A Dual Ontology of Nature, Life, and Person


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By

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The IRAFS - International Research Area on Foundations of the Sciences - is the first of the research areas based at the Pontifical Lateran University. Its official foundation dates back to October 1997, just about a year away from the premature death of him who was the first promoter and founder of the Area: EMINO DE GIORGI. Professor at the "Scuola Normale Superiore di Pisa", Member of the "Accademia dei Lincei" in Italy, of the "Academia di Francia", of the "National Academy of Sciences in US, and of the "Pontifical Academy of Sciences" in Vatican, he was one of the greatest mathematicians of the twentieth century.

- Professor De Giorgi...
- IRAFS was founded...
- The various disciplines...

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Some references

- **Main references:**
  - Basti, G.. *The quantum field theory (QFT) dual paradigm in fundamental physics and the semantic information content and measure in cognitive sciences.* In G. Dodig-Crnkovic, & R. Giovagnoli (Eds.), *Representation and Reality in Humans, Other Living Organisms, and Intelligent Machine* (pp. 177-210). Berlin, New York: Springer Verlag. doi:10.1007/978-3-319-43784 [attached].
  - [See also the wide bibliography quoted in these two papers]
The AI research program and the birth of the cognitive sciences and neurosciences

- In the famous Dartmouth Conference (1956) started officially the AI research program based on the Turing test (1954) and the consequent “AI dogma”: if a UTM is able to imitate successfully a human intelligent task, there exists some essential isomorphism between the program running in the computer and in the brain → metaphor of mind as “software” of the brain “wetware” (Putnam 1960).

- → New scientific disciplines of the cognitive sciences and neurosciences characterized by a non-reductionist approach to the mind study.

- Objective correlate of a subjective mind state is not only a neurophysiological state/function (behaviorism) but the information processing performed by such a brain function.

- Double problem at issue:
  
  1. Which type of information is managed in brains → problem of the physical foundation of the notion and measure of information in dissipative systems, and of its relationship with Shannon’s notion and measure of information of the communication engineering (the famous “bit”).

  2. Evident inadequacy of the “Turing Machine” paradigm in cognitive neuroscience able to manage only bits.
The cognitive neuroscience triangle

I/We talk of conscious state report
Intensional Logic

O-Talk\textsubscript{2} informational account
\rightarrow Extensional/Intensional Logics

O-Talk\textsubscript{1} neurophysiological account
\rightarrow Extensional logic
The Neuroethics Challenge

The Problem at Issue: Who is the Actor of a Moral Act?
The Core of the Neuroethics Approach

- One of the pioneers of the neuroethics approach is A. Damasio with his criticism against the moral rationalism of Descartes and Kant.

- Damasio’s experimental evidence that for a defect in the emotional area of their brain, intelligent patients, without attention, language, and abstract reason defects are systematically unable to make decisions that are profitable for their own persons, acceptable for their community, and then morally correct.
Toward a recovering of an intentional foundation of the moral act on a neurophysiological basis

- Damasio practically re-proposed on empirical basis the core of intentionality criticism to Kant’s moral self-referential formalism (duty for a goal vs. duty for a duty) as far as based on the intentional character of volition:
  1. Faculty of desiring in general made “moral” because informed by the abstract moral norm (Kant)
  
  Vs.:
  2. Faculty of desiring something made “moral” by the goodness of the desired goal because fulfilling person’s subjective and intersubjective capabilities, and then granting her happiness (Aquinas)

- Further Damasio’s fundamental distinction among: 1) first-person consciousness (witnessing self); 2) self-consciousness (partial self-objectification of a witnessing self); 3) moral behavior attribution to someone else (third-person attribution of consciousness).

- → Object of neuroethics research: connecting (1) to (3) for the irrelevance of (2) (moral responsiveness vs. responsibility toward community (Levy))

- Fundamental question: in which way brain mirrors reality, so to justify intentionality i.e., the aboutness of mental agency?
Who is in charge? The brain?

- Descarte’s mistake of identifying person with self-consciousness as subject of the intellectual or moral act → reaction of those like M.S. Gazzaniga attribute to the brain the role of behavior controller.

- Because of the neurophysiological evidence that any conscious volition is causally determined by the readiness potentials of neural arrays, preceding of some milliseconds (B. Libet), or even of some tenths of seconds (J.D. Haynes) the conscious expression of making a voluntary act.

- “Conscious volition, the idea that you are willing an action to happen, is an illusion”. Where it is evident that the target of this criticism is the identification of the self with self-consciousness.

- But we as persons are our brains and our bodies in relationship with our environment: our conscious behavior and our awareness is only the iceberg top, not the whole iceberg of our moral agency.

- If my motor neurons were not preparing themselves before that I decide consciously to move my arm, it would not be able to move when I decide to move… Any conscious action has a complex unconscious preparation!
A Personalistic position in Neuroethics: N. Levy

- “Identifying the self with consciousness therefore seems to be hopeless; it would shrink the self down to a practically extensionless, and probably helpless, point. Few sophisticated thinkers would be tempted by this mistake. But an analogous mistake tempts even very clear thinkers, a last legacy of the Cartesian picture. This mistake is the postulation of a control centre, a CPU in the brain, where everything comes together and where the orders are issued”.

- “We needn't fear that giving up on a central controller requires us to give up on agency, rationality or morality. We rightly want our actions and thoughts to be controlled by an agent, by ourselves, and we want ourselves to have the qualities we prize. But the only thing in the mind/brain that answers to the description of an agent is the entire ensemble: built up out of various modules and subpersonal mechanisms. And it is indeed the entire agent that is the controller of controlled processes”.

- Problem: in what precisely does consist this holistic control exerted by the whole person as a moral agent?
The Anthropological Background

The Classical Anthropology of Person
Three anthropologies

- **Dualistic**: soul separated from the body (Plato, Descartes,…)
- **Monistic**: soul is the body (Democritus, Hume,…)
- **Dual**: soul as form ordering matter into a body (Aristotle, Aquinas,…)
  - Soul as immaterial component of a living body, i.e., **form**, organizing at different levels (proteins, cells, tissues, organs…) the parts into the **unity** (wholeness) of a **body in relationship** with its environment.
  - Human person is more than a biological individual
  - She is a **psycho-physical-unity-in-community**
  - Who is able to transcend and control her community constraints, so to be the free subject of her own actions
  - Therefore the human person is ultimately constituted by a **transcendent relationship with the Absolute**, of which she becomes aware in the **religious experience**, and that is the **ultimate foundation** of the equal and inalienable dignity of each human person
The power of formal ordering without exerting any action

- The mistake of **dualism**: confusing the formal causality with an acting causality.
- The mistake of **monism**: ignoring the causal role of matter ordering.
Common sense evidences for duality matter-form

- **Continuity of an organism in time** related to persistence of dynamic information patterns in time (we change all the matter of our bodies at least twice every year and even we remain ourselves).

- **Human life and consciousness** is related to information and not only to energy exchanges, with a cultural (human) environment.

- A human “does not live of only bread…”, but of information exchange too (think at child development since the womb, at the psychical maintenance of elderlies, at the awakening out of coma, etc…)

- “Mind contains the body” at the interface with the environment, and it is not located inside it…
Refusal of a dual ontology of nature in modern science and philosophy

- Birth of modern science on mechanistic basis (Newtonian mechanics) → refusal of the dual ontology of nature.
- → False dichotomy monism-dualism in modern anthropology with the dualistic vision incompatible with the scientific vision of humans and reality.
- → Modern age as the age of the two cultures and the age of the ideologies
- → Banishment of the dual personalist vision into the hortus conclusus of the humanism.

- Recovering of a dual vision in biology by the informational approach in biological and neural sciences and more recently by the information interpretation of quantum physics → problem of the physical foundation of the notion and measure of information in fundamental physics as distinguished from the notion and measure of information in communication engineering.
Dual theory as person-body relationship theory

- **Person as subject-in-relationship exchanging with its environment energy and information.**

- Saying that mind (dualism) or brain (monism) are thinking or deciding is like saying that the hammer or the chisel and not the sculptor is the author of the statue (Aquinas).

- It is the person as **conscious-agent-in-relationship** who is thinking and deciding through the informational (ordering) control exerted via CNS on the whole body: from mind-body to person-body. Consciousness is only the top of iceberg…


- What is “information” in physics and biology? It is not the “bit” of communication engineering it is the **negentropy or free energy (energy +order: Schrödinger, Szent-Györgyi ) of quantum physics.**
The notion of “extended mind”

An isolated brain is a dead brain

A living brain is a dissipative (connected) brain “mirroring” its environment (Vitiello 2013)
Three levels of self-ordering in living systems

- Three levels of self-organization (*actio immanens*) in living bodies according to the “helmsman metaphor” or “cybernetic metaphor”:
  - **Vegetative operations** (growth, metabolism, reproduction), where “forms” and “goals” of these operations are given by nature (genetically) and only their “execution” is individually self-controlled (epigenetics: cell specialization through activation/deactivation of the same DNA sequences).
  - **Senso-motor operations**, where only the biological/social goals (instincts) are genetically given (animal intentionality)
  - **Intellective operations (intelligence and free-will)**, characterized by a control not only on the biological, but also on the social goals (human intentionality).
Outstanding experimental evidence of the intentional character of perception
The intentional brain mystery

“Formal” Inner Senses

“Intentional” inner senses

Which fundamental physics is able to support the real time (1/10 sec.) interactions of brain modules so far (many hundred millions of synapses) from each other, during an intentional act?
The QFT “miracle” of the phase interference of force fields and of their quanta (= formerly the “particles” of QM)

Quantum Diffraction

Quantum destructive/constructive interferences (resonances)

Think at the guitar chord playing an A tone with a fork (out of phase) and a diapason (in phase)
A paradigm shift in fundamental physics

The Quantum Field Theory and the Topological Modelling of Quantum Physics
The QM Standard Model (SM) picture and the cosmological “pizza”
Unsolved problems of SM: it explains <5% of matter

**Unsolved Mysteries**

Driven by new puzzles in our understanding of the physical world, particle physicists are following paths to new wonders and startling discoveries. Experiments may even find extra dimensions of space, microscopic black holes, and/or evidence of string theory.

**Why is the Universe Accelerating?**
The expansion of the universe appears to be accelerating. Is this due to Einstein’s Cosmological Constant? If not, will experiments reveal a new force of nature or even extra (hidden) dimensions of space?

**Why No Antimatter?**
Matter and antimatter were created in the Big Bang. Why do we now see only matter except for the tiny amounts of antimatter that we make in the lab and observe in cosmic rays?

**What is Dark Matter?**
Invisible forms of matter make up much of the mass observed in galaxies and clusters of galaxies. Does this dark matter consist of new types of particles that interact very weakly with ordinary matter?

**Are there Extra Dimensions?**
An indication for extra dimensions may be the extreme weakness of gravity compared with the other three fundamental forces (gravity is so weak that a small magnet can pick up a paper clip overwhelming Earth’s gravity).
From a mechanistic to a dynamic view of the universe

- The main character of the “physics beyond the Standard Model” is, indeed, that it is no longer possible to consider quantum systems as isolated systems, because of the presence of the irreducible fluctuations of the quantum vacuum (QV) in their background.

- In other terms, both fermions and gauge bosons, and not only the gauge bosons like it is in SM, have to be conceived as quanta of the relative force fields.

- In this way, the neutrino oscillations studied by Kajita and McDonald are as many phase transitions of the very same “neutrino field” → Nobel Prize 2015 in physics: SM cannot be the fundamental physics of matter!
**QFT as a «Thermal Field Theory»**

- This anti-mechanistic interpretation of all quantum particles as quanta of the relative force fields is the **core** of the quantum field theory (QFT) as irreducible to QM.

- I.e., as a **thermal field theory** based on the **III Principle of Thermodynamics**, interpreting the QV as an inner energy reservoir of all physical systems in (all) the universe(s).

- The notion of QV is the only possible explanation **at the fundamental microscopic level**, of the **III Principle** (“The entropy of a system approaches a constant value as the temperature approaches zero”).

- Indeed, the **Nobel Laureate Walter Nernst**, first discovered that for a given mole of matter (namely an ensemble of an Avogadro number of atoms or molecules), for temperatures close to the absolute 0, $T_0$, the **variation of entropy** $\Delta S$ would become infinite (by dividing by 0).
The notion of QV

▪ Nernst demonstrated that for avoiding this catastrophe we have to suppose that the molar heat capacity \( C \) is not constant at all, but vanishes, in the limit \( T \to 0 \), so to make \( \Delta S \) finite, as it has to be.

▪ → Near the absolute 0°C, there is a mismatch between the variation of the body content of energy, and the supply of energy from the outside. We can avoid such a paradox, only by supposing that such a mysterious inner supplier of energy is the vacuum. This implies:

1. The absolute 0°C is unreachable.
2. There is a unavoidable fluctuation of the constituents of matter, at every level of matter organization.
3. Ontologically, no physical body is isolated in the mechanical vacuum.
   ▪ “The vacuum becomes a bridge that connects all objects among them. No isolated body can exist, and the fundamental physical actor is no longer the atom, but the field, namely the atom space distributions variable with time. Atoms become the “quanta” of this matter field, in the same way as the photons are the quanta of the electromagnetic field” (Del Giudice).
From a discrete (particle-like) to a continuous (topological) view of quantum physics

- **Topological spaces** are spaces in which only continuous transformations (e.g., stretching, torsion, twisting, etc.) but **no ripping** are allowed, so that **only stepwise changes** of properties are possible that however **suddenly concern all the objects** defined on it.

- Intuitively, think for instance at the **curvature of a flatten space** changing simultaneously all the angles of the geometrical figures described on it, without the necessity of sending any signal among them → **quantum entanglement** in phase coherences and in phase transitions where **new collective behaviors emerge with new properties** (e.g., from Na + Cl → NaCl)

"We live in a dynamically continuous world"
Quantum systems and the infinitely many SSB’s in the QV

- In other terms, because each quantum system in QFT is immersed “from within” in the QV, connecting everything in the universe, each system corresponds to one of the indefinitely many “spontaneous symmetry breakdowns” (SSB’s) of the QV and of their “foliation” (system complexity: genus/species constitution if things) at the QV ground state (the temperature of the QV is >0°K)

- Each SSB “splits” locally the QV into a thermodynamic pair system-thermal bath, “freeing” by resonance some “bounded” energy from the QV (Goldstone Theorem).
The Nambu-Goldstone boson (NGB): quantum of «form» and not of «energy (matter)»

- Each SSB corresponds to a coherent mode of oscillation in phase – a sort of resonance phenomenon – of some of the force fields constituting the QV.

- It “breaks” the QV symmetry because, at the ground state, no phase-coherence exists, i.e., all the fields oscillate in whichever mode, and then where the entropy is maximal, and no free-energy is available as the II Principle requires.

- The quanta of these coherent modes, necessarily appearing in the equations, and experimentally observed and measured, are another type of bosons, the so-called Nambu-Goldstone bosons (NGB), the silent protagonists of all the last 15 Nobel Prizes in Physics.

- They are, however, a new type of bosons, because, despite they follow the same statistic distribution of the gauge bosons of the 3 fundamental quantum forces, nevertheless they are not quanta mediators of a new interaction force field.
The strange properties of NGB’s

- In other terms, NGB’s do not mediate any energy exchange, but they are quanta of the phase coherent modes of whichever force field, by which whichever matter (energy-mass) exchange might occur.

- Roughly, speaking, NGB’s are not quanta of “energy (matter)”, but quanta of “form”, and for this strange nature are defined “quasi-particles” in literature.

- Indeed, they vanish without residuals, and without violating the I Principle of Thermodynamics (energy balance), when the dynamic system they are “ordering” is destroyed.

- For instance, in a crystal, the NGB are named phonons, because coherent (periodic) modes of mechanical vibration of molecules, and they disappear, as soon as the crystal structure is destroyed, e.g., for a diamond at a temperature over 4000°C.
NGB’s in living matter

- In the organic matter and in water, in which only the biological molecules are active (this is the deep reason for which > 80% of our bodies is made of water, and the >90% of our molecules are of water), the complex structures of the biomolecules, and the ordered sequences of chemical reactions constituting each single biological function (fine tuning) are ultimately derived, at the fundamental level, by the NGB’s named here polarons.

- Indeed, what characterizes both these molecules, of water and organic, is a strong electrical dipole field. In such a way specific molecules can recognize each other even if distant and through a multitude of other oscillating molecules (Frölich, 1968) (Popp & Yan, 2002) → QFT phase coherence domains.

- In other terms, each phase coherence domain in thermal QFT include both the system and its thermal bath modeled as a dual equivalence between an algebra (system), and its coalgebra (thermal bath): q-HCoalg ⇔ q-HAlg
Therefore…

- “The living matter can be considered as a set of electric dipoles, whose rotational symmetry (=equivalence of all directions: quantum vacuum) has been broken» ( (Vitiello G., 2010), p. 16. For the algebraic formalism, see. (Celeghini, Rasetti, & Vitiello, 1992; Vitiello G., 1992; Del Giudice & Vitiello, 2006)
The quantum entanglement system-thermal bath in QFT and the principle of the doubling of their degrees of freedom (DDF) (=quantum mirroring system (algebra)/thermal bath (coalgebra)).

- QFT phase coherences include a system and its “thermal bath”. This is not simply the “environment” for an open system but the dynamic components of its environment with which it is entangled into one phase coherence domain, so that an energy exchange can occur only with these components (=DDF): the secret of brain mirroring with environment (deep learning).

Quantum entanglement of the visual field (visual consciousness) of humans vs. owls
Dynamic neural fields of intentional behavior

(Left). Schematic representation of human cortex (top) and limbic system (down). (Right: left). Evidence of the intentional behavior of olfactory bulb: the same olfactory stimulus induces a modulation in amplitude (top) when the cat is hungry, and no modulation when it is full; (Right: right). Dynamic attractors (closed curves: coherent states) in the overall unstable brain field dynamics related with intentional pattern recognition. Their occurrency is of the order of $\approx 10^{-1}$ sec.!
Brain entanglement in empathic relationships

- The hypothesis to be scientifically tested for which there exists however a lot of evidence is that significant parts of brain dynamics of two people in empathic relationship are dynamically entangled.

- This is the work hypothesis of a research project with the group of Dr. Tal Ben-Sousan of the Tel-Aviv University…
Conclusions
Metaphysics and Theology

A taxonomy of the different ontologies
The specific of Aquinas’ theology in the context of Christian theology

- Christian theology of the first millennium AD = Neoplatonic theology → the Divine Logos (Δογός) of the Gospel according to John, interpreted as the Mind of God in which all the Forms as Eternal Models of all changing physical things exist, like in their Exemplary Causes.

- In the Modern Age, after the demise of the Aristotelian ontology, just the persistency of such a «neo-platonic bias» in interpreting the Christian notion of creation is the ultimate source of all the misunderstandings with the evolutionary interpretation of life and, today, of the whole universe, because confusing systematically ontology and teleology that supposes a mind and hence cannot demonstrate its existence.

- Absolute originality of Aquinas’ theology as far as based on his metaphysics of participation of being, according to which the (platonic) exemplar causality consists in having in God not the fixed exemplars of all things, but the ultimate causal principle of all the forms that are therefore progressively «concreated» in the matter by the necessary concourse of the physical causes.
The notion of «being as act» participated by God to all things

- «The corporeal forms are caused not like if they would influxed by an immaterial form, but from a matter reduced by the potency to act by some physical agent composed on its turn (by matter and form)» (S. Th., I, 65, 4).

- → The core of Aquinas metaphysics as synthesis/overcoming of Plato’s and Aristotle’s ones, since its first juvenile book *De Ente et Essentia (On Being and Essence)*:

- Double composition potency-act (physical-metaphysical causality), of whichever individual things:
  1. Matter-form (=essence), according to the Aristotelian metaphysics of the physical causality;
  2. Essence-existence (=being), according to the Platonic metaphysics of the metaphysical causality, i.e., the participation (μετέχεια) «from outside the universe and before time» not of the forms, but of the «whole being», essence/existence and matter/form, of whichever thing composing the physical universe.
The Metaphysical-theological Issue of Creation

- In other terms, the pure potency of the *prote dynamis* is the first term of the creative act within which all the universe of natural beings exists in time through the concourse of the physical causes.

- The opening of Genesis reads indeed: (1) In the beginning God created heaven and earth. (2) Now the earth was a formless void, there was darkness over the deep, with a divine wind sweeping over the waters (*Gen* I).

- Therefore, they are completely missing the point those physicists, also eminent like S. Hawking (Hawking & Mlodinow, 2010), or like L. Krauss (Krauss, 2012), with the collaboration of a biologist, the everywhere present R. Dawkins with his afterward to Krauss’ book, when they pretend to explain the *creatio ex nihilo* using the infinite SSB’s of the QV.

- The QV is not “nothing”, just as the “próte dynamis” of Aristotle or the “formless void of wavy waters” of the Genesis are not “nothing”. Eventually, the Newtonian “mechanical vacuum” has some resemblance with the metaphysical “nothing”. But the mechanical vacuum is only a mathematical abstraction. Does not exist in reality!

- It is not polite, in such a case, to play with the ignorance of the people, by confusing QV that *exists*, and mechanical vacuum that is only a mathematical abstraction for justifying calculus (stopping at second derivative in order to grant integrability of the equations of mechanics).
The notion of creation as participation of the act of being and of a natural form as a boundary ("outdoor sill") between the "in" and the "out" of a dynamic material substrate
Spirituality

Without contradicting science
Conclusion

- The “lacking ring” of animal and human conscious agency is the QFT notion of information as negentropy where the free-energy that we have to add to a system at thermal equilibrium is energy + order given that an energy exchange in QFT dissipative systems supposes a force field phase coherence.

- The proper of human self-consciousness disclosing us the marvelous realm of the interior life, i.e., of the abstract thinking, of the gratuitous love, and finally of the aesthetic and mystical experiences supposes that besides the horizontal information exchanges with our fellow creatures like the superior animals, we have a vertical information exchange (= spirit) with the Absolute, giving an absolute value to each human person and making all human persons subjects with the same rights (“spirit” as the “kiss of life” with God of Gen. 2).

- Humans as “horizon line” between the material and the spiritual worlds (Aquinas)
The “anthropic sphere” with one only shared center – the relation with the Absolute – in the deep of our hearts all entangled with one another

- “Nobody of our brothers – even though he wanted it – is able to defy us. In the coldest niggard, in the center of the prostitute and of dirtiest drunkard, there is an immortal soul piously committed to breath, and that, excluded from light, practices the nocturnal adoration. (...) There are many souls, but there is no one with whom I am not in communion by the sacred part in her saying: *Pater Noster*” (Paul Claudel)

Biblical image (Gn 2) of spirit as «vital breath» of the kiss of life by God giving all of us life singularly