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Exact Science and the World in Which We Live

As it is described in Husserl's Crisis, the life-world, the Lebenswelt, is not simply the world in which we live; it is the world we live in as contrasted to the world of exact science. Furthermore it is this world, so contrasted, as named by phenomenology. "Life-world" is a word expressed in transcendentalese, not a word expressed in ordinary language. The turn to the life-world is a philosophical move, not simply a relapse into prephilosophical and prescientific experiencing.

A philosophical turn to the life-world is called for because the world we live in has been called into question and its truth has been interpreted as mere appearance by the kind of exact science carried on since Galileo. Philosophy is to allow us to repossess critically the world of our immediate involvement by showing us how this world is the foundation for what is achieved by exact science. The world we live in is changed into the world of exact science by a special handling of appearances, and only a kind of thinking that examines appearances as such, only phenomenology, is capable of telling us how the two worlds are related to each other. This issue could not be treated either by prescientific experience or by the experiences of exact science, which are constituted by different forms of appearing but which do not make appearances themselves their theme.

I. Exact Essences in The Science of Nature

Husserl uses geometrical forms as examples of exact, ideal essences, but such exact essences are found in many areas of the study of nature. Newton’s definition of a ray of light is an interesting example: we are to imagine a light beam being partially occluded up to the point at which any further occlusion would cut off the light entirely. A test charge or test particle, one which is imagined to have no effect on the field in which it moves, is another example, taken from electromagnetism. Another is a heat reservoir, a body whose temperature is not raised or lowered by the addition of heat to, or by the withdrawal of heat from the reservoir. We are to imagine, for instance, a glass of water that is somewhat cooled by an ice-cube; then imagine the ocean being practically unaffected by the addition of an ice-cube; then imagine a body totally unaffected by any such subtractions or additions of heat. Still other examples of exact essences are the ideal gas, the incompressible fluid, the perfectly flexible string (in which the stiffness is reduced to zero; the mass is taken as uniformly distributed along its length, and the tension is taken as uniform); the ideally efficient steam engine (whose energy output depends only on the temperatures of the hot source and the cold sink, with friction and dissipation reduced to zero); and the ideal voltage source (which, in contrast to any real battery, has no resistance between its terminals).

In all such cases the ideal structure is appropriate to the kind of thing we are involved with. The features of a ray of light are not the same as the features of the ideal gas; we begin with empirically different kinds of things and come to different kinds of ideal essences. Inventive genius in each domain consists in having the insight to know what sort of ideal is appropriate to the thing in question. Inventive genius consists also in seeing what variable can and ought to be projected toward a limit in the kind of thing we deal with. Carnot, for example, had to see that dissipation of heat ought to converge to zero in the case of steam machines, while Newton had to see that the thickness of the light beam should converge to a limit in the case of light.

Ideal forms therefore have to be achieved by someone, and Husserl attempts to describe what this achievement is like. He distinguishes several elements:

1) In the disclosure of an exact essence, we begin with something we experience directly, then we imagine a projection, toward a limit, of some relevant variable factor in what we experience (Krisis 22–23, Id I §74). We imagine making the surface smoother and smoother until we reach the geometrical plane, or we imagine less and less heat modification until we reach a heat reservoir. Imagination is a necessary element in this process; we cannot actually reach the limit we imagine we approach. Furthermore we cannot imagine what it would be like to reach this ideal limit; the ideal essence itself is not given even to imagination. We imagine the process of approximation, not the arrival at the limit. Also, we imagine only one or two steps in the process of approximation; we do not go through the whole process of approaching the limit. Once we define the ideal form, however, all "imperfect" but actually experienced forms become identifiable as versions of the
exact essence. They can be understood in contrast to the ideal essence we have reached in thought. When we now experience a steam engine, for example, we do not just have another engine, but an approximate version of the ideal steam engine. Exact essences give us a new way of taking the things of our direct experience (Krisis 30).

2) According to Husserl, such limit-forms are determined in order to exclude imprecision and to make exact identifications possible. We become able to identify something that is perfectly the same always and everywhere and for everyone. The things we directly experience are always imprecise, and are therefore not given as exactly the same when we perceive them again or when others perceive them. Husserl observes that even the similarities of such things are not exactly the same (Krisis 22). One actual surface will always differ in surface measurement from another even though both appear to be congruent; and even the same surface will be slightly larger or smaller or more or less irregular at different times because of its inevitable reaction to its surroundings. The ideal excludes such indeterminacy and change (Krisis 24, 27). Furthermore every object we directly experience presents different profiles at different times and to different observers, depending on the condition of the medium through which we perceive it, the condition of our own perceptive faculties, and the point of view from which we experience it. Even the yellowest yellow will look orange in certain kinds of light. But the ideal essence excludes all such subjectivity and relativity, and seems to exclude any reference to an observer at all. It seems to be the most objective of objectivities, and to achieve sameness to an ultimate degree.

3) However the ideal structure is not separable from the approximations through which it is established. It is not the case that the ideal essence drops off, like ripe fruit from a tree, from the imagined sequences of appearances that come ever closer to it as to a limit they never reach. Husserl says that idealizing thinking “conquers the infinity of the experiential world” not by excluding the imprecise identities but by arranging them in a convergent infinite series (Krisis 360, 40; see all of Beilage II). The ideal form cannot be understood except as the point toward which all such imprecise forms converge. It is not separable from them. However the person who develops and deals with the exact essences may forget this and take the ideal form as if it were concrete and separable from its approximations, as if it could be presented apart from them. He does this because he is lost in what Husserl would call positivity; he is concerned with objects and oblivious to the way objects are cognitively given and possessed. A new object seems to be presented to him in the process of idealization, this new object seems more durable and more exactly identifiable and more precisely measurable than the objects we normally encounter, and so it seems to him to be more real than the things he experiences (Krisis 43). Only if he were more alert to the working of appearances would he be able to appreciate the presentational dependence of ideal forms on the things we experience in imprecise identifications. Only if he paid attention to the process of identification itself, and not just to what is identifiable through it, could be avoid the dilemmas that arise when the ideal forms enter into ontological competition with what we experience.

For the ideal essences escape the imprecision of directly experienced objects not by separating themselves from such objects, but by a kind of omnivorous inclusion of all the objects in themselves; or, to change the metaphor and the direction of inclusion, by a kind of ghostly presentation of the ideal essence in all the “deficient” cases we experience. The circle is in all rings, not separate from them, and the ideal voltage source is in all batteries, not separate from them. When we experience a ring as a ring, we do so by seeing it against the circle, and, if we are theoretical physicists and not locomotive engineers, when we experience a steam engine we see it against the ideal engine described by Carnot and others. And somehow the “reality” of the ring seems to be the circle, and the “reality” of the coal-burning locomotive seems to be the ideally efficient steam engine.

II. Exact Essences in The Sciences of Man

In contrast to things that can be interpreted as instances of exact essences, there are other kinds of things that simply cannot be projected toward an ideal form (Id I 574). No matter how far we let our imagination range over various instances, no pattern of approximation can emerge. Examples of such “morphological” essences are what are commonly called secondary sense qualities, like tastes and colors; also, living things — trees and elephants — cannot be conceived as converging toward an ideal limit; and objects related to people, like tables and houses, are also morphological in kind, because people themselves are always different from one another. It is possible to register essential elements and distinctions in such things through the process Husserl calls eidetic intuition, but the essences of such things include in-
exactness, and they cannot be transformed into ideal, exact essences. Imprecision is built into such things and cannot be overcome by making it converge toward a limit at which it would disappear.

Because ideal, exact essences rid themselves of all involvement with human viewpoints and perspective, it would seem to be impossible to find exact essences in the structure of human existence itself, whether social or individual. Husserl claims that his own science of phenomenology examines morphological, not exact, structures in subjectivity (Id I §175, §145). In the work of both Marx and Hobbes, however, we find something like exact essences used in the analysis of the human estate.

As described in Capital, Marxian unskilled human labor, which is used to determine the value invested in things by the laboring process, is an exact essence. In fact — and Marx is well aware of this — every human being has some skill in whatever he does, and of any two people one will be at least slightly better or worse than the other in performing a particular task. But in order to establish units by which the labor invested in objects is to be measured, Marx lets the differences in human skill converge toward zero and formulates the exact essence of totally unskilled human labor.1 All human labor is then charted against this ideal, just as every ring is seen against the circle. The need for such an exact unit of measurement arises in a commercial economy, where objects are produced not primarily to be used, but to be exchanged for other objects.2 Units of human labor are used to explain the origin of exchange values in commodities. The notion of unskilled human labor, furthermore, must be seen in the context of industrialization, in which a complex process is broken down into simple motions so that each agent in the process needs less and less skill to perform his part. The person acting in this process is therefore treated as if he were unskilled, or is made to be unskilled, by the nature of the process he has entered. It is easier to imagine the limit case of totally unskilled labor in such an economy than it is in the case of society of craftsmen or farmers, where the imprecision of morphological essences could not be thought away. It is interesting that the concept of unskilled human labor is achieved because of the need for measurements and identifications, of determining how two things can be exactly the same. This is the same need that prompts us to determine exact essences in the science of nature. So we have not only the perceptual world replaced by the world of ideal physical forms, but also the world of human making replaced, in principle, by the idealized forms of undifferentiated, unskilled human performance and the exchanges that it makes possible; and in each case the ideal form is presented as the truth of what appears to us as approximation.

In Hobbes it is political life that is interpreted against a pattern of exact essences. The state of nature, for example, and the social contract, are both ideal forms. All human agreements depend on some prior agreements and sympathy, and all human conflict depends on some recognition of common rules. But Hobbes' state of nature, this war of all against all, this maximum agitation, reduces human agreement to a zero point. Then the social contract is the sudden agreement that is preceded by no other agreements. And once in this world of ideal essences, we run into other strange entities, like infants that make contracts with their mothers and sovereigns who cannot do injury to their subjects, the political analogues of lines that intersect at a dimensionless point and machines that have no internal friction.3 Just as Marx knows that all human workers do differ from one another in skill, Hobbes realizes that legal and political matters are different from mathematical ones; but he still begins to insert idealized structures as a factor in political understanding, and thinks about human affairs against the background of exact essences. And we may ask whether exact essences of Hobbes' mathematics of morals, essences which keep trying to come to life in the modern state, have not had as distressing an effect on the possibility of natural political activity as Galileo's exact essences have had on the possibility of living and

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1 Karl Marx: Capital, trans. S. Moore and E. Aveling (New York 1906), Part I, Chapter 1, Section 2, pp. 48–54.

2 Ibid., Section 4, p. 84: "This division of a product into a useful thing and a value becomes practically important, only when exchange had acquired such an extension that useful articles are produced for the purpose of being exchanged, and their character as values has therefore to be taken into account, beforehand, during production."

3 Leviathan, ed. C. B. Macpherson (Baltimore, 1968), Chapter 20, pp. 225–33. Harold Macmillan has recently made a comment that expresses the political problem of exact science. Speaking about Walter Bagehot he says, "He wrote about 'political economy,' a very good phrase, because it meant that economics was about people, the art of the possible. Now we have got this extreme form of mathematical economics which doesn't appear to be about anything in particular. But the old phrase meant exactly what it was intended to mean. It was the art of governing people in accordance with certain laws which appear to have shown themselves to be of value to organized humanity." The Economist, December 30, 1978, p. 11.
III. The Exclusion of Perspectives, Skills, Character, and Risk in The World of Exact Essences

Husserl frequently observed that in the science built upon exact essences, the world we live in and the world we directly perceive, with its imprecisions and perceptual qualities, is relegated to the condition of a merely apparent world. The mind that is fascinated by exact essences and oblivious of how they have come about considers the appearances in the lived world as merely subjective views which are to be discounted in a final description of what is and of how things are. But other things besides perceptual perspectives are also played down in the world dominated by exact science.

The world in which human skill is needed and recognized is also relegated to a mere appearance by exact science, and therefore skill and its achievements are not considered ultimately real. Skill in performance is required only when there is ambiguity in regard to how things will turn out: not merely an ambiguity in our ability to foretell the future, but a real imprecision in the things themselves. Skill consists in being able to bring about determinations that are for the good of the thing in question. In medicine, for example, certain states of an organism are likely to lead to further states that are dangerous, and medical skill consists in being able to determine the organism in such a way that the dangerous states are avoided and good states are brought about. But there are no better or worse states in an exact essence, and nothing we can do can change what an ideal essence is. To use an ancient principle, the good is not a cause in mathematics. The sheer identifiability of ideal forms, which is so attractive to the theoretical mind, excludes the imprecision in which skill is called for. The mind correlated to exact essences is the mind of someone to whom skills are indifferent.

Furthermore the mind correlated to exact essences is also indifferent to virtue and vice. Human actions are always executed in a concrete situation that calls for action. People act generously or selfishly, in a courageous or in a cowardly manner, in a temperate or self-indulgent way, or justly or unjustly. The agent's character, the kind of person the agent has morally become, makes it possible for him to recognize an opportunity to act, constitutes his ability to know what to do and how to do it, and makes him capable of carrying out the action. Just as a settled skill is needed to execute a skillful achievement, a character is the source of being able to act morally. But in the world of exact essences, there are no situations that call for human action because there are no situations that need to be determined one way or another by a human being, and the sheer objectivity of exact essences precludes any reference to an agent and an agent's character as a measure of what ought to be done.

Both the exercise of skills and the performance of virtue or vice involve a reference to the agent and to his perceptions of what is going on. Not everyone sees what ought to be done in a situation calling for action. A skilled person or a virtuous person will interpret a situation differently from the way an unskilled or a vicious person, or someone who is simply morally obtuse, will interpret it. The correct measure of a situation calling for action inevitably involves the agent as a measure of what ought to be done. Ideal essences strive to exclude any reference to an agent or observer; they are to be ideals that are absolutely the same for everyone who can go through the method that generates them. Therefore a world in which exact essences are taken to be the final reality excludes what seems to be most important to human beings: human skills and human virtues "do not count" in such a world. The only human reality left in this ideal world is the mind that generates the exact essences, and perhaps also the residue of unskilled human labor, which seems to be the only possibility of intervention left to man in this new world he has achieved. This bleaching of the world of the need for human deliberation, both in regard to skill and in regard to virtue, this underlying conviction that human being "don't count" except in a mathematical sense, is even more demoralizing than the disorientation induced when we are told that the world we perceive is not the true world.

And of course the two issues are related to each other: the reason why skills and action and deliberation are eliminated is that the world in which such things can be real, and in which they can make a difference, has been disqualified. In fact there is a tendency for people who deal primarily with exact essences to invoke the sentimental and the capricious when they attempt to say anything about the nature of action and skill. They do not

\textit{Aristotle: Metaphysics III 2, 996a-20–b1.}
know the categories appropriate to deliberation, choice, and action, and are usually unwilling to admit that there are any true necessities, any morphological essences, in the world we are immediately involved with. The only necessities they tend to acknowledge are the mathematical necessities in exact essences; all others are considered to be cultural or linguistic conventions.

Besides skill and character, another element that becomes dismissed in a world modelled on exact essences is the opportunity to take risks and to discover new alternatives in regard to the production and distribution of goods. Economists have shown that uncertainty in business and industry actually improves productivity and distribution because it provokes imaginative, more efficient responses to problems. But the problems, with their uncertainty and risk, have to be allowed to make an impression on the people who are supposed to deal with them. To shield individuals and groups from risk may make their immediate future more secure on a small scale, but it makes the large-scale future— that of the country as a whole, or that of the industry as a whole— more unstable, because the many small adaptations that are necessary are in fact never made. Competition and uncertainty improve economic performance and even reduce unemployment, thus contributing to long-term stability. Uncertainty and its attendant risks are therefore beneficial for modern economic life. However economic theories that employ exact essences will tend to neglect uncertainty and the possible response to uncertainty by imaginative individuals. When such theories become the basis for economic policy, the policies will tend to suppress imprecision and will not tolerate uncertainty. Bureaucracies and regulatory agencies are much more at home in the world of exact essences than in the world in which uncertainty must be acknowledged. And governmental policies that try to eliminate ambiguity also discourage, and finally prevent, groups and individuals from taking risks, that is, from making choices. Ironically therefore the very habit of idealized abstraction that makes modern indu-

stry and commerce possible finally threatens to stifle this economic life by suppressing the uncertainty and imprecision that characterize the life-world. Skills, virtues, and the ability to handle risk are required because there is imprecision and indeterminacy in being. It is not just that we are confused or ignorant about how things are; indeterminacy is real, and the things themselves are truly undetermined. For this reason what we do if and when we act does make a difference in the way things will be.

IV. Exact Essences and The Activity of Measuring

Why do exact essences exclude imprecision? Not all necessities or essences exclude indeterminacy; if we determine a morphological essence, our eidetic intuition discloses necessities, but it does not exclude imprecision and vagueness; on the contrary, it shows that certain kinds of imprecision are essential to particular kinds of things. We can work out eidetic necessities for morphological essences, for things like perception and memory, houses and animals, sport and war, things that cannot be made into ideal forms. And since imprecision is left in the essences we so determine, what we discover can be applied directly to the things we experience. Rover is an animal, and whatever is essential to animals is found in Rover. The eidetic necessity does not exclude the imprecision that comes along in actual experience. In contrast, an exact essence does not apply directly to the things we experience; nothing we experience can be a circle or an ideal voltage source the way Rover can be an animal. Ideal, exact essences are distinguished from the world we experience in a way eidetic necessities are not. In projecting certain variables toward a limit, the process of idealization does not merely abstract from such variable factors; it positively excludes them from the object it establishes. Idealization excludes imprecision; it does not—as eidetic intuition does—merely leave the imprecision undetermined.

But why are exact essences distinguished in this way from the things we experience? What are the presentional "motivations" that make them not immediately predictable of ordinary objects (Id I §47)? Exact essences are


6 On indeterminacy as an ontological foundation for human action, see Aristotle: Nicomachean Ethics III 3.
involved with measurement in a way that disconnects them from things. Eidetic necessities belong to the nature of a thing, but ideal, exact necessities belong to the thing as subject to being measured. Eidetic intuition treats the thing as to be understood, while the generation of exact essences treats the thing as to be measured. In idealization we transform the thing exclusively into a thing to be measured, and we exclude from it that which cannot be counted, or that which impedes accurate counting; we exclude imprecision. When we do this we are not left with the whole thing and all its necessities, but only with what is subject to exact measurement.

When we establish an exact form, when we go for example from a table top to a geometrical surface or from a pointed hill to a cone or to a pyramid, the ideal form itself does not become a unit of measurement; it becomes an ideal form of something measured. Part of the sense of such an ideal is that ideal units of measurement are also established in function of the form to be measured. That is, we not only have the ideal projection toward a surface, but also the ideal projection of units that measure the surface and its sides. We begin to operate with "the" meter and "the" inch. The exact essence and the units of measurement are moments to one another. And when the ideal form and its ideal units are generated, the ideal essence, "the" triangle or "the" cone, remains the "object" to be measured. The ideal essences are mental constructs in the sense of being something psychological. They are a possibility in the world, a possibility of presentation. They are a special kind of profile or "look" or eidet of things, the kind of look things have when they become taken as instances of a geometrical or other ideal form. The intentionally of the mind, its work of making present, is not interrupted when we deal with exact essences.

We can appreciate exact essences better if we examine the units of measurement correlated to them. Using spatial measurement as our paradigm, we can distinguish four levels in the activity of measuring. a) Measurement begins with units like an arm's length or a step which a man can pace off. b) Then the human scale can be replaced by something like a rigid body, like a piece of wood, that escapes the indeterminacy in the size of people's arms or strides. However this rigid body still has to be placed down over and over again against what is to be measured, so there is still a physical human gesture involved in using a rigid body. This gesture is like the activity of stepping off the length, the activity described under a). But then c) the measuring stick itself can be replaced by "the" meter or "the" yard. And when this occurs, the physical gestures of either pacing off or placing the rod down over and over again are sublimated into the sheer categorial activity of totalling. Furthermore the thing measured is now no longer a field or a table but a rectangle. So three things: the object measured, the unit of measure, and the gesture of measuring, are transformed at this stage. We cannot clarify any one of these without involving the other two; we cannot for example clarify what exact essences are without also clarifying the ideal units and the sublimated gesture of measuring. (It should be repeated that although the gesture of measuring has become mental, we do not measure something mental).

One more change in the measuring process can occur. d) Instead of using units we bring to the measured object, units like the inch or the meter or the step, we can use one part of the object as a unit for measuring other parts. We can use one side of the rectangle and say that the other side is twice this one. We would express this "proportionally" by stating B=2A. This kind of measuring still involves the measuring gesture, for we still "place" the shorter side "down" twice against the longer side. Also, we still have the object being measured: we continue to measure the rectangle or the circle or the cone, even though we are using one part of this object to measure the other parts. The object measured is measured by parts of itself. We have what we might call an internal system of measurement, one in which we determine the proportions of one part to others. But even when we use such parts of the ideal essence to establish equivalencies, which are expressed in equations, we still do not use the form or the essence itself as a unit of measure: the rectangle or the triangle is still the thing measured, not the unit by which we measure.

The establishment of an exact essence, like a geometrical figure, is therefore linked to the establishment of exact units by which that figure is to be measured. We must not suppose that a geometrical figure is generated simply by a kind of visual purifying of actual shapes into perfect forms: we do not just imaginatively "polish" the surface more and more until we get a plane; the process of smoothing the surface into a plane is correlated to the process of measuring the plane with exact units or with parts of its own self. The geometrical figure is not there first and only subsequently measured by us; it is there by being measurable. Furthermore other ideal essences, like light rays, ideal machines, voltage sources, perfectly flexible strings and the like, are likewise established not just by an imaginative projection toward a limit, but also by the determination of exact units by which the object is measured, units appropriate to the kind of thing in question. To complete
what we said before, inventive genius in a particular area of exact science involves not only seeing what kind of ideal is appropriate to the thing studied, but also seeing what sort of measuring units are appropriate to it.

We have distinguished between measuring units that we bring to an object (like the steps or the meter stick or "the" meter we use to measure the side of field or rectangle) and measuring units that are taken from the internal structure of the object measured (like one side being used to measure another side, or one vector used to measure another in a parallelogram of forces). Equations that are used to express the relationships in an exact essence employ the second kind of unit, the units of internal proportions. This occurs, for example, when we say that side B of a rectangle is twice side A; or that the square of the hypotenuse of a right triangle is equal to the sum of the square of the other sides; or that the efficiency of a Carnot engine is formulated as:

\[
\text{Eff.} \ times \% = 100 \frac{T_2 - T_1}{T_2}
\]

where \(T_2\) is the absolute temperature of the heat input and \(T_1\) the absolute temperature of the heat output; or when we say the force exerted on a charge \(q\) moving through a uniform magnetic field is expressed by:

\[F = qvB\sin\phi\]

where \(v\) is the particle's velocity, \(B\) is the induction of the field, and \(\phi\) is the angle between the directions of \(B\) and \(v\). In all such cases we express a whole or a system by showing how its parts of dimensions are internally related to one another. It is significant that such expressions are equations; that is, they show how parts combine to make up an identity or a whole, how the parts become equal to other parts when they are taken together.

Now when we put values into the equations, when we say side A is five feet long so side B is ten; or that \(T_2\) is 480°F and \(T_1\) is 102°F, so the efficiency of the Carnot engine is 41%; then we shift our measuring units from those which are internal to the system to those which we bring to the system; we move toward the meter, or the meter rod, or even the step; we move toward the thermometer or even the freezing of water or the melting of ice. In the levels we distinguished earlier, we move from d) to c) or b) or even to a). It is, of course, at this point of shifting to units we bring to the system that instruments are employed as factors in measurement.

Obviously units like the step and the meter stick, those used in a) and b), are parts of the life-world. And obviously the structures in d), the internal system of proportions, are not parts of the life-world. They are part of the world of exact forms. But what about c), the exact form measured by "the" meter and by other ideal units? The forms found in c) are a transformation of the types found in a) and b), a transformation which occurs because the measurements in a) and b) are now seen to anticipate the internal system of measurement found in d). When we move from a) and b) to d), we move from using units we bring to the object, to using units provided by the object itself. The idealization of the object is the legitimation of this move; it is an identification that asserts the object is the same object no matter by which of these two methods it is measured.

Finally, it may be claimed that exact essences no longer play a role in physics, that no one now believes in any sense in the reality of ideal voltage sources or frictionless machines or other ideal forms. Instead, physicists are interested in functional dependencies: of one part of what they examine upon other parts. In such physics we seem to move beyond what we earlier described as step d). But the equations and relationships expressed in algebraic formulas and in computer printouts are still determined by the transformation in the forms of measurement that takes place between stages a) and d). The formulas and the data are taken to refer to something, and the exact essences still mediate their reference. It is only because the things we experience have been transformed into ideally measurable things that algebraicization can work for them. Exact essences are still around to give sense to our figures and calculations, to provide the horizon within which such calculations can occur, and to determine that these figures refer to one kind of thing (like electrical circuits) and those figures of another (like subatomic particles). Once we have gone through exact essences to get to functional relationships, we do not leave the ideal forms entirely behind. We may be less tempted to take exact essences as a sort of depiction of what things really are like, but they still function to mediate the reference of numbers and formulas; they are a factor in the mind's intentionality, for even in exact science the mind is with things and not simply with its own constructions.

The mathematical, economic and political ideal essences become more self-sufficient as they cut the ties that bind them to the everyday world, and as they formulate their own exactness in terms of the internal relationships of their parts. The exact essences become independent, and yet remain applicable to the lived world from which they arise. As they become more
self-sufficient, they can be used more thoroughly to dominate the ordinary and the imprecise. The combination of independence and applicability gives these essences great power over the source to which they owe their being.

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