SaThZ 3 (1999) 193-206

# Whitehead and the Laws of Nature

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The question of the laws of physics, and more generally of the laws of nature was one of Whitehead's major concerns. We can even say that it predates his explicit philosophical interest. Indeed it is well-known that Whitehead was the author of an alternative conceptualization and formulation of general relativity which would be based not on *one* contortedly curved space-time but on multiple space-time systems. At the time, Whitehead's interests were, if not philosophical, at least already conceptual. He was not satisfied with Einstein's relativity, while recognizing its importance. A bit as if, starting from the link between the velocity of light and the problem of simultaneity, Einstein had approached an important new definition of the laws of nature from a wrong, that is contingent, direction. As if Einstein had penetrated a complex building using a window and not the main entrance, and had thus mapped the building as if organized around the window, maybe the laundry window, as if it was its entrance. We may recall here that it is the whole problem of archeologists dealing with the mute remains of human activities: was this a sacrificial place or a butcher's shop?

We also know that Whitehead's theory was mathematically much more complex than Einstein's, leaving to empirical, observational decision a lot of what is already decided by Einstein's equations. However it is Einstein's theory which, till now, has been used as a standard, with one dominating question: is Whitehead's formulation truly an alternative, equivalent formulation of Einstein's theory?

The remarkable point here is that this is probably not the most interesting question to be asked. It is obvious that two alternative mathematical formulations of a physical theory, even when they entail exactly the same observational consequences, may not be truly equivalent, even from the physicists point of view. The esthetical values and appetite they promote may indeed be quite different.

For instance the Heisenberg and Schrödinger formulations of quantum mechanics have been demonstrated as operationally equivalent. Nevertheless, the esthetical connection of the Schrödinger equation with classical dynamics produces no neutral effect. It leads physicists to the temptation of envisaging this quantum equation as autonomous and self-sufficient, just as a classical dynamics evolution equation. And this may leave the physicist wondering how and why this self sufficient Schrödinger function may well come to be reduced, or come to collapse as it must in order to produce well-defined probabilities associated with observation. In other words, what is usually called the measurement problem in quantum mechanics is specifically related to the appetite raised by the Schrödinger equation, acting here as a lure for feelings, problems or ambitions. If this lure ever leads to a

scientific innovation, the equivalence between the two formulations will be broken, as one and only one was the path leading outside of their common, explicit scope.

Furthermore, we know that physicists are now facing the difficult problem of creating a consistent theoretical frame including quantum physics and general relativity, the two great contemporary formulations of the so-called laws of nature. In this context, the strict equivalency problem is still less important. In order for Whitehead's proposition to become relevant for physicists, an event must happen, an encounter between physicists entertaining new problems, difficulties, appetites and demands and Whitehead's formulation of general relativity. But for this encounter to be possible, Whitehead's proposition should be formulated in a language present-day physicists would not only understand but appreciate in terms of the vital contrasts it proposes. This could have been possible if scientific practices were a bit different. Indeed, we could conceive physicists and mathematicians feeling as one of their most holy duties to enhance this probability, that is to keep translating and discussing alternative interesting versions of important laws. There is such a lot of waste and redundancy in science today that providing an on-going appetitive maintenance work for propositions like that of Whitehead which have not succeeded in interesting its contemporaries should not look like an intolerable misuse of precious resources. Such is not the situation, however. Competition and the *Vae Victis* motto are dominating 20th century science.

This leads me to the second aspect of Whitehead's thought I want to deal with before addressing the central theme of my talk. I have just concluded that we cannot discuss Whitehead's contribution to the problem of the laws of nature without taking into account the sad fact that we must leave to chance the very possibility of learning about the very meaning and value of Whitehead's work in relativity physics. Just as Whitehead himself did when he resolutely turned to philosophy of nature. It is not a question of denying that physics embodies strong values of rationality. It is a question of emphasizing that the way physics embodies these values cannot be separated from other values, corresponding to what Whitehead named „professionalism".

It is not an exaggeration to state that professionalism was very high in the list of Whitehead's problems. It is at the very center of *Science and the Modern World*, linking his intense interest for education with his rather strong misgivings about the future of Western civilization. I quote (p. 196-197):*

> „Another great fact confronting the modern world is the discovery of the method of training professionals, who specialize in particular regions of thought and thereby progressively add to the sum of knowledge within their respective limitations of subject... The situation has its danger. It produces minds in a groove. Each profession makes progress, but it is progress in its own groove. Now to be mentally in a groove is to live in contemplating a

* Zitation nach den Richtlinien von Process Studies.

> given set of abstractions. The groove prevents straying across country, and the abstraction abstracts from something to which no further attention is paid... Thus in the modern world the celibacy of the medieval learned class has been replaced by a celibacy of the intellect which is divorced from the concrete contemplation of the complete facts. Of course, no one is merely a mathematician, or merely a lawyer. People have lives outside their professions or their businesses. But the point is the restraint of serious thought within a groove. The remainder of life is treated superficially, with the imperfect categories of thought derived from one profession." [And Whitehead concludes] „The dangers arising from this aspect of professionalism are great, particularly in our democratic societies. The directive force of reason is weakened. The leading intellects lack balance. They see this set of circumstances, or that set; but not both sets together. The task of coordination is left to those who lack either the force or the character to succeed in some definite career."

I stop here in order to remark that this last harsh judgement - to lack either the force or the character to succeed in a definite career - is indeed one which keeps hovering over the head of anybody like myself, daring to comment about other people businesses. Daring, for instance, to ask for some coordination between the very different set of circumstances different scientific fields privilege, each defining its own set as the one which allows for serious thought, disqualifying neighboring others as not really scientific, or as backward, or as just waiting to be conquered by the advance of true science. On the other hand, we can recognize that Whitehead's characterization of professionalism beautifully corresponds to Thomas Kuhn's description of „normal science". Indeed Kuhn's paradigm can be described as the very groove which defines a scientific field, with its specific way to understand and abstract, its specific values and esthetical judgements, its specific pragmatic genius, recognizing and selecting the situations which can be dealt within the frame of the paradigm. And finally with its strict distinction between those „good" problems, which Kuhn calls „puzzles", the solutions of which are progressively added to the sum of disciplinary knowledge, and the so-called great problems, which would lead the mind to stray across country and are thus better dealt away in the most superficial way.

The point here is that the question of the so-called laws of nature is now part of a professional activity, that of physicists, and more precisely of physicists belonging to certain parts of physics. Indeed it is not all fields belonging to physics that may claim to have a word in the matter. I know it personally very well indeed since I worked with Ilya Prigogine. Prigogine may well be a Nobel Prize, the fact that he was trained in thermodynamics and statistical mechanics is enough for his general relativity and high energy physics colleagues to darkly frown upon his ambition to intervene within the question of the laws of nature. This question is at the top of the hierarchy, with a very limited access. Neither thermodynamics nor statistical mechanics should lead to that top.

As an example of the hierarchical contrast between the good, professional questions about the laws of nature and the others which may be dealt away, I will recall the way the famous physicist Stephen Hawking closed his famous *Brief*

*History of Time*. He produced the following prospect: when, in what he hoped was the near future, the physicists would have discovered the complete theory of the universe, that is the mathematical equations exhibiting what the universe IS, the matter will not be over. Philosophers, theologians, scientists and also ordinary people should then all take part in a general discussion about WHY the Universe IS how it IS. Now this kind of joining together may well seem generous, but this generosity is rather superficial. Indeed the discussion will hardly be a free, open one. The why to be discussed will be strictly separated from the question of how to define the universe. The how question will be over, a chapter closed by physicists, needing the physicists only.

The separation between the why and the how is an ancient matter, it was already promoted by Galileo, but the reason, at that time, was indeed not generous at all. In the Third Day discussion in his *Discorsi*, Galileo explains that we should not look for the reason of the acceleration but concentrate on the properties of an accelerated motion, that is on the question of how a body accelerates. Indeed, Galileo argues, those properties can be demonstrated, while the question of the reason is, and will probably remain, the subject for unending and vain philosophical controversies. To examine the many fictions produced by philosophers would be pointless and profitless.

I really wonder if Stephen Hawking himself truly believes that the general discussion he envisages would possibly come to a conclusion. I guess he doesn't but doesn't care, since the physicists will have achieved their job. This will be the seventh day, the rest time, the time for physicists to finally relax. And when they relax, they are ready to speak with anybody: with philosophers as well as with ordinary people. This seems very nice but we should pay attention. Indeed from the physicist's standpoint it first of all means that outside scientific experimental demonstration we enter the realm of fiction and opinion, anyway. Be they philosophical or whatever, it does not make a lot of difference.

The point is not to be „for" or „against" physics, the point is resisting its misplaced authority, the strange way physicists present their achievements: not as events marking the adventure of their demanding questions searching for satisfaction but as the progressive discovery of nature's very laws, the laws for which they would be the spokespersons, the spokespersons only.

Resisting the authority of physics is a rather general trend among philosophers. This is not astonishing since one of the ways the scientific enterprise faithfully follows Galileo's example is in having each of its effective or rhetorical successes repeating the same tune: *now that the how and the why are rightfully separated, the philosophers are asked to leave the ground, at least till the „how" questions are answered.* As Whitehead wrote, „Science repudiates philosophy" (SMW, 16). Thus philosophers have the choice. They may bow down and become the servants of scientific rationality. Or they may try and define as their own the problems science would or should never enter, for instance the value or meaning prob-

lems. And at last they may try and resist. Very often, by the way, the second category will discover that they also have to resist. This is the case now when we have social biologists or biological sociologists telling us that the scientific, rational, objective explanation for human values is the one that reduces them to a consequence of natural selection, or more precisely natural sexual selection.

How to resist misplaced authority? Here is Whitehead's true originality. Since Immanuel Kant, the usual way for philosophers is criticism. There are many critical methods but they have one common feature. They do not act as lures for new feelings, new values, new demands. They try and put limitations and since they usually do not succeed in having these limitations respected, they produce the image of the human mind as a transgressive one, always attracted by sin, always tempted by the illusory satisfactions of going beyond the safe limits of reason. So they go on, guarding the frontiers, asking again and again that scientists respect those frontiers.

Whitehead, however, was a mathematician and for him, as a mathematician, criticism was not a way to resist. Indeed critical resistance is always produced in the name of something stronger, more powerful, the source of a fixed set of limitations to be respected as such. A mathematician knows of no such fixed set of limitation. If you meet an impossibility, for instance the solution of equations entailing taking the root of a negative number, you may well create complex numbers. The point is that you have then to precisely follow, characterize and fully accept the many consequences of what you have created. Mathematics are a creative adventure the lure of which is the joining together of the highest freedom - to create new kinds of being - and the strictest obligation - to make explicit everything the existence of the new being requires, demands, produces or puts into question.

For Whitehead, to resist was to create, that is also to produce lures for a new adventure. Already in *Concept of Nature*, Whitehead relates resisting against the bifurcation of nature as we perceive it into subjective and objective ingredients with the most non critical requirement. Indeed, he states, the concept of nature to be created requires that „*we may not pick and choose*" (CN, 29) nature is „*what we are aware of in perception*" (CN, 28). Mark well, not what we perceive and can identify, but the whole indefinite complexity of what we are aware of, even if we have no words to name it. When a mathematician states „what", it means „all what", both a challenge and a pledge.

Then, in *Science and the Modern World*, the point is to justify our faith in reason as

> „the trust that the ultimate natures of things lie together in a harmony which excludes mere arbitrariness. It is the faith that at the base of things we shall not find mere arbitrary mystery. The faith in the order of nature which has made possible the growth of modern science is a particular example of a deeper faith. This faith ... springs from direct inspection of the nature of things as disclosed in our own immediate present experience" (SMW, 18).

In *Process and Reality*, the requirement is still more ambitious, and now openly identifies with speculative philosophy, as „the endeavor to frame a coherent, logical, necessary system of general ideas in terms of which every element of our experience can be interpreted" (PR, 3)

The three challenges correspond to three distinct epochs in Whitehead's life as a philosopher, but they obviously share a common risk. What is to be resisted is the temptation to *judge* experience, that is either to sort out those experiences which could be legitimated as reliable ground, starting from which serious thought may begin, or to purify the whole field in order to grasp a more general truth which each purified experience would then illustrate. Resisting the way our many specialized languages, be they scientific or philosophical, produce hierarchies and privileges does not mean resisting specialization as such, attempting some kind of a coming back towards a form of true general experience which our specialized languages would artificially distort. When mathematicians speak about general ideas, they always speak about the higher levels of artificiality, about the most specialized and sophisticated creation their field has been able to produce.

If we understand the achievement of modern sciences as a passionate and creative quest for a critical division between what it defines as sheer opinion and objective authority, I think we can inversely describe Whitehead's travel towards the full risk of speculative philosophy as the progressive discovery of all what it entails to save together what we divide in order to characterize.

Starting from *Concept of Nature*, I will now try and characterize some aspects of this travel in relation with modern sciences.

In *Concept of Nature*, besides his interest in the space-time question, one scientific object did attract Whitehead's attention. This object is the electron as it was just recognized at the time as a discrete reality with a mass and a charge, but a reality irreducibly associated with a field. We can better understand this interest if we relate it with one of the problems produced by the analysis of „what we are aware of in perception", that is the problem of the ingression of objects into events.

Whitehead named „events" the most concrete fact we are aware of. Events communicate with the passage of nature, and this concretely means that „You cannot recognize an event; because when it is gone, it is gone" (CN, 169). If we do not want Nature to bifurcate, we cannot however make recognition a purely psychological construction we would add to the passage of nature. What I am aware of when I say, „here it is again" must belong to the concept of nature. More precisely, what must belong to nature is not an object as I would define it in order to justify my recognition. What must belong to nature are objects as they are required by the very fact that there *is* recognition. Whitehead calls objects what we are aware of in perceptual recognition, that is as something which does not share in the passage of nature.

Objects are of many sorts. Many of them we do not recognize. For instance we know that most odors escape us, and we know it because we know how well a dog may recognize what we do not. In other words, what Whitehead calls objects comes *before* our sense organs: objects are not explained by our organs or our intellectual constructions, they are what both organs and intellect require if we refuse nature to bifurcate.

What we are aware of in perception requires that events and objects cannot be identified but that they cannot be separated either. We are never aware of an abstract object, in an experience of pure recognition. „An event is what is, because the object is what it is... It is equally true to say that objects are what they are because events are what they are. Nature is such that there can be no events and no objects without the ingression of objects into events." (CN, 144).

Now the electron and the field seem to exemplify quite precisely what could be meant by „ingression". And Whitehead indeed uses the term ingression in order to characterize the irreducible association between field and electrons. „The electron is not merely where its charge is. The charge is the quantitative character of certain events due to the ingression of the electron into nature. The electron is the whole field of force. Namely the electron is the systematic way in which all events are modified as the expression of its ingression." (CN, 159)

It is probably true that the dual existence of objects and events was proposed by Whitehead under the direct inspiration of the field/particles physics of his time. And it is worth recalling that this inspiration will not survive as such in *Science and the Modern World*. In *Concept of Nature*, Whitehead did attempt to join together theoretical objects stemming from experimental physics and what is required by our perceptual awareness. What was quietly left out is what will become Whitehead's central problem in *Science and the Modern World*, the characterization of the living organism.

However, even at this stage, it is worth emphasizing that the general philosophical meaning of ingression cannot be elucidated through physical theory. Experimental physics has imposed onto physical theory the impossibility to reduce either continuity to discrete particles or discrete particles to continuous fields. But even if the mathematical, that is functional, formulation of the particle-field connection was adequate - and I would add that the adequacy of contemporary field theories is rather controversial - this formulation would still not be acceptable from Whitehead's point of view. Indeed physical theory presupposes what Whitehead emphatically defines as *not belonging* to the concept of nature, that is „Nature at an instant" (CN, 57). We are never aware of nature at an instant. What we are aware of are always durations which happen and pass. And any duration has some temporal thickness. In other words the theoretical formulations of physics imply and enact an ideal of accuracy which is an ideal of thought only, an ideal which „is only realized in experience by the selection of a route of approximation" (CN, 59).

Thus we may conclude that in this case Whitehead indeed accepted direct inspiration coming from modern sciences, but the way he did it shows that what interested him was not the authority of science but its creative aspects. The electron/field irreducible association is an example of this creative aspect. It is indeed the first great exemplification of the way physics has been led to betray the image of nature we associate with scientific rationality, that of entities which can be defined in isolation and then endowed with external relations explaining how they behave together.

However, it must be added that the analogy between the ingression of objects into event and the ingression of electrons into field is never truly clarified in *Concept of Nature*. The argument about the instant as belonging not to nature but to a route of approximation is not sufficient to clarify the situation. Indeed, when our perceptual awareness, including our measurement, is concerned, the notion of something at an instant may well be an approximation. But when the theoretical formulation of what physics calls „laws of nature" is concerned, this same notion is a starting point. It is even the very starting point of modern physics, as it is associated with Galileo's laws for the motion of the falling bodies. We can go as far as saying that modern physics was born when Galileo took as physically meaningful the notion of instantaneous velocity: velocity not defined by the distance traveled over a period of time but velocity at a point and at an instant. This was the decisive step since velocity could then become a continuous function of both space and time.

As we know, Whitehead did cut the Gordian knot between metaphysics and physics in April 1925 when he took this most daring step: denying the continuity of becoming. He then stated that time was not an extensive quantity but the „sheer succession of epochal durations" (SMW, 125).

For Whitehead, this was a necessary step in order to construct a concept of becoming which would resist reduction to being, that is also a concept of realization which would affirm its relation with possibility. Realization is now understood in terms of acts of becoming, each actually a „taking position" about potentiality, each irreducible to deduction. This proposition had a dramatic consequence for what concerns the laws of physics: all „causal" or conservative laws were turned in one move into as many approximations. Whatever the definition of the fascinating objects of contemporary physics, be them virtual, real or quantum particles or the quantum void, their definition still depends on the possibility of defining temporal continuous functions. In Whitehead's metaphysical terms, it means that these definitions will never lead to an explanation of becoming, but take advantage of a possibility to explain it away. Correlatively, this possibility cannot be generalized, it enlightens on the contrary the very selective character of the objects physics privilege, objects for which the difference between becoming and „functioning", that is behaving following a given mathematical function, entails no well-defined measurable consequences.

This, by the way, is what deeply interests me in Ilya Prigogine's attempt to include the so-called arrow of time at all levels of physics. His struggle against the power of time symmetric laws in physics may well lead back to Whitehead's 1925 guess that physical science exhibits the „symptoms of the epicyclic state from which astronomy was rescued in the sixteenth century" (SMW, 135). Furthermore, Prigogine's ambition and the risks he accepts are those of a physicist: his search aims at the relevant functions defining time oriented processes. And what is most interesting is that his results confirm Whitehead's idea about functions not being able to fully describe becoming. Indeed what Prigogine often calls the „laws of chaos" define as their object not „reality" as such but a statistically well-defined grasping together of aspects of a chaotic, that is escaping physical definition, that is conformal reality. The laws describe how those aspects build up together what can be called an enduring „conformal pattern", or regular behavior. In other terms what Prigogine calls laws are functional descriptions which exhibit the privilege any such description is bound to confer to whiteheadian conformity, but they make explicit that the functional behavior they define is not that of actual physical beings. We may say they are an example of the way physics may allude to becoming. As a consequence „laws of physics" are divorced from „laws of nature". They are laws defining nature as far as nature is able to satisfy the physicist's demand for conformity.

Thanks to Lewis Ford, we know that the idea of atomic acts of becoming was something which happened to Whitehead when he was about finishing *Science and the Modern World*. This idea leads rather directly to the full-fledged speculative philosophy of *Process and Reality*, that is away from any direct connection with the laws of nature question. I will come back on this but I will first comment on what was in fact the great project of Whitehead in *Science and the Modern World*: to center the whole concept of the order of nature around one notion, that of the organism.

As its name entails, the main source of inspiration of Whitehead's philosophy of organism is now life and the living order. And the main contrast between inspiration coming from physics and from biology centers around what physicists would describe as the difference between stability and instability situations. This difference is now very important for physics, but it was not at Whitehead's time. For biologists it was always important however since it makes the difference between life and death. In other words, even for today physicists, however important, it designates a property, while for biologists it designates the very challenge any living being has to meet. All biological descriptions are in fact organized around this difference.

Whitehead sides with biologists. Nothing, no thing, may exist as an autonomous being, unproblematically maintaining its own identity. Endurance, succeeding in keeping its own identity, must now be recognized and appreciated as an achievement, with its own value. What endures has „its significance in the self-re-

tention of that which imposes itself as a definite attainment for its own sake" (SMW, 94).

In other words, to propose organisms as the central concept for the order of nature implies a radical reorganization of what it means to describe nature. If we are able to describe something it is because this something has achieved some endurance. All our so-called descriptions depend on this success and are on fact as many ways to celebrate it.

No physicist would dream his or her concepts celebrating the enduring stability of a proton as an achievement, and a chemist takes as a matter of fact that molecules may or may not react together, that is loose or keep their identity. Thus when physicists read that for Whitehead an electron within a living body is different from the electron outside it (SMW, 79) even if they both blindly run, they are usually scandalized. This conclusion is quite normal however if we take physics as an abstract version of a more general understanding, which I would call an etho-ecological understanding.

For Whitehead the ethos of an organism, its specific grasping together of aspects of its environment, cannot be dissociated from its ecology, that is from the way other organisms prehend and grasp together aspects of this organism, including the way they are themselves prehended and grasped by it. Each organism thus depends on what Whitehead calls the patience of the environment. The possibility for the environment not to be patient may easily be exemplified by many human interactions. It is well known for instance that people are unable to keep normally talking if the one they address listens without blinking, an human ethological sign meaning „yes I am listening". And we can also think about the collective dynamics of uncontrollable laughter in order to understand why Whitehead uses the beautiful word „infection" to describe the etho-ecological regime of reciprocal prehensions.

For Whitehead, biology was handicapped by its respect for physical explanation. The privilege of biological descriptions, not its dependency, should be recognized: biologists are able to explore the limits and risks of endurance as an achievement, something physicists are unable to do. Biological descriptions are more concrete than physical ones since they don't, or should never, separate the internal descriptions of the cellular togetherness, the ethological description of how an organism behaves, and the ecological description of its interdependence with the many factors which constitute its environment. They should lead to recognize all levels of descriptions as internally related, a complex of enduring patterns presupposing and affirming each others, a very important point if we remember the problem of the brain description: if we follow Whitehead, there is no way to reduce the brain to neurons, since the very description of the neurons cannot be described independently of the ethos of the brainy organism, its experience of itself, of its world, and the way others experience it. Furthermore, this correlated multiple coherence must be celebrated as a precarious fact exemplifying no higher

value than itself. In other words, the order of nature cannot be reduced to elementary mechanisms, but it cannot be understood in holistic terms either, exemplifying some kind of natural wisdom.

During the last forty years many theoreticians have tried to construct formal languages which would make adequately explicit the difference between a physical function and a biological function. It started with cybernetics circular causality and feedback, but we now have also much more sophisticated proposal. For instance, the so-called autopoietic logic with self-referential fixed points or the „edge between order and chaos" theories both try to take into account the way patterns may endure and change, be it along biological evolution or in learning processes. I would state that such theoretical languages confirm Whitehead's point, as they all make explicit that the abstract concepts which are needed in order to describe living functions and systems, must depend on, and celebrate, what succeeded in enduring. However they miss a very important point as they all try to formulate laws or rules which would produce some kind of a theoretical biology. If theory is, as in physics, what goes beyond individual facts, we should not anticipate any general theory going beyond the enduring achievement of organisms. What biologists should try and cultivate instead would be what Whitehead calls the habit of art, meaning the concrete appreciation of the distinct individual beings, the habit of enjoying the vivid values associated with biological achievements.

Physicists may well be tempted to abstract away the individual achievement the stability that their objects entails. Accordingly their theories obscures the fact that they require this achievement. In *Process and Reality*, where the term „society" has replaced the term „organism", Whitehead writes: „In fact living societies illustrate the doctrine that the laws of nature develop together with societies which constitute an epoch. They are the statistical expressions of the prevalent type of interactions" (PR, 106). In other terms, each new kind of organism, as it is able to endure and perpetuate itself, constitute an epoch, with its prevalent types of interaction. Which means also that natural laws are all social laws, relative to a society. Inversely what we call human sociological laws are laws of nature."

Keeping with my subject, which is „Whitehead and the laws of nature", I should keep strictly within the domain defined by organisms in *Science and the Modern World* and, and by societies in *Process and Reality*. However, I must go a bit further because Whitehead's move from a philosophy of nature centered around the concept of organism to speculative philosophy centered around actual entities and the atomicity of becoming also means an important new contrast.

Actual entities follow no laws at all. Whatever the kind of societies providing the main contrasts which function as their data, they are all equally defined through the categories of obligation Whitehead formulates in his scheme. This means for instance that they all must be said to be internally determined and externally free. No achievement to be celebrated here. Never does an actual entity fail to fulfill its obligation in producing itself and producing its own values. This is

why, as Whitehead now associated value with actual entities, he had to use a different other term for the achievement of endurance and he chose „importance". For instance, if there may exist sociological laws characterizing human societies and their epochs, it is because patterns of contrasts are commonly evaluated as important, this being expressed in habits, esthetical judgements, emotions, discursive terms or else. And this means that the definite attainment of value such laws exhibit may also be described as „limited, obstructive, intolerant, infecting the environment with its own aspects." (SMW, 94).

I would claim that the contrast between actual entities on one hand and organisms or societies on the other, that is between speculative philosophy and any kind of positive descriptions of what endures, is a crucial contrast for modern science itself, even while scientific descriptions can never take actual entities as their object.

First, I will argue that it proposes a crucial difference between what we usually call laws of nature, including organisms, and the description of human beings and their societies.

A biologist should celebrate any living society as an achievement, even a spider female eating her male, or plants poisoning insects. But a sociologist who would celebrate the achievement of a dictator infecting with love a whole population, or a psychologist who would celebrate the possibility, as exemplified by Stanley Milgram, to turn normal, nice people into torturers through the overwhelming sense of the importance of the scientific demonstration to achieve, would not do the same job at all. More generally, specialists of human sciences who take advantage of the endurance of what they describe in order to claim resemblance with the lawful objects of natural sciences are doing a bad job. Each time they use their knowledge in order to claim that they know what humans and human societies may or may not achieve, they contribute to give to what exists the power over what could be. O recall here what Karl Marx said: when human societies are concerned, we should not try to describe and understand them as they are but try and learn about them in terms of their possibilities of transformation. And if Marx had known Whitehead's definition of morality, he would maybe have written „moral" transformation.

In other words, in order to be relevant for living systems, the order of nature had to be organized around endurance as an achievement. Now, in order to be relevant for the way we address and describe human adventures, be them individual or collective, a new kind of order has to be constructed. This is no longer a natural order, but a speculative cosmic order, the order which takes actual entities as its component. Indeed, when people, their experiences, their dreams, hopes and crimes are concerned, it is not endurance as such, but endurance *and* potentiality, what is *and* what could be, or could have been which are relevant. The problem is no longer the risk of instability, or death, it entails potentiality, or the destruction of potentiality. It led Whitehead to the obligation of introducing God, since with-

out God he could not define potentiality, what could be, as a primordial, insisting, fact.

There is a second reason why all scientists may need speculative philosophy. Physicists, biologists, or historians have no need of it when they describe the order of nature, including the average features of human societies, the importance of human social endurance and the epochal laws which result from this endurance and express it. But they may need it in order to understand what they themselves achieve and hope in terms of human social achievement and hope, that is not separating it from their understanding of reality. Indeed the very existence of their sciences testifies for the real power of hope, the hope to produce new, relevant and interesting knowledge, and for the weak, but obstinate, forces of persuasion and morality, producing new possibilities of understanding and coherence.

While any direct comparison between Whitehead's and physicists descriptions would be a case of the famous „fallacy of misplaced concreteness", abstracting away the fact that these descriptions owe their very existence to satisfying quite divergent demands, the application of Whitehead's speculative categories leads to emphasize how those demands exemplify the one ultimate category that is creativity.

In other words, scientists may need speculative philosophy in order not to define themselves anymore as just spokespersons for the laws of nature they learn to formulate, silencing in their names philosophers or theologians, but to become able to celebrate together with philosophers or theologians both the enduring differences of importance which make their questions and interests so different *and* the common appetite for new contrasts and possibilities they all testify for. The formulation of the categoreal scheme as a matrix, in the mathematical sense, that is something the meaning of which is nothing else than the set of its applications, may be defined as a lure for such a transformation.

None of our usual descriptions, including whatever is recognized as a law of nature, can escape the saving process of translation through the application of the scheme, a translation which does not eliminate or explain away but transform any formulation, its scope and meaning. Through the application of the scheme, the most fundamental laws of nature as well as the words with which we try to grasp the fugitive experience of hope or hate should be put on the same plane, all exemplifying the ultimate category which is creativity. And this exemplification is achieved through the same transformation: abstractions, claiming to explain away becoming, are rooted back in the concrete fact that no claim can be separated away from creativity. Nothing exemplifies best creativity than the claim that there is no creativity. In order to show this, let us for instance go back to the achievement which defines experimental science, that is the separation between the „how" and the „why".

At first we must face a very strange contrast between this achievement and anything testifying for creativity. The physicists claim that they have produced a

situation which can be interpreted in one way, and in one way only. Being seems to triumph twice over becoming since both the physicist has the power to explain the temporal evolution of the object, and the experimental facts have the power to define the physicist as their spokesperson.

However the tale may be told in a much more concrete way, associating the successful separation between the „how" and the „why" with the very emotion of those so-called spokespersons, the passionate story of experimental sciences. It may well be that the how seems to triumph over the why each time objects are successfully abstracted away from the entanglement of their many relations with their environment, in order to be reproduced in a new, meaningful and controlled environment, as a function of a definite set of variables which can be manipulated at will. But the relevance of the why question is not defeated, it is just displaced. Indeed the reason why those experimental objects exist is not nature but the passionate, selective, testing quest to have nature silencing human interpretation.

In other words, experimental phenomena cannot be concretely described without including human-produced contrasts and propositions, and physicists cannot be described without including the story of the successive experimental devices which successfully exhibited the possibility of actively defining some natural behavior as „functioning", that is as conforming to experimentally well-defined variables articulated through a mathematical function.

I started this talk recalling Whitehead's problem with professionals. A true professional may indeed be described as an organism, defined by a stubborn pattern of judgments and values, and by a stable opposition between what is important and what can be dealt with in the most superficial way. I may now conclude that Whitehead's speculative philosophy can be seen as a part of his own diagnosis about our epoch, emphasizing the need to civilize specialists, be them scientists, politicians or anybody who is in position to care about our common future. Speculative philosophy is not meant as a doctrine rivaling sciences or other specialized doctrines. It is meant to function as a lure for feeling the contrasts and constraints of sciences and other specialized doctrines, a kind of feeling which is usually dealt away by professionals in the most superficial and uncivilized way.

Whitehead was no revolutionary. When he wrote about the marvelous beauty of the estuary of the Thames wantonly defaced by the Charing Cross railway bridge (SMW, 196), he knew that the true important tragedy was that the people who had decided the construction of this bridge apart from any reference to aesthetic values were honorable people. *They were just professionals*. Today more than ever, we may share Whitehead's concern.