to the here and now: open to recognizing and acting on what is spatially outside, pointed purposively always to the future to satisfy present need, while bearing also the marks of ancestors both proximate and remote.
5. This openness to the world and this relation to the world increase as one goes up certain evolutionary paths, as seen in increased powers for and pleasures in receiving (and discriminating accurately among) the distinctive presences of the world as articulated, and in

increased powers for and pleasures in acting upon and altering that world to suit the animal's needs and its increasingly complicated and subjectively felt desires. Finding and taking nourishment are more genuine accomplishments for the mobile than the sessile, for the carnivore than the grazer, for the intelligent than the dumb. Yet, though growing omnivorousness (direct or indirect) seems to correlate with—and perhaps to require—growing awareness of the limitless variety of the formed world, omnivorousness means, in principle, the willingness to homogenize and destroy the world as formed and ordered, to put it all to use for oneself, or rather, to swallow and to turn it *into* oneself.

These thoughts lead directly to the question about man.

2

The Human Form

Omnivorosus Erectus

And, though all other animals are prone, and fix their gaze upon the earth, he gave to man an uplifted face and bade him stand erect and turn his eyes to heaven.

—*Ovid*

Metamorphoses (1. 84–86)