ORAZIO CIANCIO (*)

THE SCIENTIFIC AND CULTURAL LAICIZATION OF THE FOREST-HUMAN RELATIONSHIP: THE ITALIAN THEORY

(*) President Italian Academy of Forest Sciences; ciancio@aisf.it

The Author analyzes a theory developed in forestry in Italy in the nineteen eighties: the Italian Theory. *This theory is based on the culture of complexity, on the systemic approach and on a new scientific paradigm based on the principles of* self-organization, non equilibrium *and* non-linearity. *It advocates autonomy of silviculture from the discipline originated in Germany in the XVIII century.*
The philosophical, scientific and cultural aspects of the relationships between theory and practice, and the deductive and inductive approach in scientific research are examined. Biocentrism and anthropocentrism and the theoretical implications of evolutionary biology are discussed together with the meaning of Art of scientific research. *Finally, the Author describes the founding principles of the Italian Theory, i.e.* silvosistemica *and the need for acknowledging and respecting the* rights of the forest.

Key words: complexity; silvosistemica; sustainable forest management; rights of the forest.
Parole chiave: complessità; silvosistemica; gestione forestale sostenibile; diritti del bosco.

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If the facts don't fit the theory, change the facts.

ALBERT EINSTEIN

1. PREFACE

The topic that I have proposed to analyze concerns a theory that arose and was developed in Italy in the 1990s. For this very reason, we can call it the *Italian Theory*. Over time it has become a true challenge to the established mindset in forestry. And I am referring not only to the Italian mindset, but also the world's.

Over time the Forest-Human relationship has taken on various forms and modes. On the one hand, the most basic essential needs had to be met. On the other, there has been a *culture* that has always considered the forest to be a *machine*, an *entity to be exploited* in the service of humans. But the forest is not a *machine* nor an *entity to be exploited*. It is a *system that has value in and of itself*.

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The actions of the technological human, of the "Prometheus Unbound," as defined by Hans Jonas (1990), are connected to several topics which various specialists have been analyzing for some time. But no matter how useful these analyses may have been, they have not always been able to alter the activities that have abused and humiliated the forest system. Environmental disasters that are occurring with ever greater frequency and intensity bear witness to this fact. Yet everyone knows that in order to survive, the technological human cannot do without trees and the forest.

An analysis of the "issue" associated with the *Italian Theory* implies "*the scientific and cultural laicization of the Forest-Human relationship*," a true scientific and cultural plan of action, as opposed to what is provided for by both the Italian and non-Italian "sacred texts" of silviculture. "*Laicization*" implies the *independence* of a technical discipline that arose in Germany in the 18th century based on two fundamental points: on the one hand, on a technological-financial-economic principle; and on the other, on dogmatic laws provided by elements of mathematics, with the express intent of considering it to be a science. In short, with such a methodology it fancied itself - in my opinion inappropriately - to be able to describe, predict, define, and understand every facet of the forest reality.

Moreover, it was a discipline that originated under the influence of 18th century empiricism and the prevailing positivistic fervor of the 19th century. It then developed in the 20th century with minor technical adaptations, but without significant changes on the theoretical or scientific levels. This situation, therefore, imposed and continues to impose the need to *change the mindset* and to adopt a different approach to the problematic.

The history of science teaches us that all empirical investigations must be anchored to a theoretical apparatus. This is the *raison d'être* of the epistemology and theory of scientific knowledge. So in order to not merely be analyzing the symbolic terms relating to a scientific and cultural "mutation," we must proceed theoretically, because, as we know, "*theorems have a great advantage: they make clear the assumptions and render deviations easier to deal with.*"

The above-noted "problematic" postulates the need to study the complex forest system with an *ad hoc* scientific discipline: silvosystemics (Italian: s*ilvosistemica*). Furthermore, *axiology*, the theory of values, stresses the *ethical principle* and assumes a specific meaning that in our country is unfortunately still considered purely theoretical: "*The forest has rights.*" (Ciancio, 1997; 2014; 2015).

This attempt at a multifaceted argument seeks to analyze innovations in scientific research, as well as several cognitive perspectives, that are relevant to forestry. It has now become urgent to free ourselves from the psychological subjugation to a technical past and ultrasecular laws and, at the same time, to point the way to real scientific innovation. Among the many other varied novelties in such an analysis I will pause, if only briefly, to consider the culture of complexity, the systemic point of view, the scientific paradigm of building on past research, and the relationships between Science and Humanism, as well as those among Culture, Ethics, and Art.

2. The Culture of Complexity and Systemic Point of View

At the end of the 1940s, a mathematician of great merit, Warren Weaver (1948), dealt scientifically with the problem of complex systems. He arrived at the conclusion that in Nature there are three different classes of dynamic systems:

- *simple systems*, characterized by the presence of a few variables, traditionally studied by physics and the medical/biological disciplines until the nineteenth century;
- *systems of disorganized complexity*, characterized by an extremely high number of variables, each of which however behaves individually in a random or unknown manner;
- *systems of organized complexity*, characterized by a considerable number of variables joined in an organic whole. These are the systems we encounter in biology, medicine, psychology, economics, and political science.

There is no doubt that the forest, a complex biological system, is one of the *systems of organized complexity*. The problems with such systems, Weaver maintains, "are just too complicated to yield to the old nineteenth-century techniques which were so dramatically successful on two- or three- or four-variable problems of simplicity. These new problems, moreover, cannot be handled with the statistical techniques so effective in describing average behavior in problems of disorganized complexity."

This is broadly sufficient to allow us to understand the need to change the direction of the prevailing methodology in the forestry sector. The *systemic point of view of the forest* is a reality that can no longer *not* be taken into serious consideration in research. But, with few exceptions, such problems are not part of the *culture* of forestry researchers, even for those whose interpretive frameworks for the forest are theoretical mathematical systems and who use the inductive methodology when they study its characteristics.

3. The Archetype of Research: The Old Scientific Paradigm

Most silviculturalists and forestry ecologists base their work on a *dogmatic realism* tightly connected to the certainties offered by technology. But in so doing they omit both the cognitive anchor offered by the forest considered as a system, and the realization evidenced by one of my aphorisms: "*The rational order of the forest, which is the goal of classic silviculture, represents the maximum natural disorder.*" Ultimately a technology in compliance with such a dogmatic requirement involves a *use* or perhaps better, an *abuse*, to the detriment of the functionality of the "system of organized complexity" in the forest.

Examining cultural standpoints in the forestry sector reveals an unambiguous fact. The most widely employed scientific paradigm up until now has been the *reductionist*, *determinist*, and *mechanistic* archetype also known as the Galilean, Cartesian, and Newtonian, which is based on the concept of the *objectivity* of science.

According to this paradigm, knowledge is built up indefinitely, step by step, in the belief that definitive certainties will be attained. That is, binding and definitive laws will be revealed. For some time, the scientific arena has been dominated by the metaphor according to which knowledge is like a building, with a foundation, building blocks, etc. The attitude toward the *object* of the study - in this particular case, the forest - is one of dominion and control.

Our understanding of the forest has been defined and accepted by the scientific community based on concepts, principles, theories, propositions, and techniques that build on prior work and are connected to this paradigm. Breaking down into parts and sections was the normal procedure. Research and experimentation were based, and unfortunately continue to be based, on the conviction that the behavior of the whole can be deduced from that of the individual components.

It must be underscored, however, that this paradigmatic inductive archetype allowed forestry research to obtain highly valid technical results. Moreover, the use of cutting edge technology allowed us to become better acquainted with the individual components of the forest, gaining reliability where there had been uncertainty. But, at the same time, the inductive methodology conquered forestry studies scientifically and cognitively. It halted the evolution of thought. It limited theoretical research.

Ecology highlighted this oversimplification. Initially it was sensed, then understood and recognized, that methodologically rigid and specialized scholarship had built inadequate frameworks to allow us to understand the complexity of the forest. In short, scientific research ran aground on the shoals of method, for the sake of method.

4. The New Scientific Paradigm Between Present and Future

The elaboration of a theory never happens accidentally. It requires a critical analysis of the prevailing scientific paradigm. What seemed clear and absolutely logically rigorous until just a while earlier no longer responds to the demands of *scientific explanation*. The prevailing paradigm reveals its limits. Suddenly it is realized that problems cannot be solved within the framework of codified knowledge. The shift entails a different theoretical approach and a new and different prevailing paradigm.

Such a change would add an element overturning the theoretical approach on which silviculture is based. A new construct would arise and be put into practice that could be assimilated with important and meaningful evolutions or, as some maintain, scientific revolutions. This would entail a different research strategy and the opportunity to analyze the past in order to interpret the present and imagine the future.

In 1962 Werner Heisenberg, who won the Nobel Prize in 1932 and was the originator of the *uncertainty principle* that radically modified classical physics, argued that in forming laws of causality, if we know the present, we can figure out

the future. But at the same time he noted that it is not the conclusion that is false, but rather the premise. In fact, given the current state of knowledge, it is impossible to know every determining element of the present, and thus it is not possible to predict the future.

This strategy and analysis demands our specific attention. In the course of my professional life, I worked initially in the field and then as a researcher and teacher. I formed a series of opinions derived from experiments that I had devised and conducted. I often wondered if it might be possible to state some innovative theory or another from the data that had been gathered, developed, and acquired in these experiments. The answer was always "no." The reason is clear on scientific and cognitive grounds: the inductive methodology cannot be the basis for imagining the innovative theories of the future.

Forestry researchers know that the term "ecosystem" was coined in 1935 by Arthur Tansley. We therefore need not be amazed if by now everyone, forester or not, speaks of the forest as an ecosystem. Nonetheless, in everyday practice most forestry researchers, while agreeing on the need to safeguard the ecosystem's functionality, reject the deeper meaning of the term and remain bound to the technical rigidity of the past. This is a contradiction stemming from the confluence of many factors: the *imprinting* during the researchers' university studies; the uncritical habits already noted; the conviction that if they work this way they cannot be faulted; and the certainty that no one will ever risk challenging what has been written in the "sacred texts."

The only forestry researcher who supported taking advantage of the advances in ecology in order to modernize silviculture was Alessandro De Philippis (1972). In his lecture on the occasion of his 21st year at the Italian Academy of Forest Sciences, he highlighted the opportunity for change, for proceeding toward an "ecological silviculture along ecosystemic lines or on an ecosystemic basis." This utterance can today be considered a first small step toward "systemic" awareness.

Forestry research must avail itself of an anti-reductionist, anti-determinist, and anti-mechanistic philosophy. Or rather, of a scientific paradigm whose principles are auto-organization, non-equilibrium, and non-linearity. And precisely for this reason, of a prevailing hypothetical-deductive paradigm that, with regard to the past, is not only concerned with technology, but also, and especially, with science.

The new scientific paradigm, which in the near future will inevitably lead to a significant change in forestry research, is based on the concept of the intersubjectivity of science. Descriptions of phenomena are dependent on the observer. The metaphor of knowledge is one of a network of relationships. The process of understanding is based on the *culture of complexity* and the *systemic point of view*. The experimental approach is holistic and ecocentric. Methodologically the procedure moves forward via trials and elimination of errors, i.e., successive approximation. It follows that the *ethical principle* will have a much different place in the use of the forest when compared to today.

5. Theory and Experimentation: What are the Scientific and Philosophical Implications?

Experimentation has a specific task. The objective is to verify the reliability of theories already elaborated about the forest and normally implemented in everyday practice. The most important of these theories is the one that prevails not only in Italy, but also throughout the world: "*Achieving the maximum production of timber in the shortest possible time with the least expenditure of energy, labor, and capital.*"

I wonder and wonder: what are the scientific and philosophical implications of the connection between theory and experimentation? Between deduction and induction? In scientific research these are the issues that should interest and conceptually occupy researchers who want to bring innovations into science and knowledge.

Many years ago, through my studies of the history and evolution of physics I came to realize that this problem was addressed and resolved by several scientists after a true revolutionary controversy in the 1920s and 1930s. Highly talented scientists who also loved delving into philosophy participated in the debate. These proponents of innovative research asked the following question: can experimental results determine the elaboration of a theory?

The scientist and philosopher Albert Einstein, who won the Nobel Prize in 1921, provided the answer. Among other works, Einstein was the author of the "theory of general relativity," which the great Russian physicist Lev Landau, who won the Nobel Prize in 1962, called "the most beautiful of theories" (Rovelli, 2014). On 10 June 1933 in *The Herbert Spencer Lecture at Oxford*, Einstein highlighted the *philosophical implications at the base of science.* He asserted that theory of physics is neither a simple description of experimental results nor something deducible from such a description. The physicist arrives at a theory by purely speculative means.

To summarize: deduction does not proceed from facts to theoretical suppositions, but rather from the suppositions to the facts and to data obtained experimentally. As a result, theories develop deductively and are then subjected to experiments from which it is possible to verify the reliability of the underlying theoretical principles.

Another scientist, the physicist-philosopher Niels Bohr (Nobel Prize in 1922), agreed with Albert Einstein on this interpretation. It must be emphasized, however, that Bohr and Einstein held totally different and irreconcilable positions about the theory of quantum mechanics. In December 1926, in a letter addressed to Max Born (Nobel Prize in 1954), Einstein, who was unpersuaded by the ideas of the Copenhagen School, made an observation about quantum mechanics that would become famous: "*God does not play dice with the universe*" (Bisero, 2013). To this observation Niels Bohr replied: "*Don't tell God what he has to do.*"

In this particular case, though, arguing means neither controversy nor personal conflict. The debate was not a quarrel among people who did not wish to admit that they were wrong. Both wanted to accept scientific truth. Einstein and

Bohr defended their opinions from a thirst for knowledge. In the end, Bohr won the scientific duel. But, confirming the respect that moved the two opponents, the Bohr family coat of arms contains the motto "*Contraria sunt complementa*," opposites are complementary. Subsequently, and with great intellectual honesty, Einstein admitted, "maybe I've earned the right to make mistakes."

The relationship between their scientific disciplines and philosophy has interested great scientists who over time planned and achieved both scientific advance and cultural progress. I believe, therefore, that this relationship can be well imagined with the following metaphor: "*Philosophy is the 'mother' of science.*" And that should come as no surprise. Recall that in the 16th and 17th centuries science was defined as "*natural philosophy*." The metaphor arises from observing the gap between philosophy and science which in the succeeding centuries took on the form of an unyielding contest.

Moreover, as Paolo Pecere asserts (2015), "…philosophical ideas carry out a heuristic function in the evolution of scientific thought." And further: on 7 December 1944 Einstein maintains in a letter sent to the young philosopher Robert Thornton: "a knowledge of the historic and philosophical background gives that kind of independence from prejudices of his generation from which most scientists are suffering. This independence created by philosophical insight is - in my opinion - the mark of distinction between a mere artisan or specialist and a real seeker after truth." And, I would add, after the scientific truth, too, of course. There is no certainty in science: "…the basis of science is not certainty, but continued uncertainty" (Rovelli, 2015).

6. The Forest Between Anthropocentrism and Biocentrism

The *anthropocentric point of view* has always represented the true, authentic spirit of forestry researchers. It is a heritage of ancient culture. In the past, the *simplification* and *regularity* "of" and "in" the forest was consistently researched with the intent of improving the functionality of forest systems.

It was a pervasive approach that on the one hand stemmed from an atomistic conception, which viewed the forest as separate from its surroundings and its components as distinct and measurable, and on the other hand from an anthropocentric point of view pushed to its logical conclusion: the submission of Nature to the will of humans for the fulfillment of their own needs. For this reason, it is appropriate to highlight that in this cultural context, as can be deduced from the "sacred texts" both in Italy and the rest of the world, technological leaders have been supported by the guiding spirits of experimentation and of forestry science.

This is a scientific and technical perspective that is the expression of the paradigmatic archetype already described. Or, in other words, of the "sensory experiences and rigorous demonstrations" of Galileo's new science (1632); of the Cartesian determinism in the Discourse on the Method of Rightly Conducting One's

Reason and of Seeking Truth in the Sciences (1637); and of the Newtonian mechanism in the Mathematical Principles of Natural Philosophy (1687), better known as the Principia.

I wonder over and over: can we act on Nature so as to obtain the maximum financial utility without causing irreversible damage? This is a question that demands a clear and timely answer. The answer must be communicated to everyone in order to increase what I love to call the "*Culture of the Forest*." This would mean overturning the technological and legal position of previous centuries.

For more than two decades I have asserted many times that forestry management should not be evaluated solely in financial terms. I have not claimed, nor am I claiming, that they should disregard the financial aspects, but I believe that it is necessary to distinguish the financial aspects from the economic ones. In this sense I have found unexpected support from Jorge Mario Bergaglio, Pope Francis, who in the encyclical *Laudato si'* (2015) maintains that "the principle of the maximization of profits reflects a misunderstanding of the very concept of the economy."

Many do not take into account that starting in the 1960s a conviction has grown, which then became a widespread *Culture*, that to safeguard the environment and the forest ecosystem a *biocentric approach* is needed. There are two diverse currents of thought in this formative intellectual approach. I refer to the *biocentric-individualistic* currents, based on *functional biology* that is connected to the philosophical-scientific substratum of *ontological reductionism*.

These cultural positions are often placed into contrast with the *biological-holistic* or *ecocentric* ones, whose foundation is connected to the *epistemological philosophy* of *evolutionary biology*, that is, to positions of absolute value and meaning that have to do with species, habitats, and ecosystems (Pagano, 2002). It follows from this that the use of the forest is destined to change in the near future. This is due to the changing living conditions. The influence of scientific research and of knowledge has been decisive for these perspectives, and will be even more so henceforth.

7. The Forest Culture Between Humanism, Science, Ethics, and Art

Debates between humanists and scientists have been common for a long time. But the dispute that caused a serious cleft in the Italian cultural and scientific world took place between the philosopher Bendetto Croce, the founder of Italian neoidealism, and the mathematician Federigo Enriques, a supporter of positivism, at the International Congress of Philosophy on 6 April 1911 in Bologna, at which Enriques was elected president - inappropriately, according to Croce.

In his *Logic As the Science of Pure Concept* (1905), Croce asserted that mathematical principles are not true, but rather organized contradictions; that mathematics is "vera simia Philosophiae," philosophy's ape, like is said of the devil, God's ape. In an article published in the journal *Leonardo*, moreover, Croce expressed his ideas explicitly: "Mathematics possesses neither historical truth nor […] philosophical truth. It is not science, but an instrument and practical construct" (Greco, 2011).

One may wonder what this controversy has to do with the "science of Nature" in general and with the forest in particular. The relationship between their scientific disciplines and philosophy has interested great scientists who first planned and then achieved both scientific advance and cultural progress. Among many, many others, I am referring principally to 20th-century promoters of scientific progress. From the list of most illustrious figures I cite Werner Heisenberg, Niels Bohr, Max Born, Wolfgang Pauli, Erwin Schrödinger, Albert Einstein, and Louis-Victor de Broglie, all scientists who were also men of elevated humanistic culture.

The dispute at the Congress of Bologna revealed something significant about both humanistic Culture and Science, which for a long time represented what Charles Percy Snow (1963) called the two "cultures," ascribing to them a sense of incommunicability and separateness. This is the problem, one which before now was considered unsuitable and old-fashioned by the humanistic, scientific, ethical, and artistic worlds. On the other hand it must be recognized that the above-mentioned cultural controversy affected the "issue" between *humane litterae* and Science. It negatively influenced culture, schools, politics, and even the economic development of our country for almost a century.

It was Humanism *versus* Science and connections between Ethics and Art, therefore. It was a dispute that for a long time seemed insurmountable. Fortunately, today its virulence appears to be on the wane. It has finally been understood that Humanism, Science, Ethics, and Art are not opposed to each other, but rather together make up *Culture* - the one and only true *Culture*.

8. The Art of Research; Scientific and Cultural Laicization

The metaphor explained earlier is an attempt to narrow the gap between Humanism and Science still present in some forestry research and technical spheres. It should be emphasized, though, that in reality, compared to the positivist empiricism in the founding construct of forestry science, there has been a qualitative leap. The *Art of Scientific Research* has supplanted it, and is a symbol closely tied to the civilization and the immeasurable cultural history of Italy.

It may be wondered what is meant by the *Art of Scientific Research*. Albert Einstein said "*The most beautiful experience we can have is the mysterious. It is the fundamental emotion that stands at the cradle of true art and true science*." Scientific research is a complex activity in which both conceptual and material tools are used. It takes shape in intuitions, creativity, and consciousness (Ciancio, 1994; 2014; 2015; Scheffer *et al.*, 2015). And seeing as how it is based on manual and intellectual dexterity, it is an *Art*. To be precise, the *Art of Scientific Research*. It determines the creation of new models of thought. The *Art* is the spirit of research, to be concise. In this sense, for *silvosystemics*, or the *Italian Theory*, Galileo Galilei's assertion is important: "I believe that art, like science, must strive to be faithful to nature" (Marcacci and Shea, 2015).

Innovations in science occur through the elaboration and exposition of new theories. As William E.B. Beveridge states (1950): "In creative thought it is more important to see the forest than the trees; the researcher is in danger of seeing only the trees. The scientist with a mature mind, who has reflected deeply on a wealth of scientific material, not only has had the time to accumulate technical details, but has also acquired a line of sight sufficient to glimpse the forest."

The junior researcher must know that the advance of knowledge takes place through hypothesis and metaphysical preconceptions, by the use and appreciation of intuition and the ability to make conjectures. If a real innovation is sought, what is already known cannot and must not be taken into account. The researcher who looks to the future is both innovator and artist. As an innovator, the researcher loves to think outside of frameworks of reference and glorifies the critical spirit that actually comes from the scientific laity. As an artist, the researcher uses precisely that sentiment of freedom which comes with cultural laicization.

The *Art* of research has created an important opportunity to foster a new Ethics and cognitive framework for the complex biological forest system. We have moved from a *primitive culture* based on the dominion of Human over Nature that has caused great damage to the environment and forest, to an *elevated culture*, unique to the Italian character, that has given rise to "*The scientific and cultural laicization of the Forest-Human relationship*." Therefore, the concept of protecting, preserving, and conserving the forest prevails today. The forest is no longer only the *object* of scientific exploration in order to increase timber production, but is also the *subject of rights* and, as such, an entity of exploration and study for the scientist and humanist.

Researchers, furthermore, would do well to linger on the basic principles of scientific research that, precisely because they are such, have implications of a philosophical nature and can be divided into two categories. On the one hand, these are *ontological* principles related to the object of scientific knowledge independent of its relation to the observer; and on the other hand, they are *epistemological* principles permitting a direct relationship between the experimental scientist and the object of knowledge. But there's more. The scientist-object interaction represents the ultimate reality of research (Heisenberg, 1962; Rovelli, 2014).

9. Theoretical Implications in Evolutionary Biology

Ever since the era of Galileo Galilei, René Descartes, and Isaac Newton, research has almost always kept the experimenter separate from the object of knowledge. The philosophical implication of the ontological principle has been accepted uncritically, namely *reductionism*, *determinism*, *mechanism*, and above all the validity of the *cause and effect* relationship.

But in *evolutionary biology* the ancient paradigmatic archetype, for reasons explained above, did not permit the acquisition of theoretical knowledge. This methodology, moreover, entails the *objectification* of experimental results, with the

resulting formulation of specific laws. This may hold for *molecular biology*, but certainly not for *evolutionary biology*.

Ernst Mayr (1990), one of the greatest evolutionary biologists, observes: "This discussion of reductionism can be summarized by saying that the analysis of systems is a valuable method, but that attempts at a 'reduction' of purely biological phenomena or concepts to laws of the physical sciences has rarely, if ever, led to any advance in our understanding. Reduction is at best a vacuous, but more often a thoroughly misleading and futile, approach."

It should be noted, moreover, that in the case of silviculture, all this is even more serious. Silviculture is applied biology, and in this discipline, as we've already ascertained, absolute certainty cannot be obtained. In silviculture, as asserted earlier, the only certainty is uncertainty. Or rather, in the *complex biological forest system*, unpredictability is the rule.

Charles Percy Snow asserted in 1966: "Many biologists feel the same liberation, the same joy of taking part in a grand undertaking as did physicists in the 1920s. It is highly probable that the moral and intellectual lead in science will pass over to biologists, and among them we will find the Rutherfords, Bohrs, and Franks of the next generation."

This is a prediction that has come true right on schedule. Science now considers this to be the century of biology. Snow's intuition, in my opinion also - and especially - applies in a highly meaningful way to forestry researchers and scientists.

10. The Italian Theory: Silvosystemics and Sustainable Forest Management

The radical change in silviculture heralded by Alessandro De Phillipis in 1972 arrived in the 1990s with the elaboration of *silvosystemics*, or the Italian Theory. The need to make the idea of the forest understandable from a scientific standpoint emerged from this theory.

"*The forest is a whole, unified in the network of relationships among the complex of plant and animal organisms and the complex of physical factors. In other words, a highly complex biological system* (Ciancio, 1999)."

If the premises change, then, as a result, the interpretation of the phenomena is altered. Thus, for example, the idea of the *complex forest biological system* - now accepted by most of the scientific establishment - entails the analysis and re-elaboration of epistemological, scientific, historical, ethical, and cultural problems, not to mention legal, economic, social, and political ones.

The *systemic point of view* of the forest once again makes the very premises of silviculture, forestry management, and forestry economics debatable. In recent years, the development of knowledge in the applied sciences of Nature has permitted the maturing of a new conceptual process in forestry management and the identification of alternative solutions. Work on *silvosystemics* is now discussed nationally and internationally (Messier *et al.*, 2013).

Many forestry researchers will wonder what is meant by *silvosystemics*. Just this:

"*Silvosystemics is the science of the study, cultivation, and use of the forest as an autopoietic biological system which is adaptive, extremely complex, and capable of perpetuating itself autonomously and performing numerous functions*" (Ciancio, 1999).

Sustainable forest management no longer aims at privileging one or more functions of the forest, but at creating the necessary preconditions for the resilience of the forest system. It can be defined in this manner:

"*Systemic forest management is sustainable when the forest biological system interacts harmoniously with other systems, and processes of growth fit well into a plan aimed at social and cultural progress.*"

Such a strategy is based on the best use of the most recent scientific findings. On the technical level, silvosystemics does not call for generalizable systems and methods as provided for in the "sacred texts," both Italian and non-Italian. The patchwork of environments in Italy, where changes are evident over very short distances, does not permit the generalization of similar techniques.

Systemic forest management calls for maintaining the natural character of forests, respect for the natural cycles of renewal, the restoration of forests deprived of their true character by an excessively intense management, monitoring of mutations related to biodiversity, and environmental rehabilitation. It guides choices in preserving biotopes, conserving ecotypes, and safeguarding the functionality of the ecosystem. It entails applying management styles that can maintain or increase the heterogeneity of the flora and fauna, protect endangered species, and also allow a productive use, in the global sense of that word, of the forest. All of this represents a challenge that forestry researchers must not miss.

Although it does not neglect the reductionist scientific method that is still most widely used, the Italian School of forestry is committed to scientific and technical innovation. For more than twenty years it has been working, and will continue to work, in discontinuity with the past. The theory of *silvosystemics* - the Italian Theory - has brought about an unstoppable change in science. It is a change that will become more widely known and accepted because a new generation is rising that is familiar with it. We must merely consider the many contributions already made and which will continue to be made by forestry researchers born in the digital age. As ever, "*In science the frontiers of today are the limits of tomorrow.*

11. The Rights of the Forest

On 23 May 1995, more than twenty years ago, there was a round table on the topic "The Forest and the Human" at the headquarters of the Italian Academy of Forest Sciences. After a debate that was - to put it mildly - lively, a motion I had made was approved, although only by a majority vote. It read as follows: "The forest is a complex biological system fulfilling a determining role for the maintenance of life on the planet. As with all living systems, the forest is an entity that has a 'value in and of itself'. It is the subject of rights that must be protected, preserved, and defended."

For the first time in official language at a prestigious site, the Italian Academy of Forest Sciences, a problem of an ethical nature was brought to the attention of the cultural and scientific communities. You either agreed or disagreed. Nothing is more natural or appropriate than conflicting opinions on the topic. It can be distilled into a quip: respecting nature means respecting yourself. And precisely for this reason, the Forest-Human relationship becomes one of equals in terms of ethics and culture. I believe it is a significant goal about which everyone must be informed, but especially those in the forestry sector, be they scholars, scientists, researchers, technicians, or managers.

For more than a decade, I have asserted repeatedly that the forest is a *subject of rights* and that humans must act accordingly. And for this, to tell the truth, I have been anathematized endlessly. But it is important to highlight that in these cases no importance must be given to justified or unjustified diatribes on account of any positions taken. One of my maxims states: "*Disagreement leads to knowledge, and knowledge increases the unknowns*."

Many wonder to which rights reference is being made. Well, the rights of the forest are of a dual nature: *natural rights* and *positive rights*. *Natural rights* are connected to the observation that Nature has inalienable rights on which the future of humanity depends. *Positive rights* are linked to laws respecting the Forest-Human Relationship. These are laws stemming from the defense of the forest against inevitable abuse. In other words, from defense against *hýbris*, from human arrogance, which evokes *νέμεσις*, the "wrath of the gods," or, in the present case, the punishment inflicted not by the gods, but by Nature upon those who tarnish themselves with useless and harmful virulence. Nature acts, sometimes with violence, in response to Human damage or disregard toward it. *Positive rights* form a part of *natural rights* from which are deduced *Ethics* and Human respect toward Nature and therefore also toward the Forest.

When *positive rights* do not take into account *natural rights*, imbalances and sometime incalculable reactions occur whose consequences fall inevitably onto civil society. This is the reason that drove me to *go where angels fear to tread*, into an area where I do not have a sufficient understanding, i.e., the level of understanding required of an academic. In science, as Galileo Galilei shows, one cannot and must not take heed of what William Shakespeare asserted, that "discretion is the better part of valor" (Marcacci and Shea, 2015).

As my line of defense I adopt the formula chosen in 1944 by Erwin Schrödinger (Nobel Prize in Physics for 1933), who wrote: "A scientist is supposed to have a complete and thorough knowledge, at first hand, of 'some' subjects and, therefore, is usually expected not to write on any topic of which he is not a master. This is regarded as a matter of *noblesse oblige*. For the present purpose I beg to renounce the *noblesse*, if any, and to be freed of the ensuing obligation." I acknowledge and take note of this, and thus will not back away.

In axiology, *natural rights* are superior to *positive rights*, and therefore the latter must be developed in line with and possibly adapted to the former. The laws prescribed by *positive rights* are directly connected to the understanding of Nature.

If, in issuing necessary laws, this principle is followed, then these *positive rights* gain value and the Human, observing these laws, acts so as to respect Nature. These laws gain a universal significance, as a wide variety of important authors, who have dealt with the laws for a long time, has asserted.

Whatever the opinions may be in this regard, whether scientific, cultural, or religious, one thing is certain. There can be no *positive rights* deserving respect and obedience if they are not directly connected to *natural rights*. In the matter at hand, we can make reference to the "*natural rights of the forest-complex biological system*." It is a system that is the expression of Nature, from the knowledge about which may be derived *positive rights*, i.e., the passage of laws that take account of such rights.

The technical and managerial research community must take care to stay informed of new scientific and technical findings, as politics must too, in order that we may move toward replacing current laws of the *proscriptive* sort (*"what is not forbidden is allowed"*), which are unique to positive rights, with laws that are *prescriptive* ("*what is not allowed is forbidden*"), or in other words, with laws that extol the principles of *natural rights*. This will serve to narrow, or better yet, to bridge the gap between the antithetical *categories of rights* of the complex forest biological system.

Such problems must be faced and possibly resolved, if we do not want to remain on, or worse yet, be pushed to, the margins, to the outer fringes of knowledge. It must not be forgotten that the issue of the rights of living systems, and thus also of the forest, which we have dealt with, studied, and drawn attention to for more than twenty years, is now on the agenda all over the world.

The debate that is roiling society centers on the Nature-Human relationship. Here, too, the assertion of Jorge Mario Bergoglio (2015) reassures me, on the necessity of "saving the planet from the people." But not all technical experts and researchers followed this debate. The former have been absorbed in their own, purely technical work; and the latter, due to a certain methodological and instrumental *purity*, which sometimes borders on *scientific laziness*, have lost sight of the epistemological context that underlies every innovative endeavor.

I would like to recall here an event that was, to say the least, extraordinary, which took place in the United States of America. On 19 September 2006, fully eleven years after the declaration of the rights of the forest approved at the Italian Academy of Forest Sciences, the small town of Tamaqua, in Schuykill County, Pennsylvania, approved an ordinance that changed the concept of "subject of legal rights." This ordinance recognized natural communities and ecosystems as legal persons, with their own rights (Community Environmental Legal Defense Fund, 2006).

In 1957 Italo Calvino dealt with this question in a story. Cosimo, a rebellious baron, gains renown among the *philosophes* (Voltaire, Diderot, etc.) for certain "politically correct" essays that he writes on topics such as republican constitutions and social contracts. But one of these, entitled "Draft of a Constitution for a Republican City with Declaration of the Rights of Men, Women, Children,

Domestic and Wild Animals, Including Birds, Fish, and Insects, and of Large Plants, Vegetables, and Herbs," is ignored. And yet "it was a beautiful work that could guide all rulers; but no one considered it, and it was a dead letter."

Cosimo's essay, notes Robert P. Harrison (1992), is overlooked because in its time only declarations of the rights of man were of interest, i.e., the rights of human subjects, and not those of objects or the species of Nature. Today we see the consequences of these unilateral declarations of the rights of a single species that are oblivious to the natural rights of all other species. In this sense, Cosimo's essay was ahead of its time, and also ahead of ours on this issue.

What else should be added? Any comment would be redundant and, thus, pointless. I believe one thing, though, is useful to highlight: poets, artists, and writers, especially those of Italo Calvino's caliber, are, as always, trailblazers. They create culture. Researchers and technicians need only take it into account and then to rationalize it; or in other words, to bring those intuitions and syntheses into everyday practice, especially if one or another of them is elegant and harmonious.

12. Conclusions

One question is unavoidable. Is a change in silviculture and forest management realistic? The answer is yes. We need only to avail ourselves of one guiding idea: the forest as *subject*, and not as the *object*, as it is usually considered. But what underlies this idea? To put it briefly and simply, it means asserting the *scientific and cultural laicization of the Forest-Human relationship* as regards the "sacred texts" and, consequently, considering the forest not as a collection of trees, but as a *complex biological system that has value in and of itself* (Ciancio, 1991; 2002; 2014; 2015).

In research we must avail ourselves of the hypothetical-deductive system to attain innovation and *truth - scientific truth*. The problem of respect, protection, and correct use of the forest is to be solved by applying a true and authentic *silvosystemics*. That is, first by imagining and then by proposing alternative paths that intersect with the interdisciplinary understanding of biodiversity, dishomogenization, and heterogeneity, i.e., of complexity and of the new and different paradigm for the forest system.

Ultimately the goal is to move toward cultivation based on *reading* the forest and on applying *learning* about the forest. Knowing how to read the biocenosis and knowing how to understand the symptomology that it reveals constitute one element that will lead to an optimal Forest-Human relationship. The *Forest system recognizes itself in Humans, and Humans recognize themselves in Nature.*

Before making sense of empirical data gained from experiments, we must be informed about the forest system. This means being in contact with it, sharing its life, viewing it with respect and love. There is no alternative. There is no escaping this rule. Otherwise…otherwise, we will have to make sense of data pertaining to who-knows-what.

In 1966 Louis-Victor de Broglie (Nobel Prize in 1929) asserted that the history of science teaches that the current state of our knowledge is always provisional and that there must be immense new regions to discover beyond what is known. This is a truth that should be the heritage of all who are interested in science.

I will direct some encouragement to junior forestry researchers: try to keep moving forward. To this end, I propose they reflect on the following motto that has guided me for over fifty years of research activity: "Science is made of data, as a forest is made of trees; but a pile of data isn't science, just as collection of trees isn't a forest."

I will conclude with an aphorism from chapter 44 of Petronius's *Satyricon*, which is an integral part of the logo of the Italian Academy of Forest Sciences "Serva me, servabo te" ("save me, and I will save you").

Thank you.

RIASSUNTO

La laicizzazione scientifica e culturale del rapporto bosco uomo. L'Italian Theory

Il lavoro si propone di analizzare gli aspetti relativi a una teoria nata e sviluppata in Italia negli anni novanta del secolo scorso: *l'Italian Theory*. Essa prevede l'autonomia della selvicoltura da una disciplina generata in Germania nel XVIII secolo e si basa sulla cultura della complessità, sulla visione sistemica e sull'adozione di un nuovo paradigma scientifico fondato sui principi di *autorganizzazione*, *non equilibrio*, *non linearità*.

L'articolo esamina inoltre gli aspetti filosofici, scientifici e culturali della connessione tra teoria e sperimentazione e tra deduzione e induzione nella ricerca scientifica, tra antropocentrismo e biocentrismo, cosa si intenda con Arte della ricerca scientifica, e le implicazioni teoretiche nella biologia evoluzionista.

Nell'ultima parte, il lavoro descrive le fondamenta dell'*Italian Theory*, ovvero la *silvosistemica* e la necessità di riconoscere e tutelare i diritti del bosco.

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