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EDITORIAL.

Piero Faraone

Piccardi wrote in his letter of 1970 to russian scientists (1) :

"Temperature, pressure, concentration, etc., that is, traditional variables, are not the only variables determining the course of a chemical or biological process . There are many others capable of acting on those processes . There are the variables playing in the space surrounding us…… we call them non traditional or space variables .

The processes we study are sensitive to the play of non traditional known and unknown variables and therefore, their results are changing in time if conducting in traditional conditions.

We call them fluctuating processes or fluctuating phenomena ."

Piccardi in the same letter remarked also about the opportunity to realize an interdisciplinary research in fluctuating phenomena studia :

" We must not forget that the causes of fluctuating phenomena are in the space surrounding us, and the effects are in our terrestrial systems.

The causes belong to the physical sciences , the effects to the chemical sciences and to the science of life .

The research is largely interdisciplinary, not only because of the variety and diversity of the allied disciplines, but also for the aims of the research .

We can study the physical causes for a better knowledge of the chemical science and the sciences of life, or , on the contrary, we can study the effects for a better knowledge of the physical sciences .

Heterogeneous, out of equilibrium and complex systems are, infact, universal instruments signaling the events in the space surrounding us ."

Piccardi referred also in the same letter, a simplified theory on the action of space phenomena :

" The general mechanism, according to which space phenomena of very varied nature succeed in acting on heterogeneous, out of equilibrium and complex systems, might be initially summarized in this way :

1th) All the reaches the Earth from the surrounding space, and principally from the Sun (fields, radiations,corpuscles and matter in macroscopic state) is largely stopped, absorbed and transformed by the high atmosphere. Consequently, the high atmosphere is continually under structural and topographical changes .

2th) The low frequency natural electromagnetic fields of terrestrial origin are more or less reflected on the Earth's surface according to the state of the high atmosphere .

3th) Our colloidal systems, which are very sensitive to electromagnetic low frequencies, are influenced by the natural electromagnetic fields originated on the Earth and modulated by solar activity and other external phenomena, through the high atmosphere .

This can explain why the response of the chemical tests, as regards the space phenomena, seems universal ."

The A. of present article, beginning several years ago, biological tests of CSD of air bacteria, had not so clear results after one year about of his experimental programme(2).

After a phase recognitve in 1969, where he noted a CSD–frequency variability during the time , he began his true experimental work in january-1970 and concluded it in may-1991.

The A. did not know the Piccardi studia with colloidal tests till 1971, when he seized opportunity to know personally Piccardi , at Milan-University .
He had a lovely long conversation with Piccardi , and was cordially encouraged to insist in his microbiological trials .
The A.'s researches were realized in the first time on air bacteria and after on brothcultures of several strains of Staphylococcus Aureus (3 –10, 13, 14).
More than four milions of colonies were studied complessively during twenty years, to detect the frequency number of colonies with a sector (or sectors) diferentiated , said shortly CSD.
The CSD/frequency data, presented good correlations with solar activity, geomagnetic activity (geomagnetic storms) [12, 17] and low frequency natural electromagnetic waves (11,15).
In the 1987 it was noted that microrganisms were conditioned in their growth with low frequence magnetic field (16).
The cell of the unicellular organism , is the most simplex possible example of biological life .
The presence of colloidal particles in this simplex organism realizes a physical status like for colloidal particles in Piccardi-test . Admitting a sensibility of CSD test to the external energies similarly to the colloidal tests of Piccardi , CSD test appeared less interfered than those .
In the microbial cells so simplex, a autocompensation mechanism is not present like in superior organisms and then the conseguent influences deriving from the external energies may better show his influence on biological substrate.
In this way, it's possible to detect cell bacteria modifications more simply than in superior organisms (phenotypically detectable as in CSD) .
Concluding it's suggestive the hypothesis that the sectoring differentiated are in CSD, a conseguence and simultaneously a witness of a byological selection in acting to permit the surviving only of the microorganisms adapting themselves through induced modifications by external energies (or *space variables* , as Piccardi said) .
The adapting-phenomena are in the microorganisms very quickly and this rapidity is not so incredible if it's possible to have during 24 h, from a single microbial cell, one milliard of bacteria .
This highest vital capacity of microorganisms to reproduce themselves, is the real challenging to superior organisms.
In the microorganisms the single cell easy dies but a microbial population hardly dies .
A micr.population always survives, modifying themself only through the vitality of some bacteria who have this peculiarity (not so uncommon) and the remaining microrganisms are consequently excluded from the successive generations (microrg. cells alternating).
The alternating of generations, realized very quickly through a simple mechanism, gives more shortly on the time, also the possibility to have shortly some mutation , hypothized through a phenotipical evidence like in CSD.
The big possibility to have many experimental data like it's through microorganisms, is unequalled in measure of space time - size .
The CSD-frequency showed (from 1970 to 1991) two undecennal cycles , negatively concording with solar activity , presenting also relatively constant values as minima and maxima data , in every year .
More over the A. realized with other researchers an interdisciplinar collaboration adding also statistical elaborations of CSD data obtaining significant correlations of these if compared with physical parameters (11, 12, 17) .
Is CSD frequency correlated with cosmic energies, to connect with incidence-variability of epidemies on the time ? The possibility to reply to this question, should be very interesting .
It's not casually now to remember Tchijewsky who hypothized on the years from 1930, a possible correlations between byological phenomena and solar activity; he concluded this, studiing the cronology of the big epidemies in Russia and also the origin of their periodicity.
Moreover he collected the solar activity also with social and medical phenomena.

The geomagnetic activity and the magnetic storms are actually always more considered in connecting with human health (e.g., in the hearth infarction)(18, 19, 20, 21).
Concluding, as Piccardi said , we must remember that not only the solar activity but also the cosmic radiations influence directly the ELF and the VLF waves in the jonosphere and are important component of the external energies conditioning biological substrate (24).
All these external energies, before said, are in every way strictly connected together (22).
Preparata gave us the key to go in the more secret mechanisms that are conditioning the contact between the physical phenomena and cells and his genial semplifications to explay the relation between causing and effects is decisive to know the science of life.

It's opportune to remember what **Preparata** said three years ago, in the Meeting of dec.1999, at University La Sapienza in Rome(23):
"....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 . "

Considering what Preparata said , it could better explay the relations between physical causes and biological effects and could be decisive to better know the science of life ; from this consideration it's obvious that the **interdisciplinary collaboration** is'nt an optional but it's morally (and not only) a one-way street !

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In Commemoration of Madam Carmen Capel-Boute.

Madam Carmen Capel-Boute was born in Buenos Aires in 1914 to a Belgian family.
She became a researcher in the Electro-chemical and metallurgical field at the Science Faculty of Free University in Brussels. Madame Capel-Boute was working with Prof. Pourbaix studying phenomena appearing after physical treatment of water. She suggested several interesting explanatory hypotheses regarding effects of physical factors of low energy on water solutions. In this period she read several of Piccardi's articles about the same study in "Chemical Abstracts" journal published before the 2nd World War.
Madam Capel-Boute was impressed by Piccardi's considerations. When she attended the Conference organized by CITCE on the coasts of Como's lake and Lago Maggiore, she seized the opportunity to inquire Prof. Piontelli who accompanied her, about Piccardi. She learned, that Piccardi returned to Florence as Director of Chemical-Physical Institute, leaving the Genoa University where he had chemistry-physics chair since 1938.*
Eventually madam Capel-Boute met Piccardi when visited Florence in 1950. Piccardi had a long discussion with her and found it very interesting that the water behavior was empirically utilized in the industry. Piccardi believed that some external factors of low energy influenced the variations in effects of water activation. Madam Capel-Boute and Piccardi quickly became scientific partners and their collaboration was very intense. Dr. Capel-Boute became the best collaborator of Prof. Piccardi in completing colloidal the tests and in studying phenomena of fluctuations. Piccardi made his colloidal tests in Florence from 1951 to 1972 and Capel-Boute in Brussels from 1956 to 1978. They obtained interesting results also in the mutual comparisons of their collected data.
Madam Capel-Boute became President of CIFA in 1972 (CIFA was founded by Piccardi in 1969, in Brussels). After Piccardi's death, Capel-Boute continued his work, devoting herself to CIFA, sharing her great enthusiasm and impassioned determination.
In 1987 she left CIFA Presidency, and Prof. E.P.Wedler (Biometeorology Institute of Free Berlin University), replaced her. Three years later, in 1990 Wedler died, and Capel-Boute become again CIFA President in spite of her poor health, age and her other responsibilities as CIFA General Secretary and editor-in-chief of CIFA News.
She accomplished her management-masterpiece, transferring in 1993 CIFA Head Office from Brussels to Pushchino (Russia), maintaining all typical traditions given by CIFA founder Giorgio Piccardi to this Commitee. This initiative guaranteed the future of the Committee, and CIFA obtained its new President Prof. Boris Vladimirsky (Crimean Astrophysical Observatory in Nauchny, Ukraine).
Madam Capel Boute recently passed away, and we are greatly saddened. She was close to every one of us, always with her humanity and her "unusual driving power". Her little cottage at the Isola dei Pescatori on the Lago Maggiore, will no longer be the warm site of hospitality for her collaborators and friends. Only the distance separated us from Madame Carmen, but now the distance is too unlimited….
Let's together continue our work, so that our dear Madam Carmen will have again her life through us: She has earned it!
Piero A.R. Faraone, CIFA's Vice-President.

** **CITCE** - Comitè Internazionale de Termodinamique et Cinetique Electrochimique, founded in the 1949 at Universitè Livre de Bruxelles*

GIORGIO PICCARDI: SOLAR ACTIVITY AND CHEMICAL TESTS, LECTURE TO THE U.R.S.S. ACADEMY OF SCIENCE ON APRIL 30TH , 1967

Revision by Mariagrazia Costa and Marco Fontani

Preface of the revisers

The Italian physical chemist Giorgio Piccardi, *master of the Sun* according to KAUFMANN, spent the last two decades of his life investigating non-reproducible or fluctuating phenomena (*fenomeni fluttuanti*). These researches in which he ascribed the rates of chemical, physical, and biological phenomena to extraterrestrial – especially solar – influences, had been met with either criticism or indifference from many Italian chemists. His work on flocculation rate of bismuth oxychloride (BiOCl) formed by the hydrolysis of Bismuth(III) chloride, his so called "chemical tests" were criticized. On the other hand, since significant long-term perturbations and an annual variation were present in all data sets, many other scientists stated that observations could not be conceived as purely random fluctuations. Piccardi's measurements were unambiguously correlated with solar or extraterrestrial effects. As result of this work Piccardi formulated the so called Solar Hypothesis (*ipotesi solare*).

He died in Riccione, on the Adriatic coast of Italy on December 22nd 1972, aged 77. As a friend noted, Giogio Piccardi disappeared on the winter solstice. Since August 2002 an Italian Biometheorological Centre brings his name.

INTRODUCTION

Fluctuating phenomena

Temperature, pressure, concentration, humidity etc. i.e. the traditional variables, by themselves do not determine the trend of chemical and biological processes. There are other variables capable of affecting these processes. These are the variables acting in the space which surrounds us: gravitational, electric, magnetic and electromagnetic fields, solar activity of all kinds, secondary geophysical phenomena originating from solar activity, movement of the earth in the interplanetary space and impact of the earth with matter and fields existing in the interplanetary space itself and so on. Apart from this, also those that we do not yet know, but may know in the future. We have called all these: non traditional variables, or, not to be polemic: space variables.

Processes and phenomena affected by space variables give changing results in the course of time, even if reproduced in identical traditional conditions. That is they are not reproducible or not always reproducible. We have called them fluctuating phenomena.

Fluctuating phenomena occur in systems that are heterogeneous and out of equilibrium. Thus a great number of chemical phenomena and all biological processes are fluctuating. This class of phenomena is truly very vast. In fact it includes all those occurring in matter at a colloidal state.

The role of interphases is predominant in heterogeneous systems and consequently the role of dispersed systems, of liquid structures, of fine properties of water, of liquids in movement of low frequencies and so forth is also predominant.

While investigating said phenomena we are bound to fall upon those that do not occur at an atomic or molecular level , but at the level of the great and extremely complicated structures of

heterogeneous systems, where very weak energy engenders variating, unforecastable and extremely evident effects. This is an intermediate level between the atomic, molecular and macroscopic levels.

With the same number of bricks many different things can be built, and each in a different style: houses, schools, forts, bridges, workshops. Once the money for the actual construction is available, building a house or something else makes little difference as far as expenses are concerned. Something similar takes place in nature. In fact it is important to notice that being familiar with bricks does not imply that one is familiar with the construction that will be built; just as being familiar with atoms that make up living organisms will not necessarily explain how the living organism will be and what it will do. Many renowned physicists have often agreed on this point.

Physicists are today focusing their attention on extremely complex systems such as colloids and living organisms, which owing to their extreme complexity respond to any clear signal, even if one of very low energy, and even if there is no logical or physical connection between the signal transmitter and the receiver. Small stimuli produce large variations in such systems. The theory of information and the appropriate formulation of the principle of determination, fully justify this behaviour. On the other hand chemists have long been aware of the existence of many important transformations that hardly require energy at all.

Life exists, and can only exists at this degree of complexity, in systems that are heterogeneous and out of equilibrium. In fact biological systems are out of equilibrium as long as there are alive.

The above mentioned facts agree with the modern philosophy of science. The concepts of absolute exactitude and certainty in the experimental field are giving way to more flexible concepts, by far more adherent to reality in physics. Today, for example, we are noticing that some of our dear old constants are varying in the course of time.

At this point I should consider the differences existing between the concept of simple and complex systems, of open systems, closed systems and isolated systems of the statics and dynamics of systems, but this would led us too far from our survey. I shall just add that according to the definition used in thermodynamics, an isolated system does not exchange matter or energy with the environment, that a closed system does not exchange matter but energy, and that an open system exchanges matter and energy. The systems we are studying belong to the second and third class.

Living organisms can only exist as open systems from a thermodynamic point of view. In order to subsist they require a constant exchange of matter and energy to keep far from thermodynamic equilibrium, from maximum entropy to less probable states. The energy and matter absorbed from without by living organisms would be used to delay, arrest or invert those processes that in isolated systems would unrelentingly lead to thermodynamic equilibrium, towards the most probable state, that is towards death.

Physicist Leon Brilloiun wrote in his book: Vie, matière et information (Albin Michel, Paris 1959, pag. 131): “the principle of Carnot is essentially a decree of death: the degradation of energy. It applies strictly to the (dead) world of inanimate matter. Life and thought lead to new problems which require a complete revision”.

The study of fluctuating phenomena is concerned with the relationship between living beings and forces acting in the space surrounding them, thus involving not only physical science and science of life, but also human science.

The problem of method

The fact that we are not able to control all but only a part of the conditions in which an experiment is carried out, compels us to reconsider the problem of experimental method. We cannot assert, that only experiments giving constant results in the course of time, if repeated in identical traditional conditions, are valid; we can neither assert that all those experiments giving results not reproducible in the course of time, even if carried out in identical conditions are not valid.

We must make use of the non reproducibility of the results so as to relate said phenomena with known or unknown causes of interference acting in the surrounding space. We therefore need a method

which considers the fluctuating of results as a positive element – an element giving sense and exactitude to research, including together with traditional variables, all the space variables disregarded until now.

The problem of time

As forces acting in the surrounding space vary constantly in the course of time, it is absolutely necessary if we want to proceed with rigour, to consider time not as duration but as a coordinate. A space situation corresponds to each instant (moment), and it will not remain constant but it will vary, and rarely will it return to be exactly what it was before at a given moment. Time is not then an indifferent element from a physical point of view. One hour is not exactly the same as any other hour because every hour has a different space condition.

Considering time as a coordinate, we introduce the history of phenomena in this investigation. The history of a system is important. In fact, not necessarily a system becomes what it was before if brought back to the same initial conditions. Events may have brought about long lasting changes. Not all reactions to stimuli are elastic.

We are well aware of the fact that water deriving from melted ice and water deriving from vapour condensation are different, and that much time will elapse before the two waters become similar once again. Thus two samples of the same water, that have undergone different situations once brought back to the same temperature and pressure conditions, not necessarily are identical; as supported in thermodynamics, that does not consider the factor time.

A complete revision in this field is undoubtedly necessary.

Causality and repeatability of experiments

If instead of simply taking measurements and collecting observation data, we attempt to establish a dependence relationship between two or more phenomena, we may be faced with a great many difficulty when considering a relation of cause and effect. These difficulties arise when the researcher comes up against results that fluctuate in the course of time, and that fluctuate not within the limits of experimental errors, but far beyond these.

But how are we able to exactly establish a dependence of cause and effect, when we only fix a part of the experimental conditions, while the remaining ones act independently or even unknown to us? This is the problem we daily come up against. If we ignore it, it would be lacking in scientific rigour, at least in theory.

According to Bridgman, A is a cause of B. When A reoccurs, B does the same. As this not always takes place, a group of A events is compared to a group of B events, thus assessing by means of statistics, the reliability of the correlation. This is the procedure usually followed.

However, apart from the varying concept of causal relationship, one thing seems quite certain, and that is that any empirical verification requires the repeatability of the first term A of causal relationship. If A were not repeatable, how could we exclude that the relationship of between A and B observed only once, is not simply due to hazard? Repeatability is a necessary condition. But then how can we be sure that the events of group A: A', A", A'", etc. can be compared among themselves? And similarity the events of group B: B', B", B'", etc.? In order to admit that A is repeatable we also have to admit:

That the system may be isolated so that the variation of the phenomena out of the system may not modify the event under consideration, or may do so but to a small extent.

That when the system is brought back to its initial conditions, these conditions are once again identical, notwithstanding the unquestionable differences of the events the system went through before returning to the initial conditions.

In the case of the above mentioned systems, evidently these assumptions cannot always be accepted. Bridgman wrote this effect :

1) The experiment justifies the hypothesis that a physical isolation may be possible. In practice, isolation is never complete, but it can be presumably brought to the desired degree of approximation.

2) In practice, the identity of the past process is necessary for a relatively short period of time.

It seems that logic precision cannot be reached for this point, but the physical concepts themselves do not possess the necessary precision.

Concerning this point Geymonat has added: "even though the above mentioned position is shared by many scientists devoted to physics and methodology, who consider it as the highest expression of critic awareness, it must be observed that at present a certain resistance is starting to grow against it, owing to its excessive narrowness."

In the case examined by us, experimenters and observers of fine phenomena, physical isolation can be considered a myth, as also the lack of importance ascribed to the history of events.

CHEMICAL TESTS

Absolute experiments

The factors successfully affecting a system which is heterogeneous and out of equilibrium are partly internal and partly external to the system. The internal factors are: turbulence, diffusion, germination of the solid phase, growth of small crystals, forming a micelle aggregates, contraction of interphase surface with all the phenomena that such contraction entails an so on. The external factors are: the traditional ones we can control (temperature, pressure etc.), and the spacial ones we cannot control.

The internal factors act as chance directs, while the space factors vary continuously. It is therefore impossible to obtain a costant result in the course of time, even when operating in constant traditional conditions.

Apart from this, the exact reproduction in the course of time of the chemical conditions existing in a give moment is extremely difficult if not impossible in theory. We should have to carefully control the impurities of reagents, the fine properties of water and of solvent liquids, know their history and so forth. The importance of the traces is well-known. In fact, isn't a minimum quantity of germanium sufficient to prevent a good electrolysis of zinc? An attempt to restore the identical chemical conditions, would undoubtedly lead to a great waste of time and work in the course of years.

Even an exact reproduction of physical conditions would be extremely difficult. Now if we want to keep temperature constant and this would be most desirable – we have to thermostatize the entire system under consideration. But how many fields and how many actions in loco would we introduce in the system with such operation? Electric motors, relais, agitators, turbulence, surface friction, liquid flow, presence of metal parts etc. all disturb the trend of sensitive processes such as those we are now examining. We would believe we are gaining in rigour while in reality we would not.

Differential experiments

Let us carry out two simultaneous experiments, in the same place and in the same identical traditional conditions, two precipitations for example. Let us carry out two precipitations in two beakers, one marked red and the other blue, and let us observe the relative speed of sedimentation.

This experiment is differential. The external factors, given a unity of time and place, are identical at every moment for the two reacting systems, while the internal factors will act according to chance, and this is sufficient for us to say that even the experiment acts according to chance. A differential experiment carried out on a single couple of tests will be of no significance.

Now instead of two precipitations we will carry out two series, i.e. 10 in blue beakers and 10 in the red ones. We thus have 10 pairs, each made up of a red and a blue beaker. Let us count, once the precipitation has taken place, how many times the precipitations has been more rapid in the red beakers.

Thus the chances of obtaining good results from the differential operation are greater. In fact, out of 10 pairs, the possible answers are the following:

Number of more rapid precipitations											
Blue series	0	1	2	3	4	5	6	7	8	9	10
Red series	10	9	8	7	6	5	4	3	2	1	0

(11 answers in all)

Thus, the percentage of the more rapid sedimentations of the red series, gives us a scale varying from 0 to 100. in such a way we have obtained a statistical numerical result. As on 10 pairs, the internal factors act according to chance, we will obtain, on a sufficient number of tests, a response to chance, that is approximately 50%. And this notwithstanding the fact that the external factors were always the same, in each moment, for both series.

We have verified these statements by means of experiments carried out between 15.10.1954 and 6.11.1954, with 100 series of precipitations on 10 pairs each time (i.e. 1000 pairs of precipitations in all). The results was:

1) General average: 50.4%

2) Gaussian distribution of the frequencies of the various answers, see **figure 1** .

The differential experiment repeated various times over a period, has proved that in such a way an answer to chance can be obtained. Now this is very important for a better understanding of our method of work.

Chance and not chance

Now let us alter one of the traditional conditions of the red series and let us repeat the experiment. As the alteration is not due to chance, we will find it once again in the general results. It is quite evident that if we increase the temperature in the red beakers, the number of times that the precipitation proceeds more rapidly in this series will greatly increase.

Now instead of altering the traditional variable we will modify a space variable. We will place over the beakers of the red series a thin copper plate. The copper plate cuts the atmospheric electric fields an partly absorbs or reflects electromagnetic radiations. Electric and natural electromagnetic fields are thus greatly disturbed. If the electric and electromagnetic variables are not due to chance, we will be able to trace their action in the results of our experiments.

We have verified this statement by means of experiments, and have carried out simultaneously, the above mentioned tests and other 100 series of precipitations each on the 10 pairs (i.e. 1000 pairs of precipitations), after having covered the red series with the copper plates 0.1 mm thick. The result was:

1) General average: 70.1%

2) Non gaussian distribution of the frequencies of the various results, see **figure 1**.

Evidently external actions were not due to chance during the experiment, and their effect was manifest.

Chemical tests F, D, and P

The operation described at the end of the previous paragraph is no longer a differential experiment, it is a chemical test, that is an operation giving a numerical response, which points out how the resultant of the space forces have affected the system.

The numerical response is obtained by counting, not by measuring. It is interesting to notice that from a philosophical point of view these terms are equivalent. Counting greatly simplifies the practical execution of the test, as no apparatus is necessary.

We can act on the red components of the pairs in two different ways:

1) Modifying the space conditions: i.e. carrying out the precipitations of the red series in a different environment from that of the blue series. For example: within a metal chamber in a cellar, in a cave a so forth, instead in open air. This difference in environment is enough to cause a different behaviour in the chemical system of the red beakers with respect to the blue ones, even if said system is kept in identical traditional conditions.

2) Modifying one of the reacting systems: that is altering one of the reagents of the red series, physically not chemically. If one of the reagents were water, the modification could be imposed by applying to water before using it, a low frequency electromagnetic field. Under the effect of the field, water varies its structure, becomes different and remains such for a rather long period of time: a few days. The sensitivity to external factors of the two waters, the normal and the irradiated one, is not the same and the result of our chemical operation will be statistically different in the two series.

We have three possible tests and they are collected in the following table I :

	TABLE I	
	Condition I	Condition II
Test P	Normal water	Normal water
	Unmodified space conditions	Modified space conditions
Test F	Normal water	Modified water
	Unmodified space conditions	Unmodified space conditions
Test D	Normal water	Modified water
	Modified space conditions	Modified space conditions

A fourth test can be added to these:

Test PA	Modified water	Modified water
	Unmodified space conditions	Modified space conditions

PA test is currently registered in Brussels.

Chemical tests in practice

Let us now examine the tests used for our general survey on space phenomena.

Among the many reactions of precipitations experimented in our tests (it would be useless to list them here) we have chosen a reaction whose reagent is water, that is hydrolysis. Two reasons have influenced our choice:

1) The first is a general reason: water is the most abundant liquid on the earth, the most important, the most complex, the one that differs most (owing to its extraordinary properties) from all the liquids to which it should resemble, the liquid without which life could not exist. The fine properties of water still have to be studied. At this point a more accurate investigation on water, its structure and the problems set up by this structure would be necessary. But this would lead us too far astray.

2) The second reason has a practical character: the adoption of hydrolysis simplifies things greatly, as the experiments have to be carried out with tests in far and uncomfortable places, the water reagent can be found anywhere on the spot. It will be enough to bring along the substance to be hydrolysed, that is a single reactive.

We chose bismuth chloride in acid solution as substance to be hydrolyzed. Oxichloride is obtained from hydrolyzed chloride, it is an insoluble compound which precipitates in a colloidal state, and forms an

opaque solution. In a short time, in the conditions set up by us, bismuth oxichloride flocculates and sediments. By hydrolyzing bismuth chloride a typical system which is heterogeneous and out of equilibrium, and sensitive to spacial phenomena is thus generated.

As we are faced with differential experiment the water needs not to be extremely distilled nor the bismuth chloride too pure. It is important however that the compared tests (those of the red and blue series) be carried out with the same identical reactives and at the same temperature. This identity, both in chemical composition and in temperature, is rigorously assured by taking, for each series of tests, the bismuth solution always from the same bottle and the water also from the same bottle.

The standard rules for preparation and execution of experiments with chemical tests, were given at the beginning of International Geophysical Year 1957-58, see **figure 2**.

Chemical tests in the world, from 1951 to today

The chemical tests have been studied from two different points of view, both equally necessary:

1) Physical and chemical-physical, experimental and theoretical study of the action mechanism of the tests. This has been an extremely difficult task, owing to the great delicacy of fluctuating systems and the difficulty of carrying out physical measures without disturbing the phenomena under consideration.

2) A long and extensive experimentation of a naturalistic kind, to be carried out in different spots of the Earth, in order to observe the behaviour of chemical tests over a period of time and in different places. In fact, it was necessary to know how chemical tests responded to special factors and by which were they most influenced.

It was impossible to consider the first field without having explored, at least in general, the second. table II shows how the studies on chemical tests have been distributed in different countries.

It is evident from Table II that the chemical tests have been carried out in 29 different places on the Earth, scattered both in Northern and Southern Hemispheres. In 3 places these experiments have been carried out for a long period of time and that is: Florence, since 1951; Brussels, since 1952; Kumamoto, since 1958. These are the bases of our research. I will refer in particular to the experiments carried out in Florence.

Thanks to a rigorous routine of three daily tests carried out at fixed hours (7, 11, and 17) on standardized and mechanized chemical tests, we now have many tens of thousands of numerical data, covering a period of over 16 years, including two minimum and one maximum of solar activity.

It is a perfectly homogeneous group of data which has enabled us to carry out an unexceptionable statistical elaboration, which has led to more than valid results. These results have been discussed in many international meetings, talks and symposiums expressly organized.

TABLE II

FROM	TO	AUTHOR	SPOT	LAND
01.03.51	To go on	Piccardi et al, University	FIRENZE	ITALY
01.10.52	To go on	Capel-Boute, Free University	BRUSSELS	BELGIUM
12.02.53	31.12.55	Doat, Piccardi, Weintal Wasserleitung	VIENNA	AUSTRIA
01.05.54	01.12.54	Fritsch, Tech. Hochschule	MOOSERBODEN	AUSTRIA
01.05.54	01.12.54	Fritsch, Tech. Hochschule	KAPRUN	AUSTRIA
26.04.57	29.03.58	Mayer, University	TUEBINGEN	GERMANY
23.10.57	31.12.58	Mayer, University	JUNGFRAUJOCH	SWITZERLAND
01.06.57	31.12.58	Bossolasco, University	GENOVA	ITALY
04.09.57	15.09.58	Mosetti, Geophysical Obs.	TRIESTE	ITALY
28.03.57	27.03.59	Morelli, University	BARI	ITALY
15.12.57	31.12.59	Picotti, Thalassographyc Obs.	TRIESTE	ITALY

04.09.57	15.09.62	Service Meteorologique	LEOPOLDVILLE	CONGO (ZAIRE)
02.07.57	31.08.59	Service Meteorologique	FORT DAUPHIN	MADAGASCAR
16.02.57	18.02.60	Wagner, Tech. Hochschule	VIENNA	AUSTRIA
02.07.57	31.12.59	Service Meteorologique	LIBREVILLE	GABON
06.05.58	30.11.60	T.A.A.F. (1)	PORT AUX FRANCAIS	KERGUELEN ISLANDS
26.06.58	31.08.60	Itoh, et al., University	SAPPORO	JAPAN
25.11.58	To go on	Ogata et al., University	KUMAMOTO	JAPAN
25.10.59	10.09.60	Expeditions Antartiques Belges	BASE ROI BAUDOUIN	ANTARTICA
27.02.60	01.05.61	Masini, Nordlysobservatoriet	TROMSOE	NORWAY
15.01.60	31.01.61	T.A.A.F. (1)	NEW AMSTERDAM	NEW AMSTERDAM ISLAND
11.08.61	06.09.61	Maletto et al., University	FRABOSA	ITALY
16.07.62	17.08.62	Maletto et al., University	MONTE BIANCO	ITALY
10.05.65	23.05.65	Kahn, University	BAFFIN ISLAND	ARTIC LANDS
15.06.65	19.07.65	Kahn, University	MEIGHEN ISLAND	ARTIC LANDS
04.08.65	25.08.65	Kahn, University	CORNWALLIS ISLAND	ARTIC LANDS
1964	1965	Fisher et al., N.C.A.R. (2)	BOULDER	USA

Terres Australes et Antartiques Françaises
National Centre for Atmospheric Research

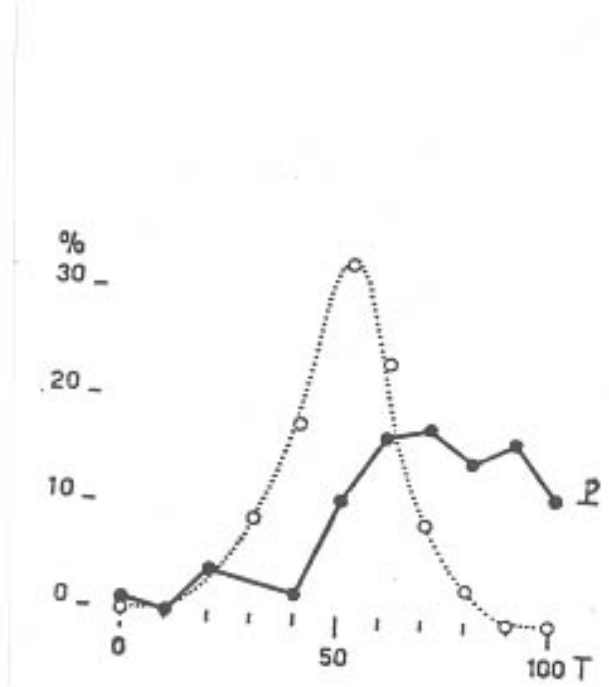
CHEMICAL TESTS AND SOLAR PHENOMENA

The processing of the collected data was carried out without preconceived ideas and without putting forth assumptions concerning the relationship between chemical tests and spacial phenomena. We did not want to ascribe the observed fluctuations to the action of given natural phenomena, as often occurs in the field of climatology. It was thought our tests would point out, with their fluctuating trend, which group of space phenomena was mostly responsible for such fluctuation. Our study was to be of a general and explorative character.

As soon as we started our research it appeared evident that the most important disturbing elements were not of a meteorological and climatic nature, as was thought by many, but of a solar nature. Chemical tests are affected: a) by solar phenomena; b) by secondary phenomena, which originate on the Earth from solar activity; c) by non solar phenomena, as low frequency electromagnetic fields artificially produced. Solar phenomena gives predominant effects overall.

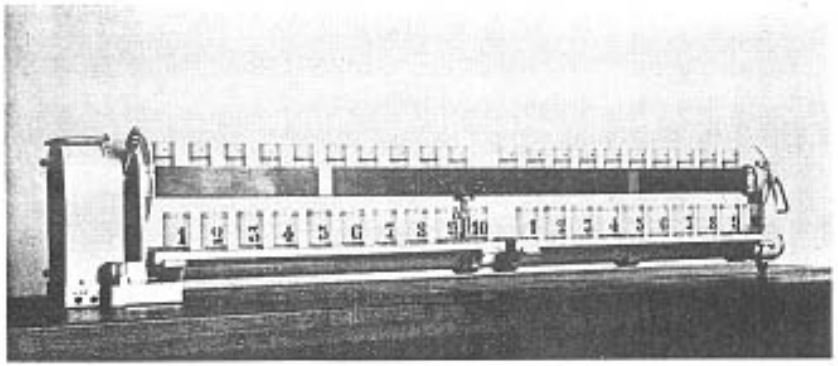
Chemical tests and sun spots

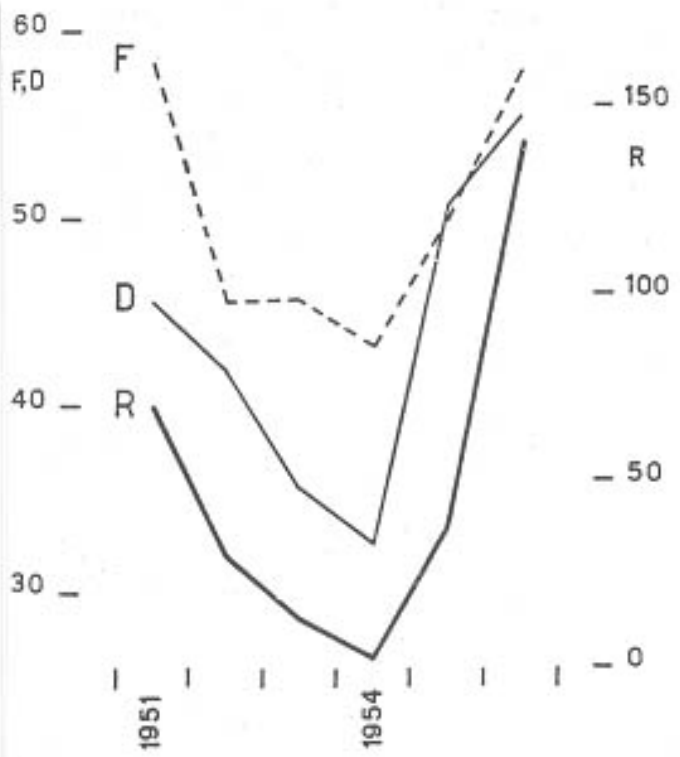
The routine of chemical tests was started in Florence in 1951. During the first two years of work not much was discovered on the nature of the agents affecting the tests. A very strong annual variation had appeared, and we will discuss this aspect further on. But as early as the end of the third year (that is in 1953) we caught a glimpse of a possible relationship between chemical tests and solar activity. The relative number of sun spots, Wolf's number R, was taken in first approximation, as an index of solar activity. It was thus possible to forecast how the tests would behave in the following years. The values of the tests had greatly decreased from year to year from 1951 to 1953. The same had occurred for number R.



F.1

F.2





F.3

FIGURE 1 Chance and not chance. On the abscissa the percentage; on the ordinate: the frequency of the percentage. Note the perfect symetry of the distribution around 50% in the case of the blank test , and the dyssimetry of the distribution in the case of chemical test P .

FIGURE 2 - The syncronous mixer Model 20 A , in use for chemical tests .

FIGURE 3 - Chemical tests F, D and Wolf's Number R. Annual averages. On the abscissa : time in years.

As the minimum solar activity was forecast for 1954, if a real connection existed between chemical tests and solar activity, a decrease would be noticed in the tests in the course of 1954, immediately followed by a rapid increase in the following years. **Figure 3** shows the trend of the yearly averages of chemical tests F and D and of number R between 1951 and 1957. Our forecast proved correct

A more complete survey was to follow this first empirical observation. Dr. U. Becker,Fraunhofer Institute, Freiburg i. B., directed by Prof. Kiepenheuer, undertook this task. Becker calculated, on data collected in Florence, the rotation averages according to Bartels (1 rotation = exactly 27 days) of test F, D and R number. The first rotation considered was the 1612 (March 13 – April 8 1951) the last was the 1666 (March 10 – April 5 1955). The direct comparison between the rotation averages gave a good correlation between D and R. But the correlation would have been even better if the comparison had been made between the n rotation average of R and the n + 1 rotation average of test D.

In order to eliminate short term fluctuations, weeks or months, Becker smoothed to 5 the rotation averages of F, D, and R. A 5-rotation interval corresponds to 135 days. The short term fluctuations flattened but not the yearly or longer period ones. The constellation of points representing the current averages of 5 rotations, in diagram R, D, **Figure 4**, and R, F, is so tightly arranged around the regression line that the correlation appears more than significant. The regression lines are:

Test D = 0.34R + 29
Test F = 0.23R+ 40

It was then necessary to demonstrate that the discovered relationships were not trivial correlations between magnitudes that vary simultaneously by chance, without connection between them. Becker then smoothed the rotation averages to 13. In other words he shifted an annual average from rotation to rotation (13 rotations = approximately 1 year). **Figure 5**. F, D and R vary again in a perfectly parallel manner and they reveal a minimum in correspondence with the 1653 rotation. The 1653 rotation corresponds with the minimum of solar activity. Thus it was doubtless that we were not faced with a trivial correlation. The relationship between R and F, D tests over the period of minimum solar activity had been fully demonstrated.

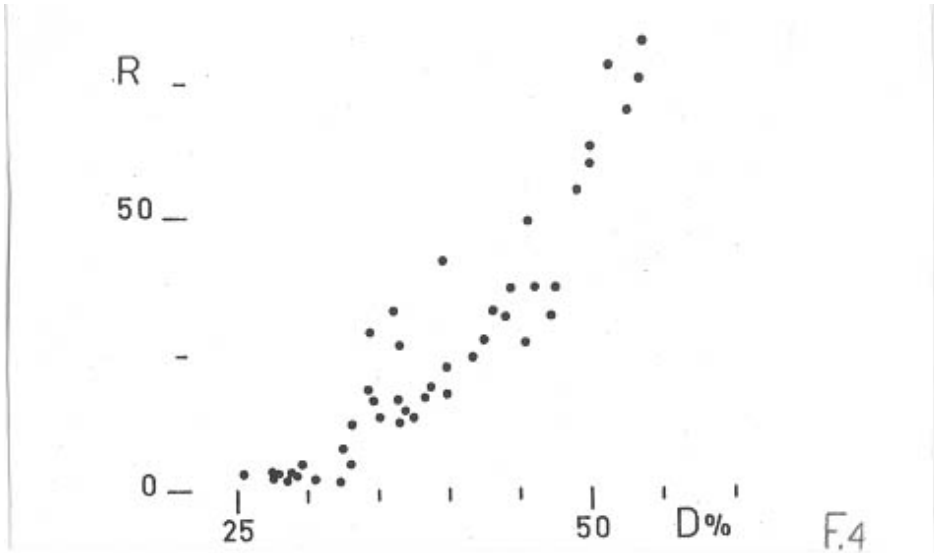
Other studies followed these first ones, when the solar activity was sufficiently great, and we were also able to detect a saturation effect. Let us reconsider the rotation averages smoothed to 13 and let us follow them over a period. See **Figure 6**. It is evident that when R exceeds 50, D is no longer proportional to R. The representative curve flattens and tends towards a horizontal asymptote. R can rise from 50 to 100, 200 or 250, D does not exceed value 60. The same takes place with F. This fact is highly important and it enable us to understand many things in the field of biology. In fact it is very easy to saturate a system which is heterogeneous and out of equilibrium.

The correlation were checked immediately after, by Prof. Berg, University of Cologne, who found them indisputable. Our results were thus included in Vol. XXX of Probleme der Kosmischen Physik, Solar-Terrestrische Beziehungen in Metereologie un Biologie. Lipsia , 1956.

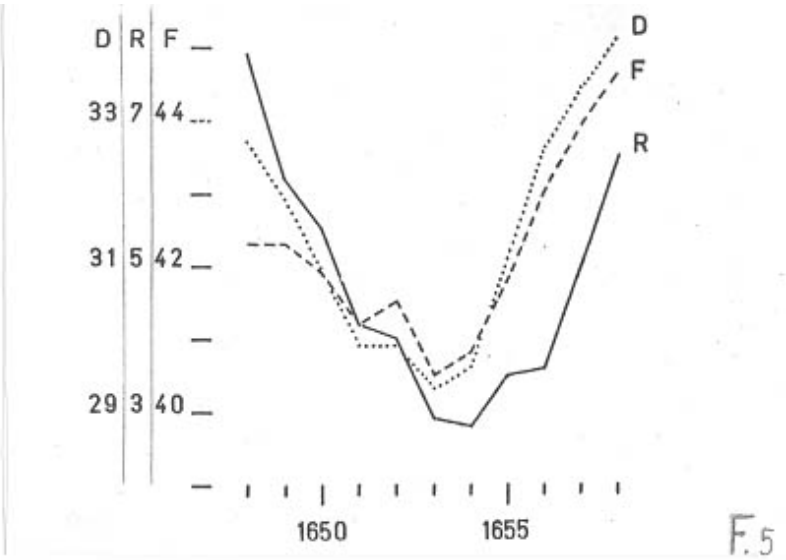
Test F and chromospheric eruption

Becker wanted to make sure that the chemical tests responded not only to general sun spot activity but also to single chromospheric events. He examined the second and third class chromospheric eruption reported in the Quarterly Bullettin on the Solar Activity 1951-1953. The eruptions chosen were those observed simultaneously by various observatories, with the same intensity, or with a known and reproducible scale of intensity. After a rigorous selection 37 eruption were chosen.

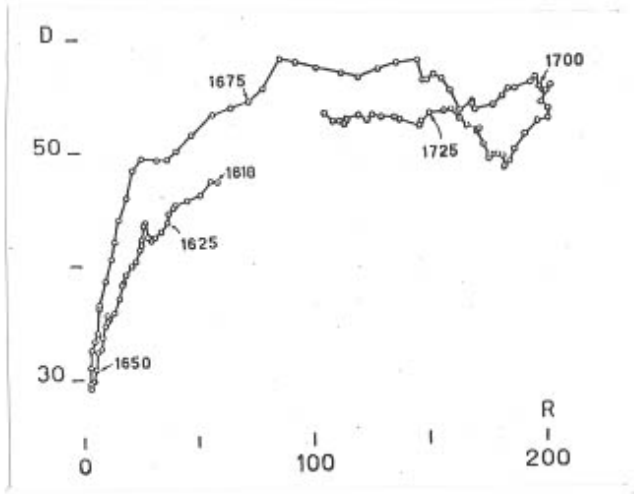
The effect of the eruptions consists in a great and sudden rise of the values of test F. The effect is noticeable in single eruptions in 80% of the cases. See **Figure 7**. Test D does not seem to be affected by the eruptions and remains still.



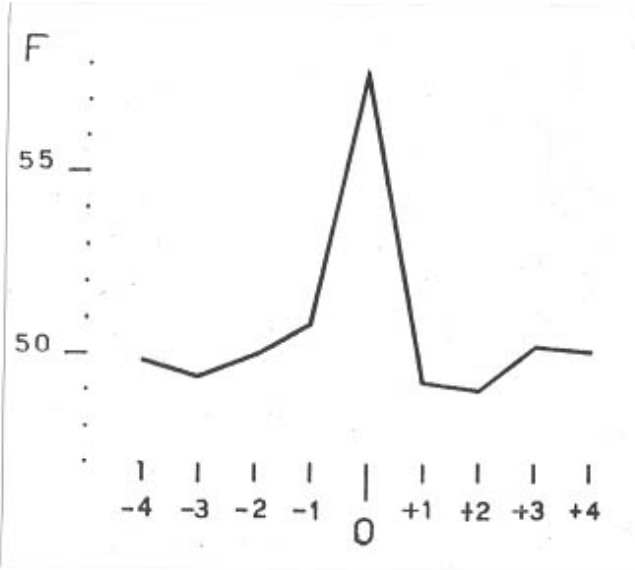
F.4



F.5



F.6



F.7

FIGURE 4 - Correlation between test D and solar activity, according to Becker .

FIGURE 5.-.Test D , test F and R in function of time . On the abscissa: time in solar rotation according to Bartels .

FIGURE 6 -.Relation between test D and Wolf's Number R according to Becker. The numbers on the graph indicate the solar rotation .

FIGURE 7 - Effect of solar eruptions on test F. Method of suprposed epochs according to Becker.On the abscissa: the day of eruption (0) , four days before and four days after .

Becker studied the effect of the eruptions following the method of superimposed epoch. He first built a model with 37 dummy zero days, corresponding to days 1 and 15 of every month, taken within the considered time interval. He superimposed the values of tests F and D of the zero days, of the four preceding days and of the four following days, and computed the dispersion of his model. The dispersion was + 2.74; - 2.74. After that he superimposed the values of test F and D corresponding to the days of the eruptions on the four days preceding and on the four days following that of the eruptions. He then compared the two series of values. During the days of the eruption the shift average of the model was of +9.5. The effect of the eruption is therefore 3.5 times greater than the dispersion of the model, and is thus statistically certain. A further statistical demonstration on the basis of the t-test proof fully convalidated this result.

Berg was to say: "Here for the first time we have the connection between a terrestrial experiment and solar phenomena, guaranteed by the adoption of a severe conventional condition of a remainder probability not over 0.3%."

Here are the data concerning the effect of chromospheric eruptions on the test F in the three considered years. See table III.

TABLE III

	-4	-3	-2	-1	0	+1	+2	+3	+4
1951	53.6	57.5	60.2	60.2	63.7	60.1	55.7	55.8	55.0
1952	45.1	43.6	39.8	40.6	54.8	39.1	41.2	46.5	47.2
1953	44.0	40.0	42.0	46.0	57.0	40.0	48.0	44.0	54.0

Chemical tests and solar corona – The anomaly of 1958

During the maximum of solar cycle 1954-1964, an important fact was noticed: while Wolf's number, as a function of time, described a characteristic bell-shaped curve, the chemical test, in correspondence to 1958, presented a secondary minimum, almost a specular image of the curve representing R. Evidently something other than sun spot activity had acted on the tests.

Now this was not an isolated fact. A few authors had already noticed similar phenomena in previous cycles or in the same cycle: Besrukova, on water levels lake Victoria in Africa; Vitels on the shifting of masses of air in the artic aurora zone; Bossolasco et al. on global solar radiations; Berg on widespread metereological phenomena; Schoulz on the frequency of functional leucopaenias in URSS.

It was Gnévishev however who found the key to this problem. His extremely accurate studies on the intensity of the green solar corona (λ = 5303) underlined that the intensity of the corona had strongly decreased in 1958, so that its trend was forked during the cycle. He supposed this fact with a theoretical interpretation. Gnévishev and Sazanov discovered a marked minimum even on the distribution of the baric formations at 5000 m of altitude in the Northern Hemisphere, and this perfectly corresponded to the minimum presented by the corona.

Figure 8 shows the trend of R, the intensity of the green solar corona and of the chemical tests F and D. Gnévishev also related the intensity of the solar corona with test P. The parallelism existing between the values of the tests and the values of the corona intensity, prove once again the dependence of the chemical tests on solar activity. In this way we have demonstrated that the solar corona give its own rhythm to many terrestrial phenomena and to chemical tests.

General statistical considerations on the relationship between solar phenomena and chemical tests

In 1962, after 12 years of uninterrupted routine research, we had been able to observe minimum and maximum solar activity. We therefore had data corresponding to the various phases of the

solar cycle. Let us thus consider from a general statistical point of view the correlations between chemical tests and solar phenomena.

By the end of 1962 we had over 30.000 responses to our tests collected in Florence, as previously described constituting a homogeneous group of data. Thanks to the cooperation of the Electronic Computation Centre of the University of Florence, we correlated the F, D and P data with the various solar indexes: R, hydrogen floccules, calcium floccules, and filaments. The results of our survey are illustrated in table IV. The additional table shows, with 140 degrees of freedom, the correlation coefficients, the level of probability and the percentages of reliability, so the reader might understand the validity of our correlation.

Test F and test D usually give the best correlations at the 11 UT, when the sun in Florence is at its utmost height on the horizon; and not as good at 17 UT when the sun is for half of the year below the horizon. Therefore an hour effect evidently exists. The best correlations are those between D and calcium floccules. The worst are those between P and hydrogen floccules. This is the most we could wish from an overall analysis of our data.

We separately correlated the data collected when R was below 50 and when R was above 50. The correlation for R < 50 were even more significant, those for R > 50 were less significant, thought fully reliable. This indirectly proves the existence of a state of saturation for high values of R.

TABLE IV – Linear Correlation Coefficients –

TEST	UT	R	H - Floc.	Ca - Floc.	Fil.
F	08	0.291	0.344	0.370	0.364
F	11	0.307	0.375	0.424	0.408
F	17	0.165	0.326	0.354	0.340
D	08	0.516	0.604	0.628	0.580
D	11	0.549	0.593	0.649	0.590
D	17	0.321	0.432	0.455	0.494
P	08	0.282	0.181	0.291	0.244
P	11	0.117	0.156	0.241	0.255
P	17	0.205	0.164	0.275	0.235
F	08 + 11	0.313	0.375	0.415	0.403
D	08 + 11	0.548	0.616	0.657	0.602
P	08 + 11	0.209	0.174	0.275	0.258
F	08+11+17	0.313	0.380	0.419	0.416
D	08+11+17	0.554	0.621	0.662	0.607
P	08+11+17	0.213	0.175	0.281	0.256

Correlation Coefficients 140 degrees of freedom	Probability Level	Percentage of Reliability
0.1396	0.100	90.0
0.1662	0.050	95.0
0.1962	0.020	98.0
0.2163	0.010	99.0
0.2667	0.001	99.9

This vast statistical verification has indisputably pointed out that solar activity is noticeable on the basis of the behaviour of chemical tests. In the case of chemical tests, the traditional statistical methods are not always the best (notwithstanding the fact that they had given good results). Throwing things together pell-mell into the statistical bundle, equalizing, sinking into mean values, thousands of data whose fluctuations are not due to experimental errors but to space factors, are all operations that prevent a full and realistic outlook on facts. At this point we should once again consider the repeatability of experiments and causal dependence. This touches the basis of the philosophy of science. In order to illustrate to my colleagues the new general problems set up by fluctuating phenomena, I wrote two reports: one was read at the SIGEM[1] meeting in Genoa, April 1966, and one at the IUCSTR[2] meeting in Belgrade, August 1966.

Upon the advice of Prof. Link of the Astronomical Institute of the Academy of Science of Czechoslovakia, we started by first studying solar eruptions. Eruptions were called to our attention by the Observatories of Arcetri and Ondrejov. The result was extremely brilliant; we noticed, each time, a coincidence between chemical data and solar data; and if at times it was the astronomers who signalled the eruptions to us, more often we signalled them to the astronomers, who later found them on the tracing of their radiotelescopes.

Highly interesting was the discovery a posteriori of a great outburst of solar high energy particles on November 12, 1960, called to our attention by the international organizations as a special event. We were lucky enough to observe that the outburst had not only affected the normal routine chemical test, but also a completely different test, that we were carrying out in a cellar: the polymerisation of acrylonitryle. In **Figures 9** and **10**, is reported the behaviour of chemical tests P and F when a solar eruption occurs.

Chemical tests therefore evidently follow the solar phenomena as single event. Therefore we cannot exclude that in a near future they may be useful for forecasting said events.

Besides a great number of experimental studies carried out on fluctuating phenomena, and long routine, Mme Capel Boute has also carried out important statistical studies on data she herself collected in Brussels (ever since 1952) and our data in Florence (ever since 1951) . Mme Capel Boute examined how solar effects varied during an eleven-year cycle, at two different latitudes. She found a significant positive correlation between the F tests recorded in Florence and Brussels, during the years preceding the minimum of solar activity of 1954, and significant negative correlation during the years preceding the maximum of 1958. She found no correlation between test D registered in Florence and in Brussels. She found no correlation between test D and F recorded in the same place, during the years of minimum solar activity, but found a significant positive correlation during the years of maximum solar activity.

Mme Capel Boute also studied the daily variations of tests F, D, and P. van der Elst, CEN, Brussels, invited us to consider all the pairs that could be formed by uniting 2 by 2 the containers of the blue and red series, instead of a given series of pairs. He asked us to work on a matrix, instead of on a principal diagonal of it, as we were doing then. Mme Capel Boute did an experimental verification of the two methods. The two methods proved equivalent, which enabled us to continue with our old method, by far simpler and more practical, instead of adopting the new one, by far more satisfactory from a theoretical point of view, but by far more difficult to apply.

CHEMICAL TESTS AND CORPUSCOLAR SOLAR RADIATION

At this point we must refer to the work done on the relationship between chemical tests and corpuscular solar radiations. We will examine three different phenomena: Proton eruption, cosmic radiations and the Forbush effect.

Chemical tests and proton eruptions

[1] Società Italiana Geofisica e Meteorologica
[2] Inter Union Commission on Solar and Terrestrial Relationship

In 1966 Dr. Krivsky, Astronomical Institute of the Academy of Science of Chekoslovakia (Observatory of Ondrejov), gave us a list of 56 proton eruptions observed between 1956 and 1965, in order to study any possible correlation between proton eruptions and our chemical Tests. We examined the data according to the method of superimposed epochs, following the same method used for chromospheric eruptions. After a first exam we noticed that test P seemed to respond the best to proton eruptions.

Synchronizing the 56 indicated eruptions, we noticed in correspondence with the zero day, a peak that was not too high, wide at the base, but evident. This led us to believe in the existence of a correlation. We then separately examined the proton eruptions occurred between 1956 and 1958, those between half of 1958 and half of 1960 and finally those occurred after the first half of 1960. The first period included 20 eruptions, the second 16 and the third 20. In this way we had isolated the year 1959. See **Figure 9**.

The eruptions of the first period show a high peak in correspondence with the zero day. Those of the second period (including 1959) are not interpretable, those of the third period on the contrary, show a peak that is not too high and is wide at the base. In other words the connection between test P and the proton eruptions is at first extremely good, then bad and finally it becomes mediocre. It is difficult to explain such a behaviour. We will therefore mention a fact that agrees with what has just been mentioned. The P test behaviour during the year 1959 was quite different in comparison with other years. See **Figure 10**.

Chemical test D and cosmic radiations

It is of great interest to examine the connections between other corpuscular radiations and chemical tests: cosmic radiations of a galactic origin, and high energy solar cosmic rays. Unfortunately we have not made much progress in this field owing to lack of data and time. We simply were able to relate the hard cosmic radiations recorded on Hafelekar, near Innsbruck, by Prof. Steinmaurer. He kindly submitted to our attention in 1953 a series of data duly corrected due to the effect of pressure. We noticed that test D seemed to respond to the variations of the cosmic radiations. We found a vague general relationship and, for two three month periods, a perfect parallelism between intensity of cosmic radiations and test D. See **Figure 11**. This field remains to be explored.

Chemical test D and the Forbush effect

Dr. Krivsky, of the Ondrejov Observatory, in 1966 kindly sent us a list of Forbush effects, asking us to examine any possible connection between our tests and said effects.

Dr. Senatra, found a weak correlation between chemical test D and Forbush effect, during the years 1960-61-63. No correlation was found in 1959.

Dr. Senatra, considered also the possible reasons of this unusual P test behaviour in 1959. On the basis of her investigation it seems possible to ascribe the anomaly of 1959 to the dissymmetry of eruptions in the northern and southern hemispheres of the sun. In 1959 the eruptions in the northern hemisphere were predominant. Such great predominance has never occurred from 1957 to our present day. We will continue our studies on the basis of the dissymmetry in the two solar hemispheres. The above mentioned facts are merely indicative.

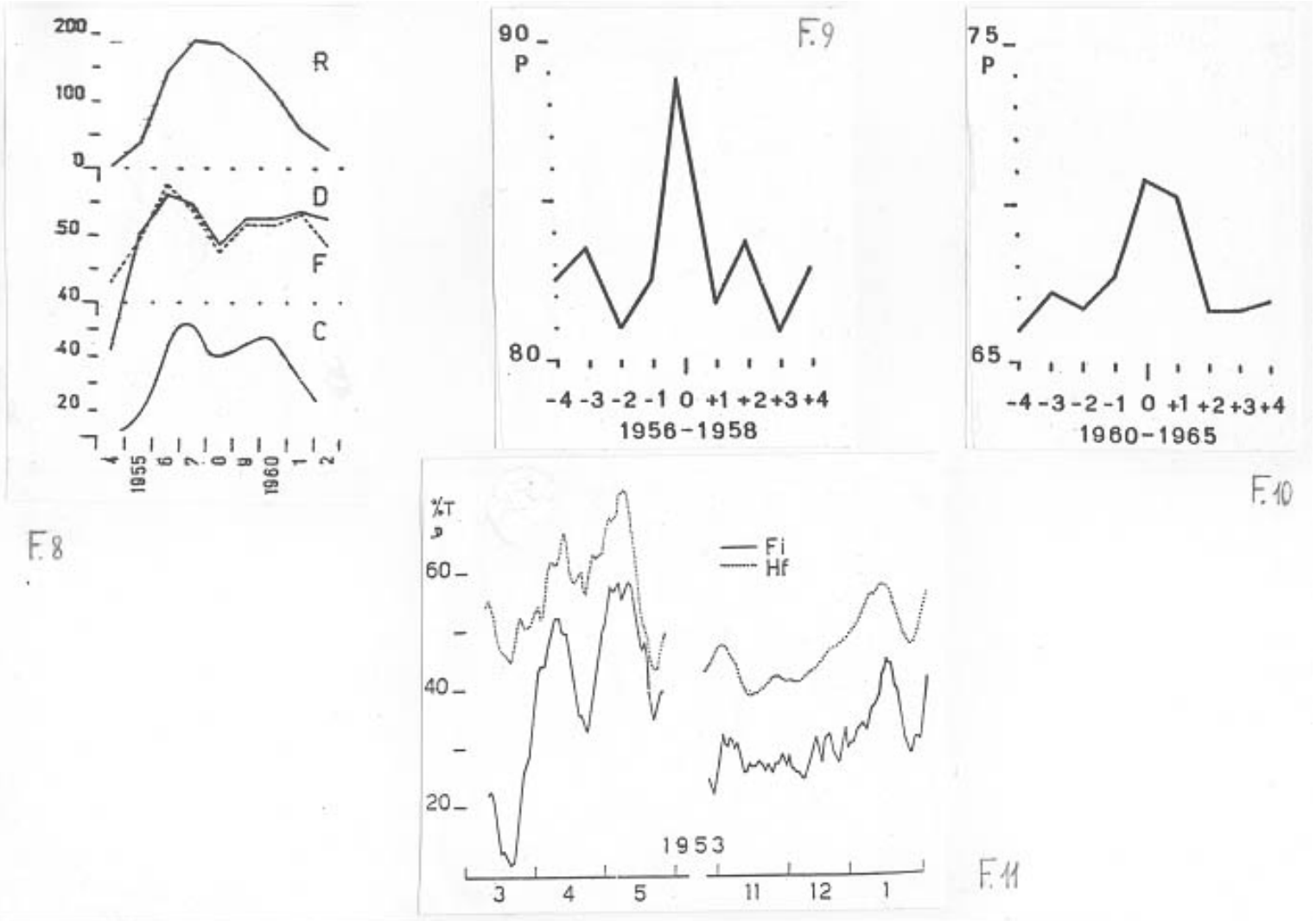


FIGURE 8 - The relation between Piccardi's chemical tests F and D and the coronal line density (l5303 A), average around the limb. On the abscissa: time in years. On the ordinate: Wolf 's Number R , chemical tests F , D and the intensity of the green corona C .

FIGURE 9 - Test P during 20 proton solar eruptions observed from the beginning of the 1956 to the beginning of the 1958 . The maximum on zero day appeared high and acute .

FIGURE 10 - Test P during 20 proton solar eruptions observed from the end of the1960 to the end of the 1965.The connection between proton eruptions and P test is again observable .

FIGURE 11 - Test D in Florence and intensity of cosmic radiation on Hafelekar (Innsbruck) during two periods of three months each, in 1953. On the abscissa : time. On the ordinate: D test and the intensity of the cosmic radiation (on arbitrary scale) .

MODULATION OF SOLAR EFFECTS ON THE TESTS

Annual variation of tests F, D and P

The solar influence on chemical tests, proved by means of a direct correlation, should be noticeable indirectly on the basis of the trends of the various tests over a period of time. Obviously if this influence exists, it must be modulated from the relative position earth- sun, that is from the revolution of the earth around the sun, and therefore from the position of the sun on the horizon and from the distance of the earth from the sun. In other words it should show an annual variation. As for us, we have observed annual variations ever since the beginning of our research.

Test F reveals a sinusoidal annual variation, with a minimum in July. This variation, evidenced by Becker ever since 1953, was confirmed by us by means of 15 years of data (1951-1966). The amplitude of the variation is not great: about 6% of the average ordinate.

Test P also reveals an annual variation, but it is not a simple sinusoid, in fact it is made up of a double wave. The principal minimum occurs in July as in test F. The average amplitude of the variation is rather large: 20% of the average ordinate. See **Figure 12**.

Test D also reveals an annual cycloidal variation. This variation was observed right at the beginning of our research and was highly evident. The average amplitude of the variation is extremely large: in the first 9 years it was 33% of the average ordinate. This variation, similarly to that of test P, is made up of a double wave. But while the annual variations of tests F and P have not changed their characteristics in the course of time, those of the test D have, and owing to this we will have to consider the case of test D separately.

Anyways, the existence of annual variations in the trend of each test, proves the dependence of the test on solar phenomena.

Annual variation of test D and solar hypothesis

Test D shows a marked cycloidal variation. This cycloidal variation (and not sinusoidal) seemed to exclude that the variation of test D was due to seasonal factors. See **Figure 13**. Once again the meteorological and climatic variables were excluded by the trend of test D.

At first Becker thought the variations were accidental, or to be ascribed to an accidental minimum of the number of solar spots (as test D was affected by the activity of solar spots). However, during the following years the variations of test D persisted while the minimum of solar spots disappeared. Thus the annual variation of test D could not depend on solar activity. This being the case, the above mentioned cycloidal variations had to be explained by means of a special work hypothesis.

A cycloid results from the combination of a circular uniform motion with a rectilinear uniform motion. Now as the variation was annual, we obviously considered the revolution of the earth around the sun as the circular motion. Consequently, having accepted the earth's revolution as the motion component of the cycloid, we necessarily considered the movement of the sun towards its apex (constellation of Hercules), as the rectilinear motion.

The motion of the sun towards its apex forms a 53° 26' angle with the ecliptic plane.

The resulting motion is helicoidal , and varies greatly in direction and speed . The projection of this motion in the ecliptical plane is a cycloid. Here are the standard data, that have enabled us to study in first approximation the helicoidal motion:

Linear speed of the earth on its orbit 30 Km/s

Linear speed of the sun towards its apex 19Km/s

Equatorial coordinates of the standard apex α 270 °, ξ 30 °

Assuming that the earth describes a circular orbit with uniform motion, we obtain that:

1 in spring the earth moves in its equatorial plane at a maximum speed of 45 Km/s
2 in autumn the earth moves, if not along its axis, then in a direction not too far removed from that of the north pole, at a minimum speed of 24 Km/s.
3 except for a short period around spring equinox, the earth moves with the northern hemisphere leading. See **Figure 14** .

If space were empty and avoid of fields, the helicoidal motion would not have any physical consequences. But as space is not empty and avoid of fields, this motion must have noteworthy consequences. In fact, the physical condition of a magnetic body, surrounded by an electrical charged atmosphere, which moves in a space field, must be affected by speed and direction variations. Besides this Prof. Giao (University of Lisbon) has considered the Solar Hipothesis from a relativistic point of view.

If we bear in mind that the galactic coordinates of the centre of the galaxy are l = 325° and b = 0 and those of the solar apex are l = 23 ° b = 22 ° we notice that in spring the earth moves approximately towards the galactic centre, that is along the lines of force of an eventual radial field and perpendicularly to the lines of force of an eventual dipolar field. This consideration might prove useful.

Exact computations on the helicoidal motion were carried out at the Institute of Mathematics of the University of Florence by Dr. Quilghini. An animated model of the helicoidal motion was presented in the Planetarium of Brussels during the world fair in 1958. See **Figure 15**.

The hypothesis according to which the helicoidal motion of the earth through fields of force existing in interplanetary space, should produce significant effects, was called the Solar Hypothesis.

Experiments in the Northern and Southern Hemispheres and the Solar Hypothesis

According to the solar hypothesis the chemical tests had responded to the variation of the Earth's motion in interplanetary space. Therefore, the chemical tests should have evidenced two facts on the basis of the solar hypothesis.

1) Contemporaneity of the annual D test minimum in the two hemispheres (and not at 6 month displacement, as for any seasonal factor).

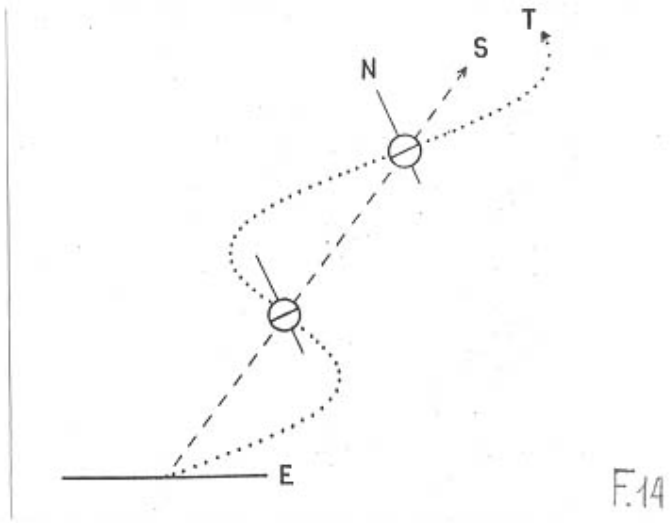
2) Asimmetry of the behaviour of the chemical tests in the Northern and Southern hemispheres.

The first fact depends on the general character of the disturbance generated by the helicoidal motion. The disturbance invests the whole earth. The second depends on the impact of the Northern hemisphere against matter and fields of force existing in space. In order to verify the two facts foreseen by the solar hypothesis, experiments were carried out in the Northern and Southern hemispheres, during the IGY 1957-1958 and the following IGC 1959.

The stations of basic importance were:

Brussels (Belgium)	latitude	50° 47' N
Florence (Italy)	latitude	43° 46' N
Libreville (Gabon)	latitude	00° 25' N
Leopoldville (Congo)	latitude	04° 20' S
Fort Dauphin (Madagascar)	latitude	25° 00' S
Port aux Français (Kerguelen Islands)	latitude	49° 21' S

Here are the results related to the contemporaneity of the annual variations of test D. See **Figure 16.**



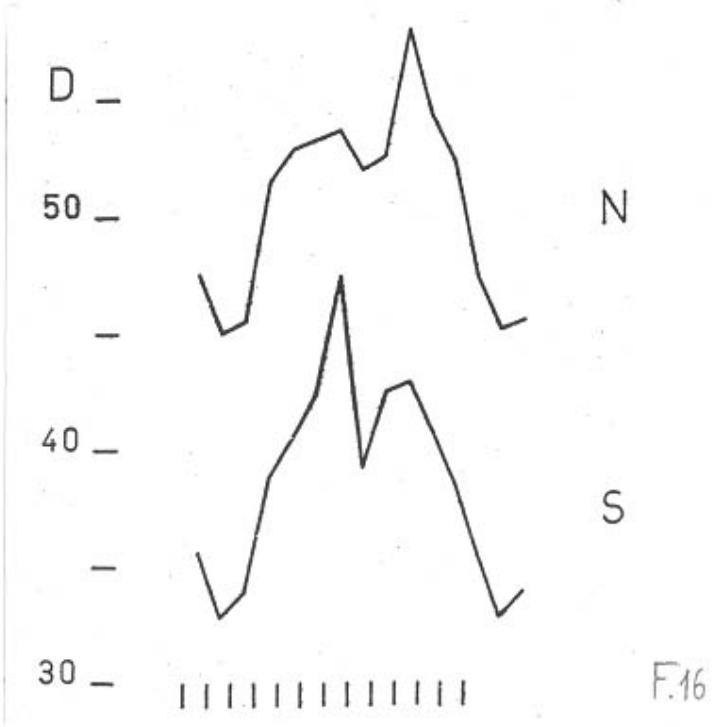


FIGURE 14-Helicoidal motion of the Earth in the Galaxy . E = plan of ecliptic; S= solar apex; N= north pole direction ; T= elicoidal path of the Earth .

FIGURE 15-Animated model of the helicoidal motion of the Earth in the Galaxy, presented by Piccardi at the World-Fair 1958 in Brussells, to demonstrate "Solar Hypothesis" .

FIGURE 16-Annual variation on D test in the Northern and in the Southern Earth hemispheres (mean latitudes) On the abscissa: the twelve months of the year . On the ordinate: D test monthly averages of two years, 1957-1959, on the occasion of IGY .

Here are the results concerning the dissymmetry of test F in the two hemispheres, at the moment which, according to the solar hypothesis, dissymmetry is at its maximum. (September 1958 and September 1959):

Brussels	51.0			
Firenze	50.3	Northern average	49.7 F	
Libreville	47.8			
Leopoldville	46.8			
Fort Dauphin	30.5	Southern average	32.8 F	
Port aux Français	21,2			

Always fort test F we found the following elements on the averages of two whole years (1958-1959):

Brussels	51.2			
Firenze	49.9	Northern average	50.1 F	
Libreville	49.3			
Leopoldville	45.6			
Fort Dauphin	28.7	Southern average	33.2 F	
Port aux Français	25,4			

The solar hypothesis, after these results, proved a useful working hypothesis, capable of forecasting and harmonizing, within a general frame new phenomena.

Shift of the annual variation of test D

Test D, as previously mentioned, has greatly modified its annual trend over the years. Its annual minimum in spring, extremely low in 1951, was gradually attenuated until it disappeared by 1961. It reappeared immediately after but shifted in autumn. Evidently, a great variation, greater than that of a solar cycle, with very long period had taken place. It could not be ascribed to spots, corona or, in general, to solar activity. It is difficult to explain such an important fact, but if we want to make a hypothesis we have to examine two different facts:

1) Inversion of the polarity of the sun's polar magnetic field. But this phenomena is not yet clear.

2) The action of two great planets, Jupiter and Saturn. I will dwell on this.

In 1951, at the outset of our investigation, Jupiter and Saturn were in opposition, (Jupiter at 0 h and Saturn at 12 h). In 1961 the two planets were in conjunction (both at 20 h). Now, if the shift of test D is to be connected with the relative position of the two great planets, in a few years (1972) it should change once again its annual trend. The problem will be solved by itself. I simply want at mention that at this point the influence of planets on many phenomena (even the solar ones) is truly obvious (Nelson RCA, USA, and the Czechoslovak School). The same shift of the annual variation of D test is observable on the data gathered by Ogata et al. in Kumamoto (Japan).

Periodical analysis of chemical tests fluctuations – The law of Mosetti

A further consideration in favour of a relationship between chemical tests and solar phenomena.

Mosetti, Osservatorio Geofisico Sperimentale, Trieste, carried out in 1955 and 1956 a periodical analysis of chemical tests fluctuations, according to Vercelli and Labrouste (not the periodic analysis

according to Fourier). The analysis pointed out that the periodical components of the chemical tests fluctuations are sinusoidal oscillations. The period of each oscillation was constant throughout the whole time interval under consideration. Therefore we were not faced with meaningless accidental oscillations. On the other hand all the chemical tests revealed the same periodical components. The length of periods, placed in order, formed a geometrical progression, with rate $\sqrt{2}$. Basic period: one year.

Mosetti had previously observed that the same law governs solar spots activity and many natural physical and biological phenomena. The periodical analysis of the chemical tests fluctuation gave a considerable contribution to the law of Mosetti.

We resumed the periodical analysis in 1966 on new and vaster set of data. More than 10 years had passed. The analysis fully reconfirmed the validity of the law of Mosetti for test D. At present we are studying test F and test P.

As they can be resolved in the same periodicities, chemical data and Wolf's number must connected. . This is what we wanted to know. The same connection exists with a moltitude of natural phenomena and this must be observable: the Sun dominates the Earth.

CHEMICAL TESTS AND BIOLOGICAL TESTS

A long series of biological experiments, carried out alongside the chemical experiments, proved that biological tests behaved in the same way as the chemical tests. On the whole, biological tests followed the fluctuations noticed in the chemical tests. From a certain point of view, the inorganic chemical test could be taken as the model of the biological test. Biological experiments are either absolute or comparative and the latter imply comparing the behaviour of a given system with that of a control system. Even the control system is heterogeneous and out of equilibrium and therfore it is not a safe reference point. An example of this is when the space actions saturate both the system which is being experimented and that of control. The result in this case is certainly not the expected one.

In order to know whether the control result can be considered valid, we must dispose of a different kind of reference system, having a true relationship with the action of space forces. The chemical test has the necessary requirements for this kind of system: it is sensitive to the external forces, it is very rapid, it can be repeated at will a great many number of times, it is cheap, it is not affected by factors evaluated with difficulty such as heredity, nutrition, sickness or disease, fatigue, sexual stimuli, etc. As such, it can be the third point of the comparative experiment, the one capable of giving sense and rigour to the result of a biological test. Test P is the best reference point because it does not require to act directly on the system, but only requires to modify, in part, the surrounding space conditions.

CONCLUSION

The chemical system we have adopted as routine tests, are not only heterogeneous and out of equilibrium, but also polydispersed, at least during the course of their evolution. The size and characteristics of the particles making up said systems are very different, thus forming a truly infinite range.

The infinite variety of initial particles causes the tests to respond to any space signal. Consequently they also respond to the resultant of the forces acting in space during the formation of the polydispersed system. This response has a universal character.

Unlike physical instruments that can only measure one kind of signal, chemical tests react to a multitude of signals. Each signal has its own characteristics, structure, trend and can be recognised by analysing the chemical data, considered as a function of time. In fact by elaborating our data, on the basis of traditional statistical methods, Burkard, University of Graz, observed a relationship between chemical tests and geophysical phenomena such as magnetism, topography of stratum at 96 mb, relative topography of levels at 500 and 1000 mb.

In other words, chemical tests could be used as a new means of exploring space from the Earth.

My gratitude goes to four pioneers of heliogeophysics and heliobiology: Eigenson, Sherbinovsky, Thijevsky and Schoulz who, thanks to their work in their respective fields, have supported our ideas and our long research.

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Could Prof. Piccardi become “fashionable” again?

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Piccardi revisited in a modern lab

In the frame of the research activity pursued at Pirelli Labs S.p.A., we have had the opportunity of reviewing some of the experimental reports published by Prof. Piccardi during several decades of scientific activity. The revival of the early work of this Italian scientist in the field of bioelectromagnetism is a rather uncommon circumstance, and some of the main reasons for it could be worthy of a more detailed comment.

In the last decade, an increasing interest has been paid by the scientific community to the rather challenging and cryptic issue of biological effects mediated by electromagnetic fields (EMF). From time to time, the attention of the public opinion is drawn to this problem, with intensive and sometimes raging discussion among the experts. It is generally accepted that, especially for low-frequency exposure, the minimal energy of the EMF photons and the lack of noticeable effect of induction in non-metallic conductors (like the saline solution enclosed in, or surrounding the cells) cannot cause the disruption of the strong covalent bonds contained in organic molecules, nor can impair the cell’s functionality by a temperature increase due to Joule heating. However, several renowned research groups have accumulated a body of evidence that strongly supports the hypothesis of the existence of a non-thermal damage mechanism. Needless to say, this outcome prompts for a wholly new development of physical models able to understand and explain this unexpected feature of condensed matter.

In our attempt to find a theoretical foundation for several phenomena observed by teams collaborating with our lab on cellular membrane damage caused by EMF, we have decided to reconsider the findings of Prof.Piccardi, who –up to our best knowledge- has been the first scientist to devote a significant part of his work to the subject of low-energy interaction in physical chemistry. The corpus of Piccardi’s articles is not easily accessible, having been published on old journals more than half a century ago.

Three unusual experiments

It is not within the scope of Pirelli Labs to deal with the mainstream of Piccardi studies (biometeorology, cosmic ray showers effects on living tissues et.c.), so our evaluation has been necessarily restricted to those tests, which could more directly lead to useful insight in the new chemical physics of liquid water exposed to weak ELF.

The attentive review of Piccardi’s production, eventually recovered from his co-workers, allowed us to identify a limited number of interesting experiments, whose replication is currently under discussion:

A) Effects of low-frequency EMF on physical properties of water

In year 1964, the group of Prof. Piccardi published an interesting article [Ref.1] in which an extensive series of measurements of water electrical conductivity in different regimes of exposure to 10kHz EMF was reported. It was shown that, in samples of water hermetically closed in conductivity-probing cells, this physical parameter was steadily increasing when the sample was exposed to EMF, while a reference cell, kept at the same temperature but not irradiated, displayed just an initial increase in conductivity destined to flatten in few days. Piccardi left open the route for an explanation in which the ions of the container's glass, passed into the solution, could play a role. Nevertheless, the different answer of the system to the presence (or absence) of the EMF was confirmed beyond any reasonable doubt.

B)Variation of water conductivity because of the previous "thermal history" of the sample

Piccardi claimed [Ref.2] that two sealed samples of water measured in the same conditions but having underwent different thermal cycles (the first was heated up to boiling, the second frozen and molten again), displayed significant differences in the values of electrical conductivity. Effects due to possible solubilization of container's glass ions were studied in detail and shown to be irrelevant.

C) Seasonal variation of water pH

An unexplained, but intriguing, research of the Piccardi team is described in [Ref.3]. Further to an accurate campaign of measurements extended over a year, Piccardi was able to show that the difference of potential between a sample of water stirred for some minutes and a similar sample not stirred was varying during the year. Piccardi made some attempt to correlate this effect with the available data about the incidence direction and strength of the "solar wind", assuming that its very energetic particles could play a role (although unclear) in the phenomenon.

Possible modern explanations of Piccardi's results

As one of the last heirs of the positivistic tradition of the Italian physics of XIXth century, Piccardi focused on the rigorous collection of a huge mount of data supporting his claims, without endeavouring, in general, to frame them in a new theoretical structure. The possible oddities of water behaviour in the liquid phase have, however, prompted in the recent year the renewed effort of several theoretical and applied physicists, that are trying to identify and to prove new models able to justify –for instance- the effects of 50 Hz EMF irradiation on living tissues.

Among many valuable proposals, the pioneering work of the late Prof. Giuliano Preparata [Ref.4] appears to offer new opportunities, yet to be confirmed but potentially most innovative and exciting. According to the research of this author, water could be viewed as a mixture of two phases: an incoherent "gas" of molecules intermixed with an huge number of "coherence domains", volumes of space where the singular molecules of water, interacting with an "entrapped" electromagnetic field, lose their individual character becoming a macroscopic quantum object loosely similar to a supercurrent or a Bose-Einstein condensate. The new object with his collective quantum behaviour could be sensitive to a flux of low-energy incoming photons; moreover, it could at as a "racetrack" able to modify the behaviour of ions present in the solution. Both these effects could have a deep influence on bioelectromagnetism experiments.

The demonstration (if any) of coherence domains' reality could open the way to a new interpretation of Piccardi's work, as the two-phase model of water devised by Preparata and co-workers could allow modifications of the hidden structure of liquid water, by variations of the coherence domains parameters due to thermal or electric effects, all characterized by low amount of exchanged energy.

Piccardi as a teacher of scientific correctness and freedom of thought

Apart from the validity of the scientific route followed by Piccardi –which has still to be confirmed by new experiments- the modern readers of his articles is deeply and sincerely impressed by the attitude of this man toward his research topic, his students and the scientific community. The work of Piccardi was evidently done in a most serious way, and the quest for the truth was evidently a prominent goal for him, in spite of the controversial nature of his studies. Piccardi –according to a recent biography published in Italy- was patient, open to third-party scrutiny, and was even the strictest critic of his own work. He was well aware that his "solar hypothesis" of cosmic effects on terrestrial experiments (probably due to solar activity, cosmic particles et.c.) made his research dangerously contiguous with non-scientific areas (like astrology et.c.) and he paid the outmost attention to guarantee the highest quality by developing experimental protocols, that even today are striking because of their inherent ingenuity and optimisation. However, he refused the biased "scepticism" which, in the recent years, seems to overwhelm any possibility of discussion on exotic and unconventional ideas.
It is rather discomforting to observe in 2003 that, after all, the scientific environment in the '50s and '60s could still accept and gave credibility to the investigations of Piccardi, who –in modern terms- was actually thinking of some "water memory" effect. The same, unfortunately, would not happen today in the academic world, whose hysterical reactions to the issues of Cold Fusion and Benveniste's ideas are symptoms of a widespread conformism, scarcely compatible with the basic tenets of freedom of thought. Our Lab, without giving any *a-priori* endorsement to Piccardi's solar hypothesis", deems nevertheless useful to dedicate a moderate and reasonable amount of resources to a topic which in our humble opinion deserved a closer and more thorough analysis.

Riferimenti:

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Authors' Remarking

Dr. Faraone P.,on paragraph ***Material and Methods*** of a his recent paper [*],: answers here to the readers for some their questions .

The 1th question is : Why a sterile agar media was streaked every day with a brothculture to reading on day after the CSD ? Why is it not preferred to utilize every day a colony taken directly from the agar media-culture, emusioned and streaked on surface of another sterile agar media for CSD reading ?

Because this last method does'nt permit to have a CSD frequency so well confrontable with CSD frequency of the previously recorded data ; however these data may be in some way confrontable, utilizing a broth-emulsion of several colonies (10 about) for streaking a sterile agar surface to CSD reading on day after.

The 2th q . is : Why innumerable abnormal colonies of S.Aureus [not corresponding at all to the typical CSD-forms] appeare initially in successive streaking on agar media surfaces with daily brothcultures ?

It's necessary to insist repeating day after day, broth cultures to verify the persistence of this phenomenon with control of the colonies increased on agar media surface , by lens of 8-10 magnifications or microscope (better by stereo microscope , utilizing incident and transmitted light) .
If these abnormal colonies are persisting after 7-10 days, excluding dominant presence of typical CSD forms, it shall be better to change the utilized S.Aureus strain with another one . But this drawback was not so frequent .

[*] "*Anticipations of deepinings through astrophysical influence in appearing sectors of microbial colonies named CSD* (Some statistical correlations and reminiscences about lost data) ."
This paper was published as Supplement, with the last Cifa News n° 31 .

Letters to CIFA

Dear collegues of C.News-Office ,
As concording with dr. Valenzi, I think the opportunity to inform you of a recent reporting shown **[1]** *in New Scientist, of some researchers of* ***Houston University*** *and J.Space Center of* ***NASA*** .
In every way I desire to make shortly some remarks before to show the abstract after pointed .
I think that is indubitable that microorganisms liable to have mutations or other genetic type changing on sea level about, like it's reported in my studia on CSD,1970-1991 , these microorganisms may present their propensity much more in space, where radiant energies have more high intensity and consequently the microorganisms are more able to do many more problems for human health .
Therefore I think to do'nt let out the opportunity to remember and well consider as reference, studia of biological CSD phenomena, as a whole, and particularly in their periodical intensity variations during the time and in their significant correlations with several physical factors, present in space .

Faraone Piero A.R.

[1] *"Getting to grips with mystery space bugs"*

New Scientist vol 177 issue 2380 - 01 February 2003, page 20

Dangerous mutants on the bridge are not merely the stuff of *Star Trek* .
On long space flights ,normally harmless bacteria could mutate in unforeseen ways and threaten the crew's health or the life-support systems.
So NASA is developing a "gene chip" to identify such menacing microbes en route.
Most bacteria found on spacecraft have been carried aboard by the crew .
On extended missions, the crew will have to grow plants and recycle waste, water and air, providing unique ecological niches in which the bugs could flourish. On Earth, species that cause disease or other problems tend to be well known and behave in familiar ways.
But in the alien conditions of near-zero gravity and increased radiation , little-known bugs might become virulent, and even familiar species could start behaving differently , for example clogging up air filters or water purification systems . There is evidence to support this concern .
Simulated *microgravity* experiments have shown that *Salmonella* bacteria become more virulent.
And George Fox of the University of Houston, Texas , and his team have found microgravity causes changes in gene expression in *E. coli* bacteria .
" If [a microorganism] for some reason is causing a problem, we need to have a mechanism of figuring out what it is," he says .
Bacteria can be identified using probe DNA sequences that each bind only to a specific species .
But it would be impossible to carry probes for every possible bacterium that could mutate .
So Fox and his colleague Richard Willson have developed a means of quickly identifying which group of microorganisms a mystery bug belongs to .
Instead of DNA, they look at portions of the bacteria's ribosomal RNA . These regions are highly variable, and groups of related bacteria have unique signature sequences .
The researchers are building a chip that will incorporate 4000 RNA probes , carefully chosen to cover a wide range of bacteria . Although the chip can't pinpoint the exact organism, if a mystery microbe's signature matches any one of the probes, the astronauts will know roughly what they are up against.
"It doesn't have the yes-no answer of the single- target probes," says Willson.
But it would almost always provide at least some information - suggesting which antibiotics might be effective , for example .
Duane Pierson, director of microbiology at NASA's Johnson Space Center in Houston, agrees.
He says that while bacterial infections in space haven't caused astronauts any major problems so far, they remain a concern. "If you are going to Mars, you don't want to have to send somebody back because of some sort of infection which could have been prevented if we understood more about it," he says.
"This technology could be very valuable." The gene chip could also help on Earth . For instance, in front - line bio defence , it could quickly identify whether a suspicious powder in an envelope is a microbe or just sugar.
And in cases of infectious diseases, if clinicians are unable to identify the exact organism, despite clear signs of infection in a patient, the chip could at least narrow things down . "This is a way of getting a clue about the puzzling cases," says Willson .

Remarks : *the underlinings above written are'nt in the original cited text .*