The question of form is an extremely important issue in contemporary philosophy and culture. Before addressing the topic directly, I would like to show how wide ranging a problem it is.

1.

The issue of form arises most obviously in regard to living material substances, to cellular organisms, plants, animals, and human beings. There we have the most obvious examples of a material and a formal dimension, of a contrast between material and formal causality. In our modern scientific understanding, however, the formal generally gets reduced to the material component of a thing, and instead of being recognized as a cause, the form, to the extent that its existence is acknowledged at all, is considered to be the effect of its material conditions. Thus, living things are thought to be simply temporary arrangements of atoms and forces that have come to be as they are because of natural selection. The human activities of thinking, feeling, deliberating, and choosing are thought to be essentially neurological activities which, in turn, are reducible to chemical and electrical elements and forces. The scientific enterprise, the project-oriented kind of thinking we now call science, is driven by the desire to show how what seems to be the forms of living things and the forms of mental activity are really only complex versions of purely material elements and their forces.

In this reductionism, form is taken to be an effect and not a cause. Even in the traditional understanding, form is an effect in a certain sense. If the material cause is truly a cause, it brings about an effect, and its effect is the concrete thing, which includes the form. The material cause, however, exercises its causation precisely as the material cause, as being the ingredient substrate that allows the form to be and to exercise its causality. The material cause, in turn, is governed by the form. Thus, in the traditional understanding, the formal and the material causes together, each in its own way, bring about the being of
the concrete thing. Years ago, Rudolf Boehm, a German philosopher noted for his work on Husserl, formulated the reciprocal causation of matter and form by a terse phrase, "Conditions condition their cause, and causes cause their conditions."

In our modern understanding, however, the material cause is changed into a kind of efficient mechanical cause that generates the apparent form. What completely drops out of sight is any sense of effective formal causality. If the form is recognized at all, it is taken to be a configuration or structure or a mere appearance, but it lacks any governing role. Formal causality disappears, and the form is thought to be simply an effect.

Two historical developments have played a major role in bringing us to this intellectual and cultural situation in which form is diminished and matter exalted. The first was expressed in Francis Bacon's dilution of form as an explanatory principle in the new science for which he was the apologist and first great theoretician. For Francis Bacon, science has as its goal the study of the laws of nature, which are the laws of matter; it does not set out to study natural forms as they had been traditionally understood. These laws will be the same for all natural beings, both those in the heavens and those on the earth, both the living and the inert. Science is the knowledge of the laws of matter as such, not primarily the knowledge of substantial forms of things.

Knowledge of the laws of nature, Bacon promised, will enhance human control over nature and will lead to an improvement in the human condition and a relief of its many distresses. It is a productive and useful thing to know the laws of nature, and knowledge is sought for the power it gives. As Bacon says of his own project, "My purpose ... is to try whether I cannot in very fact lay more firmly the foundations and extend more widely the limits of the power and greatness of man." He wants to help bring about "the victory of art over nature."

In contrast with the power that comes from knowing the laws of nature, knowing the substantial forms of things does not enhance our power at all. Rather, according to Bacon, the presumed knowledge of forms is useful only in disputations and serves only the vain glory of victory in argument. We might observe that knowing forms would actually put limits on human endeavor, because the forms would indicate how things simply must be; rather than expand human power, knowing the forms of things sets boundaries for what we can attempt. Furthermore, in the Baconian view, forms are not the object of true science; they do not reveal what things are, but instead are figments or projections of our own minds. To quote the famous 51st aphorism from the first book of the New Organon:

The human understanding is of its own nature prone to abstractions and gives a substance and reality to things which are fleeting. But to resolve nature into abstractions is less to our purpose than to dissect her into parts; as did the
school of Democritus, which went further into nature than the rest. Matter rather than forms should be the object of our attention, its configurations and changes of configuration, and simple action, and law of action or motion; for forms are figments of human mind, unless you will call those laws of action forms.\(^5\)

The substance of things is found, not in their apparent forms, but in what they are made of. This reductionist and utilitarian attitude is found to a greater or lesser degree in many later philosophers, such as Hobbes, Descartes, Newton, and Spinoza. The same attitude still pervades our contemporary scientific enterprise and, beyond that, the assumptions of almost all people who have gone to college or in some other way have breathed in the general opinions that circulate in our world.

This Baconian outlook may have its deeper origin in Machiavelli. Machiavelli did not speak about natural science, but he did remove the formal—the good and the noble—from the domain of human affairs and politics, and he reduced the political to the elemental forces that lie below the merely apparent form of political life. We might say that what Bacon did was to take the Machiavellian understanding of human nature and extend it to nature as a whole.

The other historical development that has led us to our present situation in regard to form was Darwin's introduction of the theory of the descent of species through natural selection. Francis Bacon gave us a way in which we might possibly view things, but Darwin's theory seemed to make the Baconian viewpoint not just possible but necessary. Darwin seemed to uncover the mechanism by which elemental forces generated the complex wholes that seem to possess form; the mechanism is natural selection, whereby environmental pressures allow certain syntheses, which arise by chance, to survive better than their competitors and to proliferate. What looks like the regularity and the necessity of form is really the outcome of random occurrence joined with environmental opportunity. Note that such a theory of development and life holds up as the highest good not the excellence of the individual in a species, but sheer survival. The lowest common denominator, survival, is the good that rules in evolution, just as the elemental forces expressed in the laws of nature, the lowest common denominator in matter, rule over the whole of nature.

I might add that the discovery of DNA has been taken to explain, in turn, the mechanism by which natural selection occurs. It is mutations in that governing molecule that yield differences in the phenotype and thereby allow a new variant to survive in situations in which others perish. Thus, if Darwin provides a mechanism to validate the Baconian rejection of forms, Crick and Watson provide a mechanism to validate Darwin. Everything seems to converge on the material, and the form becomes more and more a principle that is only remembered as a
historical curiosity.

The realm of living substances and species is the place in which the issue of form and matter is especially prominent, but the reduction of the formal to the material occurs in many other domains as well. In understanding the human condition, for example, moral activity is often reduced to the elemental passions, and the political is reduced to the economic, which in turn is reduced to the passions of gratification and security. In art, the formal is debunked into the passionate seeking expression, and even in popular movies and sitcoms, the noble is shown to be at best a strategy for survival, at worst a mere cover for passionate self-interest. Freudian reductionism parallels the Baconian. Machiavelli’s expulsion of what he calls imaginary kingdoms is imitated in countless ways. We might say, with some irony, that these diverse reductions of human forms are like so many different participations in the one great Machiavellian refusal of the form of the good. Furthermore, these reductions of the human to the animal—or, say, the moral to the passionate—are, in turn, expected to be still further reduced to the elements and forces of sheer matter through the promised discoveries of neurology and molecular biology. Some people have begun to wonder ominously about how our moral and social life will be effected when society at large—or, at least, Western society at large—begins to realize that men are only machines, that the human as such is a great delusion.

In our modern intellectual and cultural life, there has been a wholesale slaughter of the forms of things. The biological extinction of various animal and plant species is as nothing compared to the intellectual disappearance of forms. I think that the recent apparition of deconstruction in our academic and literary life is related to this cultural death of form; the deconstructionists, in effect, are like those sinister figures who walk around the battlefield after the rout and shoot the wounded.

2.

Having made some remarks about the imperilled condition of form, let us now turn to what can be done about it. I want to say in advance that we cannot now simply reassert the Aristotelian and medieval notion of form; we must take into account the accomplishments of modern science. But as we accept the discoveries of science, we should not lose hope that form and its causality can be restated in a new way in our new context. Indeed, the restoration of form can be seen as a major challenge to the philosophers and scientists who realize that the modern venture, as successful as it has been, provides only a partial view of the whole of things, and that the presence and the causality of form are among the important issues that it leaves out. To restore form will involve showing how form serves in both definition and display: how it brings unity to the things it informs, and how it functions as the look or eidos in their
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manifestation.

As a modest contribution to the rehabilitation of form, I offer the following three remarks.

(1) My first comment concerns the modern idea that matter and the laws of nature are the same everywhere, in the heavens and in the sublunary sphere. One of the major innovations of the new science was the discovery that the matter of the heavens, the quintessence, is really not different from the matter in and around the earth. This discovery was made by the early modern astronomers, by Tycho Brahe and Galileo, and accepted by Bacon. I want to question this claim.

The sublunary sphere is the domain where living things with all their forms have developed. In the presence of living creatures, however, matter itself gets transformed and elevated. Living creatures generate new kinds of chemical compounds; there are no enzymes or proteins in outer space as such. The form of living things gradually creates its own substrate. Even if there are other planets on which life has developed, life will have brought about on them an environment in which it can flourish. Wherever life arises, it generates a distinction between the "sublunary" and the celestial, even in regard to the kind of matter found in both places. Thus, a distinction between the "sublunary" and the celestial is not inappropriate even in our time, and it is only within the environment of the sublunary that forms of life can flourish.

It is interesting that the physical sciences of the very small and the very large have converged, that particle physics and astrophysics have joined forces. Specialists in one are often specialists in the other; both sciences do deal with a common kind of matter. Subatomic particles and their forces are the same in the heavens and on earth, and nuclear reactions in the stars generate out of hydrogen and helium all the other elements in the periodic table. But when such elements are incorporated into living things, an entirely new situation arises, one that carves out a niche for itself within the heavens and sets up a sphere with chemically new types of matter in it. When living things release the matter they have transformed, they modify the "sublunary" world in which they live and make it into a qualitatively different world. We are aware of only one such sphere. It is possible that it is the only one, but even if there are many, each would still have to be distinguished from the rest of the cosmos. Furthermore, even if there are many such spheres of life, they remain minute in size compared with the vast stretches of the lifeless world. The domain of life and the proliferation of forms may be the highest and the best in the cosmos, but it is hardly the biggest.

The point I want to make by drawing the distinction between the "sublunary" and the celestial forms of matter is that we must not allow atomic physics and astrophysics to provide the only context in which we discuss the problem and the restoration of form. Astronomy is not where we look to deal with the problem of form. Even though the "sublunary" world or worlds may be only a tiny part of the cosmos, it is in them, or
in it, that the problem of form arises most clearly. The problem of form arises most vividly where life has proliferated.

Furthermore, form predominates in the world in which we directly perceive, grasp, taste, smell, and hear things. Our senses have evolved to deal with things in the sublunary world: they allow us to recognize prey and predator, the edible and the poisonous, surfaces we can walk on and those that will not support us, friend and foe. It is in this context that the forms of things display themselves and are recognized by us in our sensory experience. We should not subconsciously concede that astrophysics and microphysics set the standard for our experience and that the problem of form has to be somehow determined by the kind of artificial viewing that we carry on when we use telescopes, mass spectroscopy, and particle accelerators. We must use hypothetical models in astrophysics and in particle physics, but we do not also have to use models when we see surfaces around us, walk across a street, or recognize that something is edible by the way it looks, smells, and tastes. We make immediate distinctions and we recognize forms immediately within the world in which we live. This world is also part of the cosmos; it does exist, we perceive its articulations, and the kind of formal causality we find in it is a legitimate kind of causation. We should not abandon the authority of the modes of perception and thinking that recognize things in the sublunary world; we must not think that only the telescope and the supercollider give us the true substance of things.

(2) The second point I wish to make is that there is an inherent contradiction in the speech on the person who denies the existence of form. Such a speaker has to assume forms in what he says. In this respect, the denier of forms is like the speaker who rejects the principle of noncontradiction. Such a person may deny the principle of noncontradiction, but his very denial is parasitic on the principle and, hence, implicitly affirms it. In regard to form, if we make any distinctions at all between one thing and another, we have implicitly affirmed the fact that things are formally distinguishable.

This self-refutation in the speech of those who deny forms occurs in two different ways. First, the very scientific inquiry into the elementary materials out of which life is made requires that we acknowledge that there is something to be explained, namely the living thing: Only because the living can be distinguished from the nonliving can we look for the material elements that make it up. Likewise, when we look for the neurological basis for cognitive activities, such as visual perception, we must have acknowledged that there is such an activity, that there is visual perception, that the form of perception is different from, say, that of memory. Thus, the very reductionist projects that science pursues involves a surreptitious acceptance of form as that which is to be explained. In neurology, for example, these or those neural activities and pathways are specified by us only because they are the substrate and the material cause for perception. The neural activities have to be defined by perception taken as a form. If they were not so defined, they
would simply blend into the overall activity of the brain and nervous system and would not be the targets of scientific investigation. Thus, those who would reduce the formal to the material still must appeal to form to define their project. This is the first way in which those who deny form must still assert it in their discourse.

The second way in which they do so is by making use of form in their nontheoretical life, when they return to living, thinking, and choosing within the world. In their nonscientific attitude they do distinguish between animals and plants, between perception and memory, between vice and weakness, between politics and economics, and do not treat everything as homogeneous matter.

The kind of argument I have sketched in this my second point has been called the argument by retorsion: it shows that someone who denies something must, when he speaks or lives, affirm the thing or principle that he denies. The classic example of the argument by retorsion is found in Aristotle's attack on the speaker who denies the principle of contradiction (Metaphysics 4.4). The argument by retorsion is one of the essential philosophical arguments, but there is something unsatisfying about it. It shows that our interlocutor has to concede something, but it does not explain why. It merely shows that, not why. It has something of the *tu quoque* about it. Furthermore, if our interlocutor is truly insistent, he will gladly concede that he is contradicting himself, and will say that such contradiction is part of the human condition. For example, if we say that he has to assume forms when he lives his ordinary life in the world, he will simply say that such delusion is necessary for human survival, but that science has shown us that it is a delusion, perhaps a transcendental delusion, and not truth. It does not seem sufficient, therefore, simply to show that we cannot avoid appealing to form; it would be desirable to have a more positive argument, and to such a positive argument I turn in my third point.

(3) My third point deals with DNA and living things. As I mentioned before, the discovery of the DNA molecule as the carrier of the genetic code has been used to support the reductionist position. DNA is said to be the vehicle whereby sheer material elements and forces complicate themselves into living wholes. But I would suggest that DNA can also be used to support the reality and causality of form.

The key is in the notion of information and coding. We are told that DNA operates as a code and that it carries information. But coded information cannot be reduced simply to the material elements in which it is encoded. Information is not simply material, and a code is never merely a causal trigger. What is needed is a philosophical analysis of the nature of DNA coding. Such an analysis would be carried out by contrasting DNA with higher levels of encoding, such as those found in immune systems and those found in animals and man. In the opposite direction, the function of DNA in living things would be contrasted with the development of crystals, in which no coding, but mere material assimilation, takes place, and with the structure of chemical reactions.
By placing DNA between crystals and chemical reactions, on the one hand, and immunity systems, animal signals, and human speech, on the other, it would be possible to show that DNA is elevated above the simple material world and partakes of something like the information that is communicated in higher levels of living things. As a byproduct of this investigation, we would clarify how human language and speech themselves are embedded in a wider cosmic and natural context. Human language and speech are not abruptly introduced, without antecedents, into the world of nature by a purely thinking substance, as they are in the descriptions given by Descartes. There are antecedents to human speech, there is transmission of information, even in the living cells that make up human life.

If DNA is taken as a code or as information, one of the questions that arise is, Who sends the message encoded in it, and what does this message say? Obviously, we will be speaking analogously when we address this question, because the notions of speaker and message will have been greatly transformed, but there is some sense in which the concepts do function here. I would suggest that it is the plant or animal form that encodes itself into the DNA, and that the form is what the DNA serves to communicate. The form is both speaker and message in DNA. An important consequence that bears on the restoration of form is the following: if it is true that form both expresses itself and is expressed in the DNA code, then form could not be merely a human projection, it could not be a mere figment of our minds. There is something in nature that intends or targets or signifies it as well. Form is signified by something in the natural world; it is signified by the DNA that transmits it. When we then give expression to the form in our speech about the world, we are giving a more elevated spiritual formulation to something that has already been expressed by nature itself.

Furthermore, if the form of the parent organisms can be seen as somehow expressing itself in the DNA, then the DNA cannot be seen as merely the effect of material elements. DNA cannot be taken as merely a channel for mechanical causality. The formal makes a difference in nature itself. The manner in which a living form inscribes itself, analogously speaking, in its DNA can be taken as an indication of how formal causality works. Aristotle spoke rather simplistically about this; he just said that the form mastered or organized its material conditions. We can speak about a mediation between form and matter, a mediation accomplished by the incredibly subtle working of the DNA molecule and its coded information. An appropriate philosophical reflection on DNA can make a great contribution to the Aristotelian concept of form and the causality of form. It can help us avoid the feeling that form is somehow an insubstantial, diaphanous, dreamy sort of cause. It would give us a sense of formal causality that has an effect in nature. As a further consequence, once we clarify how form works through DNA, and once we thereby recognize form, we can then go on to raise the issues of virtue and excellence that come along with the notion of form and that
make no sense apart from it.

To develop this notion of form and DNA would require that we truly think beyond the instinctual reductionism of our intellectual and cultural climate. Even if we could formulate the role of form in very clear terms, I do not think it would succeed immediately in overcoming the reductionist bias. I think this bias is so deeply entrenched in our modern way of thinking that only the passage and the lessons of time will make people move beyond it. Furthermore, there is something simplistic about mechanical explanations that makes them appealing to many people. Only after many decades or even centuries have gone by, during which people continue to try to reduce the formal to the material and fail to do so, will the culture be softened up enough to take formal causation seriously. Nevertheless, the effort to restore form must be made, in order to provide an alternative for those who want one, for those who are willing to recognize that the formal has a place in being, and to prepare the way for the time when people in general will be more receptive to it.

Furthermore, I think that a more sophisticated understanding of form will also change our notions of evolution. The random element in natural selection will have been seen as only part of the picture, only part of the motivation in the development of organisms. Something like formal pressure and even a cosmic sense of reason will also be seen to function in it.⁶

3.

In the final part of my paper, I would like to expand the dimensions of the issues of form beyond those I have treated so far. I have spoken of form primarily in regard to living substances, and have also discussed it, in less detail, in regard to the definition of human awareness and moral and political life. There is still, however, another domain of form that should be mentioned: the sense of form found in logic and mathematics, where we speak of the logical form of sentences or arguments, or the mathematical form of equations and proofs. I think it would be unduly restrictive if we omitted this sense of form; even to understand the form of living things properly, we need this more extreme sort of form as a contrast, and must mention it, however briefly.

I want to draw attention to the extreme abstraction that has marked modern logic and mathematics. In logic we have, since the nineteenth century, focused on sets rather than kinds and, hence, we have worked almost exclusively with an extensional logic instead of one dealing with content. In mathematics we have, since Vieta, dealt not with geometric spaces, which had a kind of content and rootedness in the real world, but with algebraic formalities, again entirely emptied of content. These formalizations in logic and mathematics have come along with the denial of form in natural science. They have been the logical counterpart of the nominalism that marks modern science, so any attempt to
rehabilitate formal causality must also deal with formalism in logic and mathematics.

The task is to show how the formal structures of logic and mathematics can be rooted in the perceptions we have of the things in the world. When we articulate a thing and its features, we do so on the basis of perception and even in perception. The forms of subject and predicate do not only belong to words and concepts, they belong in articulated perception. They belong to the way things show up for us. Likewise, numbers are not just a special kind of concept; they are kinds of collections in which groups of things can be presented to us. It would be a major project to show how the various particular forms in logic and mathematics arise from perceptual and intentional experience. The forms of logic and mathematics should be related to the forms of being and to the kinds of things into which being is articulated. This enterprise also is part of the rehabilitation of form.

If we include logical and mathematical form in the problem of form, we touch on an issue that I have only alluded to throughout my paper. It is not enough just to ask to speak of form; it is essential that we consider also formal causality. Only if form is given a causal role will we avoid seeing it as merely a figment of mind, a mere gestalt and configuration rather than a principle that affects the being of things and serves truly to explain why things are the way they are. Then, however, the question arises, In what sense can logical and mathematical form exercise formal causality? Are they not merely the deposit of linguistic and mathematical conventions? Or are the axioms of mathematics and the laws of logic somehow part of the principles of being? These questions would take us deeper into antiquity than our appeal to Aristotle; they would take us to Plato and the Pythagoreans, and would intensify our reappropriation of form.

The restoration of form is a major challenge but, also, a fruitful one for those philosophers who believe that we can learn from antiquity even as we accept the discoveries brought about by the methods of modern and contemporary science.

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Notes

1. Aron Gurwitzch used to call Francis Bacon the public-relations man for the new science. Bacon was that, but he was also something far more important: one of the first to define both the nature and the human significance of modern science.

2. It is very difficult to determine the exact use of the term "form" in Bacon. It seems certain that he moves away from the scholastic and Aristotelian sense
of form as the determining cause of things and that he replaces this traditional use by taking form to mean the laws governing basic elements: "For when I speak of forms, I mean nothing more than those laws and determinations of absolute actuality which govern and constitute any simple nature, as heat, light, weight, in every kind of matter and subject that is susceptible of them. Thus the form of heat or the form of light is the same thing as the law of heat or the law of light." The New Organon, ed. Fulton H. Anderson (New York: Bobbs-Merrill, 1960), II.18.

3. Ibid., I.116.
4. Ibid., I.117.

5. Ibid., I.51. I would like to recall Bacon's remarkable statement about the impulses that move atoms to combine into more complex natures: "For the summary law of nature, that impulse of desire impressed by God upon the primary particles of matter which makes them come together, and which by repetition and multiplication produces all the variety of nature, is a thing which mortal thought may glance at, but can hardly take in." Cupid, or the Atom, chap. 17 in The Wisdom of the Ancients, in Selected Writings of Francis Bacon (New York: Modern Library, 1955), 414.


7. I am grateful to my colleagues Richard Hassing and John McCarthy for comments on earlier versions of this paper.