ESTRATTO

Proceedings

THE ROLE OF QUANTUM ELECTRO DYNAMICA (QED) IN MEDICINE

Institute of Pharmacology, University of Rome "La Sapienza"
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edited by
Vincenzo I. Valenzi, Baldassare Messina

The meeting was organized by "Centro Studi di Biometeorologia"

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G. Preparata, dimenticato dopo una vita per la salute pubblica.

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CENTRO STUDI DI BIOMETEOROLOGIA Onlus

Proceedings

Meeting 14/12/1999

Institute of Pharmacology University of Rome "La Sapienza"

The role of QED (Quantum Electro Dynamics) in medicine

QED & Medicine	**Giuliano Preparata**
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Editors: ***Vincenzo I. Valenzi, Baldassare Messina.***

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QED & MEDICINE

di Giuliano Preparata
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What follows is the result of a few years of reflections on the impact on Biology and Medicine of some recent developments in our physical understanding of condensed matter. The new rather different picture of matter that emerges from the application of the most advanced methods of Quantum ElectroDynamics (QED) is likely to change in a drastic way our views of condensed matter, both inanimate and living, and to have profound consequences on the relationships between Physics and the Life Sciences, and on the development of a new approach to the latter ones.

1. The paradigm of Molecular Biology : the *mechanization* of Medicine

The Medicine of this end of Century (the institutionalized one of the Faculties of Medicine and of the public Health Systems) is the result and consequence, I believe, of the scientific (and philosophical) developments that have dominated the XX Century. Even though in the last hundred years many things have happened of truly revolutionary character, only one great revolution has dominated the science and the picture of the world that follows from it, let us call it the *atomistic revolution*.

Destroyed at the beginning of the Century by the experiments of Ernest Rutherford, the thermodynamical paradigm, which claimed for the physical systems a global, holistic character described by the collective physical variables of thermodynamics, such as temperature, pressure, density etc., there emerged in its place the *atomistic* one that, resurrecting from the depths of the past the ideas of Democritos and Epicurus, gave body to a picture of matter infinitely fragmented in a myriad of tiny components, atoms and molecules, *glued* together in the condensed state, liquid or solid, by forces of electrostatic nature, which due to the electrical neutrality of matter have a very small range, comparable to the size of the components, the Å ngstrom, one hundred millionth of a cm. Such a huge **Electrostatic Meccano** by which today's science pretends to build any piece of matter, from the simplest (?), a glass of water, to the endless sophistication of the human genome, permeates in a profound and apparently irreversible way today's view of matter, whose properties but reflect those of the elementary components. And given the essential simplicity of such atomic-molecular components and of their interactions that are capable to tie them only in pairs (or at most in triplets), the conviction that pervades the scientific community is that *all* problems of condensed matter, including the living one, can be solved through the computational tools that the computer technology of a hopefully not too distant future shall be able to provide.

The consequence of such a view of the world that contemplates, as claimed in a recent rather popular book[1], the essential end of science, is that also Biology , Medicine

[1]Paul Horgan, The end of Science, 1995

and all that pertains to life can be analyzed in terms of the electrostatic interactions among the atomic-molecular components. Molecular Biology (MB) is today in a dominant position through its paradigms that are completely rooted in the *atomistic* paradigm of contemporary Physics. I believe that the consequences of this positivistic and mechanistic view of Medicine have been truly devastating : the medical doctor, key figure for the realization of man's aspiration to live a healthy and harmonious life and to die a tranquil and serene death, has been largely substituted both in the diagnosis and in the therapy by more or less *intelligent* machines and by more and more sophisticated drugs, aggressively promoted by multinationals with breathtaking budgets.

The problem of health, that since antiquity sees the physician (in his various forms of shaman, wizard, surgeon, healer, philosopher etc.) in his central role of dispenser of medical arts and knowledges and of counsel and *analyst* of the sick, sees him today in the role of an executor of protocols more or less rigid, of an essentially *global* character. The *mechanization* of Medicine has turned him into a sort of a robot, deprived of his humanity, alien toward the desperate demand of the sick not only of a cure but also of a spiritual help to get out of the emotional situation that, probably, unchained his sickness. I am convinced that a similar state of affairs, so desperately unsatisfactory, can only be reversed with a radical change of paradigm , that does away for ever with the *atomistic* view which today shapes not only science but also society, so centered on the *individual* and the satisfaction of his personal needs, with no consideration of the *coherence* among individuals and of a social system that transcends the individual in a collective organization, whose needs and structures go far beyond those, often petty, of the essentially isolated individual-consumer.

To be more specific, the first more tenacious obstacle to the progress and the *humanization* of Medicine is, I believe, today's paradigm of MB, deeply rooted on the view of the world that springs out of the *atomistic revolution*. The conviction, that permeates MB, that the dynamic drama of condensed matter, both living and inanimate, has its origin in <u>local</u> electrostatic interactions leads to the equation:

FORM = FUNCTION ,

according to which each mechanism of biological interaction is so highly selective due to the mutual recognition that the molecular participants owe to well defined spatial configurations, as depicted by the well-known metaphor of the *key and the keyhole* . The expression of the genetic code in the production of aminoacids and then of proteins is all based on such mechanisms, like all other biochemical events of the cell. Such molecular traffic in which *Chance* and *Necessity* play alternate roles (as with great effectiveness Jacques Monod has argued) is the subject of the great research program of modern MB, which focuses its remarkable efforts upon a detailed analysis, no doubt important and most useful, of the most diverse chains of reactions and of the effects that particular drugs (molecules) exert upon their evolution.

However to a deeper analysis this view, and the expectations based upon it, show very wide gaps and inconsistencies. First of all the idea of the *key and the keyhole* is really untenable. While the *Necessity* in the interaction *key-keyhole*, receptor-ligand, doesn't present any conceptual difficulty, it is in the *Chance* that there lingers an unsustainable

pitfall. Indeed, when we deal with millions if not billions of different keys and keyholes how can it happen that a diffusive dynamics, totally random, of the molecular components can in reasonable times bring that key (among millions of others) in contact with that keyhole (among millions of others) ? It is a legitimate and fundamental question to which Monod gives no answer, nor anybody after him seems to have been compelled to give a more or less plausible estimate of the necessary times, and compare them with the incredible swiftness and synchronism of the molecular happenings of the cell. But the difficulty remains : the times involved in a diffusive dynamics can't be but very long not only for the extreme slowness of the *Brownian motion* of large molecules within the cell (for a typical diffusion constant of $10^{-10}\,\mathrm{cm}^2/\mathrm{sec}$ it takes about 10 seconds for a molecule to cross a medium sized cell) but also for the large probability of error that a molecule has in recognizing another. The experimental evidence is totally contrary to such key point of the paradigm of MB.

Another point that is strongly adverse to the MB paradigm is WATER. This most simple and light molecule, which however makes up 70% of the weight of our body (and 99% of the number of our molecules!) has practically no function in the biochemical dynamics of the cell and of the cell tissues. And yet in absence of water proteins do not fold correctly, ions, so important for the energetic of the cell, do not form, etc. etc. . It is thus clear that something very important is missing, but what ? On this the paradigm is totally silent.

I am convinced that anybody who is concerned about science, about the progress of this noble and creative human activity, should demand from the scientific community a serious reflection about these and other extremely grave gaps of the paradigm. Not only, but they should also pay attention to any attempt that, based on reasonable assumptions, might overcome such fundamental difficulties. In the following I shall try and argue that such an attempt concretely exists and is based on a theory of condensed matter that follows from the application of the developments of QED in the last fifteen years to the analysis of atomic-molecular systems at the densities of ordinary matter.

2. From *atomism* to a collective description of matter : QED coherence in matter

Going beyond the *atomistic* view that underlies the MB paradigm requires the utilization of the most recent theoretical developments Quantum Field Theory (QFT), the most advanced tool of modern theoretical physics. QFT brings to its achievement a conceptual revolution, sparked by the discoveries of Max Planck at the beginning of '900, whose potential has remained largely unexpressed due to the development in the middle of the '20's of Quantum Mechanics (QM), a theoretical realization plagued by a series of paradoxes and antinomies related to the notion of *wave-particle* on which it is founded, that focuses the attention upon the *particle* aspect of quantum physics. Led back to the main stream of the dominating *atomistic revolution,* the *quantum revolution*, obscured, and in a sense paralyzed by the contradictions of QM, has lost its progressive potential to provide us with a new view of condensed matter, at variance with the classical one, based upon the aggregation of elementary objects, atoms and molecules. Modern TQC, that

overcomes in a natural way the contradictions of QM, at the same time frees the revolutionary potential of quantum physics giving us a vision of condensed matter in which the elementary systems, atoms and molecules, lose the individuality they have in the *atomistic* view, to give rise to collective systems whose wave nature becomes prevalent.

This fundamental aspect emerges from the discovery of new solutions of the QFT that governs the dynamics of ordinary matter, Quantum ElectroDynamyics (QED). As Hepp and Lieb have shown at the beginning of the '70's for a particular physical system (the LASER model of Dicke) and the writer in general fifteen years later (and totally independently), any system of identical atoms and molecules above a given density and below a given temperature (depending on the particular system) goes over to a state that is totally different from what is predicted by today's condensed matter theory. Its nature is akin to the state of the atoms of a LASER oscillating in phase and in tune with an electromagnetic field that resonates at their frequency, thus generating a radiation that is coherent both spatially and temporally. The fundamental difference is that in the LASER such state is reached with particular tricks: first one needs an energy source – the *pump* – to excite a number of atoms, give rise to and sustain the atomic oscillations; second one must confine the system in a box whose walls are finely adjusted mirrors – the *optical cavity* – so as to confine the electromagnetic field resonating with the atoms. A highly contrived set of procedures, without which the LASER can in no way work. On the contrary the coherent state predicted by the QED analysis emerges spontaneously provided two collective, thermodynamical variables are in the appropriate range. And in ordinary condensed matter this normally happens.

The remarkable order that characterizes these systems is thus reached without any sophisticated external action but emerges every time density and temperature are right. An extraordinary mechanism that creates order locally, i.e. lowers the entropy of the atomic-molecular system provided the prevailing thermodynamical conditions are appropriate. It is not difficult to recognize in all this the crucial characters of the mechanisms of life, where a complex network of reactions and interactions works with an energy expenditure and an external interference that are negligible. But there is more. The atomic-molecular system that above the critical temperature has the chaotic features of a gas (where the discontinuous particle aspect of modern condensed matter, together with its intuitive plausibility is completely reestablished), in the coherent state acquires the typical characters of a macroscopic wave, described by an amplitude and a phase, varying with continuity in space and time. A physical system of this kind behaves in a manner completely different from a more or less chaotic ensemble of a large number N (typically 10^{23}) of atoms-little balls : the matter oscillations in phase with those of a particular mode of the electromagnetic field produce effects, like in a LASER, that under certain conditions are proportional to N^2 and not to N, in a network of interactions where what happens at a point involves the behavior of matter in a macroscopic spatial region and not only the few atoms that surround that point, like it is assumed in the Generally Accepted Condensed Matter Physics (GACMP). What emerges from the new coherent solutions of QED is a completely new world, implausible, totally removed from the common intuition built upon three centuries of galileo-newtonian science and essentially agreed upon by the normal condensed matter scientist of today : a world where the little balls-atoms become true matter waves, capable to interact collectively and

not locally, sensitive to time-dependent electromagnetic perturbations with which they resonate when certain frequencies happen to belong to their spectrum. A new scenario thus opens, totally unknown to the normal condensed matter physicist, where a new dimension, the electromagnetic one, gets unveiled and with it a hoard of new mechanisms of interaction and order for matter systems, living and inanimate. In particular the oscillation phase of the new coherent states introduces a fascinating new element, capable to suffer modulations of high physical relevance through totally negligible energy exchanges : we are here in the domain of *subtle energies* that are so popular in the *alternative* communities.

To get back to the research program realized since the discovery of QED coherent states in 1986, we have finally understood the *why* of phenomena known since a long time such as cold Superconductivity and Magnetism, whose explanations within GACMP does not really exist, not to mention the Superfluidity of ^4He and ^3He and the more recent hot Superconductivity. A large effort has been made in the study of water, which has turned out to be completely different from what is predicted by the problematic computer simulations of GACMP : it is organized in *Coherence Domains* (of the dimension of one tenth of a micron) in which the structure of molecules is completely different from the gas phase. This solves a large number of puzzles that finally receive a simple and natural explanation : the high specific heat, the maximum density at 4°C, the large dielectric constant, strange and unexpected magnetic properties, the peculiarities of ice and of the glassy states. The list could continue, but for the purpose of this Lecture I believe this is enough : it behooves upon me to emphasize that Coherent QED (CQED) with its metamorphosis of atoms into matter waves takes finally back to the realm of scientific rationality a large class of phenomena, known since a long time, whose explanation from first principles had until now revealed itself impossible.

A last consideration on the *discredited* Cold Fusion, whose *excommunication* originates first from economy (the global energy policy) but has a powerful support in the attitude of the scientific community that, based on the GACMP can but recognize its *impossibility*, thus ignoring its incontrovertible experimental reality which, since the discovery of Fleischmann and Pons in 1989 has found several confirmations. As I have shown (together with E. Del Giudice and T. Bressani) soon after the announcement of its discovery, those phenomena in the new theory of QED coherence are totally reasonable, thus prompting us to develop ideas and projects that promise within a reasonable time (with the recent openings toward these researches by ENEA, the Italian agency for energy research) a radical solution of the energy problem, that is creating so many miseries and inequalities in this world at the end of the millennium.

3. **A bridge between QED and Medicine**

It is now high time to address the problem of how the *paradigm shift* in condensed matter physics, implied by CQED will finally bear upon Medicine and in general upon our understanding of life, from the elementary cell mechanisms to the great problems of brain and consciousness.

We must be immediately aware that the solution of these problems will require a close collaboration between the new physicists and the new biologists-physicians in the construction of a bridge between physics and biology and medicine, whose arches start on one side from the general laws of the coherent physics and on the other end with a varied panorama of experiences and conceptions (that have been marginalized by the academic world), which by incorporating ancient wisdoms point towards a global, holistic view of life. And this construction shall be successful if and only if during the works the two groups will be able to communicate their experiences and their results in a continuous dialogue aimed at avoiding that the two sides of the construction finally diverge. I shall thus end this presentation by briefly describing what the new physics has been able to build of the first section of the bridge towards Medicine.

This section will concentrate on three arches:

(i) the new physics of water;
(ii) a possible origin of coherence in cell tissues;
(iii) the interaction of very weak, low frequency magnetic fields with the ions' systems of the cell.

The consolidation and the finishing of these arches will require, like I said, a deep exchange with biologists and physicians.

(i) The new physics of water

In the first section I have already noticed that one of the most blatant pitfalls of the dominating paradigm is the absence and the misunderstanding of the role of water in the complex molecular interactions. And, considered the ubiquity of water in biological systems, this appears as a truly devastating defect.

In CQED water is no more the simple system, whose short range interactions, though extremely (and inexplicably) complex however do not succeed in promoting it to the role of protagonist of the drama of life. Indeed through the CQED interaction we have been able to prove [2] that water organizes itself in *Coherence Domains* (CD) of the size of a tenth of a micron (10^{-5} cm) in which a few million molecules oscillate in phase with the coherent electromagnetic field. Such CD's, like islands in a sea, are surrounded by interstices (whose size increases with temperature) of incoherent liquid, a sort of high density gas of molecules kept together by short range forces similar (but for the simplicity of the interactions) to what lies at the base of the current models of water. Such two fluid forms of water, whose experimental evidence is really impressive (as impressive as the total misapprehension of it by the standard view) have completely different, and I daresay complementary roles and features.

In the coherent part, that is highly structured in tetrahedral shapes that simulate the so called *Hydrogen bond* there form magnetic structures capable in principle to interact with weak electromagnetic signals, and store the information they carry. In this interesting consequence of CQED, whose evidence is in some strange magnetic properties that are known since long (like the *decalcarization* of water subject to appropriate magnetic fields) and are totally incomprehensible within the paradigm, there

[2] R.Arani, I. Bono, E. Del Giudice, G.Preparata, *Int. J. of Mod. Phys. B,* **9** (1995) 1813.

lies, we believe, the theoretical bases to understand Homeopathy, and the clinical trials mentioned in this Seminar, from general physical principles.

In the incoherent part, which endows water with a remarkable (and necessary for the mechanisms of life) *plasticity*, there linger the ions' systems, whose coherent aspects have been treated in a recent work in collaboration with E. Del Giudice and M. Fleischmann [3]. The important role of ions' systems in the energetic of the cell is universally recognized, this new property of water sheds finally light on their formation and dynamics.

Naturally CQED is capable of accounting for all the peculiar physical properties I have mentioned above , but this most interesting chapter of physics is outside the purposes of this Lecture and the interested reader is referred to the available literature.

(ii) A possible origin of the coherence of cell tissues

A couple of years ago there appeared in the scientific journal *Nature* a strange article with the title *Like charge attraction in metastable colloidal crystallites* [4] in which the two American physicists reported the results of a series of experiments on small plastic balls, half a micron in diameter, immersed in water and endowed with a negative surface charge through an electrolytic process. Such systems had been studied since long as good models of ordered structures kept together by appropriate confining mechanisms and Coulomb repulsion among the charged balls. By varying a few parameters of the system the two scientists observed that, once lifted the confining device, such structures instead of immediately dissolving due to Coulomb repulsion remained stable for a few hours before being destroyed by thermal fluctuations. Hence the provocative title of the paper, that suggested the *impossible*, i.e. that like charges may attract instead of repelling each other, as well known since the famous experiments of Colonel Coulomb at the end of the XVIII century. What does it mean ?

Naturally within GACMP there exists no explanation (strangely enough this does not seem to worry any of the followers of the paradigm: oh unswerving power of the paradigm ! and of tranquil life !) : two like charges can't but repel. In CQED things are drastically different, as E. Del Giudice and I have shown in an article with the title : *Electrodynamical like charge attractions in metastable colloidal crystallites*[5]. In fact the plasma oscillations of the surface electrons through the interaction with the resonant mode of the quantized electromagnetic field exert collective attractive forces upon each other capable of overcoming the Coulomb repulsion and of generating the observed attraction, also quantitatively.

But this success of CQED, besides giving a corroboration of its validity, we believe has important consequences upon MB and Medicine. Let's see why. It is clear that this system, as far as the intercellular interactions are concerned, is a good model for a tissue : the balls' dimensions are comparable with those of a medium sized cell, while the negative charge is what accounts for the negative membrane potential. Thus the existence of ordered tissues depends on attractive interactions whose mechanism is, probably, that of the little balls. The consequent energy gain tends to exclude any *foreign*

[3] E. Del Giudice, M. Fleischmann and G. Preparata, QED coherence and electrolyte solutions, (1999) , in press.
[4] A. Larsen and D. Grier, Nature, **385**, 230 (1997).
[5] E. Del Giudice and G. Preparata, Mod. Phys. Lett. **21** (1998), 881.

little ball, whose electronic oscillation has a frequency different from that of the cells of the tissue, provided it is larger than the energy gain that the intruder cell can realize by interacting with its neighbors. Now, if for some reason the electronic coherence of the tissue (related to the level of the membrane potential) decreases below the level where the energy gain of the intruder cell is advantageous, here comes the tumor : the intruder cells begin to proliferate interfering with the proper functioning of the tissue. It seems to me that this arch of the bridge may be of great help for those who on the other side face day after day this terrible modern plague.

(iii) <u>The interaction of extremely weak magnetic fields with the ions' systems of the cell.</u>

It belongs to common wisdom (?) that the only interaction between electromagnetic fields and living matter involves the mere exchange of energy, so that its effects become perceptible and dangerous only when the temperature of the affected body rises above its normal value. This is essentially what happens in a microwave oven. When the relevant electromagnetic fields are instead much below such threshold, it is believed, these interactions are totally innocuous, *pace* of the prophets of doom who in the panoply of emitters of very weak electromagnetic fields, from high voltage power lines , to cellular phones, to the large radars of the military see sources of apocalyptic disasters.

Naturally all this is completely reasonable in the GACMP framework, where there is no room for coherent behaviors of the atomic-molecular constituents of the cell. But in CQED, once again the situation changes drastically as I have shown in a recent paper in collaboration with E. Del Giudice and G. Talpo [6] . As G. Talpo will concentrate its contribution on this subject I will not describe this work and limit myself to emphasize its potential to understand subtle aspects of the energetic of the cell related to its ionic *traffic*.

I believe it is time to conclude, also because in going on I could enter a territory largely unfamiliar. All things considered it seems to me we have reached a stage of the development of both Physics and Medicine in which the paradigms that have so far dominated begin to show deep inconsistencies. On the other hand, there is in both disciplines a small but highly motivated group of people who not only have understood the weaknesses of the paradigms, but have interesting and relevant ideas of how they can be overcome. It is also highly exciting that the concept of *coherent interaction* appears to be the basis for a strong unification of the ideas and of a powerful impulse to build the bridge between what is the most quantitative and precise of the scientific disciplines and the one that, due to the paradigm of MB, has become the most rigid and dogmatic sector of scientific research. I have great confidence that we will succeed and that this bridge will be completed sooner than we can expect today.

[6] E. Del Giudice, G.Preparata and G. Talpo, *On the" 'unreasonable" effects of ELF magnetic fields upon a system of ions,* (1999) to be published.

Past and future in medicine

Prof. Baldassare Messina
(Director of the Bio-meteorological Centre and President of Italian Medical Association of Hydro-climatology, Talassology and Physical Therapy).

Riassunto

La storia della medicina ci insegna che gli scienziati di ogni tempo hanno affrontato l'eterno conflitto tra ciò che è noto ed accettato come "legge", e nuove idee che tentavano di osservare ed interpretare i fenomeni fisiopatologici e le possibili cure. Un problema analogo sembra porsi oggi con il predominio della chimica e della fisica classica nell'interpretazione della materia vivente, con i nuovi "sacerdoti", che vigilano sull'ortodossia scientifica di quanto si agita nel mondo della ricerca. Certo, il rigore metodologico è essenziale quando si fa scienza , ma anche il coraggio di procedere su nuove frontiere dove le "certezze" e le "Leggi" inevitabilmente entrano in crisi.

It is not a casual choice to hold this seminar in the Medical and Pharmacological Institute of Medicine and Surgery of the University of Rome "La Sapienza": it gives experts of various sectors and human knowledge the chance to meet at the beginning of 2000 and to bring up many questions.
I refer, as everybody does in this last period, to the beginning of the second millennium. Nowadays, 2000 is an abusively used term, since it is not anymore a concept or a temporal term, but expression of several innovations in different sections; from human activities already existent or to realize, to a new thought, from scientific research to social organisations. Not realizing them means being excluded from progress of history and from remaining in memory or to overcome traditions.

This is valid also for our Centre. The fact that we are here means that we have followed with attention the development of human thoughts and scientific researches: let's just consider the numerous relations among different universes like Italian and foreign ones.
We left it to others to follow those that bring nowhere and to admire puffed up persons that sooner or later deflates.
For all active members of the human society professions and roles are the result of technologies development and a way of thinking, of facing problems and evaluating results.
To reach this the interaction among sectors, different to those we belong to, is unavoidable.
Phenomenon which are apparently far, are often interconnected. These interconnections are not always evident, and rarely contemporary.
In medicine it is possible to use new and recent techniques of highest levels and to prescribe drugs and a new understanding.

To comprehend the influence that we might define external to human organism, and living nature, it is necessary to analyse quality (how) and quantity (dimension of action) of internal and external physical and chemical forces, (i.e. the meteorological aspects) and the mathematical principles that govern them.

- The influence on molecular groups, organs and tissues and how they are elaborated and transmitted to other molecules, organs.
- The influence of the entire organism.
- The modern modality of evaluation and quantity of those influence and effects.

Many of these studies, and their current meaning used in past, as their effects on social conventions, were always part of medicine and history.

A brief synthesis of medical history, starts in the Roman culture, with the "teurgical" medicine and

their relative deism and temples (Apollo the medical knowledge, Anzina etc) This believe was followed by an unmoral concept, which considered therapeutically techniques as cleaning effects, like exclusion of bad humours. This explains the frequent use of cloisters, and excessive blood taking.

Paracelso introduced the jatro-chemistry, or the importance of chemical composition in body and its therapeutic value. Just in a second moment the interest was oriented more and more towards what we consider nowadays the physic. This statement does not mean that medical mentality changed immediately, but at least the clinical one.
Hypocrite's new mentality, that replaced Esculapio's ones, son of Arsinone and Apollo, who was identified by the ancient Greek with Imhotel a prestigious architect and Egyptian doctor of the third millennium a. C. and then Galeno, who had to wait for Galileo, for approximately two thousand years, until the introduction of experimental methods.

For long time, on the basis of the Aristotelian logic, and later following Galileo's and Newton's mechanical-cosmological example and various experimental demonstrations specifically mechanic and classic, were accepted all aspects of nature and human knowledge, inclusive art, policy and justice. According to Cartesio they corresponded to precise laws, able to define relation of cause-effect for any situations, that could be exactly foreseen. The success of mechanic encouraged and supported this idea.
Towards the end of the last century, throughout Poincare's (1885) important observations, Galileo's and Newton's model of classic mechanic, ran towards crisis, since it was not anymore able to explain new knowledge. Beginning from then, they needed to be revised and integrated.
Above all from thermodynamic, considering Prigogine "La nascita del tempo" Ed Bompiani 1988, and also other philosophical movements gave birth and developed the quantum mechanic and the interest of not determination (W. Heisenberg), of probabilism and recently the physic and complexity.
Referring to these ideas the theory of deterministically chaos, casual behaviours, was formed. These ideas are considered new borders of tidiness and the most interesting and the most involving scientific and cultural innovations of the last century.
Unforeseen results of a system without any causality, were defined as deterministically chaos. The chaos is not the consequence of stochastic processes, which are aleatory and unforeseen but reveals a tidy world. Complicated systems are able to fit in any situation and have the feature of self-organisation (consider the human course and within its limits the human being).

Not everybody agrees with the opinion above, i.e. Israel does not say expressively that it is an imposition, but he considers revolution of chaos a weak expression of thought. The refuse of Marcuse, Feyerabend, Vattimo. The science as an ideal, said also anti-science.
Anyway, there is an enormous development of new ideas, either internal or external to medicine, that tend to influence medicine more and more.
I know very well that following new ideas is not easy and to sustain that thinking is more important than experimenting could be an offence.

However the Bio-meteorological Centre wanted this seminar, because spreading new know-how, technologies and evaluations of results is important as long as its precise quantum knowledge, in order to give science new and modern responses of their existence and influence on physiological and pathological processes, on human nature and to suggest new precaution therapies and cures for human beings and the environment where they live.

Effects of magnetic fields on living matter

By Getullio Talpo (Centro Studi di Biometeorologia Roma)

Riassunto

I campi elettromagnetici (e.m.) esercitano la loro azione sui sistemi biologici, producendo effetti termici e non termici. A proposito degli efetti non termici il recente contributo di Zhadin, sull'effetto di deboli campi e m.. su una soluzione di acido glutammico sottoposta ad un campo magnetico statico simile a quello terrestre ed ad un campo variabile, ha messo in luce che alla frequenza di risonanza del ciclotrone degli ioni si hanno picchi di correnti nella soluzione. Queste osservazioni "irragionevoli" possono essere comprese nell'ambito della QED.

Biomedical researchers trying to probe the effects of magnetic fields on living organisms are facing a major problem still unsolved. By irradiating living organism with low intensity electromagnetic (e.m.) fields, sometimes so tiny as a few microteslas, one produces significant biological and clinical outcomes, usually beneficial to the organism. However, such effects decrease or disappear altogether the e.m. fields are further increased, unfavorable physiological and clinical results are produced, whereas cell cultures exhibit genetic or functional mutations. Why is it so?

There is actually a simple explanation only for the last phenomenon: when an organism absorbs e.m. waves the irradiated tissues are heated and when the temperature rises more then 0'1 degrees, biological components undergo chemical damage. This occurs when the magnetic field intensity exceeds the threshold of about ten volts per meters.

Contrary to the widespread tendency of researchers to focus on the field intensity as the main controlling factor of the biological and physiological changes, there is an experimental and theoretical tradition, originated mainly in eastern Europe, which has singled out as the most interesting field of research the phenomenon of the "cyclotron frequency" of the ions nearby the cell membranes. Cyclotron Resonance- which is referred to also a IPR o Larmor motion-is a well-known phenomenon in Classical Physics. It occurs when an e.m. radiation having a sharply defined frequency is absorbed by the outermost electron of atoms belonging to a non metallic solid submitted to a static magnetic field B, parallel to the variable magnetic field. In such condition the ion is forced to rotate as a spindle around the direction of the static field; the radius of rotation and the speed are proportional to the intensity of the applied alternating magnetic field.

Since ions moving across the liquid or the solid collide with the lattice in order to have a cyclotronic precession should be able to complete a sizeable portion of the orbit in a time shorter than the time interval between two collision of the ion against the surrounding molecules.

The lattice molecules do not stand still, since they perform random movements, the so-called Brownian motions, whose amplitude increase with temperature. Thus the cyclotronic precession of charge carriers is possible at an alternating magnetic field intensity decreasing with temperature, actually when temperature is raised the surrounding molecules span a larger region at the higher speed, so they fill a larger volume in the unit of time.

Many experiments have shown that ions in cell membranes start precession motion when at physiological body temperatures and within the Earth magnetic field extremely are applied, whose frequency be a cyclotronic frequency appropriate to exiting static magnetic fields and the ions species.

Such experiments have elicited many doubts and reservations, and then they seem to violate the well know laws of thermodynamics. As a matter of fact, Maxwell equations predict that in given experimental conditions the e.m. force has a strength at least ten millions of times smaller than the force originating from the thermal motions of matter molecules, whose intensity is proportional to T (K is the Boltzamann's constant and T is the temperature).

The solve this puzzle, it has been proposed that the well known hydrophobic nature of the lipid double layer, which is the backbone of the cell membrane, would create a vacuum in the ions channels traversing the membrane, so that ions could perform their precession unhindered by any collision. However, a very clear experiment reported by a group led by Zhadin has shown that in the above physical conditions and for the above values, of temperature and magnetic fields cyclotronic motions appear in a non biological system, an aqueous solutions of glutamic acid. So the above proposal is disproved and a paradox, the "kt paradox", waits for an explanation.

Giuliano preparata, in his presentation at this meeting, has provided a complete explanation for this paradox and all related phenomena; so I have been left with the only task of telling you why, since I was struggling with the phenomena I had delved in to my prevision studies (to which I will come soon), my encounter with Emilio Del Giudice, has been a very lucky opportunity for me.

In my experiments I have measured by an impedence-meter the intensity loss (resistance) and the phase variation (reactance) of an electric current going through a living organism, these data, through a mathematical treatment supplemented by the referral to general available information on the body functioning, provides useful information on the electrolytes dissolved into it. I have developed an analytical model for processing the experimental data.

My still unpublished experiments have shown that in living organisms resistence and reactance change in a significant way when low intensity fields, whose frequency is the cyclotronic frequency at the value the Earth magnetic fields of the ions species present in the organism, are applied. This change is the consequence of the ion change of the concentration of ionic species near the cell membrane. Finally the observation has revealed that the changes of ion concentration are related to physiological and clinical reactions (local variations of temperature, of the peripherical blood circulation and so on), which appear highly significant both for their amplitude and their functioning.

I was stunned by these observations since I know some physics; just for this reason my encounter with Giuliano and Emilio has been highly productive. Actually they have shown, together with the famous electrochemist Martin Fleischmann, that ions in an aqueous solution form a totally coherent system, also at room temperature.

The final solution of the puzzling mystery of the "unreasonable" behaviour of magnetic field, at the cyclotron frequency was thus and hand. It was possible to understand why effect, as probed by clinical consequences, decreased at increasing field intensity.

Actually Giuliano and Emilio, with my cooperation, have proved in a theoretical paper to be published that ions dissolved in the boundary layer separating the membrane and the coherence domains of water have an effective temperature which is zero since they are in a coherent state and they move in a medium- the boundary layer of the water coherence domains whose size is about 80 Angostrom- where the frictional losses are vanishing. So ions when confined in this space are able to move in a frictionless way as a skater on ice and then the "kt paradoxe" fades away.

When the radius of the ions precession increases under a larger field intensity, ions invade a region where there is friction- this is the space filled by the non coherent fraction of water-, so the effect disappears.

This discovery is of paramount importance for biology and medicine, since sheds light on the influence of the magnetic field on the kinetics of ions and of the organic polar structures across The cell membranes or, in other words, on they role in on the onset and preservation of homeostasis and so-called Circadian-Rythms. In fact living organisms are immersed in the Earth's static magnetic fields (ELF), which vary during the day and the different season and have intensities and frequencies included in the right window to produce cyclotron movements of ion across the membranes.

A peculiar source of alternating magnetic fields is provided by the "Schuman modes", well known to geophysicists, that are present in the space enclosed by the ionosphere. Furthermore, the influence of the solar winds on the magnetosphere produce additional alternating magnetic fields whose frequencies and intensities vary during the day, the season and the Moon phases; frequency and intensity of such fields are also included in the range of values explored in many laboratory experiments.

I wish to stress that both phenomena reported above occur at the cyclotron frequencies for many ions and organic polar structure present in liquid matter, so that they might be regarded as fundamental for determing the physiological equilibrium.

Finally, to complete the whole picture, we should keep in mind that our nervous system, as shown by the experiences of magnetoencephalography, is able to produce magnetic fields, which seem unlikely to be a mere "background" noise" of the bioelectric activity, but could posses a specific organic function.

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Coherent mechanisms in electromagnetic radiation physical interaction models on biological systems.

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Riassunto

La presenza di meccanismi coerenti alla base di molti fenomeni biologici appare ineludibile malgrado ciò entri spesso in contraddizione con i principi della termodinamica classica. Infatti sembra difficile ipotizzare un mondo biologico che origini tutto dal caso, senza la presenza di meccanismi di autorganizzazione che operino a vari livelli (molecolare, cellulare e dell'intero sistema biologico). E' quindi saggio esercitare una grande prudenza e intensificare studi teorici e sperimentali che approfondiscano la nostra conoscenza della materia vivente.

I'm sorry for the long title, perhaps, hiding doubts and ignorance, despite the genuine aim to understand.

When almost twenty years ago I started to be involved on the problem of electromagnetic interaction on living systems, never I would thought to threat fundamental problems like that discussed in this meeting. I will tray to face the problem directly starting by the fact that in the electromagnetic interaction, at low frequencies, is very hard, on foundation of classical electrodynamics and of thermodynamics principles, to hypnotize effects that, in last analysis, lessen to a transfer of heath, more or les selective, to tissues. These theoretical forecast is strongly founded, mostly in the case of homogeneous media when the conditions are not far from the equilibrium. These results have been placed into discussion by a series of experiments showing the presence of non-forecast effects. Obviously these experiments are not able to follow the chain of events in a manner to join the effect directly to the primary electromagnetic interaction. This difficulty is not truly due to this kind of research but is common to the biophysical research, which is not so developed to allow a reconstruction of trajectories the comes from the primary events (so called signals by the biologists) to the occurrence of significant biological phenomena. I think will be necessary many years before to overcome this problem.

We come now to the problem of electromagnetic interaction on biological molecules, cells and tissues. It is necessary to find models that obviously are not alternatives to that hypothesized on the basis of classical electrodynamics, explaining the thermal effect. This models must facilitate the hypothesis that in the primary interaction there is not only a generic energy transfer to the molecules, in our case mostly to water that is wide-ranging the major constituent of living systems, but alternatively hypothesize:

a) The direct or indirect damage of a particular biological structure;
b) The production of signals that can modify the behavior of exposed biological system.

The first hypothesis look remote whether the field strength are not very high, the second instead, which I propose to call mimic effect, is widely practicable, despite very riskily from a scientific point of view.

The formulation of "ad hoc" models, founded on some observations without theoretical and experimental verifications on the single steps of the whole event, is seen with extreme diffidence by physicists (and by those referring to physical models), it is instead very common in biology. So I want put in evidence the difficulties there are for researchers with different background to work

together on the same problem. In particular, for electromagnetic theory experts there is usually the difficulty to understand that the interaction with a living system is not a problem that can be solved taking into account only a homogeneous medium and looking only at primary interaction mechanisms. The biologist, instead, must understand that empirical models, very weak for there capability of prevision (and so to reconstruct the events) are usually rejected in many scientific sectors.

I reach, so, the central point regarding the presence of coherent mechanisms to the basis of many biological phenomena. This presence in the organization of living systems is to me a sort of postulate of the biology. Thus I don't want to tell that the thermodynamic laws cannot be applied to the living systems, I want to tell only that it is difficult to hypothesize a biological world originating all by the chance, without the presence of self-organization mechanisms operating in the different levels (molecular, cellular and of whole biological system) So I want justify a personal sympathy for the physical models justifying coherent system behaviors. I understand, obviously, that a think is to hypothesize a coherent mechanism at the level of an organized and complex system and another to do this to the atomic and molecular level.

In effect the problem of electromagnetic interaction can be synthesized in following statement: It is necessary do not scramble the interaction in an homogenous media, in which the charges are partially free of bound in a well defined way, with that on the living systems. The latter are composite and heterogeneous media from an electromagnetic point of view, in which the charges are frequently bond in a particular way for reasons lying on the "biological" behavior of exposed system. The straightforward consequence of this is that the charge in a biological system is not all equivalent (there are million of proof of this) thus an interaction involving there is not only a simple energy transfer but can produce consequences deeply dissimilar.
I would like to conclude with the recall of a principle (frequently referred as a law), that of Murphy, that tell" as think can happen it will happen", in my life as health physicist I could verify that often is true, also events very un-probably sometimes will happen. In the same time I would like to appeal to a major prudence by all sides, prudence that is largely necessary to exert as larger is large the ignorance of the facts. Truly mine it is.

Neurobiology and Quantum Electro Dynamic Coherence (QED) of mental states

Mariano Bizzarri[1]

RIASSUNTO. *La neurobiologia della trasmissione sinaptica può oggi essere compresa solo ricorrendo alla teoria della Elettrodinamica Quantistica (QED), considerata la natura delle interazioni che intervengono a livello sinaptico dove la coerenza delle fluttuazioni del campo QED assicura l'espressione funzionale. È ipotizzabile che stati mentali diversi condizioni paradigmi di coerenza diversa e quindi sensiìbili variazioni nella modulazione di funzioni altrimenti solo potenziali*.

I think we are all quite familiar with the work of Betz, Margenau and Eccles[ii] on the physics of synaptic transmission, the prototype *par excellence* of the biological interaction that allows the brain to transduce information.

The synaptic button is a functional modification of the (presynaptic) axonal membrane having the function of releasing single neurotransmitter vesicles and capable of interacting with specific receptors present on the neighbouring (postsynaptic) neuron. The transmitter acts as an information molecule and the vesicle as a whole represents the "quantum" packet of the synaptic ending. This definition is supported by the analysis of the mechanism - exocytosis - that precedes the release of the vesicle. What happens experimentally is that exocytosis produces one or more depolarization waves that, on propagating from the neuron body to the axonal ending, causes a change in potential (from – 70 mV in the resting state to 20 mV) which opens the Ca^{++} channels and allows a number of cations lying between 5 and 10,000 molecules to enter. Only four of these are enough to saturate the calmodulin that triggers the release of a single synaptic vesicle. Ca^{++} ion availability thus does not represent a limiting factor for the entire process, just as the "background noise" produced by the bioelectric activity does not represent a disturbing factor since it is resolved by the redundancy mechanism of the afferent messages, the summation of which leads to the discharge. And yet, research on isolated nerve sections or individual neurons has shown that exocytosis does not always occur and has a probability of $p(_v) < 1$. To be precise it has an experimental probability of $0.05<p(_v)<0.5$ or $p(_v) = f \pm\varepsilon = 0.25 \pm 0.20$. It is clear however that, in the *complex* overall situation regarding the organism, vesicle release *must* necessarily be unitary ($p_{(v)} = 1$), considering that each impulse or appropriate mental command is followed by a response that may be traced to a coherent series of synaptic transmissions. The important question to ask is what makes the $p_{(v)}$ vary?

In this regard, Eccles suggests that "exocytosis is apparently partly controlled by an unknown holistic property of the presynaptic lattice"[1], a property, I might add, that represents a specific function of the field generated by the lattice itself which, from this point of view, behaves no differently from the semi-structured configuration taken on by water in the vicinity of biological macromolecules. For Eccles "a mental intention is able to act effectively on nervous events by means of a temporary increase in the probability of exocytosis … the intention couples the large number of probability amplitudes to produce a *coherent* action". In this sense, the "field" of the presynaptic crystal lattice somehow begins to resonate with the electromagnetic field generated by the axonal discharge, and their mutual interaction induces a metastable state in the vesicle lattice during which exocytosis may occur and, in physical terms, may be likened to a transition phase. At this point Eccles introduces a few simplifications that, in our opinion, are unacceptable. He treats the presynaptic vesicle as a "quasi-particle" with a mass of between 10^{-17} and 10^{-23} g (a range far below its true value) and which thus ends up by

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displaying wave behaviour, and may thus be described by Schrödinger's equation. In fact the vesicle *is not free* to move as it is by no means immersed in *empty* space, and it must be assumed that the electromagnetic field must *necessarily interact* with the paracrystalline lattice of the presynaptic cytoplasm. Eccles actually does this, but without drawing the necessary conclusions. It is the existence of this specific interaction, as studied by quantum electrodynamics (QED)[iii], that can explain why each depolarization is followed by an effective exocytosis and why the latter involve a single vesicle. The quantum mechanism of synaptic vesicle release actually takes place in an environment of *coherent interaction between a field of matter (the paracrystalline lattice) and an electromagnetic field (linked to the depolarization triggered by the nervous impulse), and paves the way to a full understanding of the functional dialectic that takes place between the "mind" and the "body".*

We now know how the psychological (perceptive, cognitive, emotional), immunological and endocrine functions are closely linked to the specific *configuration* adopted by the "mind", and are therefore state-dependent. In other words, they may be considered as "Field Functions", thus setting up an analogical correspondence between neurophysiological and physical concepts. Mental states are in fact functional configurations of the brain characterized by a specific pattern of neuroimmunoendocrine activation and by a specific spectrum of electroencephalographic activities (EEG) which is defined according to site, coherence and predominant wavelength. Each mental state is to the set of organic functions as the tune is to the set of notes: it is the tune that assigns the form and position to each component, to each "note". The overall coherence is probably what characterizes the QED field interaction with that generated by the field of matter, the "organization" of which is actually "orchestrated" by the interaction itself. If we take the example proposed by Sermonti referring to the electromagnetic activity of the neural tube which "generates the fibres and the circuits that will receive it [....] the nerve fibres transmit the impulses before they are constituted, they are organized by the impulses themselves of which they are the vectors"[iv]. A similar case is that of the geometry of snowflakes, the hexagonal symmetry of which reflects the properties of the crystal lattice of the water molecule. This does not explain however why snowflakes all have the same characteristics and why each radius is identical to the others. Wiener[v], the first to observe these peculiarities, suggested that "in order to get each radius to correspond to the others there seems to be an *active electromagnetic type force* … [such that] we may seek the secret of the organization of the snowflake in the dynamics of its oscillations". The vibrations of nucleic acids have a similar importance. In this case the molecular oscillations display variable frequencies, i.e. a non-linear phenomenon, that nevertheless cease quickly and are coordinated so as to undergo a synchronized evolution with a mean frequency of about 10 oscillations per second. It is surprise how close this value is to that of the α rhythm characterizing an EEG recorded during meditation, as well as to numerous other biological rhythms (such as the light emitted by a firefly). What is important to note here is how a non-linear interaction can produce a coherent process having an easily identifiable structure. To continue with the analogy drawn earlier, this structure is the tune.

It may be postulated that, in man, the interactions among the "fields" described by the QED change according to the functional configuration adopted by the mind. One of the difficulties frequently encountered in dealing with the mind-body relationship is related to the fact of taking as a sole parameter of the mental function that represented by the waking state, while the human being regularly experiences different mental states - all of which *necessary* - among which the waking state seems actually to be the least efficient. A *"mental state" may be likened to an operating system, that is, to that* functional configuration of a computer *that allows access to certain functions (but not others) and allows programmes "compatible" with that particular configuration to be run. A computer's operating system may be compared with a* Mental State *if the latter can be considered as that* very special configuration for which the brain is able to activate, whether consciously or not, some but not all of the functions (programmes) potentially available to it. In other words*, the "operating" rules of the system that we call* the mind can enable information to circulate in different ways*, so that the correct functioning of the various apparatuses are differentially influenced by it according to the functional configuration prevailing at the time. This definition deliberately emphasizes the close dependence of the cognitive and bioregulatory functions not so much on the "brain" in the*

strictly anatomical meaning of the term as on its functional configuration *and the corresponding degree of activation. In other words the brain's "functions" vary widely according to the prevailing mental state*[vi]*. Brain functions thus become "field functions", giving the latter a precise meaning in QED terms.* The difference between the neurophysiological and psychological "operating systems" is probably necessary in order to ensure a correct treatment of all the information reaching our organism *and which often displays important qualitative differences. The transition from one operating system to another is largely mediated by the quality of the sensory (smell, taste, sight, hearing, touch) and mental (thoughts, emotions) stimuli reaching the brain and that may combine to "stabilize" but also to "weaken" a given Mental State. These states may be interpreted in the light of QED, and the respective transition may be subjected to a specific thermodynamic treatment.*

What does vary from one state to another is actually the probability *that given information will be transmitted. If we take the example of analgesia, we see that the probability of the mind transmitting the message capable of activating the mechanism is close to zero under ordinary waking conditions, while it approaches one when the person is in a state of self-hypnosis. What is known in neurobiology as a phase of transition from a mental state A to a mental state B is the equivalent, in physical terms, of a field regime that goes from a probability of* $p_{(a)} = 0$ *to one of* $p_{(b)} = 1$*. I should like to emphasize another fundamental characteristic of these phase transitions:* the transition from A→B and possibly from B→A is a transformation that does not take place along a physiological continuum but proceeds by discrete, that is, quantum, steps.

These transformations of state are accompanied by definite changes in the EEG plot and in the associated electromagnetic field, of which very few investigations have so far been made. The change is accompanied by coherent modifications of the (neuroimmunoendocrine) network as a whole; some of these are practically instantaneous, for example, the salivary secretion of IgA and cortisol, which points to the existence of an electromagnetic propagating mechanism, since the secreting cells have no nerve innervation. No chemical mechanism may be envisaged owing to the relatively long time that would be needed between the diffusion of the hormone molecule, its arrival in the target tissue and the elaboration of a response. A similar mechanism is probably involved in other integrated physiological responses for which it is not possible to invoke effects mediated directly by nerve innervation or by the endocrine system. The "coherence" of these biochemical functions actually lies in their capacity to "resonate" *in time with the modifications in the electrodynamic field that gives them a form, an order and a rhythm.*

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What an electromagnetic biology could teach us

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Riassunto

I grandi progressi della biologia e della chimica, poco si sono integrati con l'analogo sviluppo della fisica e della fisica quantistica in particolare. Negli ultimi decenni soprattutto sulla base del contributo teorico di Giuliano Preparata, si è sviluppato un nuovo punto di vista sulla materia condensata fondato sull'uso sistematico dell'Elettrodinamica quantistica. In nostri sforzi vogliono contribuire all'estensione di queste conoscenze elettrodinamiche quantistiche dalla materia inanimata alla materia animata che in fondo non è altro che un forma specialmente organizzata della prima.

A new scientific paradigm differs from an old one not simply because it provides different answers to the old questions, but mainly because it raises entirely new questions.

In his presentation in this Meeting, Giuliano Preparata has shown how Quantum Electrodynamics (QED) could generate a new vision of condensed matter and, in particular, of living matter.

We have learnt from the talk of Giuliano that condensed matter and living matter cannot be reduced only to their molecular components, but they must reduced, at least as far as the "coherent fraction" is concerned, to the molecules oscillating in tune with an electromagnetic (e. m.) field, confined within a coherence domain (CD) whose size is inversely proportional to the energy jump performed by the oscillating molecules.

When energy is supplied to a coherent piece of matter, it could either extract molecules from the collective oscillation by spoiling the phase agreement with the other molecules or start coherent excitations of matter, which release in turn this energy to the (coherent) environment in form of coherent waves. The existence of a coherent regime allows us to answer a first basic question: how homeostasis is produced and maintained in living matter? Each living system works and performs because its component molecules interact among themselves according to long sequences of chemical reactions whose space-time ordering is sharply defined. There is no room for random encounters and reactions; the biological reactions are all governed by chemical codes, whose prototype is the code at work in the synthesis of proteins controlled by nucleic acids. Molecular biologists take these codes as a dogma, but no effort is devoted to the understanding of their dynamic origin.

The space-time order in biochemistry cannot be the product of the chemical interactions whose range is too short (a few Angstroms) to allow the molecules to detect each other from afar and, moreover, when they are inside a crowd of other molecules, not involved in the specific biochemical sequence. QED solves completely this problem, since, within a coherent medium, molecules may interact through their common coupling to the electromagnetic field and the intensity of the force depends inversely upon the difference of their oscillation frequencies, so that molecules whose oscillation frequencies are significantly different ignore each other, whereas resonant molecules attract themselves strongly. We get thus a selective recognition code based on the e.m. resonance which could provide the dynamic basis to the biochemical codes. E. m. fields

have a long range and then are able to produce a recognition at a distance, also in a crowd of non resonating molecules.

Let us answers one more question; why the energy released by biochemical reactions is totally invested as a supply for structural and physiological functions and is not dissipated as heat giving rise to wild temperature fluctuations, as occurs in the usual chemical reactors?

As a matter of fact, in a coherent medium, when the energy necessary to detune the correlated molecules is large enough as occurs in biological matter, the output of a chemical reaction does not spread among independently moving molecules whose kinetic energy gets increased, but is supplied to a network of correlated molecules, so that, as on a string of a violin, a wave arises. This wave, whose frequency depends on the strength of the coherence of the medium, is basically a moving e.m. field, thus able to attract co-resonating molecules. In a coherent medium the energy output of a chemical reaction does not increase the random movements of the components, increasing thus the entropy of the whole system, but on the contrary strengthens and widens the coherence of the system, binding more and more molecules to it. These molecules, in turn, by creating new coherence domains, add new e.m. oscillations to the orchestra of the existing ones. The biological system is thus able to grow without losing its own coherence, actually increasing and deepening it. Biochemistry is no longer the play of independent molecules, able only to collide randomly, as the usually chemistry in the gas phase which mechanistic thinkers assume as the archetype of every chemistry; on the contrary biochemistry is the work of molecules coupled with the e.m. field and , through this coupling, able to produce growth and order at very low entropy and at (almost) constant temperature.

Finally, the interplay between chemical and e.m coherence could open the pathway toward the bridge between biological and psychic phenomena, which has been the unfulfilled dream of the founders of the psychodynamic movement as Freud and disciples of his like Ferenczi and Reich.

The network of coherent waves which arises from a network of chemical reactions and open the way to a further network of chemical reactions, when considered in itself as an object , shows an intriguing similarity with the libido that Freudians considered as the engine of the emotional in sphere in the individual.

It is a fascinating perspective for the future that the network of coherent excitations, originated at the biochemical level and propagated through the coherent medium, could be the physical basis of the pulsional longings. The bridge between biology and psychodynamics could be the next bridge beyond that between physics and biology.

QED (Quantum Electro-Dynamics) and Medical Practice

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Riassunto

Negli anni 50–60, prima Reinold Voll, poi Franz Morell e Rash, hanno tentato di realizzare un'integrazione tra gli insegnamenti dell'agopuntura cinese con la moderna elettronica. Da questo tentativo è nata l'Elettroagopuntura secondo Voll (EAV) che nonostante mantenga ancora molti aspetti teorici e pratici insoddisfacenti, sembra rappresentare un progresso importante nella diagnostica e nella terapia medica corrente, di cui solo futuri studi rigorosi e forniti di strumenti concettuali adeguati (forse la QED), potranno valutarne potenzialità e limiti.

It was thirty years ago, in a conference held in Desio (MI, Italy) by Prof. Sirtori, I heard, for the first time, about the possibility of measuring the electrical skin parameters and their variability, especially in some area or points.

It took a lot of years for me to deduce some observations which seem relevant for medical practice and that, finally, could have a theoretical basis in Quantum Electro-Dynamics (QED).

In the same manner we collect information using an E.C.G. about heart functionality and possible heart injury, so we could do studying the electrical skin values of determined and particular areas, pointing out relations referred to internal functions and situations.

Moreover, making the subject interact with specific electromagnetic signals, we can get interesting responses.

The research on electrical skin phenomena, (which has had a strong impulse in the whole world in the last twenty years), till now has pointed out how skin, mainly considered as a separation structure with a mechanical protection role, also constitutes an active biological interface (which acts as an intermediary) between influence of external stimuli and internal organs and functions.

Skin, as a receptor and actuator organ, is functionally related to nervous system. Electro-skin activity seems to express such a connection, not only reflecting the different degree of regulatory functionality of skin related process, but also as an index of the different conditions of internal organs as shown by the maps of Chinese acupuncture integrated with German electroacupuncture .

Dr. Reinhold Voll, a German doctor (1), was one of the founders of this diagnostic method. He, accidentally, observed that the measured electrical skin parameters of a patient varied according to the presence of a contact with medicines or not. Starting from this serendipitous observation, a lot of researches were made which only today are submitted to systematic evaluation according to official science research methods. In particular, the theories developed by Prof. Del Giudice and Prof. Preparata, essentially based on QED, can give us physical and mathematical models that are able to explain such a surprising observation (2, 3).

The observations have been carried out with an EAV (Voll's Electric Acupuncture) instrument, which gathers theory and practice of Chinese acupuncture with modern electronics possibilities. The EAV measure system consists essentially of a generator, which applies a direct current of about 8 μA (microampere) with a difference of potential of 1 Volt between two acupuncture points. The current flows into a circuit formed by a wire which ends in a tag electrode, that is used by the operator to test the points, the patient, that holds in a hand a cylindrical electrode from which departs another wire connected to an ammeter and, then, to the generator. Connected to the main wire, there is another one, which leads to a metallic box for phiales, used to measure the interference due to medicines, foods or other kinds of solutions to be tested (4).

If the human body reactions or that of the organ corresponding to the tested point are normal, the measured electromotive force should be about 0.8 Volt. In practice we set the potential

in a way that the ohmmeter shows a value of 50 on arbitrary 100 units graduated scale. In this conditions the current intensity ranges from 5 up to 11 μA (microampere).

In case of pathology of an organ related to the tested point, it has been observed an increase, or diminution, of the skin resistance and, then, a diminution, or an increase, of the electrical conductibility which corresponds to a fall, or a rise, of the 100 units graduate index. German electroacupuncture maps confirm these effects. Moreover, it has been observed that, when signals of different nature and origin normalise the electrical parameters measured by EAV, there is a regression of the tested pathology. These personal experiments are the basis of numerous clinical results, which worth, I believe, further researches for a scientific comprehension and validation.

After the first EAV (Voll Electro Acupuncture) followed more or less complex technological developments, enriched with new functions and software for collected electrical skin data elaboration and analysis. For example, the MORA, conceived by Dr. Franz Morell (5), which seems to allow a medical electromagnetic therapy; the Performance 2000, the last born from Medtronik, conceived by another German doctor, Dr. Schimmel, which allows to measure the real current (microampere) related to the points, overcoming the limits of relative 100 unit scale and VEGA tester.

On the basis of these experiments, we can imagine how, beyond the known and studied communication systems, which govern both the physiology and pathology ofthe different functions and the life itself of the human being (circulatory, emathic and lymphatic system, hormonal system, nervous system), there is an electromagnetic network. Through this system, cells and organs could communicate among themselves.

We can connect to this network in an indirect way using the instruments described above, which allow us to detect the response of the human body to the different electromagnetic signals, are they natural or not. An important sign of the electromagnetic nature of the active input comes from the fact that we obtain the same results if we connect the tested product via radio to the EAV(fig.n°1). Using these techniques, we can also study food and pharmacological intolerance.

These studies could integrate the data coming from examinations, analysis, etc. normally done and give us a better and faster diagnosis useful for a more adequate and precise therapy.

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From drug intolerance to a SEP(Skin electric Parameters) driven therapy. Some preliminary observation.

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Riassunto

L'interazione farmaco recettore è esclusivamente di natura chimica? La "pallottola magica" è una particella o un'onda? Sono domande che sorgono dallo studio pilota sulle intolleranze farmacologiche. Le prime osservazioni mettono in luce un nuovo scenario costituito da circuiti elettrici corporei misurabili sulla cute, all'interno dei quali le variazioni di conduttanza indotta da segnali fisici, appaiono giocare un ruolo nella diagnostica delle intolleranze e nella guida alla scelta dei farmaci, che sembrano avere oltre ad un'azione chimica ben nota, un'azione fisica di tipo quantistico che per essere compresa necessita di ulteriori studi teorici e sperimentali.

1- The magic bullet

Only in recent times, in the 19th Century, Pharmacology has accepted as it own frame of reference the Galilein point view on science, putting aside old fashioned doctrines and time honoured prejudices which never have undergone rigorous experimental tests. Actually at the time most therapies were the outcome of more or less imaginary beliefs on the aetiology and subsequent evolution of the disease or from sketchy observation on the beneficial effects of selected remedies on some individuals (1).

In 1872 Bucheim (2) defined the aim of Pharmacology as follows. << should we replace our present fuzzy ideas about the drug dynamics with a rigorous physiological conceptual frame, we would the have achieved a fundamental progress. However, the knowledge of the action of a definite drug should imply that we are able to derive all the details of its activity from its chemical structure>>

A fundamental progress for understanding the relationship between a drug and the cell components has been achieved when the concept of "drug receptor" has been formulated.

Paul Ehrlich (1845-1915) deserves the merit of having the insight that the effect of drugs could be understood against as the consequence of their chemical interaction with the tissue. Then he stood against the "vitalistic" approach, still deeply rooted in the early years of the century; the basic tenet of "vitalism" was that the effectiveness and specificity of drug could not arise from the laws of physics and chemistry, but would require the active presence of some supposed "vital forces", Ehrlich (3), on the contrary, stressed that, to be effective, the molecular components of a drug should "bind" to some specific component of the cell. He defined accordingly the receptors as "the active group of molecule of the protoplasm where it is possible to bind a corresponding chemical group of a molecule not belonging to the protoplasm>> . To better explain this concept he proposed the suggestive definition of a <<magic bullet>> able to hit its specific target (the "receptor") in the crowd of chemical components of the living organism.

2. Drug intolerance

However the "magic bullet" is not always able to get the target. Frequently, in spite of the ceaseless progresses of pharmacology, adverse and intolerance against the drugs may occur and produce situations where a careful evaluation of the risk/benefit ratio of the use of the drug is mandatory. A fraction as the 70/75% of the disease induced by drugs cannot admit any explanation in terms of the usual immunological reactions, although those symptoms were induced by drugs

which were well known allergens. In these cases the disease has been christened as "pseudo-allergy" or drug intolerance. The drugs which elicit largest pseudo-allergic response are the antiinflammation non steroid ones, some antibiotics, the local anaesthetics etc.
The most frequent symptoms are quite similar to exhibited by "real" allergic reactions, but less intense and acute. In the "real" allergies the typical diagnostic probes are the skin reactions, the nose and mouth stimulation tests, the measurement of the specific IgE (Rast), the "in vitro" lymphocitary blastization and others.

In the last four years, Dr Umberto Grieco (see his contribution to this meeting) has made us familiar with the experiences of the Voll Electroacupunture, that have achieved surprising successes in the diagnosis of the food and drug intolerance. After many exchanges with Umberto and a number of tests a the Centre of Immuno-allergology led by prof. Franco Filiaci, we were convinced that a controlled investigation was useful with the aim of checking these surprising phenomena.

In a nutshell, the appearance of electric voltage on the skin suggested that an electromagnetic (e.m.) mechanism could underlie these strange pseudo-allergies; since these symptoms were the effects of drug, the intriguing possibility arose that the molecules of drugs could extrinsecate an e.m. action apart from the universally accepted chemical action.

In order to probe this possibility, in the 1998-99 many discussions(4) occurred in the Rome medical research community, which have included , among other, Dr Paolo Cascino, Prof. Baldassare Messina, Prof. Maria Luisa Roseghini, prof. Franco Filiaci and prof. Vincenzo Martinelli. The practical outcome of these debates has been the start–up in April '99 of a wide-range research program, run by the Surgeon Department of the University of Rome "La Sapienza", on a population of patients provided by Italian Treasury Police (Guardia di Finanza).

The object of the research is the systematic measurement of the skin electric parameters and the search for correlation's with the existence of food and drug intolerance.

In the first experiments an EAV-Voll Electric acupuntures (5-6) equipment has been used. This equipment measures the electric conductance in the body along paths which coincide with the meridians as recognised by Chinese acupunture (fig.1-2). Notice that the present understanding of the skin electrophysiological effects does not yet allow a satisfactory modelling of the phenomenon and , furthermore, the intrumentations, which is produced mainly in Germany, is not yet so reliable to guarantee a complete reproducibility of the tests. It in thus mandatory to correlate the EAV data with the usual clinical and diagnostic results.

3. Outlook of the research

The pilot study program has involved so far more than 250 volunteers and the crossing of the EAV and clinical evidence has opened a new horizon to the drug therapies.

The preliminary results, to be checked further with double blind tests, show a dramatic improvement of the risk/benefit ratio by the avoidance of the drugs which exhibit lowering of these adverse reactions by a skilful use of the EAV techniques.

The main problems to decipher the physics dynamics of this interplay between chemical drugs and the body electric conductance. We have observed how drug and food introductions in biological system, can increase or decrease the coherence of the system. Analogous to what occurs in super conductive materials (see volume "From quark to crystals" of Giuliano Preparata, in press) an increase of coherence is associated to phenomenon of high conductance. It is in this way that we observe that an efficient drug, produces in the electrical circuit of the human body, an increase of conductance of approximately 30/70%, that is correlated to an increase of energetic power provable with "chinesiological" tests and impressionable clinical improvements.

This is the rationale of the convocation of the today Meeting on the possible role of Quantum ElectroDynamics (QED)(7) in Medicine. We have invited Giuliano Preparata and Emilio Del Giudice in order they help us to understand by the QED mechanism how drugs could show an

action -at- a- distance, which should underlie the body electric phenomena and open new ways to the drug electrodynamics.

P.I.

In the last study in preparation of double blind trial, we have observed in twenty allergic patients, that the association of an antihistaminic drug (loratidine, mizolastine, cetirizine ecc) whit a cortisonic drug (betametasone , mometasone, deflazacort), driven from the SEP (Skin Electrical Parameter), give an 90/% of regression of the symptoms allergic (rhinitis, ecc). This results are obtained from patients, without intake of drug, but with the utilise of the drug for electrodynamics action, with application of the drug external to the body. The development of intolerance to the drug, seems strongly correlated to the fall of the conductance in the body. The substitution of drugs with the improvements the conductance, is correlate to immediate regression of intolerance and allergic symptoms.

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