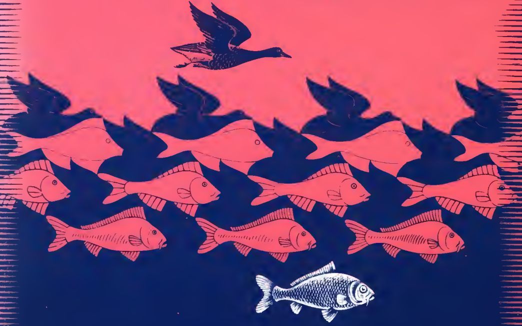
Professor C. LOUIS KERVRAN

Member of the New York Academy of Science
Director of Conferences of the Paris University
Member of Conseil d'Hygiene de la Seine

# BIOlogical TRANSmutations



**The movement of life stems from the constant change of one element into another.**

Translation and Adaptation by Michel Abehsera

# BIOLOGICAL TRANSMUTATIONS

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By

**Professor C. LOUIS KERVRAN**

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English Version Michel Abehsera

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# Biological Transmutations and their applications in:
# Chemistry, Physics, Biology, Ecology, Medicine, Nutrition, Agronomy, Geology.

**C. Louis Kervran 1901-1983**

Nominated for the 1975 Nobel Prize in Physiology. Nominator: Hiroshi Maruyana M.D. Ex-professor, Faculty of Medicine, Osaka University. Nomination supported by Professor L. Tanon, President of the Superior Counsel of Hygiene of France. In a last minute change, the prize went to someone else.

*Other Works by C. Louis Kervran*

## ORIGINAL FRENCH EDITIONS:

| | |
|---|---|
| Safe Limits of Alternative Tensions | RGE Paris 1937 |
| Resistance of the Human Body to Electricity | Lahure 1936 |
| Electrocution at Low Tension is avoidable | Masson 1939 |
| Aberrant Metabolism and Biological Transmutations Revue Generale des Sciences Pures et Appliquées | 1960 |
| Biological Transmutations, Abnormal metabolisms in Nitrogen Potassium and Magnesium | Maloine 1963 |
| Natural Transmutations, non Radioactive, A New Property of Matter | 1963 |
| Low Energy Transmutations, Synthesis and Developments | 1964 |
| Proofs Relative to the Existence of Biological Transmutations, In Biology, defeat of the Lavoisier Law of Matter's Invariability | Maloine Library S.A. 1968 |
| Biological Transmutations in Agronomy, Conferences at the National Agronomy Institute | Maloine Library S.A. 1970 |
| Geological and Physical Proofs of Low Energy Transmutations | Maloine Library S.A. 1973 |
| Biological Proofs of Low Energy Transmutations, with added note of O. Costa de Beauregard (Theoretical Physics) | Maloine 1975 |
| Biological Transmutations and Modern Physics | Maloine 1982 |

*All of the above books and publications are in French.*

## ENGLISH TRANSLATIONS:

(The present volume combines three original french works)

| | |
|---|---|
| Biological Transmutations (From the French 1966 Edition) | Crosby Lockwood, Glasgow 1980 |
| "Bread's Biological Transmutations" in collaboration with Jacques de Langre, in English, | Happiness Press Out of Print, see update below 1978 |
| "Good Bread, Evil Bread, Baking by the Biological Transmutations Principle" An expanded and revised edition of the 1978 title above. | Happiness Press 1988 |

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# INTRODUCTION TO THE SECOND EDITION

Fate and circumstances! In the fall of 1972, a friend sent to me, from Old Mexico, a copy of Michel Abehsera's translation of Professor Kervran's *Biological Transmutations*. During the following years, so long as the book was in print, I bought dozens of copies for friends and others whom I thought might share my fascination with this incredible hypothesis. The reactions were mixed, and challenging: Can it be proven? What does it mean? Impossible, of course! It would be wonderful if true. Being concerned with both plant and animal nutrition, I became convinced the idea should be put into practice. To do this, at least in an acceptable way, meant proving the hypothesis by repeatable experiment, not an easy task, I was to learn. Early on, my DVM friend, John Whittaker, said: "Why try to prove it? Biological Transmutation just is, and it is just beautiful." Later, in a private conversation, James Lovelock, internationally known atmospheric chemist, remarked that, in reality, it is practically impossible to prove anything whatsoever. And besides, he said, "...even if you did prove biological transmutations to yourself and to me, no one else would believe it!" My curiosity went out of control. In the fall of 1981, I began a serious effort to research Professor Kervran's works. Progress was slow and discouraging. Finally, in August 1982 I tracked down Chris Bird. I knew that he, with Peter Tompkins, had written *The Secret Life Of Plants*, a 1972 non-fiction best seller containing a chapter about Professor Kervran. My assumption that he knew this French genius personally was correct. Chris sent me a 2500 page file, his years of correspondence, a typescript of his translation of Kervran's 1973 book, *Proofs in Geology and Physics of Weak Energy Transmutations*, and his partial translation of the 1975 book, *Proofs in Biology of Weak Energy Transmutations*. But this was only the beginning.

Professor Kervran died February 2, 1983. Just three months prior, his last book, *Biological Transmutations and Modern Physics,* his "swan song", had been published by Maloine, Paris. I had this book translated and the typescript has now been partially edited. Subsequently, Chris retrieved from Europe hundreds of pages of Professor Kervran's worldwide correspondence together with an incredible number of published and unpublished papers and articles, including copies of all of Kervran's eight published books. In the fall of 1984, Chris translated the entirety of the 1970 book, *Biological Transmutations in Agronomy,* a series of lectures given by Kervran at the National Institute for Agronomy in 1969. He also translated hundreds of pages of correspondence, and our own translator finished this part of the project.

Professor Kervran's archive file now contains over 5000 pages. The accumulation of related materials seems endless. I have resisted a number of requests to edit and publish the three fully translated books. Together, Professor Kervran's many books display a valuable progression of knowledge, but individually they do not do justice to the man or his ideas. Michel Abehsera's translation avoids this problem by summarizing Professor Kervran's pre-1970 position. A major book is in the formative stages, a book which will not only detail Professor Kervran's saga, but also compare and contrast his observations and theories with those of others. In addition there are new perspectives in both physics and biology to be integrated into this fascinating story.

The biological transmutation hypothesis cannot be treated as an isolated subject. It questions the very nature of substance, a subject philosophers and physicists alike continue to ponder. I remain convinced there are elemental transmutations in living systems, and further, that living systems may very well also create elements. Curiously, in the final analysis, it becomes difficult to distinguish between transmutation and creation.

To my best knowledge, of the thousands of experiments performed to prove or disprove Professor Kervran's theory, none are conclusive. This is to say, in the view of normal science, each and every experiment contains a flaw, some factual, some simply a loophole through which doubt can enter and invalidate the data. Fundamental problems remain to be resolved in designing a scientifically acceptable crucial experiment.

First, there is the problem of measuring the before and after composition of a singular living system. To satisfy the scientific mind, absolutely reliable data can be had only by killing the system. To analyze one killed system and compare the data with that of an apparently identical living system, killed after an experimental period, leaves the data open to criticism, justified or not.

Secondly, living systems are open systems, and it is extremely complicated, if not impossible, to totally isolate them under the laboratory conditions required for accurate monitoring. Further, all methods of isolation create an unnatural environment for living systems. For example, in laboratory experiments with oats, the culture water must be free of all chemical elements, absolutely pure. This "laboratory water" is dead water, not the same as the living water found in nature, a problem with which Professor Kervran was much concerned. In addition, in nature, plants are symbiotically dependent on bacteria. It is apparent that in all the extensive experiments with oats the culture water was "contaminated" with bacteria. Thus, these were not pure plant experiments, but experiments with plants and bacteria. No doubt, the kinds and quantities of bacteria present in the culture is a significant if not crucial factor.

Thirdly, biological processes are at best periodic, and at worst fluctuating. This requires an experimental protocol which allows for cosmological influences. Even if the scientific community was tolerant of such parameters, which allude to astrology, they make the uniform replication of experiments ever so much more difficult.

Living matter exhibits a number of self-evident properties, such as evolution, symbiosis, and bacterial pleomorphism, phenomena which remain beyond science, facts without theory. We now have an enormous collection of facts about evolution, but the phenomenon resists scientific explanation. We do not have an acceptable theory of evolution. Unbelievably complex symbiotic relations between different kinds of living systems are recognized and cataloged, but a theory of symbiosis is so elusive some biologists now question if there is really a difference between symbiosis and parasitism. Bacterial pleomorphism has been recognized by a few biologists for over one hundred years. Extensive hard evidence for this phenomenon has been accumulating since 1960, but the facts are only self-evident, without theory……not scientifically acceptable!

It is obvious to my mind that biological transmutations must be included in the list of "self-evident-facts-without-theory" properties of living matter. My friend, Dr. Whittaker, was prophetic when he said, "*…biological transmutation just is*." The phenomenon cannot be explained by normal physics or chemistry. This is not to say the structure of science cannot be evolved to a point where such properties of living systems can be utilized in practical applications rather than excluded with prejudice.

Though much has been learned during the fifteen years since this translation of Professor Kervran's work was first published, it remains an excellent introduction into the complexities of a fascinating and elusive natural phenomenon.

Jacques de Langre is to be complimented for his initiative in having this important book republished.

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February 18, 1987

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# FOREWORD

This English edition of the works of Louis Kervran is intended for everyone: scholar, layman, or college student. It could have been directed toward a scholar's mind exclusively, presenting itself to him in cold scientific terms, but this would have slowed down progress. If, in Mr. Kervran's words, scientists "have made of science another job," it would not be ethical to present it to them alone. The problems of ecology, medicine and nutrition, and the alarming rise of radioactivity are too acute to be dealt with solely through academic channels. It is within everyone's ability to comprehend the biological transmutations as long as there is a desire for true knowledge. To understand the biological transmutations requires nothing more than to cast aside all rigid thought while studying them. Transmutation is no more and no less than a reality which teaches us about change. In change we find life, and by change we create life. Our only constant is our goal of becoming Man.

The principles of the biological transmutations affect every phase of our existence. They are already being applied without patent or license by industrial, dietetic and pharmaceutical products based on Kervran's research. Transmutations are now recognized in medicine. They have opened the door to new treatments and therapeutics for reputedly "incurable" diseases. There are solutions already projected for curing arteriosclerosis, rheumatism, excessive arterial tensions, decalcification, kidney stones, hormonal deficiencies, etc., in a natural way, without danger to the patient. Agronomists are already practicing Kervran's findings on a large scale. Dietitians are the biggest beneficiaries, because dietetics is too close to man's body and soul to remain an academic and isolated science. In accordance with this law of the change of elements which Louis Kervran uncovered, there is now a movement by hundreds of thousands of people to eat in a natural way.

The U.S.A. is ecologically in bad shape. Only through the understanding and practice of biological transmutations can this alarming problem be solved. The land is not only polluted but is in some parts barren. Heavy chemicals have killed it. No ecological problem can be solved on the surface; it can only be remedied as its name indicates: ecologically. This means that it can be done only through natural law. Ecology starts with man, mind and body. If his body is clean, his environment will be clean, naturally. If our tastes are sensorial, if our measure of happiness and health is comfort, then ecology is relegated to a mere science with man as a hopelessly retarded child who must be dealt with by caresses and long walks for a year or two or three, until the end of his invalid life. Ecology is often synonymous with attractive environment. Cans of beer are removed from beaches; hands are cleaned; everyone returns home satisfied. That is merely a good cleaning job.

What about man? What about his body and mind? If the food being consumed does not change, the problem of ecology will worsen. If scientists do not change their minds about nutrition, man, a biological part of this earth, will soon be extinct. Intestines must be healed, since they are as polluted as our streams. The populace must be educated to choose food that does not come canned, bagged in plastic, or chemically treated. From the need of the consumer, from this need only, can the ecological problems be considered—and solved. From a good earth one regenerates one's health. Our blood is but the product of an agent, the earth. The biological creates the physiological. Has this become a secret, or has man become so mechanical, so enslaved to fast relief in any possible way, that he has become accustomed to the "miracle pill"? His pain is relieved in seconds. This is proof enough for him to believe in the "scientific way." But that is not true science.

In a letter to the author of this English version, Louis Kervran wrote: "I hold the same conception as you do: if one desires to bring about a deep change in science, it is not to the high scientific spheres that he should address himself, but to the masses. Not being narrowminded like the specialist, they can see the synthesis of things and not just their details. This is how I have been progressing in this world during the last ten years. . . . But one should not be so absolute in judgment as to say that all scientists are narrowminded. I have found great support among known personalities, but they are a minority. They are lost in the crowd and cannot vanquish the obstacles and inertia created by the too many. Science has become a petty job. Fifty years ago there were a few thousand men of science; now it is by the hundreds of thousands that one counts them, so that the average level of quality has greatly diminished."

What Mr. Kervran means is that man has become mechanical in his thinking and doing. The physiological, which is what we "are," and the biological, from which our daily nourishment comes, are but a shadow of what man used to be when he was free. What is freedom if it is not to be free in every way, from our most minute cell to our most expansive dreams? He is free who can afford to let the interactions between cell and spirit take place in the most harmonious way. There is no freedom in intellect. "Freedom" of that sort lasts for the duration of a thought, of an act. To be truly free is to be able to establish peace between all opposites within us. That is at least the beginning of freedom.

Mr. Kervran, with his discovery of biological transmutation, has given this chaotic and scientific world the Alladin's Lamp by which we can save ourselves and our diseased earth. From mechanical men we will raise ourselves to physiological and spiritual beings. That which is mechanical does not believe in change, nor in beauty, nor even in man. The mechanical mind lives within the hour. If it projects an idea for the future, it is but a steel-like construction erected out of stress, a protection from the "invaders." The mechanical man is afraid. He thinks the enemy is outside of him, so he protects himself a bit more every day until he loses the natural immunity he inherited from this just world.

With biological transmutations we are taught a lesson about freedom. We learn that an element is free to become another when it meets its opposite. It travels from one state to another, procreating newborn atoms. It is the hope of Mr. Louis Kervran and this author that biological transmutations will be applied to the fullest extent in the U.S.A. and in the whole world.

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In 1799 the French chemist Vauquelin was so intrigued by the quantity of lime excreted every day by hens that he decided to put a hen in a cage and feed it oats exclusively. Having measured the quantity of lime that was present in a pound of oats, he gave the oats to the hen. When the grains had been eaten, he analyzed the quantity of lime excreted through the eggs and fecal matter. The hen was found to have excreted five times more lime than it had taken in the food. Vauquelin concluded that lime had been created, but he could not determine the cause.

In 1822 Prout, an Englishman, was the first to clearly define the problems of the transmutation of elements. He systematically studied the increase of limestone (a compound consisting chiefly of calcium carbonate) inside an incubating chicken egg, proving that limestone is not contributed by the shell.

In 1831 the Frenchman Choubard let watercress seeds germinate in an insoluble dish (sand, glass, etc., washed with acids, rinsed with water, heated). He verified that the young plants contained minerals which had not existed in the seeds.

Others followed. In 1844 Vogel experimented with watercress seeds placed under a large bell jar. Keeping the air "analyzed," he added a nutritive solution containing no sulfur whatsoever. After their germination he analyzed the young plants, finding that they contained more sulfur than the seeds from which they stemmed. This phenomenon remained obscure to Vogel, who concluded that either sulfur is not a simple body or there was an unknown source of sulfur.

A few years later Lauwes and Gilbert considered the weight variation of ashes during vegetation. They observed, in analyzing the ashes, an inexplicable variation in the amount of magnesium. In 1875 von Herzeele went a step further by verifying a weight increase in the ashes of young plants stemmed from germinating seeds. He made a culture without soil in a well-studied medium. Later on he carried out experiments related to Vogel's earlier study of the weight variation of magnesium, already considered by Lauwes and Gilbert. Von Herzeele then concluded that there was a transmutation of elements.

He seems to have been the first to research the origin and destination of an element. His remarkable work remained without echo in the scientific world. In 1950 Hauschka took it out of the dark to publish von Herzeele's findings in one of his books.

Branfield, Lakhovsky, Spindler and Freundler, among others, followed. None of them arrived at clear conclusions.

Baranger, chief of the laboratory of organic chemistry at the École Polytechnique in Paris, became acquainted with von Herzeele's work. In 1960 he published the first results, handed to him by A. Spindler, of the variations of phosphorus and calcium in germinated seeds. Baranger concluded that a transmutation of elements had occurred, but his research, like that of his predecessors, failed to show the mechanism by which the discrepancy was produced.

It was in 1959 that Louis Kervran started publishing his discoveries. At about that time the coincidental works of the above scientists became known to him. In the summer of that same year, Mr. Kervran came to a conclusion concerning his many years of systematic research. He did his best to prove his conviction to the scientific world, a conviction that none before him had been able to put down in clear formulas. Having waited for years, witnessing thousands of convergent analyses, he succeeded in demonstrating that not only molecules but atoms themselves can be transformed. He verified that there is transmutation of matter from one simple body to another, from one atom to another.

All the proof was presented, yet Kervran encountered violent opposition from skeptical people who were reluctant to accept something new. On the other hand, warmest congratulations and encouragement poured in from very great personalities of science, who now saw light in what had always been obscure to them. Already in 1959 Kervran had found solid help among those having true scientific spirit.

In July 1960 a French scientific review published an article on Louis Kervran. That was enough for the public to know what many scholars had refused to see. Magazines, radio and television gave millions the chance to be informed about the "transmutations." It was not until 1962 that *Biological Transmutations* was published by Librarie Maloine. In a matter of a few months, the first edition was sold out and reprinted. A third one was to follow two years later. Successively came *Transmutations Naturelles, Transmutations à Faible Energie, Preuves Relatives à l'Existense des Transmutations Biologiques,* and *Transmutations Biologiques en Agronomie.*

In the preface of *Transmutations Naturelles* Jean Lombard, a geologist of worldwide reputation, wrote these words: "The true workers of science, who are always ready to welcome new suggestions, sometimes ask themselves if the greatest obstacle to the progress of science is not bad memory on the part of the scholars; they wish to remind the latter that some of their predecessors were burnt because they proposed 'interpretations' which have now become foremost truths. If pioneers of science were still being burnt, I would not give much for Louis Kervran's skin."

In January 1963 a group of scientists listened to Louis Kervran. After that meeting a report was written by Fischoff, saying: "We are convinced that there is here a series of observations and phenomena of the highest importance for the progress of our knowledge in physics, biology, geology, cosmology, etc. . . . The great merit of Louis Kervran is to have felt strongly that there was something strange in the facts he brings to us and that there was a need for something 'new' to explain it. He obstinately followed an idea and patiently, for many long years, accumulated facts, observations, and results—having no apparent link—at last assembling all these converging facts and ideas to form a daring hypothesis, solid and thrilling. Daring, for it appears to be opposed to the classical conception of nuclear physics and biology. Solid, for the invoked and observed facts are very many, sustained by an infallible reasoning argument. Thrilling, for it opens new perspectives and horizons in biology, medicine, energetics, physics, cosmogony, etc."

Twelve years have passed since *Biological Transmutations* became public. The debate of the times continues. France is now divided into two camps, those for Kervran and those against him. English scientists have invited Louis Kervran to give a series of lectures and demonstrations. Scientists from Switzerland, Italy and Belgium have already heard him and are starting to put transmutations into practice. Russia contacted Kervran. All books about transmutations have been translated into Russian, but not yet on a commercial scale. They can be consulted now in the Moscow Library. Russian scientists are now organizing a congress exclusively dedicated to transmutations, to be held in 1973. The Chinese Embassy officially and insistently invited Kervran many times to go to Peking for three months to give Chinese scholars a chance to learn about his work. Nine years ago the Dow Chemical Company invited Kervran to come to the U.S.A. Mr. Kervran, however, could not honor the invitation at that time.

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After I had finished the present book and had written the major part of this Foreword, I went to see Mr. Louis Kervran in Europe to make corrections. What I had done was to put all his books into one. It was not an easy task. Choosing the most essential parts was the first difficulty, for everything seemed essential. Another difficulty kept arising at almost every sentence. Kervran's statements were directed at French scientists, who do not ask for as much precision as their American colleagues do. My problem, then, was to remain loyal to the text while rendering it in a manner suited to the American scientific mentality. In other words, what was required was a first-class writer who reasoned as well as he wrote, who was thoroughly familiar with English and French, chemistry, biology, nuclear physics, etc., and who was flexible enough to trust the concept of transmutation as a "new science."

If I ever chose myself to do the present work it was not because I am that kind of a writer, but simply because I could not find anyone even half-qualified to do it. There are not many scientists who know French well enough to decipher Kervran's texts. I reasoned and convinced myself thus: this is a new way of looking at science; it is up to the reader—whoever he may be, scientist or layman—to go ahead and grow with it. My role will be limited to that of a catalyst.

This I may have done well, but I humbly declare myself incapable of doing what really ought to have been done. Being busy with studying and teaching, I could afford to spend only six months on the book (twelve hours daily). Truly it needed another six months. In short, this book needed a man richer than I in all respects, one who would have spent a year or two at his desk thinking and working only on the transmutations.

This book is not a textbook or something to use in the laboratory. Its sole purpose is to stir the minds of those who are still truly concerned about this earth ecologically. I would never finish if I were to cite all the possible applications of the biological transmutations. Of special importance is the place they will occupy between the scientist and the metaphysician. So far there has never been a direct dialogue between the two, because of the differences in language. Now I believe their meeting is possible, for the biological transmutations teach us about the movement of life. From this movement the scientist will see that science can no longer limit itself to the study of the physical alone, for movement also implies elevation toward the metaphysical, not entropy. From this same movement, animating the invisible elements, the metaphysician will learn that life is worth studying in its most singular aspects. He will discover in the minute that which he always knew, that life is a continual renewal of self and cell.

I would like to end this foreword by presenting, in a few words, Mr. Kervran. I had expected to meet a scientist with whom I would discuss—as men usually do when they meet—philosophy. But things did not happen as I anticipated, for he showed himself such a dragon in science that nothing but science was discussed. Mr. Kervran knew his subject well; he seemed to have read all the scientific books and articles published all over the world, to know the work of every living scientist. And when I told him that he had given to science a new direction and hope, he answered, his face growing red, "I simply pointed out what has always existed."

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The chapters of this book have been placed in the best possible order for the reader who is unfamiliar with the biological transmutations to become acquainted with them.

The reader will perhaps meet some difficulties which I myself met upon first reading Mr. Kervran's books. For this reason I advise him to read this book more than once, or, if he wishes, to go directly to the chapter of his choice (Medicine, Agriculture, etc.). In this manner he will learn rapidly where the biological transmutations can be applied.

May this book be the instrument of a new era in which men of good will and understanding bring justice and peace on earth.

The English and often the sense of the following text were made clear by Susan Hatsell. Robert Jones and Hinda Zweig made pertinent remarks contributing greatly to the clarity of many difficult parts.

For all these I am grateful.

M. A.

If we cannot yet explain in biological terms the theoretical aspects of biological transmutations, the primary fact is that they do exist and that no one denies that anymore. It is to Mr. Louis Kervran that we owe this and I am pleased to recommend the lecture contained in this last book, which will be of interest to physicists, chemists, biologists and geologists.

*—R. Furon, Professor at the Science Faculty of Paris*

Kervran's book is of particular interest for it provides the solution to numerous problems of biochemistry which until now have not been satisfactorily solved, despite numerous studies made in France and foreign countries. Mr. Kervran's conclusions are supported by quantities of observations, reflections, and experiments undertaken for the past twenty years, thus opening a new channel for chemistry and biology.

His book deserves to be widely appreciated, not only for the documentation it gives but also for its clear and excellent style which is pleasant and easy, as is not always the case with scientific articles which are often unattractive to the uninitiated.

*—Professor L. Tanon, Vice President of the Academy of Medicine of Paris*

The true workers of science who are always ready to welcome new suggestions sometimes ask themselves if the greatest obstacle to the progress of science is not bad memory on the part of the scholars; they wish to remind the latter that some of their predecessors were burnt because they proposed "interpretations" which have now become foremost truths. If pioneers of science were still being burnt, I would not give much for Louis Kervran's skin.

*—Jean Lombard, Geologist of worldwide reputation*

# INTRODUCTION

> *It is premature to reduce the vital process to the quite insufficiently developed conceptions of 19th and even 20th century physics and chemistry.*
>
> L. de Broglie

Lavoisier was a great scholar of the 18th century. He is considered the father of modern chemistry. The general principle with which he worked and from which he derived his new science is that nothing is lost, nothing is created, everything is transformed. The atom being considered the smallest particle of matter and a constant in nature, it was assumed that no element could be created. The atom could not disappear. If it should separate from a molecule of two or more atoms, it could be found unchanged in another molecule.

This principle could in no way be refuted or even debated. It was the basis of the official science of the 19th century. Those who studied it gave it a general extension and applied it to every science close in spirit and form to chemistry. There were enough experiments to support it. It was not until the 20th century that this principle, left undiscussed for more than one hundred years, saw its first officially recognized contradiction. This was the discovery of natural radioactivity, showing that some bodies can be transmuted into different bodies, a principle for which the alchemists of the Middle Ages were so exaggeratedly ridiculed in the 18th and 19th centuries. An atom of radium was finally transformed into a non-radioactive and stable atom of lead, as one can read in books concerning the discovery of radium by Marie Curie.

In chemistry the label "element" is given to what in common language is termed a "body." "Element" is the actual scientific term, which is why we label oxygen, sulfur, calcium, copper, etc., elements. Atoms have a number of protons (heavy particles charged with positive electricity, constituting, along with the neutrons, the atom's nucleus) equal to the number of electrons (light particles charged with negative electricity, moving in orbits around the nucleus). An atom is electrically neutral because it has an equal number of electrons and protons.

Elements were long ago called "simple bodies" because they represent the simplest possible unit of matter. They had existed since the creation of our planet, and could be neither created nor broken down by man. They could only be "moved" from one molecule (or composed body) to another. It is on these simple bodies that Lavoisier's law is based.

It was established that there are 92 elements in nature, this being deduced and assembled from analagous cases concerning properties of matter by Mendeleev who, in the middle of the 19th century, classified the known elements in a table. The table was charted with empty boxes which were to be filled with new elements corresponding to the characteristics foreseen in a specific box.

Some boxes remained empty, not only because some elements were yet to be isolated, but also because some of the elements no longer existed on earth, being radioactive elements which had long ago been transmuted into other elements. This theory remained precarious until the 20th century when it became possible to produce these lost elements [1] artificially, with nuclear physics. This breach with Lavoisier's law, however, concerned only radioactive bodies studied in nuclear physics. In chemistry the teaching continued as before that nothing is lost, that it is impossible to create something by chemical reaction. This is conceded in "chemistry."

## Chemistry and its limits

The serious error of scientists consists in their saying that reactions occurring in living matter are solely chemical reactions,

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[1] These elements might never have existed in natural form, but may be created under artificial conditions in a laboratory.

that chemistry can and must explain life. That is why in science we find such terms as "biochemistry." It is certain that a great number of manifestations of life are produced by chemical reactions. But the belief that there is only chemical reaction and that every observation must be explained in terms of a chemical reaction, is false. One of the purposes of this book is to show that matter has a property heretofore unseen, a property which is neither chemistry nor nuclear physics in its present state. In other words, the laws of chemistry are not on trial here. The error of numerous chemists and biochemists lies in their desire to apply the laws of chemistry at any cost, with unverified assertions, in a field where chemistry is not always applicable. In the final phase the result might be "chemistry," but only as a consequence of the unperceived phenomenon of transmutation.

This severe error has led the scientific world to believe that one should find at the other end of an organism exactly what was originally given it. In other words, scientists expect to obtain a null balance sheet, counting that which has been retained by the organism or that which the organism has used up from its reserve. But balance sheets are never null. Today's scientists avoid the problem by saying that something escaped them during the experiment—unfortunately, a confession of incompetence.

Specialists in biochemistry fail to tell us why a chemically pure reaction, such as the one in which an atom of nitrogen and an atom of oxygen are combined, can be realized only *in vitro* at the electric arc temperature (or at a very high temperature and pressure). Living organisms do the same at room temperature! Many similar cases can be cited showing that the living organism is capable of reactions which can be reproduced in the laboratory only by a great deal of energy. Proteins are hydrolyzed in the stomach at 37° C in a slightly acid medium, but this same reaction requires a 120° C temperature and a highly concentrated acid medium to be realized *in vitro.*

Enzymes, which are a kind of biological catalyst, are no doubt responsible for making this *in vivo* reaction possible at low temperature. But the exact mechanism is not known; (it differs, however, from the catalysis with which we are familiar in chemistry).

Again, Lavoisier's law is not being rejected here, nor is any law of chemistry. What is rejected is the attitude of too many chemists who apply chemistry in every domain. The phenomenon studied in the next pages is not chemistry. Einstein wrote, "The essential is to get rid of deeply rooted prejudices, which we often repeat without examining them." [1]

The aim of this book is not to give a very detailed explanation of the mechanisms of biological transmutation, but only to show that they exist and, better, that they are being applied. They will be explained, perhaps, in the future at a time when science is ready.

We are probably on the eve of a great change in physics. Too many physicists have thoroughly committed themselves to paths which but lead to quicksand. But we are departing from our subject. My intention was only to remind the reader that great men of science, such as Einstein, de Broglie, etc., are teaching us to remain modest, to recognize that our knowledge is far from absolute, that teachings are not always true, and that there are transient hypotheses, even in physics which is labeled an "exact science." This is even more true in biology, where the complexity is enormous and where we must be most cautious in our explanations. We observe results, but to describe the detailed mechanism leading to these results is always more or less subjective. It is hoped that this book may be objective so that it might assure the reader of the existence of a phenomenon other than chemistry —a deeper kind of phenomenon, not a mere exchange of electrons in the peripheral shell of the atom.

The limitations of chemistry can be revealed by a few typical examples in which researchers have failed to give any substantial explanation of certain phenomena. Other examples will demonstrate that there is a biological transmutation of elements. If the reader finds his faith in Lavoisier's law somewhat shaken, he will be further surprised to find that many other explanations given him in the past are unfounded or tenuous, existing only to satisfy the dogma of "the invariability of elements."

For example, it is said that when a plant is enriched in an element different from those it previously contained, it has "obviously" taken that element from the soil or from the jar in which the experiment was conducted. Terms such as these are used: "concentrated," "preferentially fixed," etc.; and the question is dismissed. Those who employ such terms have never measured

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[1] *La Relativité*, Payot Publ. (Paris 1956).

the total content of the element in question—neither in the experimental jar nor in the soil—before and after cultivation. The latter should have been done if only to determine whether what was added to the plant was still in the jar. There is much talk about a possible source "by migration," but coming from where? And why? By what process—through impermeable soil?

Thus we must change our way of thinking entirely and be more cautious about what teachings we accept. Let us cite F. Dagognet who, in *Atoms*, revolts against the simplistic teachings of many of his colleagues. To use just one of his examples, he writes about respiration: "The $CO_2$ is exhaled before the oxygen enters; more exactly, the formation of the pyruvic acid or the "acetyl-coenzyme A" takes place without its help, or at least without its direct influence. We are miles away from Lavoisier and the first biochemists who believed that respiration is combustion."

Brillouin, a great physicist, readily admitted that not all laws of physio-chemistry deduced from experiments performed on dead matter are necessarily true with regard to living matter.[1] He cites the case of one of the laws of thermodynamics, that of the degradation of energy, which is certainly false in biology. In the latter case it is the other way around: life is a struggle against the degradation of matter. It is the force opposite that of entropy ("negative entropy"!) which maintains life. Explanations given by physicists—where they try to show that this law of Carnot is an absolute law, always true, applicable to the "living"—are of baffling naïveté. They do not dispute the fact, proven by experiments, that energy is provided by the living, but they declare that the living being receives that energy from its environment. Why then bring out the 2nd law of Carnot-Clausius, which has value only in a closed medium with no exchange whatsoever with the outside? This has nothing to do with entropy, positive or "negative." These are empty words. J. Rueff declared that Clausius, by setting forth his principle, "committed an audacious, if not hazardous, generalization, for it has value only in isolated systems formed of elements independent of one another."[2]

It is not difficult to see that life itself is in complete opposition with the law of entropy. Why? What is the secret? It is not known.

[1] *Vie, Matière et Observations*, edit. A. Michel (Paris 1959).

[2] J. Rueff, *Les Dieux et les Rois*, Hachette Publ. (Paris 1967).

What we can see, nonetheless, is that there are inexplicable phenomena which it is our role to decipher, be it with chemistry, physics, or biological transmutations.

## Physics

All laws of classical physics have been deduced from experiments made on dead matter. The principle of divergence—of elastic waves, acoustic, ballistic, luminous, or material: all the physical waves of the inert—is not applicable to biology. Physicists such as Watan, Adams, Mac Lennan, Penrose, and Percival have shown the link between a progressing entropy (a degradation of energy or, more exactly, an increasing degree of molecular disorder) and the retardation of the waves. With Costa de Beauregard we can speak of a unity in physics, whose laws about dead and living matter would be as front and back, inseparable and complementary. We recognize here the concept central to Far Eastern philosophy, that of Yin and Yang, a unique principle with two faces.

Physicists were not surprised at the news: the biological transmutations made sense to them. In a way, they had been waiting for them. It was in the order of things. That is why the physicists were the first to give their support. To reject the biological transmutations *a priori* in the name of nuclear physics—a science based on observations of dead matter—is to evince an ignorance of this duality (yin and yang) which exists in all aspects of physics.

The greatest men of science now recognize that neither the chemistry nor the physics of inert matter is integrally applicable to living matter. Szent-Györgyi, who was awarded the Nobel Prize, expressed this point quite well in his disagreement with the physicists of yesteryear: "This makes the relationship between the physicist and the biologist rather delicate. . . . If I had always accepted the physicist's verdict, I would have abandoned this way of research. I am glad that I did not do it." He arrived at the conclusion that molecular biochemistry is not enough to make us understand what happens in living matter, that one should take a step down in the structure and study the atom, because it is at the sub-atomic level that the unknown is being produced. Otherwise "physics is the science of probabilities . . . biology the science of the improbable."[1] The improbable surely happens, because quantum mechanics proceeds only on the basis of statistics. But in biology things are different. An electron makes a sure jump and one only; it never misses the target. (This explains the small amount of energy necessary.) Why? This fact brought Szent-Györgyi to write: "Even quantum mechanics should be improved in order to be applicable in the analysis of most problems in biology." We are hanging in the air!

Let us recognize, however, that Szent-Györgyi and the others who follow the same path have but glided over the atom. They saw only what happens in the outer layer. They then remained in the field of physio-chemistry as it is now conceived—that is to say, the physical study of the movements of electrons in the peripheral layers. (The electrons, becoming "excited," jump to place themselves in levels other than those of their normal orbit.)

It will be widely demonstrated that there are other biological phenomena unexplainable by the movements of the electrons—that is, by chemistry or physico-chemistry—because of a frequent incompatibility between biology and these sciences.

L. de Broglie recognizes this incompatibility in *Matter and Light.* He wonders if "the new conceptions of physics would help us understand why the classical methods of objective science have difficulty in adapting themselves to the vital order." Modern physics, as it was developed in the second half of the 20th century, has its roots in quantum mechanics. It took shape with Bohr and Planck and found precision with L. de Broglie in the beginning of this century, blossoming in 1960 with Gabor and Brillouin. Then came Jorden, Augier, Davilliers, etc., who touched on the different observations which had led them to believe that the microscopic physics of the inert is not always valid in living matter, where the parts are interdependent. These parts are all coordinated and have obvious interaction; otherwise there is no life. All this brings us far from Einstein, Heisenberg, Schrödinger, and Dirac. It is now widely admitted that a molecular reaction in living matter is controlled by a modification of the position of the electrons in their orbit (thus by their energy); that it is at the subatomic level that the chemical reaction is first prepared. But one

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[1] Szent-Györgyi, *Introduction to a Submolecular Biology,* Acad. Press (London 1960).

must probe even more deeply in the study of the atom, not only because it is unknown why and how these electrons "get started," but because other phenomena intervene in the heart of the atom.

Today physicists are obliged to recognize that at the subatomic level laws such as the conservation of mass or energy are not always observed, even in the physics of the inert. Bohr long ago recognized that we cannot say *a priori* that the law of conservation is valid at the level of the atom. J. Debiesse, director of the Centre d'Etudes Nucléaires of Saclay, remarked that the emission of $\pi$ mesons occurs with the sudden increase of the system's mass and energy. (Thus the energy does not increase due to a loss of mass; there is also an increase of mass.) Debiesse writes, "It remains to be seen whether at the speed of exchange $10^{-23}$ seconds the law of conservation of mass and the law of energy are still valid." Such things brought R. Furon to say, "The rapid advance of our scientific knowledge excludes any orthodoxy and conformism" (in the magazine *Revue Générale des Sciences*, Paris).

Let us accept these lessons of modesty from our most eminent scholars. We shall then be ready, with no preconceived purpose, to become acquainted with the following study. Einstein's law of $E = Mc^2$ will not, then, be accepted as absolute in advance. Even Einstein himself indicated the limits of this law of "special relativity," special because it is applicable only to non-accelerated and non-circulatory movements. (Einstein's first postulate admits that his law is valid only in a uniform and rectilinear movement.) Another restriction, pointed out by Einstein, is that this law is valid only if one accepts as the second postulate a constant celerity "c" for light. He then declares that that same postulate is cancelled out by his law of General Relativity; otherwise it would be impossible to explain the curvature of light under an intense gravimetric effect.[1] Let us take the example of the luminous ray coming from a star skimming over the sun's edge. The star is visible sooner than would be possible if the calculation were made when light comes in a straight line. (This phenomenon has been observed during solar eclipses.) It was thought that it might be the result

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[1] A constant speed is represented by a straight line. If positive energy is given to the mobile, the line curves in upward. A negative energy X reduces the speed, causing the line to curve in downward. The acceleration by gravitation curves the light. Its speed is no longer constant.

of a diffraction occurring when light goes through the chromosphere of the sun (or perhaps only through its "crown"), in other words, when the ray goes through an area more dense than the "vacuum" of space. This occurrence implies a variation of the speed of light, which diminishes or increases in proportion to the density of the media passed through. This curvature would then allow us to calculate the refractive index of the solar chromosphere.

I could continue to point out "weaknesses" in the presently practiced science of physics. However, it would take many pages simply to discuss the fact that not all energies brought into play in biology are of the same nature as those of gravitation.

There is not the least doubt that Lavoisier was perfectly correct in his field. We understand why. Chemistry is the science of the combination of atoms; it studies in a specific way the variations in the links between the peripheral electrons of the atoms, which gather into molecules.

## The symbols in nuclear physics

The chemical symbol for the atom is not always sufficient when we are dealing with the atom's nucleus. It is often necessary to indicate the total number of particles (i.e. protons and neutrons, which are both nucleons or particles of the nucleus). This is because the natural elements are made of different atom combinations: all the atoms of the same element have an identical number of protons and electrons, since a normal atom is electrically neutral, but it was discovered that the number of neutrons in a nucleus can be different. A neutron owes its name to its being neutral. It has almost the same mass as a proton.

Atoms having the same number of protons but a different number of neutrons are called "isotopes." They are written thus: $^{24}Mg$, $^{25}Mg$, $^{26}Mg$ [these being stable (non-radioactive) isotopes of magnesium], which means that in these nuclei there are 24, 25, or 26 nucleons. Since all have 12 protons, the number of neutrons can easily be found by subtraction. Likewise, we have $^{10}B$, $^{11}B$ for boron, $^{12}C$ and $^{13}C$ for carbon, $^{28}Si$, $^{29}Si$, $^{30}Si$, for silicon, etc.

Notations of this kind can often be found: $^{16}_{8}O$, $^{17}_{8}O$, $^{18}_{8}O$, for example, which are the three stable isotopes of oxygen. The small index 8 means that there are $16 - 8 = 8$ neutrons in the isotope 16, $17 - 8 = 9$ neutrons in the isotope 17, and $18 - 8 = 10$ neutrons in the isotope 18.

The phenomenon of biological transmutation applies to the nuclei of the atoms, but the most important and abundant of these transmutations are found to occur mostly with the first 20 elements and to a lesser extent with the next 10 (from a total of 92 elements). The elements are put in order according to the number of their protons (and electrons). Thus hydrogen (H) comes first; it has only one proton and one electron. Then comes helium (He) which has 2 protons; lithium (Li), 3, etc.

Simplified notations have been chosen so that everyone can understand. Our aim is not to pursue theoretical explanations but to observe facts which cannot be understood in terms of chemical reaction. It is in explaining these that comparisons with chemistry might sometimes prove useful. Reality is too complex to be always accessible by our present scientific knowledge. We do not know, for example, why, during electrolysis (with no system of evaporation in effect), hydrogen and oxygen appear on the electrodes in gaseous form, although in water they do not exist in this form.

No one knows much about what goes on in a catalysis, nor even what happens in a chemical reaction (ignoring, for example, the instantaneous energies). No one knows how the releasing process from wake to sleep comes about, how aspirin works, etc. This is why theories will be avoided here. Only results will be shown, together with phenomena observed in the past and kept in the dark.

Many answers will be given in the following chapters. Systematic experiments which have been made to verify the conclusions of the past ten years will be cited. All precautions will be summarily indicated in order to avoid assuming the position of an analyst of mineral chemistry.

It may be that some chemists and atomic physicists will be hurt. Biological transmutation is a new science which has not yet found its own language, hence there is no way to make ourselves understood except to use the "old" symbols familiar to us all.

In such a study as the present work, it is rather difficult to avoid approaching the many separate fields of science. May the specialists of every particular branch excuse such presumption. Sometimes the exact and desired term is not used, either because the branch under consideration is insufficiently familiar or because hermetic terms would have rendered the text inaccessible to a larger public. This applies even to the specialists themselves, because the vast synthesis projected here places the essential part of this work outside any single discipline. It is hoped above all that no aspect of this exposé has been distorted for the sake of simplification.

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We have proposed the symbol $:=:$ to distinguish it from the symbol $=$ which is good in mathematics or chemistry, indicating two valences, and to distinguish it also from the symbol $\leftrightarrows$ used in chemical reactions, which means that the reaction is reversible. If we want to indicate the only direction the reaction takes, we write (in chemistry): $2Na + O \rightarrow Na_2O$.

With the type of reaction occurring in biological transmutations, in order to make clear that no chemistry is involved and thereby avoid confusion, we note $Na + O := K$. This indicates a reaction from left to right. There is no reversibility as is found in chemistry where one may end up with an equilibrium between the atoms on the left (the constituents) and the composed molecule on the right. In our reactions when we indicate $:=:$ we mean that the reaction is reversible but not with the same agents. Different enzymes are required; some can be made only by animals and some by plants.

The reactions can be subtractions; the potassium nitrate in saltpeter—which is found in the lime on walls—comes from calcium when bacteria cause a subtraction of hydrogen in the middle of the calcium atom. Calcium − hydrogen = potassium, or $^{40}Ca - {}^{1}H = {}^{39}K$.

It can be seen that potassium has two origins: sodium plus oxygen, and calcium minus hydrogen. A law now emerges from these biological transmutations: reactions at the nuclear level of the atom always involve hydrogen and oxygen. In biology, there are not only chemical reactions with oxygen (oxidation) or hydrogen (reduction). There exists a phenomenon deeper than the mere "hookings" of the peripheric electrons.

It might be useful to know that very often, to simplify our writing, we write only the number of nucleons (above and at the left of the symbol); we do this because we take for granted that the reader knows how many protons there are—see Mendeleev's periodic table—and the number of protons is sufficient to identify the element. Thus if, for example, the symbol Na is given, one knows it is sodium; it would be repetitive to add the number of protons to again indicate that it is sodium.

For practical reasons, however, one may record the proton number also. If one has ${}_{11}\mathrm{Na} + {}_{8}\mathrm{O} :=: {}_{19}\mathrm{K}$, he adds the protons (written below and on the left) and automatically gets the atomic number of potassium.

The same method would be used for other elements.

The complete writing is ${}^{23}_{11}\mathrm{Na} + {}^{16}_{8}\mathrm{O} :=: {}^{39}_{19}\mathrm{K}$, the numbers on the left giving the numbers on the far right. It is important to note that in this type of notation the number above and on the left is not the atomic mass, but the number of nucleons.

# I

# ABERRANT OBSERVATIONS

## On chickens

My parents had a few chickens which they kept in a chicken coop adjoining a yard. We lived in Brittany, France, where my father worked as a government official. The area was full of slate rock and granite, but absolutely devoid of limestone. Limestone was never given to the chickens, yet every day during the egg-laying season they laid eggs with calcareous shells. At that time I had not yet asked myself from where that limestone came, but I was intrigued to observe that when the chickens were let loose in the yard, they scratched about incessantly for fragments of mica strewn on the ground. (Mica is one of the components of granite, along with quartz and feldspar; all are components of silica. This is all I knew then when I was in elementary school.) I noticed this neat choice that had been made by the chickens, when the sun shined after a rain: well washed off, these hundreds of visible fragments looked like tiny mirrors. The imprints of the chickens' beaks were easy to follow.

No one could explain to me why chickens scratched mica and not sand. Whenever a chicken was killed I observed my mother opening the gizzard and finding small grains of sand, but never mica. Where did this mica go? Into the stomach? Why was this mineral swallowed by the chicken? This problem intrigued me and remained in my subconscious like anything mysterious, because I rather liked to have "solid and logical" explanations . . . the whys of all children.

## On incandescent stoves

In the elementary school classroom in the borough where I lived, we were heated by a rudimentary stove made of cast iron. There was a key on the pipe to regulate the draft—or we could push or pull the ashtray. Old oak was mainly used. When the wood caught fire, the stove very quickly began to "snore" and became red. Then everyone complained of headaches. That is why an "officer in charge" was appointed to turn off the key or push the ashtray when the stove started growing red.

The headaches, the teacher told us, came from the carbon monoxide emitted by the stove at the red-hot point. At school, however, the belief was that slow combustion gives off carbon monoxide (CO), while fast combustion produces carbon dioxide ($CO_2$), which is less dangerous. We were advised against sleeping in a room having a stove with a slow draft.

I couldn't make up my mind. If the stove becomes red, it is precisely because it has a good draft system, a very good one, and there should be no formation of carbon monoxide. All the explanations given to the questions I later asked my teachers were so little convincing that this mystery also stayed in my subconscious.

The scientific answer is this: red-hot cast iron becomes porous and allows the CO within the stove to seep out instead of leaving by way of the smoke pipe. If I objected that there could not then be carbon monoxide from a fast, complete combustion, the reply was that $CO_2$ went through the red-hot cast iron, became rich in carbon, and then became carbon monoxide. This meant that the cast iron would eventually lose its carbon! I have never seen a few hundred grams of coal (approximately 40 grams per kilo of cast iron) disappear from a cast iron stove to produce a stove of steel! These hundreds of grams of carbon would have burned quickly! Even if cast iron is porous when incandescent, I do not believe carbon monoxide is produced at the contact of $CO_2$ with cast iron. If carbon monoxide (CO) were formed, it would burn immediately to give $CO_2$. Thus, to make things worse, we are considering unreal conditions, since if the stove draws well it is because there is depression. This means that if the cast iron is porous, there won't be any gas seeping out. On the contrary, there will be an "air call" through the porous wall!

But what really happened? Undeniably a red-hot stove in a closed room brings about intoxication, sometimes deadly, from carbon monoxide.

The explanation of all this came to me indirectly when I was fifty years old, although when I was still a child the problem had already repeatedly presented itself. I had to wait until 1955 for a convergence of mortal accidents to make me doubt the theory of the "invariance of matter." Notwithstanding the current respect for official prescriptions, there were nonetheless many people who had met death by carbon monoxide intoxication, although it was attested to by many analyses that the victims could not have inhaled carbon monoxide. I crossed the Rubicon, and with coworkers (eleven were engineers from the finest schools of France) undertook a long series of experiments. We secured the help of official laboratories along with the cooperation—for blood analysis—of many M.D.'s. I abandoned my postulate concerning the invariance of matter in order to confirm or nullify my hypothesis about the real cause of death, intending to concentrate only on results, whatever they might be.

In the meantime, in the spring of 1959 I was led to conclusions which revealed the explanation. Balance sheets had been established on teams of workers. The Minister of the Sahara himself, Jacques Soustelle, an ethnologist, had given me the opportunity to make a close study near petroleum wells. In spite of the prevalent classicism, I decided in the summer to publish these aberrant balance sheets established from chemical and physical points of view, but resulting from research I had made with the cooperation of the most eminent specialists of organic chemistry, together with professors of medicine who believed that I was on solid ground.

As a high official of the French government, I had the unique privilege of using any official laboratory. I could thus have the collaboration of the most eminent specialized chiefs of laboratories, professors of universities, etc. (for it is impossible nowadays to ask the same laboratory to make different experiments). This privilege proved very useful to me. Without such a synthesis of disciplines my task would have been impossible. No isolated specialist could have succeeded. I thank all the eminent men of science who brought me the support of their high qualifications, permitting me to prove and confirm the validity of my theories.

## On welders

In 1935 I made an observation which left me perplexed. A blowtorch welder was mortally intoxicated by carbon monoxide. My job was to investigate the conditions surrounding the accident in order to determine the causes and eventually prevent them. Nothing enabled me to discover the source of this carbon monoxide.

Many times after that such accidents occurred, and on no occasion could I find the link which would lead me to the origin of the inhaled carbon monoxide. These facts remained in my subconscious until 1955. It was not until that year that I saw the light.

That same year in the space of a few months, three oxyacetylene welders died. I received all the detailed reports, including autopsies. All evidence indicated that the welders, who were all steel cutters, had died from oxycarbonaemia and not from nitrogen oxides.

Analysis showed that the inhaled air had too small a percentage of carbon monoxide to be dangerous. It was then decided, with the assistance of M.D.'s working for the companies, to make blood analyses on all the victims' comrades, although they looked in rather good health. We found that those doing the same work were deeply affected with chronic oxycarbonaemia, some to a level approaching that of fatal accident.

I put together all I had and imputed the fault to working conditions, although analysis of the air inhaled by the workers proved that there was no source of carbon monoxide anywhere. Investigations were made in different places. The impregnation with oxycarbonaemia was general. After four years of research, using the most delicate of methods, I could conclude:

1) that the strong blow-torches with which the workers cut metal do not liberate carbon monoxide, but do bring a large surface of ferrous metal to incandescence.
2) that those workers who were bending down to their work—

and only they, not their helpers standing by—inhaled the air which licked the ferrous and incandescent metal.

3) that the analysis of the inhaled air showed an absence of carbon monoxide, meaning that the air was always a combination of nitrogen and oxygen. This explained the fact that never, even though a great number of investigations were made the world over, was carbon monoxide found in the inhaled air.
4) that carbon monoxide—being detected in the blood of the workers, not in the blood of the helpers—could only have an endogenous formation when this air is breathed. In other words, it was activated by the air's contact with a ferrous and incandescent metal. This would shed light on the observations made in places using cast iron stoves heated to incandescence.

The oxygen in the inhaled air was not sufficient to allow a formation of CO in the organism. There is O, but C is needed. From where does it come? After much research I thought that it was activated nitrogen which produced carbon in the organism (at the level of red corpuscles irrigating pulmonary alveoli). This question hasn't been cleared up. The nitrogen molecule (there is never free atomic nitrogen; isolated nitrogen is always in the form of $N_2$) contains two nuclei of nitrogen enveloped by the electrons of the molecular orbit. In the heart of the molecule the two nuclei vibrate at a known frequency. Were this submitted to a vibratory and outer energy more or less of the same period, could it be a resonance which at a certain time provokes the passage of a proton with its neutron from one nucleus to another? All this occurs without any change of the peripheral electrons. On one hand, there remains a nucleus with one proton missing, thus carbon; the other nucleus acquires one more proton and becomes oxygen. It is thus a phenomenon having nothing to do with nuclear physics; one remains at the molecular state. But we have here an internal remodeling by the removal of a proton from one nucleus to another. The measurements taken show that in the molecule $N_2$ the distance between the two nuclei of nitrogen is 1.12 Ångströms, whereas in the CO molecule the distance between the C and O nuclei is 1.09 Ångströms.

This removal of a nuclei when a proton and its neutron ex-

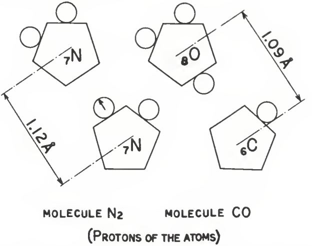

*Fig. 1 The change of place of a proton—arrow on the left—makes an $N_2$ molecule become a CO molecule.*

change places does not seem radioactive: it could occur under the energetic action of an unidentified enzyme at the level of the pulmonary air cells, or perhaps in the thickness of the membrane of the erythrocytes going through the air cell. It has not yet been proved that I was mistaken.

Controversies arose when I published the above explanation in 1960. A specialist advanced the following opinion: the heat of the inhaled air led to a dilation, a reduction of density, thus to the rarefaction of the inhaled air. From this would result a diminution of the oxygen pressure, which is conducive to "bad combustion" in the blood, hence CO is formed instead of $CO_2$. It is easy to see that this hypothesis has no value whatsoever. The breathing in of hot air would not lead to the same effect if there were no contact with an incandescent metal.

Nevertheless, a systematic study [1] was made in 1963 by a friend, Professor Desoille, and his colleague Truffert, both holding high official positions. They demonstrated that the phenomenon was independent of oxygen pressure. In 1964 I also showed that this phenomenon does not occur when the metal sheet is brought to a temperature of 400° C; one needs at least the deep red, and

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[1] H. Desoille, Absence de corrélation entre la pression de l'oxygène et l'oxyde de Carbone dans le sang, Arch. Mal. Prof., July 1963.

when the sheet is bright red the effect is quick. Oxygen is not the cause; thus my first publications in 1960 were confirmed. Nor does this same effect occur if one exchanges the nitrogen of the air with helium. Nitrogen alone is the origin of this endogenous production of carbon monoxide. The phenomenon being clarified, since my position in the scientific world permitted it, I notified "inspectors" of the measures to be taken in factories to avoid oxycarbonic intoxication once and for all.

# II

# POTASSIUM

It appeared useful to me to gather together all the results of my research concerning the aberrant metabolism of potassium. This research has permitted me to verify

1) that the vital phenomenon is not of a chemical order; it goes deeply into the atom, starting in the nucleus. Organic chemistry is only the final stage of molecular rearrangement.
2) that the nucleus of the atom in light elements is quite different from what nuclear physics regards as the average type, the latter having value only for the heavy elements.
3) that Nature moves particles from one nucleus to another—particles such as hydrogen and oxygen nuclei and, in some cases, the nuclei of carbon and lithium. There is thus a transmutation.
4) that biological transmutation is a phenomenon completely different from the atomic fissions or fusions of physics; that it reveals a property of matter not yet seen prior to this work.

My research was directed mostly towards the reactions taking place inside the nuclei of sodium, magnesium, potassium, calcium, nitrogen and, in a lesser degree, phosphorus, sulfur and chlorine, etc. The major role of potassium appeared to me to be a biological regulator; it can be produced endogenously from sodium. This reaction allowed me to calculate the endothermal energy necessary to tie a nucleus of oxygen to a nucleus of sodium, giving a nucleus of potassium:

$$Na_{23} + O_{16} = K_{39}$$

This process necessitates only one millionth the energy of a reaction of nuclear physics *in vitro.*

## Relation between potassium and temperature

There is abundant literature concerning this subject. Here are a few experiments cited by Reinberg:

It seems that it was Bachrach who first studied this phenomenon: he made cultures of lactic bacteria and brewer's yeast in a hyperpotassic medium at different temperatures. After one month the multiplication of these unicellular organisms was maximum in media richer in potassium, at the highest temperature. (With high temperature but a small amount of potassium the results are different.)

Ets and Boyd (study on the sciatic nerve of the frog) showed that cold is inhibitory. When potassium is added, this blocking occurs—but only at higher temperatures; the effect is even more accentuated when the K rate is higher.

Hundreds of experiments of this sort have revealed a correlation between the temperature at which the metabolism of living tissue occurs and the tissue's potassium content. But the nature and cause of this relation have not been determined.

E. G. Martin verified that an excess of potassium stops the heart of a fresh-water turtle cultured in a cold medium. If the temperature is raised, the potassic inhibition ceases. There is then a maximum potassium concentration not to be exceeded and a minimum which must remain in proportion to the temperature. Let us note that, for man, the "fork" in the plasma is from 150 to 200 mg/1, variable with every individual, but beyond 300 mg/1 there is danger. If a relation between K and temperature has been seen, it does not seem to have perceived that this is a relation of opposition: an excessively high temperature slows or stops physiological activity; the organism reacts by secreting K.

## Relation between potassium, oxygen and hydrogen

The relation between potassium, oxygen and hydrogen has been perceived and various works contain references to it, but here, too, no general explanation has been seen.

### a) *Relation between potassium and oxygen*

It has become apparent that potassium is most abundant where oxygen is present, i.e. where the metabolism is very active and the breathing deep—thus, in fully active tissue.

It is necessary to keep in mind the reaction $Na + O = K$, in order to understand that endogenous potassium is possible only if it has access to oxygen for its formation. This fact sheds light on the following findings:

Latshaw and Miller established that in corn, on the average, 45% of the plant's total potassium is in the leaf (where respiration is strong), 35% in the stem, 13% in the kernel, 4% in the bale, and 3% in the root. These values vary, of course, according to the age of the plant, to season, and also to light (which is not surprising, since respiration is linked to chlorophylian photosynthesis). It has been verified that in potato leaves K is at its maximum during the day and at its minimum at night.

Broyer showed that a small amount of oxygen increases the potassium content in the roots of barley, tomatoes and rice. The same is true of man and animals, where the potassium content is directly proportional to breathing activity or to the activity of tissues which require much oxygen.

That is why cancerous tumors are richer in K, a fact having been verified in man and in the sarcoma of the chicken (Moravek).

An increase in K content leads to an elevation of arterial tension, to the activation of the vaso-motor reactions. (The opposite is true with Mg and Ca). An increase of K from an injection in the cerebro-spinal liquid provides an intense breathing stimulation.

An animal is put to sleep with an injection of Mg and awakened with K (by an injection in the infundibulary area, with no effect in other areas of the brain). Oxygenation slows down during sleep or under the influence of narcotics. Potassium does the same. During sleep the metabolism is slowed down. There are less exchanges, less O, and thus less K; this reduction of K at the end of the sleeping period can attain to 16.6% in the plasma.

An excess of K diminishes the frequency and amplitude of the systols; at the extreme there is heart failure, the muscles and arteries having been loosened. Muscular activity necessitates oxygen, thus leading to an increase of K in the extra-cellular medium. Tipton verified this on the cat, Heppel on the rabbit, Bureau on the frog, Fenn on man, etc.

Heart failure in man occurs when $K = 9$ to 12 m Eq/1 in the plasma (approximately 350 to 450 mg/1).

For more details concerning the effect of K on the heart I refer the reader to specialized books. It follows that there is a Na/K relation which must remain within limits and that this required balance also implies limits for the K/Ca relation. One sometimes studies the $Na + K / Ca + Mg$ relation. Darrow showed that the K variation greatly affects the electrocardiogram, which reveals a hyper or hypo "potassemia" or "kalemia"; this is due to a lack of polarization which is itself dependent upon the relation between Na and K on each face of the superficial layer of the nervous fiber. The ratios of concentration between Na in the outer medium and K in the nervous cell modify the difference in potential.

A young rat needs 15 mg of K per day. It needs only 2 mg when it is an adult. The average amount of K necessary for a human baby is 9 gr per day, which means that a nursing mother's milk is relatively rich in K (500 mg/1) but poor in Na.

### b) *Relation between potassium and hydrogen*

If there is abundant literature showing that the presence of K is dependent on the availability of oxygen, there are also several experiments showing its relation to hydrogen, for according to our reaction, $K + H = Ca$. In other words, if K is too abundant in the presence of H, it will give Ca.

The presence of H is linked to acidity (low pH). An excess of H ions signifies an acidity that might become dangerous for the cell. However, in that case K can join an H nucleus to produce Ca, thereby establishing alkalinity and an optimum Ca/K ratio. The agent of equilibrium is thus K. The effects between K and Ca are opposite in appearance only; they are in fact complementary.

Hoagland writes that there is a clear tendency toward acidification of the cellular medium, freezing $H^+$ ions; the addition of $K^+$ ions leads to the alkalinization of the cellular liquids.

Reinberg notices that "the alkalinization of the cellular liquids with K is well known by arboriculturists, who use potassium nitrate to speed up fruit maturation."

It is of interest to point out that the proportions of K and Ca are of the same order in animal life—in the plasma as well as in sea water, where life began. Here is a Reinberg table:

| | Contents in m Eq/1 | | | | |
|---|---|---|---|---|---|
| | K | Na | Ca | Mg | Cl |
| Sea water | 10 | 450 | 20 | 100 | 530 |
| Rat | 6.2 | 145 | 6.2 | 3.2 | 116 |
| Dog | 4.7 | 142 | 4.9 | 1.8 | 108 |
| Man | 4.5 | 140 | 5 | 2 | 102 |

If one compares the weights in milligrams, one finds that Na/K in sea water is from 25 to 27, in the plasma of man from 17 to 18 (varying from 15 to 22 according to the individual), but in cells it is K which predominates. In the red globule, the vehicle of oxygen, Na gives an abundance of K. $Na + O = K$, because $K/Na =$ approximately 180!

In sea animals the percentage is almost the same as in sea water. In fresh-water or land animals it is lower, but there the K/Na ratio is much higher. This indicates a more active life and more oxygenated blood, since K and O "go hand in hand," while Na decreases.

However, in land animals we find that the K/Ca ratio in the plasma is very close to 1, due to the reversibility of the reaction

$$K_{39} + H_1 \rightleftarrows Ca_{40}$$

Conditions are different inside the cell; it is here that the reaction takes place. Na penetrates the cell and fuses with O to give K; thus there is less Na and more K, but little Ca.

The following is another of Reinberg's charts: (m Eq/1)

| | K | Na | Ca | Mg | Cl |
|---|---|---|---|---|---|
| Octopus' muscle | 101 | 81 | 3.7 | 12.7 | 93 |
| Cat's muscle | 151 | 28.5 | 1.2 | 15.4 | 18 |
| Man's red blood corpuscle | 105 | 10 | 0 | 5.5 | 80 |

The cells of land plants are richer in potassium and Ca and poorer in sodium than those of animals.

A few examples:

| | K | Na | Mg | Ca |
|---|---|---|---|---|
| Mushroom | 102 | 8.7 | 4 | 11.5 |
| Potato | 115 | 8.7 | 25 | 7.5 |
| Chestnut | 135 | 8.7 | 33 | 20 |
| Wheat (grain) | 118 | 8.7 | 112 | 22.5 |
| Corn (germ) | 197 | 36 | 440 | 34 |
| Date | 165 | 4.3 | 52 | 32.5 |
| Asparagus | 64 | 1.3 | 9.1 | 12.5 |
| Strawberry | 40 | 2.2 | 17.5 | 22.5 |
| Grape | 64 | 2.7 | 8.3 | 5 |

Darrow pointed out that a K increase in the cell decreases the cell's acidity because it causes a decrease in H. Thus the alkalinization takes place when K takes H to give Ca. Ca is taken back by the outside liquid and excreted, producing a negative Ca balance sheet. More Ca is excreted than ingested, but the main source of Ca is Mg:

$$Mg_{24} + O_{16} = Ca_{40}$$

The internal equilibrium of the animal cell postulates a large K content and a small Ca content. The reactions with H help to reduce acidification, since H is taken away.

It has been found that micro-organisms in the soil excrete H ions which acidify the soil; however, K neutralizes this acidity when it comes in contact with the roots.

If the calcium concentration in the nutritive medium is increased, there is a smaller absorption of K. This can be explained by the fact of reversibility:

$$\mathrm{K} + \mathrm{H} \rightleftarrows \mathrm{Ca}$$

This specific reaction allows a biological equilibrium to be maintained.

We shall learn more about the metabolism of potassium in other chapters. This present chapter was intended to acquaint the reader with some simple facts as a basis for helping him understand what the book hopes to convey.

# III

# SODIUM-POTASSIUM

We have seen how sodium can be transmuted into potassium. This reaction is very important in animal biology. I have described it many times in my earlier books.

I confirmed this phenomenon, thanks to the ethnologist Jacques Soustelle, Minister of the Sahara, who gave me the opportunity to make experiments on teams of workers. The latter were busy drilling wells under extremely difficult conditions. It is common knowledge that in the Sahara Desert it is dangerous to remain too long in the sun. The fact that people could work hard on metallic platforms unshaded from the hot summer sun remained unexplained. Systematic research was conducted with the help of a military doctor and his assistants.

A voluntary team was followed carefully for six months. Everything they ingested and excreted was weighed and reported. The balance sheet showed that during great heat the potassium emitted through perspiration was greatly increased. However, sea salt ingestion increased also. The workers were given extra salt in the form of tablets which they sucked. But this ingested salt was not entirely secreted. What happened to it? It could not possibly have been stored in the body, because the difference between ingestion and excretion was so great that an accumulation of it would have been impossible.

The biggest mystery lay in the thermal balance sheet. By their work and food, and by the heat endured in the sun and in the shade (ambient temperature was higher than body temperature), the workers averaged 4,085 kilocalories per day in those six months, reaching more than 7,000 kilocalories per day in the summer. Perspiration averaged 4.12 liters per day, and due to the extreme dry heat it did not even drip, but evaporated instantly. 540 kilocalories are needed to evaporate a liter of water. With such an imbalance the workers should have died from "hyperthermia" because the heat could be released only through perspiration—that is, $540 \times 4.12 = 2{,}225$ kilocalories, and $4{,}085 - 2{,}225 = 1.860$ kilocalories per day, according to the classical balance sheet. Such an excess is obviously impossible.

I came to the conclusion that it was sodium which, disappearing to become potassium, created an endothermal reaction (thus causing heat to be absorbed.) Hence by instinct one consumes more salt in a dry and hot country. This is why salt is so important in Africa, the Middle East, etc., where caravans travel up to 1,000 kilometers to bring back salt. In Taoudeni, a unique city in the middle of the Sahara 1,000 kilometers north of Timbuktu, the monetary unit is the salt bar. Also, notice the importance given salt in the Bible.

The transmutation from sodium to potassium was confirmed by another experiment made in a more arid part of the Sahara with the help of the Marine Militaire. This experiment took eight months. Systematic research was carried out in a physiology laboratory where it was found that a man making a major physical effort during three hours, in a temperature of 39° C with a humidity of 60%, would experience an increase of three times his usual rate of potassium in proportion to sodium, in his urine. This reaction has a biological significance. It has been commonly known that people struck with a lesion in the surrenal glands reject much more potassium, even if it is not given to them. It was never understood from where this potassium came—the small reserve which the organism can mobilize does not justify such a massive excretion! (On the other hand, salt has been found to disappear in the organisms of people inflicted with Addison's disease.)

Blood plasma is very rich in sodium chloride (sea salt), containing approximately 7 grams per liter. However, the rate of sodium chloride diminished in the blood even with normally salted food. This enigma was classified and forgotten among the mysterious phenomena of life, the sodium-potassium relationship ignored.

M.D.'s have seen the blood's potassium increase at a dangerous rate. Excess potassium diminishes nerve excitability, making the electric potential equal in the two faces of the nervous cell wall.

Normally the outer medium of the cell is richer in sodium and poorer in potassium than the interior of the cell. The ratio between the ions of potassium in the interior and exterior of the cell defines the membrane's potential. Abnormal balance results in a paralysis of the nerves of the heart and lungs; this in turn causes syncope and ultimately death. Some doctors thought that by replacing plasma too rich in potassium with an artificial serum containing only sodium chloride, they would achieve good results. Unfortunately this attempt was followed by the immediate death of the patient.

The reader has probably discerned that the potassium came from sodium and that whenever fresh sodium is injected into the organism, it is immediately transmuted into potassium.

Professor Perrault, a "famous hospital boss" and a member of the Faculté de Medecine of Paris, once asked me to give his students a lecture explaining what was really happening. It had been found that aldosterone had provoked this transmutation. In cases of surrenal lesion the opposite hormone is not sufficiently secreted and the balance is lost.

Reactions of this kind occur in accordance with the physiological condition of the patient. Thermal balance sheets of food as calculated by dietitians have a relative value; according to chemical experiments made in laboratories, chemical energy is released only by the combustion of carbon in food, most of all in carbohydrates (sugar).

The sodium-potassium link presents itself in many varied forms. A study made on terrestrial and marine iguana showed that some species secrete from a special nasal gland a liquid containing up to 190 times more potassium than is in their blood plasma, at a rate of 190 cm$^3$ per hour. A solution of sodium chloride added to the cesspool of these reptiles stimulated a potassium increase in the excretion of their nasal glands, but no sodium increase. If potassium chloride has been added, the potassium concentration and the glandular flow would still have increased.

Dr. Jullien[1] (from the Faculté des Sciences of Besançon) has proved that if tenches are put in water salted with 14‰ sodium chloride, the rate of potassium chloride rises from 3.95 g/l to 5.40 g/l after four hours, i.e. a 36% increase.

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[1] Annales Scientifiques de l'Université de Besançon, 2$^a$ Série Zoologie et Physiologie fasc. 13–1959.

The same result can be achieved in three days (72 hours) using water salted with 8‰ NaCl. KCl passes from 3.95 g/l to 5.39 g/l.

The calcium chloride content remains 0.300 g/l from beginning to end in the experiment. In order to be sure that it is not the cellular potassium of the blood globules that enters into the plasma, one must take the precaution of measuring the total K in the blood (plasma + globules).

This potassium increase cannot be attributed to a loss of water, for the relative concentration of all the salts would then be uniform. We have seen that the concentration of calcium salt does not change; there is absorption of NaCl only, hence a slight sodium chloride increase in the blood. The NaCl content increases from 5.10 g/l to 6.60 g/l after four hours in water salted to 14‰, and to 6.40 g/l in 72 hours in water salted at 8‰, which is a 25% increase as opposed to 36% for potassium chloride (with no variation in the calcium chloride content).

The problem of the passage from sodium to potassium is of

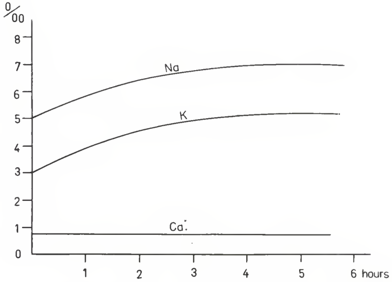

*Fig. 2 Variation of Na, K, and Ca in the blood of a tench in water containing 14‰ NaCl.*

great importance in physiology. This valuable mechanism of nature insures the thermal regulation of the organism. The reader will recall the experiment made in the Sahara, in which case the variation of the K/Na balance sheet was remarkably parallel to that of the thermal balance sheet.

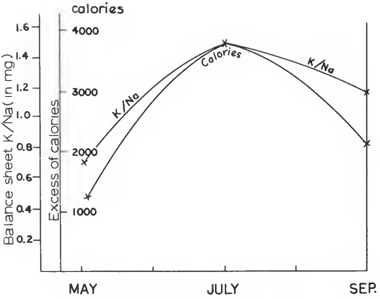

*Fig. 3 K/Na and thermal balance sheets.*

The body was receiving more heat than it received while its temperature remained normal, due to evaporation, perspiration, etc. In physiology laboratories, experiments made on men have shown an increase in potassium excretion under hot conditions if the organism can dispose of sodium. (This observation justifies such "empirical" practices as giving hot, salty vegetable broth in cases of fever.)

An addition of potassium allows a tissue in culture to continue living at a higher temperature. The secretion of potassium is thus a defense reaction by the organism, occurring in cases of accidental increase in temperature. It establishes a new equilibrium. (For example, the fever remains constant at 39° C.) It appeared that here was the explanation of how an organism combats fever: the transformation from sodium to potassium is made through a strongly endothermal nuclido-biological reaction (sodium + oxygen). From the K/Na and thermal balance sheets which I had made in the Sahara on two similar teams, I obtained a quantitative comparison indicating the value of the endothermal energy resulting from this reaction. Let us recall the practical applications, such as salty drinks for the prevention of hyperthermia among workers being exposed to dry heat. M.D.'s and professors of medicine are now better able to understand the mechanisms of fever, for it is obvious that the thermal equilibrium's being at an unusually high temperature does not result from the perspiration evaporating. Thus the specific heat of the evaporated water does not affect heat loss, whereas the inflammation which is the cause of hyperthermia continues to supply calories. It is an endogenous and endothermal reaction which maintains the equilibrium by an intense excretion of potassium, showing that the potassium is produced in the organism, which then rejects the excess.

Much research in biology has been done concerning oxygen consumption in cases where sodium increases and potassium decreases. "The oxygen consumption of some invertebrates (as seen in the snail's heart, mussel, etc.) increases, depending on the Na/K ratio," writes Reinberg in *Sodium and Life*. If there is a shortage of oxygen, there is no longer a diminution of Na accompanying an increase in K. Na and O are thus necessary for verifying the increase in K.

In *Annals of the New York Academy of Sciences* (July 1966), a collective volume of more than 600 pages, dedicated to the recent progress in the study of biological membranes, we find under the signature of H. H. Ussings: "The excess oxygen consumption seems to derive from some anomaly in the handling of sodium" (p. 544); or, "It is seen that in all experiments the oxygen consumption per equivalent ion (of sodium) is much higher than normal" (p. 545); and, "The oxygen consumption is increased in proportion to the amount of sodium transported" (p. 553). The author verifies these facts without attempting to explain them.

The "transport" of sodium is generally considered to be an exchange with potassium through the cellular wall—potassium being more abundant in the intra-cellular medium than in the exterior one. This is a classical theory. There is no reason to doubt it; the number of experiments and their variety provide confirmation of this phenomenon. But one is almost always satisfied with such an explanation—an explanation mistakenly generalized, which might be true qualitatively but not quantitatively.

There is no simple exchange through the wall. Lichtenstein and Leaf (1966) recognize this fact. They say, "However, previous studies have demonstrated no quantitative relationship between net sodium transport and potassium uptake from the serosal sodium," and, faced with the contradictions of classical hypotheses in opposition with the facts, they add, "Further studies, in fact, have led us to the somewhat uncomfortable conclusion that the major effect of removing potassium from the serosal medium is to somehow reduce the mucosal barrier's permeability to sodium, so that insufficient sodium can gain access through that surface."[1]

The authors came to another uncomfortable conclusion. They saw a possible explanation from the classical point of view: that there is no proportionality between the potassium extracted from the serosal medium and the sodium that is removed. Thus it is not a case of exchange, as has always been maintained by the orthodox, for we have seen that it is impossible to postulate a one-direction movement of potassium without stipulating a disappearance of sodium to achieve a quantitative equilibrium of matter and electric charges.

This observation enables us to understand why a great specialist of hormonal problems, Perrault, professor at the Faculty of Medicine and chief of a department of a large hospital in Paris, could have verified long ago that "potassium was coming from nowhere." Without being supplied, potassium appears in great quantities; it can only have been created on the spot. In 1963 he introduced the only explanation possible in view of these verifications (in the cell): (1) no introduction of Na; (2) diminution of Na; (3) increase of K; (4) oxygen consumption. In other words, it could only be the reaction producing the biological transmutation that we have described: ${}_{11}\text{Na} + {}_{8}\text{O} :=: {}_{19}\text{K}$. Three years later many research workers all over the world were obliged

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[1] Annals of the New York Academy of Sciences, July 1966.

to recognize that the exchange through the walls is a partial view only, insufficient quantitatively speaking, and that the four experimental facts mentioned above are indissolubly bound and occurring simultaneously. Even before Perrault made his observations, at least three Sorbonne professors, to my knowledge, had introduced this phenomenon in their teachings. Since 1963 many more university professors have joined them, as I learned by accident. I have also the names of a few professors in colleges and schools of agriculture, engineers and agronomists who have presented these notions in class teachings, newspapers, or lectures. There is, to my knowledge, at least one brochure edited by a group of teachers explaining a few of the biological transmutations of the elements, for the purpose of enlightening primary school teachers. An agricultural correspondence school devotes a whole chapter to it.

I should never finish if I were to cite all the observations that have been made concerning the relation between Na and K. In Reinberg's book[1] alone there are pages about it. For example: "The optimum temperature, corresponding to the maximum work of the heart, is proportionally lower when the value of the Na/K relation in the medium is higher. There is a contractile inhibition in the sodic medium; one increases it by adding K."

In a culture *in vitro* one should add potassium, for an isolated tissue cannot produce it; the aldosterone, which is secreted by the cortex of the surrenal (according to a mechanism by which the hypophysis intervenes) is the main hormone performing this reaction. "An excessive supply of sodium can determine the increase of the urinary elimination of potassium" (Reinberg).

The studies are many and all converge in one direction. Watan has shown that kidneys continue to secrete potassium even when a special diet deficient in potassium is followed for several weeks.

Lehman (Director of the physiology laboratory of Dortmund) declares, "The excretion of potassium does not make us appreciate its absorption." He also writes, "The increase in potassium excretion during work at high temperatures is not due to a larger supply of potassium."

It must be made clear that experiments and discoveries of this kind show that in abnormal conditions the organism proceeds with an accelerated transmutation from sodium to potassium.

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[1] Potassium et la Vie, P.U.F. Pub., 1955.

One should not then conclude that potassium is not useful under normal conditions, since sodium can produce it. The sodium-potassium relation should be put into perspective in order to answer certain questions asked by dietitians.

# IV

# CALCIUM

This chapter won't involve a detailed study of the verified abnormalities in calcium metabolism. It will simply attempt to attract attention to the origins of calcium in order to show how the reactions that I have established modify present views in fields other than biology.

Calcium is one of the most abundant elements in the earth's crust (3.25%). Oxygen comes first (49.13%), then Si (26.0%), Al (17.45%), and Fe (4.2%).

If the great formations of limestone are from the Secondary Era, how is it that one nevertheless finds them before the Primary Era, in the Pre-Cambrian? They are being formed nowadays in animals and plants, and we see that calcium has three origins:

—It can come from potassium:

$$K_{39} + H_1 \rightarrow Ca_{40}$$

—from magnesium:

$$Mg_{24} + O_{16} \rightarrow Ca_{40}$$

—from silicon:

$$Si_{28} + C_{12} \rightarrow Ca_{40}$$

These three potential origins of calcium are by far the most important; from them alone I have gleaned valuable observations and experiments.

Does this mean that there are no other possible origins? I would not risk making such an assertion. Let me say only that I have no grounds on which to base such research. What I can say for the time being is that these other origins are quantitatively of little importance.

## Isotopes of calcium

I would like to point out that heavy hydrogen ($^2H$) or deuterium (D) rarely enters into these nuclido-biological reactions, nor have I ever found such to be the case throughout my research. I will neglect, then, the deuterium reactions, since I have never been able to bring them to light. This does not mean that they do not exist; one could perhaps find transmutations made with $^2H$. However, they are rare and of small quantitative importance.

Here are the reactions that I have verified in my research concerning the origin of calcium:

a) Potassium as a base:

$$K_{39} + H_1 \rightarrow Ca_{40}$$

$$K_{41} + H_1 \rightarrow Ca_{42}$$

b) Magnesium as a base, with stable isotopes of oxygen:

$$Mg_{24} + O_{16} \rightarrow Ca_{40}$$

$$Mg_{26} + O_{16} \rightarrow Ca_{42}$$

$$Mg_{25} + O_{17} \rightarrow Ca_{42}$$

$$Mg_{25} + O_{18} \rightarrow Ca_{43}$$

$$Mg_{24} + O_{18} \rightarrow Ca_{42}$$

$$Mg_{26} + O_{18} \rightarrow Ca_{44}$$

c) From stable isotopes of silicon and carbon:

$$Si_{28} + C_{12} \rightarrow Ca_{40}$$

$$Si_{30} + C_{12} \rightarrow Ca_{42}$$

$$Si_{29} + C_{13} \rightarrow Ca_{42}$$

$$Si_{30} + C_{13} \rightarrow Ca_{43}$$

Thus $Ca_{40}$, $Ca_{42}$, and $Ca_{43}$ can come from K, Mg, or Si; but $Ca_{44}$ can only come from Mg.

One must then be prepared to admit that the calcium formed by shells and originating from the magnesium of sea-water is richer in $Ca_{44}$, more so than if the shells' formation had taken place on land. Organisms succeed in doing the transmutations better with heavy isotopes, making a greater proportion of heavy isotopes necessary in elements of organic origin. (This proportion is extremely variable, so much so that the proportion indicated in the tables of nuclear physics can be only approximate.)

Thus one should avoid using the numbers given in the Periodic Table of Elements, where one is presented with raw forms of mineral elements which are mixings of isotopes having no value in biology. The given figures of these tables are used in chemistry, but are too gross to be used in the study of the nuclido-biological reactions where nature operates at the level of the nucleus. (Chemistry deals with the molecular level.)

As an example, let us take the reaction Si + C → Ca. The tables give:

$$^{14}Si \ + \ ^{6}C$$

$$28.06 + 12.01 = 40.07$$

But these same tables give 40.08 as the atomic mass for Ca, not 40.07. There is indicated a mass gain, thus an emission of energy, if these inaccurate figures are referred to.

The following is an example proving that one should not use the Table of Elements' atomic mass numbers in studying the nuclido-biological reactions. As a matter of fact, the same applies to calcium, whose origin is either potassium or magnesium.

$$\mathrm{K} + \mathrm{H} \rightarrow \mathrm{Ca}$$

$$39.096 + 1.008 = 40.104 \quad (\text{false figures for Ca} = 40.08)$$

$$\mathrm{Mg} + \mathrm{O} \rightarrow \mathrm{Ca}$$

$$24.32 + 16 = 40.32 \qquad (\text{false figures for Ca} = 40.08)$$

There is always a mass gain indicated, which is false.

We have seen that *a priori*, according to the laws that we have deduced from experiments, there should be more $Ca_{44}$ in shells and in other animal and vegetal organisms that make their calcium from the magnesium of sea water. This has been verified: the more active the organism, the more oxygen it consumes and the richer it will be in $Ca_{44}$. An organism's activity is proportional to the existing temperature: its metabolism is more active in warm media than in cold. It follows that a shell will have a higher $Ca_{44}/Ca_{42}$ ratio if the animal which secreted it is from a warm sea. A study of this $Ca_{44}/Ca_{42}$ ratio in fossil shells has been proposed, to determine the temperature of the sea during the epoch corresponding to the fossil's life.

## Calcium production by plants

Von Herzeele established around 1850 that germinating seeds without a supply of calcium saw a calcium increase in the young plants analyzed 30 days after the germinating process.

The results were contested because they were contrary to Lavoisier's law. However, the operatory precision von Herzeele employed left no room for doubt. P. Baranger, Chief of the Laboratory of Organic Chemistry at l'Ecole Polytechnique de Paris, thought that von Herzeele's analyses were insufficiently precise, and had the curiosity to conduct the experiment all over again with all modern scientific rigor.

The results of his analysis executed on three equal portions of 200 identical seeds, each one weighing 7.2 gr, were submitted to a professional statistician in order to detect any possible operatory error. Taking only the most typical case, where the seeds' sprouts had only a supply of doubly-distilled water (water distilled only once is not pure enough), and with all chances of systematic error having been averted, there was more calcium found after the germination.

Thus scientific proof that calcium can be created in biological reactions has been acquired in one of our most celebrated schools. But no interpretation of the phenomenon was offered.

# V

# POTASSIUM-CALCIUM

## Reversible Transmutations

My youthful observations gave birth to a subsequent idea of a possible transmutation from potassium to calcium. Hens in a granitic region devoid of limestone can lay eggs with calcareous shells every day; but these hens, free to move around in the yard, scratch about for fragments of mica strewn on the ground.

In a clayey area hens need limestone, but not if mica is present. The difference between clay and mica is that the latter contains some silicate of potassium.

1) Hens kept in a chicken coop on clayey soil were without a source of limestone. After a few days their reserves were exhausted and the deficiency became apparent as eggs with soft shells began to be produced. On that same day, purified mica was given to them. The hens jumped on it and began scratching around it very rapidly, panting over it; then they rested, rolling their heads on it, threw it into the air, and began scratching it again. The next day eggs with normal shells (weight 7 gr) were laid.

Thus, in the 20 hours that intervened, the hens transformed a supply of potassium into calcium. Two eggs are never produced at the same time; one egg is laid and the shell of the next one begins to be formed a few hours later. The egg composition is determined by the food eaten the week prior to the laying of the egg. But the shell, on the contrary, is formed by a rapid excretion.

An experiment of this kind, using the same mica, was undertaken with guinea-fowls over a period of forty days. The administering of the mica was suspended three times and each time a soft-shelled egg was laid, providing new evidence to complement the numerous observations which have shown that potassium cannot be stored in the organism.

2) One of the observations that intrigued me and contributed to my "conversion" was the presence of saltpeter in the limestone on walls. This phenomenon is not new to man. Saltpeter was used in making gunpowder before man learned, in the last quarter of the nineteenth century, how to make saltpeter (which is potassium nitrate) from potassium chloride.

Saltpeter has been extracted not only from limestone on walls, but from soil of calcareous regions having a humid, warm climate alternating with a dry season. Right at the beginning of the dry season the soil is covered by a thick white layer resembling snow. The first gathering of saltpeter can be followed by a second one only a short time later.

On the walls of my house at the seashore I noticed that saltpeter sprang up continually, despite my frequent efforts at scraping it. It is doubtful that the limestone contained such quantities of potassium, for I had removed the saltpeter many times a year for eleven years.

I thought then that only calcium could be the origin of potassium (calcium — hydrogen = potassium).

$${}^{40}_{20}\text{Ca} - {}^{1}_{1}\text{H} := {}^{39}_{19}\text{K}$$

I compared this experiment with the one in which hens made eggs with calcareous shells without the use of limestone, after they had consumed mica. (Mica contains potassium silicate.) In the hens the opposite reaction occurs: potassium + hydrogen = calcium.

Thus there is a reversible reaction in nature. The parallels between these two reactions helped lead me to the hypothesis that transmutation occurs with an addition or subtraction of hydrogen, by the removal of a proton only, at the level of the nuclei.

This experiment on hens proved that there is a calcium-potassium relation, with potassium becoming calcium. This reaction is opposite the one that produces saltpeter. A transformation from potassium to calcium is also verified in man, in whom it aids calcification (but only in a very small degree).

Here is a nuclido-biological reaction with ± H (which means that it is reversible, but not in the same organism):

$${}^{39}_{19}\mathrm{K} + {}^{1}_{1}\mathrm{H} :\rightleftharpoons: {}^{40}_{20}\mathrm{Ca}$$

## Passage from calcium to potassium

In a report made on the formation of granite G. Choubert cites an aberrant observation. Limestone of the second Pre-Cambrian Age can give potassic adinolites containing up to 12% $K_2O$.

The author writes, "The limestone is first transformed into marble. Then suddenly, without undergoing any transition, it changes into adinolite. What process other than some mysterious one could explain a transformation from limestone to a silico-potassic rock at the contact of a calco-magnesian magma?"[1] (These calco-magnesian rocks are the dolerites, gabbros, and pyroxenolites.)

A study of certain adinolites has shown the latter to have been formed from a contact with dykes and dolerites incapable of producing such quantities of potassium. Mr. Choubert writes, "The potassic input could have come from nowhere . . . hence potash is born on the spot by atomic reaction."

We can thus see how in 1952 Mr. Choubert had perceived the situation clearly. An explanation of this phenomenon was afforded by our experiments which showed that transmutation did occur on the specific element cited by Choubert.

[1] "L'origine des granites et la physique nucléaire," published in the bulletin *Notes du Service Géologique*, Vol. VI, Rabat 1952.

# VI

# PRODUCTION OF CALCIUM FROM SILICON

For those who doubt the reaction $Si + C \rightarrow Ca$, showing that at the nuclear level calcium can come from silicon, it will be enough to point out a few observations made by different scientists.

After I had discovered the reaction Dr. Charruyer, Chairman of the Department of Physics at the Medical School of Limoges, mentioned to me that he had found in primitive grounds geodes of calcite in slaty rocks which were very hard, compact, and absolutely impermeable. These rhomboidal forms of calcium carbonate can be very big and weigh many kilos, but due to their impermeability, there is no possibility that they could have come by migration. They could only have had an endogenous origin in one of the components of the schists. In my opinion they could only have come from the reaction given above, since C also comes from the schists in the reaction $Si \rightarrow C + O$.

The ability of silica to change into limestone has been recognized for ages, since in antiquity horsetail (*Equisetum*) was used for recalcification. (Horsetail is rich in silica.) It was also used for curing tuberculosis because it speeds up calcification of the lung caverns, thus promoting quicker healing. In 1846 Pierre Jousset, one of the great masters of homeopathy, showed in a thesis the effect of silica on people stricken with tuberculosis.

P. Van Thieghem had pointed out in *Traité de Botanique* (1899) that in the thallus of fucus, which grows in siliceous rocks, there is a high proportion of calcium sulfate.

This production of limestone by organic silica, as explained by the reaction $Si_{28} + C_{12} \rightarrow Ca_{40}$, has only recently attracted the attention of modern scientists . . . even though the phenomenon was generally known in antiquity.

The therapeutic method of recalcification has been used only rarely, for the most part by doctors who are traditionalists, healers, and homeopaths, etc., believing in natural remedies.

Wasn't it heresy to say that silica could recalcify? It was a denial of Lavoisier's chemistry, still official. That is probably why plants rich in silica, such as horsetail, were very recently erased from the pharmacopoeia in France.

In fact it is not unusual to meet people who still use horsetail in decoction or infusion. Some laboratories make an extract of it. It has been put on sale in pharmacies, but in order that the label conform with the pharmacopoeia, tricalcic phosphate is added to it.

Another horsetail extract, prepared differently by another laboratory, does not contain added calcium; it is presented as a dietetic product for all those wishing to avoid the risk of decalcification. Many pregnant women use it.

Nature has many ways to prevent a deficiency resulting not from the lack of an element but from an insufficient production of the enzyme that carries out the transmutation. Calcium is not assimilable, at least not for man—unless it is proved otherwise. Decalcification may occur when there is a deficiency of the enzyme which transmutes sodium into magnesium, but it usually occurs because of a deficiency of the enzyme which transmutes magnesium into calcium. It is much better to recalcify with potassium and organic silica.

Decalcification can then occur when saltless diets are prescribed, especially diets without chloride.

There has never been a counter-indication for the use of silica, except in excess as with any kind of food; however, the body's silica tolerance is great.

Organic silica's action is fast: nails cease breaking and become normal after fifteen days if extracts are used; a longer time is required for horsetail decoctions.

Spectacular results have been obtained in the repairing of broken bones, but this we shall see in a chapter specifically dedicated to medicine. I shall demonstrate that fractures are repaired and healed faster with organic silica extracts than with the administration of calcium. Mineral calcium is a residue and the organism does not assimilate it; it is found in this terminal stage in man and in higher animals. However, plants have the opposite reaction and can use calcium directly.

For man, organic silica (which can only be found in plants in the springtime) must be used, because mineral silica has the opposite effect: it decalcifies.

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The relation of silicon to calcium is also apparent in a careful study made on an egg in incubation. A chicken just hatched has a skeleton of bones and thus of calcium. However, there is an insufficient amount of calcium in the egg. Nevertheless, at the time of birth the chick's skeleton contains four times more calcium than the egg (both yoke and white).

It has been debated that the calcium comes from the shell—again a groundless assertion. Many research workers intrigued by the disproportion between the calcium in the skeleton and that of the egg wanted to see if there really was a migration from the shell. However, the latter has never been proved.

One can point out that the composition of batrachians and fish eggs is approximately the same as that of birds, and they have no noticeable calcareous envelopes. At its hatching the little one nevertheless has a calcareous skeleton, even in a fresh-water area lacking in calcium.

Research workers have discovered that the calcium weight in the egg does not change up to the 10th day. At the moment the membrane under the shell breaks away from it, the air chamber grows bigger—there is no possibility of migration of calcium toward the egg.

This membrane under the shell contains organic silica—approximately 0.5% in the outer leaf—in proportion to the fresh matter weight.

Limestone increases in the egg at an average of 0.04 g on the 10th day to 0.05 g the 14th day and 0.06 g the 16th day; then ossification comes about suddenly and the limestone attains 0.10 g on the 17th day, 0.13 on the 18th day, 0.17 on the 19th day, and 0.18 on the 20th. Thus from the 16th to the 20th day the limestone triples.

Most recent research shows that limestone "grows" when it comes in contact with the outer leaf of the shell. Dr. A. Charnot, Chief of the laboratory in Rabat, has verified that the membrane under the shell contains, for 100 g:

154.79 mg of silica ($SiO_2$) in the inner leaf
464.80 mg of silica in the outer leaf.

For further information on the production of calcium from silicon, see the chapter on medicine and nutrition.

# VII

## MAGNESIUM

## Endogenous Production

The link between "dolomie" and limestone is well known, although it has never been explained. It has been verified and that is all! In their uncertainty, specialists use terms such as "consanguinity of calcium carbonate and magnesia," "genetic consanguinity," "unitarian genesis," etc. The enrichment of dolomie in magnesia is called "metasomatism." This change of "soma" is in fact a transmutation perhaps identical to one of the bacteria-generated reactions occurring in the genesis of raw saltpeter. The latter contains magnesium nitrate in addition to potassium nitrate. The magnesium derives from calcium according to the reaction $Mg_{24} \rightarrow Ca_{40} - O_{16}$. The term "dolomite" has a precise meaning as a mineral: it is the magnesium carbonate which is found in varying quantities in rocks. Dolomie is the association of minerals. Limestone almost always contains some dolomie. The rare banks of dolomie are sought for the fabrication of cement.

In warm marine waters, plants (calcareous seaweeds) fix magnesium calcite; Ca and Mg are not separated. These seaweeds fix the magnesium of sea water and transmute Mg into Ca so that one always finds a mixture of these two elements. The same applies to shells in warm waters. Dolomites are prevalent in corals at a depth of 200 meters. Do the animalcules of the coral have difficulty in producing a transmutation at this depth with a 20 kg cm$^2$ pressure? Either the temperature is too low at that level or the factors of depth and temperature both come into play. A third possibility is that cold impedes the development of the coral—

and Mg is linked to both cold and heat. Cold provokes the reaction $Na + H \rightarrow Mg$, Mg affording protection against cold, whereas $Na \pm O \rightarrow K$ provides protection against heat. Coral beds in cold environments produce Mg; those in warmer and more oxygenated waters are, as they approach the surface, able to easily transmute magnesium into calcium ($Mg + O \rightarrow Ca$), making the coral at the surface a non-magnesian limestone.

Meanwhile, some authors[1] had shown aberrant analyses for magnesium. In 1856 Lauwes and Gilbert verified that there was less magnesium in the ashes of grass receiving magnesia salts than in plants receiving no fertilizer. Branfield, in *Continuous Creation* (1950), writes that the chloroplasts of plants cultured in water free of magnesium contain chlorophyll and thus magnesium. In 1929 Gortner established that there is 4.5% MgO in the ashes of chlorophyll.

In the past, deeper and more precise research had shown that magnesium is related to other elements, but no one could see the nature of the link.

Von Herzeele noted an increase of magnesia in plants germinated without the help of magnesium. He also thought he had found the relation between Na and K with Mg; but he had always used Ca in a complex solution. Because of this his deductions were contested.

Barbier and Craminade declared that "each of the Na, Mg, and K cations present in small quantities is exchanged as if the mass of other cations were constituted only of calcium."

The link between Na, Mg, K and Ca is thus perceived. D. Bertrand writes that the movement of magnesium "supposes a close correlation between the development of the micro-organisms and the development of the plant, and this has never been studied."[2]

In 1942 Hunter, experimenting on lucern grass, concluded, "One often admits that $K + Ca + Mg$ is practically constant." In 1947 Prince, Simmerman and Beau, studying lucern in twenty different soils, say "The most significant and simple factor influencing the amount of Mg absorbed by lucern is the K content. If in cases of successive culture this content decreases, the mag-

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[1] a) A. Ronna, Rothamsted, "Un Demi-Siècle d'Experience en Agronomie par Lauwes and Gilbert," *La Maison Rustique,* Paris 1900.

b) Brochures published from 1875 to 1883 by Verlag von Hermann, Peters, Berlin.

[2] *Le Magnesium et la Vie,* P.U.F. Pub., Paris.

nesium content increases, even if the lucern grows in a soil deficient in Mg." The authors did not even ask themselves how there could be an increase in magnesium.

"Agronomists engage themselves in perfectly useless expenses by needlessly compensating a presumably insufficient magnesium content," writes D. Bertrand. He adds, "The liming can modify in great proportions the quantities of magnesium absorbable or absorbed by the plants."[1] No one could be closer to the truth . . . and not see it!

The Imperial Bureau of Soil Science in England makes the following statement: "A significant magnesium deficiency in the soil is undoubtedly more common than we have thought until now."

But, Bertrand writes, "It does not seem to preoccupy anyone anymore." The agronomist does not seem to care that magnesium comes by itself!

## Endogenous production

Magnesium is considered to be one of the most important elements in life—not only in plants, where the chlorophyll molecule is built around an atom of magnesium, but also in animal life.

The importance of magnesium is such that in 1960 D. Bertrand wrote a whole book about it, called *Magnesium and Life.*

### *Aberrant results*

A) VEGETAL

The results given by D. Bertrand are completely aberrant: no magnesium fertilizer is given to the soil, yet the vegetal matter takes away great quantities of magnesium.

A few examples:

| | Mg taken away in Kg/ha * |
|---|---|
| Wheat | 12.8 (grain and straw) |
| Corn | 54.5 (grain and straw) |

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[1] *Le Magnesium et la Vie*, P.U.F. Pub., Paris.

| | |
|---|---|
| Potatoes | 24.5 (haulm and tubercule) |
| Sugar beets | 37.2 (leaves and roots) |
| Fodder beets | 35.2 (leaves and roots) |
| Artichoke | 20.5 (head) |
| Cauliflower | 40.9 |

° 1 ha = 2.471 acres

However, virgin land contains, in its arable soil, from 30 to 120 kg of Mg per hectare (ha). Regarding this fact D. Bertrand writes, "The major part of arable lands would very quickly be exhausted, a conclusion which this experiment invalidates." So? He does not see any explanation.

### B) ANIMAL—THE RAT

In 1918 Osborn and Mendel made very careful experiments on the rat. Concerning this, D. Bertrand wrote, "They could verify that the rat requires a small amount of magnesium. But in spite of their care it was not possible for them to prove that magnesium is necessary to a rat's life." These results were contested, the precision of the methods of analysis called into question. However, the most precise methods of analysis were at that time confirming the aberrant behavior of magnesium. D. Bertrand declares, "The experiment made on the rat proved that the latter keeps the magnesium rate of its organism constant. Medes, Bukner and Peter fixed the Mg at 45 mg for 100 grams of fresh weight, but found that no matter how old the rat—29, 60, or 90 days old—the amount of magnesium in its diet had a very small influence on the amount of magnesium in its organism."[1]

Thus it is of little importance whether there is a deficiency in ingestion. Here again, however, practical means for solving the problem were seen. D. Bertrand cites Mendel, Benedict and Bogerth who say, "A diet rich in calcium increases the elimination of magnesium and thus increases the need for it." This last assumption is erroneous, for no one saw that it is Ca which produces Mg and that the more Ca is added, the more Mg will be found, as happens in plants!

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[1] *Transmutation à Faible Energie*, 2nd revised edition, p. 100, Maloine Pub. (Paris).

### C) MAN

I will state here only a few experiments made in the Sahara with the cooperation of Prohuza, an official organization. I had been sent there officially in 1959 by the ethnologist Jacques Soustelle. I was able to observe the working conditions and have access to the detailed results of all the analyses (research coordinated by D. Borrey).

The experiment took place near Ouargla with a team of petroleum workers; it lasted six months. Here is a magnesium balance sheet (values in milligrams, per man per day):

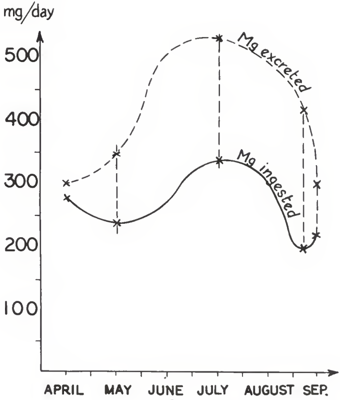

*Fig. 4 Average variation of Mg in petroleum workers in the Sahara. (Between the two graphic curves, the negative balance sheet = excess in excretion.)*

| | Ingested | Excreted | Balance sheet |
|---|---|---|---|
| April | 288 | 290 | — 2 |
| May | 247 | 354 | —107 |
| July | 348 | 528 | —180 |
| Sept. 5–9 | 198 | 420 | —222 |
| Sept. 12–16 | 211 | 286 | — 75 |
| Average | 258.4 | 375.6 | —117.2 |

These aberrant results were to be verified with the cooperation of the French Marine Militaire. Prohuza, which was really interested in the problem of living in a hot climate, made the experiment again, this time using a physiology laboratory situated in a drier climate near Tindouf. The experiment lasted eight months.

Here is the magnesium balance sheet. I will give only the general average, per man per day.

| Ingested | Excreted | Excess |
|---|---|---|
| 314 | 570 | 256 |

which equals 80% more rejected than ingested.

Thus no matter who the team of research workers or which laboratory of analysis (first experiment by the Pharmacy Faculty of Strasburg, second experiment by the laboratory of the Marine Nationale de Toulon) it was confirmed that during great dry heat an organism secretes more magnesium than it receives and in such quantities that there can be no question of an error or a mobilization of reserves. The amount of magnesium able to be mobilized in the human body is only 5 gr; but the August figures (from the second experiment) reveal:

| Ingested | Excreted | Excess |
|---|---|---|
| 395 | 1047.5 | 652 |

It is quite obvious that in eight days these people would have lost all the magnesium they could mobilize; they nevertheless "survived" eight months.

Let me point out that the balance sheets of sodium were, on the contrary, positive; i.e. in this hot and dry climate the organism was absorbing more sodium than it excreted, and no sodium accumulation was observed. It is interesting to know that the salt in a hot and dry country is richer in magnesium than sea salt, that most of the waters of arid, warm regions are salted and very rich in magnesium.

This continuous increase of magnesium comes from sodium by means of the reaction Na + H →Mg. (The sodium in plasma is the source of the magnesium production in animals.) We have the formula $^{23}_{11}\text{Na} + ^{1}_{1}\text{H} :=: ^{24}_{12}\text{Mg}$.

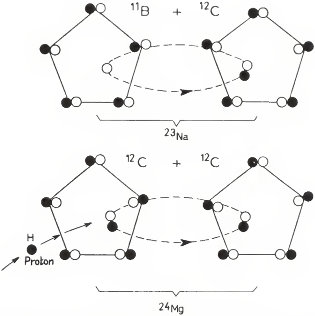

*Fig. 5 Passage from sodium 23 to magnesium 24: $^{23}Na + ^{1}H :=: ^{24}Mg$ The occlusion of H would take place in the boron $^{11}B$ to give carbon $^{12}C$.*

**Note:** The two parts of the nucleus are superimposed. For diagrammatical clarity we are representing these figurations side by side, indicating the liaison orbits by dotted lines.

**Ed. Note:** We advise the reader to consult all the books about magnesium that he can find on the market. He will be able, after reading this book, to make sense out of almost all the aberrant metabolisms of this element. He may also obtain much information from J. I. Rodale's book *Magnesium: The Nutrient That Could Change Your Life,*[1] from which he will learn the multiple and important role of magnesium.

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[1] Prevention/Pyramid Publishers.

# VIII

# MAGNESIUM-CALCIUM RELATION

There is abundant literature on calcium, but there is relatively little systematic research available on magnesium, the central constituent of the chlorophyll molecule (having a porphyric structure of one magnesium atom fused with four nitrogen atoms).

The harvesting of crops involves the removal of the soil's magnesium. Nevertheless, it is rare to find an author who advises restitution of magnesium to the soil, as Liebig's theory[1] would warrant. Why is Liebig not heard? Quite simply because in most fields magnesium is inexhaustible. There is a magnesium autogenesis which has remained one of the enigmas of agronomy.

Already in 1858 Malagut and Durocher had written, "Although magnesium is found in almost all vegetal life, one should not conclude that the importance of this matter in arable soil is as great as that of lime (CaO). It has been observed that when magnesia is missing, lime can replace it; but the opposite does not hold true."

## Experiments

The following experiment was carried out: a group of animals fed with a diet deficient in magnesium was compared to another animal group receiving a normal diet. Since 1918 different countries have conducted intensive research of this kind, considering

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[1] The qualitative restitution to the soil of the quantity taken by the harvest.

the male/female factor as well, since the latter has an influence on quantitative variations. But the direction was found to be the same in all animals.

Some scientists varied the phosphorus, calcium, and magnesium amounts in the diet and verified the resulting weight differences in the animals. The result of this was an attempt to fix in the food an optimum Mg content in any way possible; for example, with calcium (Ca/Mg), with potassium (P/Mg), or by keeping P/Ca constant.

If the magnesium percentage is decreased to 2.5 mg for 100 g of food (which implies the purging of the food in order to take out the Mg normally present), the magnesium deficiency is such that rats become rachitic, their hair dull and shaggy and their tails depilated.

## Variations of Ca in proportion to Mg

The influence of magnesium on the assimilation of carbohydrates (vegetarian diet, large bread consumption, etc.) has been shown. The need for magnesium in man and animals is greater whenever their nourishment is rich in carbohydrates. That is why a generous supply is always given to animals who are being fattened by an increased ingestion of carbohydrates.

Demolon studied the balance sheet of calcium (and phosphorus) in dairy cows and found a negative balance sheet.[1] These animals secrete more calcium than they ingest. I have made the same verification with regard to hens.

There has been a mystery concerning the formation of the shellfish carapace. It has been said that the animal "fixes" the calcium of the sea, but this is another unfounded assertion.

One day my grandchildren brought me a crab that was in the process of molting; it was a soft mass. So that it would continue to live, we placed it in a cave containing a very small amount of sea water. The next day it had already acquired a firmer carapace, which was completed the day after. In approximately thirty hours a crab forms its carapace which, for a 17 × 10 cm size, weighs 350 g. The calcium content of sea water is very small (on the

[1] *Le Phosphore et la Vie* (P.U.F. 1949).

average, Ca = 0.042%). The molting shellfish is unprotected from marine animals and, being very vulnerable, it hides and does not hunt.

A body analysis of the crab has shown that its hepato-pancreas alone stocks a small amount of limestone (calcium carbonate) before the molting, but that its carapace contains forty times more limestone than its pancreas. Then?

We have seen that the magnesium (and potassium) found in sea water (5‰ magnesium salts and 0.5‰ potassium salts) can give calcium and that it is essentially magnesium which is utilized by the shellfish to make its carapace.

At the Maritime Laboratory of Roscoff, a crayfish was put in a sea water basin from which limestone had been removed by precipitation; the animal made its shell anyway.

Chemical analysis made on animals secreting their shells has revealed that limestone is formed on the outer side of a membrane although on the opposite side of the membrane, where matter enters, there is no limestone. This fact has left specialists perplexed.

Of course, scientists who have been experimenting in this field are criticized by other analysts; that is in the order of things. But the innovator is not always wrong; nothing is perfect (the perfect being inaccessible to man) and someone will always find a point to criticize, for that is how progress is made. I will therefore refrain from claiming that the methods I have used thus far are perfect. However, I judge results valuable when they are of relative value when measured against variations obtained by the same method.

I have accepted the research of the authors cited, insofar as they provide strong guarantees. With this research the chemists-biologists demonstrate, themselves, that with regard to living matter there are inadequacies in Lavoisier's law concerning the conservation of matter. Thesis judges concur with them, thus showing that our conclusions concerning the failure of Lavoisier's law in the field of biology are beginning to be officially admitted.

# IX

# THE LINK OF MAGNESIUM WITH CALCIUM AND PHOSPHORUS

Until now it has been impossible to refute here the classical explanations popular among most scientists. This would have taken too much time and would have lent a polemical character to this work, diluting a substance which I wanted, above all, to be objective. Furthermore, I have always supposed that the reader knows as well as I the scholastic explanations, making it a waste of time to discuss them.

Many of my correspondents and colleagues have told me that it is unnecessary to discuss the arguments of "systematic opponents." One of them wrote to me, "Expurgate your work of . . . stagnant opinions. Make a clean sweep of ignorance." Nevertheless, I believe it will be beneficial to give the reader, in what follows, an example of objections he may confront from persons wishing to debate certain issues.

## Various studies concerning the magnesium-calcium link

We have seen that calcium could have had many origins, one of which is magnesium ($_{12}\mathrm{Mg} + {}_{8}\mathrm{O} :=: {}_{20}\mathrm{Ca}$). Geologists believe that magnesium was twelve times more abundant in the Pre-Cambrian era. We know that in sea water, strongly deficient in calcium but containing magnesium, a molting crustacean can make its shell. We also know that in the germinating seeds of certain plants, magnesium diminishes while calcium increases. (In certain plants K decreases while Ca increases.)

The link between magnesium and calcium has now been widely studied by many research workers. In 1964, in one of the laboratories of the Institut National de la Recherche Agronomique (I.N.R.A.), P. Larvor and his colleagues[1] conducted an experiment with calves in order to demonstrate that the skeleton does not develop at all when the diet is deficient in magnesium. The calcium rate in the blood and muscles becomes too low and tetany results. Eventually death occurs, preceded by convulsions, if the magnesium deficiency is prolonged. Conversely, an overdose of magnesium helps develop the skeleton and also promotes a rapid increase in weight.

A study by Dr. L. Bertrand[2] on spasmophilia, comprising 83 references, shows that in cases of magnesium deficiency hypocalcemia occurs, causing tetany (spasmophilia). The administration of calcium cannot re-establish the normal calcemia. On the other hand, a magnesium ingestion causes a calcium increase. (Magnesium is most often administered in the form of chloride.)

It would be impossible to cite all the applications now being made of the established fact that without magnesium the organism cannot have calcium. I have also verified a link between calcium and phosphorus, and these discoveries are developed in many of my books.

The link with phosphorus hasn't been investigated a great deal by other research workers, however. Whatever was studied came to my knowledge only incidentally, during the magnesium-calcium study. However, despite the many experiments on the subject of the magnesium-calcium link, some critics nonetheless declared that what had happened was either:

a) a "mobilization" of calcium, causing it to leave the skeleton, thereby increasing the calcium rate in the muscles and blood, or

b) a "catalytic" action by magnesium (necessary for the "fixing" of calcium).

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[1] P.Larvor et coll., Effets du magnésium sur la croissance du veau, I.N.R.A., Paris 1964.

[2] *La Spasmophilie*, edit. Les Cahiers Sandoz, Paris, June 1966.

However, nothing of that sort occurs. Decalcification was not verified, by any means. The bone became more solid and developed in young subjects. A catalytic action by magnesium did not seem valid either, for a catalyst remains intact at the end of the reaction.

## Experimental procedure

a) *Animals*

Forty-eight female mice weighing an average of 25 g each were divided into two equal lots. One lot was put aside to serve as a control. The remaining lot was given, through an oesophagus probe, a dosage of 100 mg per kg of magnesium chloride per day. The animals were put in different cages—twelve to a cage. Their feces were collected in Erlenmayer type bottles. Plenty of water was provided and food was given by cramming. Three times a day each animal received 1.5 ml of mash made of crackers reduced to a powder with water added (1 g of powder for 2.5 ml of water).

The experiment lasted five days. On the sixth day the animals were sacrificed with ether after a twenty-four hour fast.

b) *Mineralization analysis*

Both batches of mice were dissolved in nitro-sulfuric acid. The collected excreta were added to each corresponding lot of mice. After mineralization with perchloric acid, the phosphorus content was determined by a colored reaction employing sulfuric aminonaphtol sulfonic-molybdate. The calcium was first measured by direct complexometry in raw solution.

c) *Results*

| | Control | Treated |
|---|---|---|
| Total weight before experiment | 614 g | 604 g |
| Total weight after experiment | 628 g | 620 g |
| Calcium weight | 1.87 g | 2.48 g |
| Phosphorus weight | 1.83 g | 2.40 g |

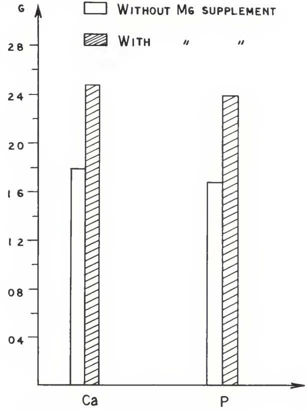

*Fig. 6 Ca and P contents in 24 mice, with and without magnesium supplement.*

d) *Commentary*

In order to facilitate the comparison, I have arranged that the total animal weight be equal for the total of each of the two lots, assuming that P and Ca are proportional to weight. The treated lot was 10 g lighter at the outset. If the difference is rounded off to the 1/60th and if the control mice weighed as much as the treated ones, we would have for the control lot:

$$\text{Ca} = 1.84$$
$$\text{P} = 1.80$$

Assuming an equal weight for the two lots, the receivers of magnesium saw an increase of

$2.48 - 1.84 = 0.64$ g (or 34.78%) for Ca
$2.40 - 1.80 = 0.60$ g (or 33.3%) for P

### e) *Conclusion*

Hence we see clearly and beyond any mathematical or statistical contestation that calcium and phosphorus increase when magnesium is given in overdose, and that this occurs within a few days. If an error had resulted from the analytic method, it would have taken the same direction for the two lots and the difference would have remained the same. We can therefore assert beyond the shadow of a doubt that magnesium was the source of the rapid increase of calcium and phosphorus.

Let us recall that in the organism certain mechanisms often enter into play: calcium and phosphorus may have other origins. (Calcium may come from silicon and potassium, phosphorus from sulfur and nitrogen.) Due to the metabolic complexities of the animal, complementary experiments were made on grains and microorganisms, the sole purpose being to clarify Nature's mechanisms.

The following objection, among others, was given to me: the weight increase in the animals receiving magnesium resulted from their being bloated with water. If that were the case it would follow that those receiving Mg would have been thirstier. Observation shows, however, that magnesium chloride does not cause thirst; one may take it regularly and still remain "as thin as a string." The $Mg^{++}$ ion does not cause retention of water in the tissues; it is $Na^{+}$ that provokes water retention at the level of the renal tube, hence the impression of thirst. That is why taking sodium chloride is not advisable in a case of oedema.

To the objection that the experiment was rather short, it is easy to answer that an experiment's duration is proportional to the subject's speed of metabolism, thus to the subject's growth rate and weight increase. In the case of microorganisms, we have seen that an experiment may last 2 days; for mice, weighing an average of 25 g, we adapted our research to 6 days. Larvor experimented on calves weighing 50 kg before the experiment. With an overdose of Mg, they weighed 75 kg after 4 weeks. But with a magnesium deficiency they weighed only 65 kg.

**Ed. Note:** A few other experiments concerning the magnesium-calcium link will be given, with commentary, in the chapter on nutrition and medicine. I placed them thus because I felt that the latter chapter would attract the attention of the layman who, at this time, is drawn to subjects related to the improvement of his health.

# X

# PHOSPHORUS

Phosphorus is very often linked to sulphur; it is found in amino acids. A vital element of the highest importance, it not only has an important role in the bones, in gray matter, and in the envelopes of neurons, but it is in fact a constituent element of the nucleic acids.

In the chain of DNA molecules a phosphoric group alternates with a deoxyribose. Phosphorus is thus one of the constituents of deoxyribo-nucleic acid, which carries the hereditary genetic code.

It is also found in ribonucleic acid (RNA). Phosphorus and sulfur, which are major elements of life, are linked in the relation $P + H \rightleftarrows S$, which allows nature to go from one to the other in case of a deficiency.

The reader will recall these previously shown relations:

$$Na + H \rightarrow Mg$$
$$Na \rightarrow Li + O$$
$$Mg + Li \rightarrow P$$
$$Mg + O \rightarrow Ca$$

These reactions explain the P/Ca equilibrium and the chemical combinations in the form of calcium phosphate occurring in the bones.

However, the organic phosphorus of nucleic acids seems also to derive from sulfur, which is a "condensate" or "doublet" of oxygen.

The phosphorus and sulfur link is brought out in the following remark by A. Voisin: "Giving mineral phosphate to the soil does not modify the phosphate content of a cereal, but increases its thiamin content" (Vitamin $B_1$).[1]

The P/S balance shows why the organism cannot accept a local excess of P and explains the brutal effects of some phosphoric esters used as insecticides.

It is certain that nature has other methods of producing phosphorus.

The layers of phosphates in ores are calcium phosphates. This is not astonishing since P and Ca have a common origin, but the fluorine content of the ores is also considerable ($F/P_2O_5 = 9\%$, on the average). It seems that the following reaction occurred:

$$P_{31} \rightleftarrows C_{12} + F_{19}$$

The phosphorus "birth" was never explained; plants make it, and A. Demolon and A. Marquet say, "The essential characteristic of phosphorus is its fixation and its concentration in the superficial zone of cultivated soils, always noticeably richer underground."[2]

Mr. P. Dahiez from his laboratory of soil study points out a reaction opposite in direction from the one cited by A. Voisin. He writes, "Some soils treated with derivatives of sulfur, when analyzed, gave high percentages of phosphorus, whereas other soils evidenced a phosphorus deficiency." He also cites for us other "quite curious facts whose explanations cannot be given by the data ordinarily yielded in agronomy."

In the animal organism the fabrication of phosphorus may follow another process, deriving from the chlorine of the blood's sodium chloride:

$$\begin{aligned} Cl - O &\rightarrow F \\ F + C &\rightarrow P \end{aligned}$$

This is a possibility. However at this time we do not have, even from exceptional cases, a cross-reference confirming that this reaction is possible except in the presence of fluorine in phosphate lies. This fluorine possibly comes from sea water.

Phosphorus deficencies impede plant development, preventing protein molecules from being formed. So, because the amino

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[1] "Sol, Herbe, Cancer," *La Maison Rustique*, Paris 1959.

[2] *Le Phosphore et la Vie*, P.U.F. edit., Paris 1949.

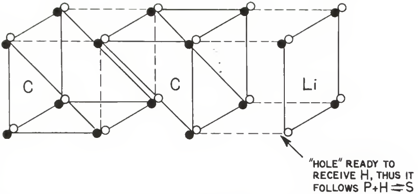

*Fig. 7 Diagrams of the nuclei of phosphorus and sulfur. One recognizes, on the left (solid lines), the two nuclei C* ($2.C \rightarrow Mg$)*. The isolated vertical plan on the right is Li, and* $Mg + Li \rightarrow P$*. Li, linked to the set, can receive H. When H is added we have* $P + H \rightarrow S$*. It is clear (dotted lines) that the set is also equivalent to* $2.0 - H \rightarrow P$*. If H is added the result is* $2.0 \rightarrow S$*.*

acids cannot be formed, phosphorus was believed to be linked to nitrogen. The establishing of this link rests upon the fact that the ratio of the total nitrogen in phosphorated fats (phosphatides) is constant in the different plants. In fact, there is no direct link. It is a phosphorus deficiency which impedes the formation of the amino molecules, also causing a reduction of the other elements. But it is also the sign of a deficiency in elements, causing the plant to make up for the deficient phosphorus.

The phosphorus-calcium link is commonly known. When much phosphorus is produced in an animal, much calcium is also produced.

Negative balance sheets of P and Ca are also cited by Demolon, who indicates that the weights of these elements given for dairy cows "are noticeably inferior to the quantities of these elements which leave the animal's body with the milk"[1] (approximately 3 g of P and 3 g of Ca for every liter of milk). But the cow has other needs for these elements in the maintenance of its body, and it excretes through the urine and fecal matter quantities which, together with what the milk takes away, exceed very significantly that which food brings to it. A declaration such as "The cow borrows calcium and phosphorus from its own reserves"

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[1] *Le Phosphore et la Vie,* P.U.F. Pub., Paris 1949.

is unacceptable. One good dairy cow, weighing 700 kilos and giving 30 liters of milk a day, needs 111 g of P per day (3 g per liter of milk + 3 g per 100 kilos of weight). Another cow was given 98 g of P per day, which is a daily deficit of 13 g compared to that of the first cow. In 100 days it would have taken 1300 g of P, although its whole body (skeleton, flesh, blood) contained only 4500 g. It is obviously impossible to reduce the amount of phosphorus to such proportions. There is, then, an endogenous production of phosphorus (which is also true for calcium, and in the same relative proportions).

## Application for Geology

In some parts of my books references are cited pertaining to the simultaneous presence of Li and P (in plants, bones, ores). This is surely a case of fortuitous association.

If $P - Li \rightarrow Mg$, we have seen that Mg and P are precisely linked to such an extent that if the organism excretes more P than it receives, it also excretes more Mg than it ingests. The negative balance sheets of P always corresponded—with the same subjects, within the same time—to the negative balance sheets of Mg. The average on the observed negative balance sheets was 134 mg of phosphorus excreted per day per man. These balance sheets were calculated simultaneously with the negative balance sheets on calcium. The calcium represented 321 mg/day per man, whereas the negative balance sheets of magnesium averaged 163 mg for the same days.

The opposite is equally true: whenever there is a positive balance sheet for Mg, there is a positive balance sheet for P and Ca, showing not an association but a filiation. P is born from Mg, but only in the presence of Li which, in organisms of higher animals, comes from the sodium of the blood plasma ($Na - O \rightarrow Li$).

P can also be formed in magnesium rocks by "frittage" of Mg, with Li coming from potassium ($K - 2.0 \rightarrow Li$), thus indicating that phosphorus can be found in the soil without sea water being present.

But we also saw in the formation of the dolomies that Mg can derive from calcium ($Ca - O \rightarrow Mg$). A lie of limestone influenced, I believe, by bacteria, can give Mg. If there are alkali (Na or K) present, there is a possibility of producing phosphorus which, along with calcium, can give calcium phosphate.

This is another method of forming calcium phosphates, and it is probable that the two types of lies (marine and continental) exist.

The phosphorus in lies is linked to the presence of bacteria. This seems to show that P has an endogenous formation due to a specific enzyme yet to be investigated.

This enzyme needs Mg, or at least it seems that Mg is the most abundant origin of P. Furthermore, the phytin in plants is a magnesium salt of a phosphoric ester.

Research is being done in many laboratories to clarify this formation of P. Here are those discoveries which were brought to my attention after I had published my discoveries.

a) In the germination of seeds there is a P variation between the seed and the young plant having germinated without a P supply.
b) During the activity of yeasts the P content also changes.
c) A seaweed rich in calcium (where, for example, $Ca/Mg = 6$) has been sown with bacteria in order to study the P genesis.

## Phosphorus variation in the germination of seeds

The variations of organic forms during plant maturation is a solely chemical operation, a rearrangement of atoms and molecules. Y. Colin made a study on sunflower seeds during maturation.[1] He saw some aspects of the phospho-organic compounds' variations in the seeds and in wheat germ. We will only expose the results of the total phosphorus variation during germination, which is a case of the transmutation of one element.

### *Methods of dosage*

There is no room here to condense the 84 pages of the Colin thesis, but it appears useful to make a rapid survey of the difficulties of such a problem. With a reaction which appears as the separation of a compound one runs the risk of blocking, in a totally insoluble form, another compound no longer able to be

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[1] Y. Colin, "Evolution des Composés Phosphoriques au Cours de la Germination," *Bulletin Soc. Chim. Biology,* 1934.

dosed. This is why research on the separation of various compounds has given birth to a different problem.

Phosphorus is found in the form of phosphoric esters, such as the phospho-lipids and the phospho-amino-lipids. In the phospholipids one finds lecithins and, most of all, the derivative of glycerophosphoric acid. Also present are the phosphoric esters of sugars such as monophosphoric ester, disphosphoric-hexose, monophosphoric-hexose, etc.

The phospho-lipids vary during germination. W. Maxwell, in 1891, may have been the first to put this into prospective. Others followed, using different seeds. In 1910 Miller verified that in sunflower seeds the lipidic reserves decrease from 55.6 to 13.5% after 13 days. In 1902 Iwanow found that in vetch the lipidic phosphorus, which is 11.6% of the total phosphorus present at the beginning of the germination, is only 6.6% after 20 days. The protein content falls from 52.5 to 13.7%.

In 1912 Bernadini and Morelli showed that during the germination of 500 seeds of wheat the phosphotidic phosphorus increased from 19 mg to 55 mg in the light, whereas it disappeared completely after a few days in the dark.[1]

*Experiments in the light*

In an experiment done in the Museum of Natural History greenhouses, half of the basins received light and half were covered with black paper. The greenhouse temperature at the moment of maximal insolation was 30° C (in May). The rapidity of germination made possible the first harvest after two days, the second after three days, the third after six days, and the fourth after nine days.

Here are some figures, in mg, on sample gatherings consisting each time of 400 seeds of lentils which were germinated in the light:

| | Lipidic | Nucleic | Phytinic | Mineral | Total |
|---|---|---|---|---|---|
| Before germination | 12.67 mg | 10.4 mg | 50.63 mg | 18.30 mg | 92.00 mg |
| After two days | 11.85 | 9.76 | 48.38 | 21.81 | 91.80 |
| After three days | 11.35 | 11.15 | 38.31 | 30.84 | 91.65 |
| After six days | 10.25 | 12.50 | 12.64 | 54.61 | 90.00 |
| After nine days | 9.45 | 15.25 | 0 | 62.30 | 87.00 |

[1] Colin, "Evolution des Composés Phosphoriques au Cours de la Germination."

Thus along with the variations in the different compounds of phosphorus, an important fact is established: the total phosphorus diminishes up to 5.43%.

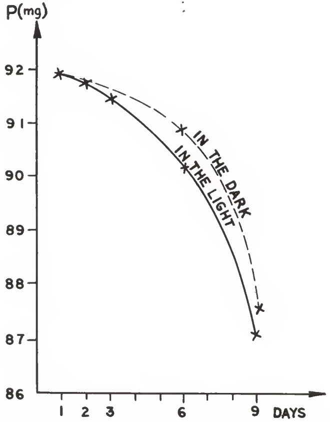

*Fig. 8 Variations of total P in the germination of lentils (May).*

Another experiment was conducted from the 23rd of June to the 4th of July (12 days). This time it was conducted on portions of 325 seeds of lentils, but on porous paper imbibed with doubly-distilled water. The average weight of every portion of lentils was 26.63 gr.

| | P Total |
|---|---|
| June 23 (before germination) | 112 mg |
| June 27 (after 5 days) | 111 |
| June 30 (after 8 days) | 110 |
| July 4 (after 12 days) | 105 |

There was a 6.25% decrease in phosphorus (experiment made in the light).

All experiments concerning the total phosphorus variation during germination converge and one must conclude, beyond any dispute, that there is a certain disappearance of phosphorus, varying with the particular species of seed, the germinating conditions, and the time of year—but always in a highly significant

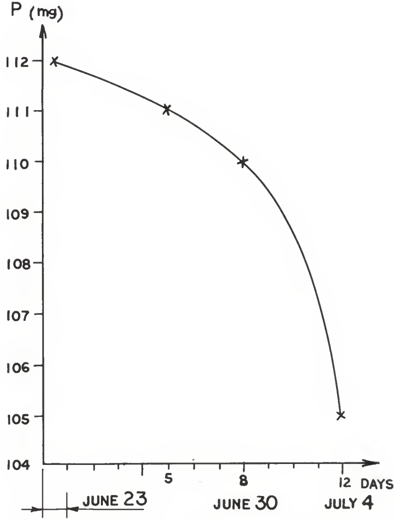

*Fig. 9 Another variation of total P in lentils germinated in the light (summer).*

degree. No error can be imputed to these results since, whatever the methods, the laboratories that were employed had the most modern equipment, the operators were different, and the results always pointed in the same direction.

# XI

# ABERRANT METABOLISM OF SOME LIVING ORGANISMS

## a) *Life sustained with clay: a shrimp living in the dark*

In a medium entirely composed of humid clay, life is possible. The humid clay is compact, thus air cannot enter. This clay is impermeable to carbon and oxygen. Oxygen can, nonetheless, be produced by dissociation of the water molecule—and we understand how plants use the oxygen from water. The oxygen that plants reject into the air does not come from the absorbed air, of which the plants would have retained the carbon of the available carbon dioxide. Would the living organisms in the clay then be able to extract their oxygen? This question remains unanswered, but let us admit such a possibility.

Another problem remains to be solved: carbon is necessary to any organic life. Animal and vegetal tissues are composites of carbon. They develop by making new tissues, thus by taking carbon. Furthermore they breathe, ultimately rejecting carbon dioxide ($CO_2$). This means that the carbon supply must be renewed because animals do not take back the carbon dioxide which they excrete—it is a poison for them. In clay, animals avoid these rejected gases by moving continually from one place to another. The rejected carbon dioxide, being at a pressure superior to that of the ambient gas, is little by little diffused. The carbon dioxide on the outside cannot enter because of the great pressure inside the clay.

It has been known for a long time that living organisms inhabit clay while having no organic supply from the outside. This fact has intrigued research workers and an important study was made in a laboratory installed in the cave of Moulis, France; the results were published in several French scientific magazines.

Let us note the case of the Niphargus shrimp, a small animal half-an-inch in length that lives in the clay of caves. If a shrimp is given organic matter (meat, etc.), it vegetates and dies. It also dies if it is not kept in humid clay. Experiments have shown that it grows normally in pure clay to which nothing has been added. Research workers therefore thought that the shrimp lived on clay and nothing but clay, an impossibility according to the laws of biochemistry. Actually, it cannot live thus in clay alone, but this clay contains microorganisms which work for the shrimp, making vitamins, various mineral products, nitrogen, phosphorus, and calcium, etc.

### b) *Earthworms*

The earthworms' role has long been ignored. They were thought to be good only for the mechanical function of making the soil lighter. Notwithstanding, some research workers have demonstrated that annelids modify the chemical composition of the earth.

In his *Treatise on Microbiology of the Soil*[1] Pochon, of the Institut Pasteur, gives various experimental results. The earthworms increase the quantity of limestone in the soil. Their glands excrete $CO_3Ca$ so that the pH of soil containing earthworms increases. Earthworms are most abundant in neutral or slightly acidic soil and can be found in good soil by the hundreds of thousands per acre. Some authors declare that each worm ingests 1/10th of a gram of earth per second, which is three tons per year. Darwin gives a higher figure, but one should be careful with such calculations since earthworms have resting periods in winter and in dry seasons. Other believable figures, which resulted from observations made in England, indicate that a field of earthworms rejects an average of 57 tons/ha/year (23 tons per acre per year): the equivalent of four spreadings of farm manure per year. But this constitutes only the amount of earth rejected on the soil's surface. One cannot deduce from this the exact weight of earth having passed through the digestive tube of each worm. Com-

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[1] Dunod Publ. (Paris 1954).

pared to the surrounding soil, these rejected excrements were five times richer in nitrogen, two times richer in calcium, two-and-a-half times richer in magnesium, seven times richer in phosphorus, and eleven times richer in potassium.

### c) *To live on an iron wire*

In one of my books I noted the curious case of plants commonly called "spanish moss" which grow in green masses, most often on copper wires. Their botanical name is *Tillandsia*. They are usually found in humid, warm regions on telephone wires. They adhere to the wire by means of viscous disks and can also cling to branches, dead trees, and rocks.

According to Pfeiffer, the analysis [1] of these plants shows that they contain approximately 17% $Fe_2O_3$ in their ashes but little noticeable amounts of copper, although the analysis was made on plants growing on copper wires.

These curious plants grow without roots; they have no contact with the soil. That is what intrigued everyone: where did they obtain the minerals revealed in the analysis? One may suppose that water, carbon, and nitrogen were obtained from the air, but what of the other minerals?

Everything that has been written about the origin of these minerals is but groundless assertion. It has been proposed that the rain brings them—in minute traces, of course—and that they accumulate with time. Others say that they come from dust. All this to respect the dogma of the non-creation of matter. But these hypotheses are unsatisfactory.

H. Friedel, in his work *Les Conquêtes de la Vie*, also writes about these plants: "I must confess that all my notions about the vegetal have been overthrown in Antibes in the Hennessy garden, where I saw *Bromeliaceae* develop in the air on an iron wire. . . . In order to adopt oneself to such a 'territory' one must really be a vegetal." [2]

What allows us to reject the above hypothesis is that these plants can acclimatize themselves in a greenhouse. In Alsace, France, successful experiments have been made on copper wires in greenhouses. The hypothesis given about atmospheric dust and

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[1] *Fécondité de la Terre*, p. 152–156.

[2] Larousse, 1967, p. 128.

rain is then of no value. In the greenhouses there was only air, sun, water vapor from the humidity of the air, and symbiosis with copper. No copper was found in the plant, but iron was found. No chlorine was in the air either, although there was some in the plant.

There are other examples, too numerous to list. Here is one that Pfeiffer cites: "The *Sarothamnus vulgaris* is quite an amazing plant. It is particularly rich in lime . . . moreover, its roots secrete lime which is deposited in circles on the bark, so much so that it is the plant which provides limestone for the soil. But the *Sarothamnus vulgaris* grows almost exclusively in siliceous fields. That is why it is particularly appropriate for the preparation of fallow fields."[1]

[1] *Fécondité de la Terre* p. 157.

# XII

# NITROGEN

When I proposed that nitrogen could become carbon monoxide and commented on experiments demonstrating this, I was sometimes told that I had given a rather "audacious explanation."

It would take too long to set forth all the reasons that led me to the identity $2\,N_{14} \rightarrow C_{12} + O_{16}$. Such an undertaking would require a lengthy discourse citing all the inconsistencies in previous attempts at explaining the aberrant behavior of nitrogen in biology.

I shall therefore limit myself to a few brief examples of experiments showing the relation of nitrogen to other elements.

## Aberrant metabolism of nitrogen

I shall cite a few examples, some of which have been borrowed from Terroine,[1] the author of three important volumes dealing with the metabolism of nitrogen.

The first volume contains a chapter entited "Do Nitrogen Leakages Occur?" In addition to his own experiments, Terroine cites 51 articles by different authors.

### 1) *Animals*

If a dog is given 15, then 30, and finally 45 g of nitrogen per day (measured according to the weight of ingested meat), its intestines reject 0.30, 0.55, and 0.67 g per day, respectively.

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[1] *Métabolisme de l'Azote,* edit. P.U.F., Paris 1933.

Hence, with increased ingestion there is a proportionally smaller excretion of N. Thus the amount of nitrogen present does not depend solely on the food regimen.

### VERIFICATION

To confirm this, numerous experiments have been made. They are related by Terroine:

A small portion of an animal's intestine was emptied and then ligatured. After a few days this part, which could not have received anything from the intestines, contained an amalgam of nitrogenous substances. There had thus been a nitrogen production on the inside wall of the intestine.

Persher gave a dog 2.33 g of nitrogen per day, but the dog excreted 3.70 g every day.

In the case of man, Seller decreased the ration of ingested nitrogen on each successive day. He began with 4.30 g, arriving after eight days at 3.67 g. But the quantity rejected in the stools changed only from 5.75 on the first day to 5.04 on the eighth day.

"The rejection is always superior to the ingestion," says Terroine, adding, "but there is more. The examination of the above data not only proves that there is a persistent nitrogen loss but also that there is a quantitative constant of this loss." He concludes that there is certainly an "endogenous metabolism of nitrogen."[1]

### OTHER EXAMPLES

A man given 0.3 g of nitrogen per day rejects, through his intestines, an average of 0.5 g. A pig ingests 0.2 g/day and rejects 0.3 g through the intestines. A man who has been fasting for ten days still rejects 0.3 g of nitrogen through his intestines.

### DISAPPEARANCE OF INGESTED NITROGEN

With a normal regimen the endogenous production of nitrogen does not show up in the balance sheets since the latter are always positive (i.e. one ingests more nitrogen than one excretes). This factor has made the balance sheet figures suspect, for classical science has found it impossible to discover where the excess goes; obviously there is not a lifelong accumulation! There are unre-

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[1] Terroine, *Métabolisme de l'Azote, edit.* P.U.F., Paris, t.I., 1933.

vealed "leakages" of nitrogen and, despite thousands of experiments made by many scientists, this has remained unexplained.

### A FEW EXAMPLES

The following experiment was made with a group of rats. It was established that each rat contained 5.96 g of nitrogen. The group of rats was put on a fast of quite long duration. Every day their fecal matter and urine were collected. (A rat does not perspire, thus there is no elimination from the skin pores.)

The animals were sacrificed in order to measure the total nitrogen of their bodies; the excretions were then added. The total N weight remained 0.55 g less per animal than the nitrogen weight present at the beginning of the experiment. The rats had lost an average of 10% each; (one of them even lost 55%).

A rat was enclosed for two months in a sealed tube containing air and a chorella culture; nonetheless the atmosphere's nitrogen content diminished a great deal, a phenomenon which is incomprehensible according to classical chemistry. The oxygen increased. In this case, the nitrogen had been used in the form of $C + O$.

### ENDOGENOUS PRODUCTION OF NITROGEN

We have seen that the greater the amount of ingested nitrogen, the less the proportion rejected by the fecal channel. This shows that nitrogen disappears through the digestive channels.

Conversely, if food becomes deficient in nitrogen, the intestines' endogenous production of nitrogen increases as if by a defense reaction on the part of the organism. Hence intestinal action vitally needs carbohydrates. The body grows thin due to the disappearance of carbohydrates which have been transformed into excreted nitrogen.

Let us totally suppress nitrogen ingestion by administering carbohydrates absolutely devoid of nitrogen—sugar, for example:

a) A dog put on a fast excretes 2 g of nitrogen per day. When given 85 g of sugar, he excretes only 1 g of nitrogen per day. After a few days he is given 120 g of sugar per day; he then excretes only 0.5 g of nitrogen.

b) A man put on a complete fast rejects a total of 11.9 g of nitrogen per day (of which ⅕ to ⅒ is eliminated through fecal channels). When he is given sugar he excretes only 6.3 g of nitrogen per day. From this we learn that the organism does not have to take carbohydrates from the reserves of its tissues if its intestines supply what it needs in order to make nitrogen. No longer "hungry for nitrogen," it produces it in smaller quantities (providing only what it needs for local functions). These smaller quantities do not create a strong need for carbohydrates.

It is thus clear that the only valid explanation is a transmutation from carbohydrates to nitrogen, and vice versa.

c) If this reasoning is correct, an animal receiving a small amount of nitrogen would then produce a lot of it! In fact carnivorous animals, which receive much nitrogen, do not produce it and excrete very little of it. What they ingest disappears for the most part in their organisms, being utilized for their nourishment, contributing to weight gain, i.e. enabling them to produce carbohydrates. The balance sheets here are positive: one no longer finds nitrogen in its own form.

Conversely, herbivorous animals, whose nourishment contains a small amount of nitrogenous substances, are great producers of nitrogen: a two-year-old ox (herbivorous) excretes 13 times as much nitrogen as a man (omnivorous) of equal weight.

### AGENTS OF TRANSMUTATION

By which means do the intestines create what is called "nitrification" and "denitrification" (words which in reality ill define transmutation)?

We know that the bacteria of the intestinal flora are the agents. It is false, however, to say that all bacteria remove nitrogen and, when food containing nitrogen is lacking, use the nitrogen in the air. (This hypothesis has been given by a few authors who neglected to measure the quantity of air in the intestine and its speed of renewal.)

If this endogenous production of nitrogen were derived from the air and were fixed organically in the molecules of the fecal matter, the process would occur regardless of the nitrogen content in the food. However, we have seen how the endogenous production of nitrogen is linked to carbohydrates and is not directly dependent on nitrogen ingestion.

Bacteria are the agents of the transmutations of nitrogen into carbon and oxygen, at the level of the intestinal wall. Other bacteria are responsible for the opposite reactions.

### 2) *Plants*

Many books have been written about nitrogen. One of them, *Respiration and Nitrogenous Metabolism* by A. Moyse, is devoted to the leaf and cites a great number of references. Here, too, remarks are cited showing that the relation between carbohydrates and nitrogen has long been perceived:

Borodin (1876–1878) estimates that "there is a decomposition and a continual regeneration of proteins," a statement which was to be confirmed by Gregory and Sen in 1937.

Among the most interesting and memorable experiments Moyse cites are those related to the stems of detached leaves which have been placed in the dark in a controlled medium. For some time, these leaves continue to live. However, after four days a decline is noticeable. The decline accelerates after the sixth day; in such cases death usually occurs after ten days.

In summarizing the results of a few experiments made by Moyse on the stems of wheat, buckwheat and sorrel leaves, we have the following data: [1]

—total nitrogen (solely organic) before the operation: 13.64 mg

—total nitrogen at death: 22.8 mg, in the form of mineral nitrogen ($NH_3$).

Thus when death occurred there had been a 70% increase in nitrogen. This increase could not have resulted from a passage of organic nitrogen to mineral nitrogen. Furthermore, 82 mg of carbon disappeared. (The conditions of the experiment do not allow us to determine where the carbon went, but it is clear that nitrogen was produced.)

Moyse points out another phenomenon concerning the nitrogen increase: "The direct origin by liberation of the pre-existing amides in the proteins and the indirect origin by conversion of the aspartic acid are not sufficient to explain this increase."

It can be understood, according to the preceding experiments, how manure may be a great source of ammoniac. There is not only a loss of proteinic nitrogen but an endogenous formation of $NH_3$ from the carbohydrates of straw and cellulose.

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[1] Moyse, *Respiration et Metabolisme Azoté* (*de la Feuille*), edit. Hermann, Paris 1950.

Zaleski (1897) remarked that "leaves can form proteins even in darkness, and proteogenesis requires only the presence of high quantities of soluable carbohydrates." Light facilitates proteogenesis, not only because of carbohydrate enrichment by photosynthesis, but also because photosynthesis is accompanied by $O_2$ at the level of the protoplasm. Darkness favors loss of protein because it causes the $O_2$ pressure to diminish.

When exposed to light the leaf rejects oxygen by chlorophylian action. The oxygen pressure is thus stronger in the leaf than in the air, and that is why the oxygen leaves. In the dark it is the opposite: the leaf absorbs oxygen; there is only respiration.

This interaction with oxygen is also observed in the fact that proteins are formed in young and growing tissues which are rich in oxygen. Hence the N content varies from the roots to the leaves, according to season and amount of light.

⁂

It seems useful to insert at the end of this chapter a few more clarifications concerning the mysterious accidents by oxicarbonaemia. This subject was treated previously in the chapter "Aberrant Observations," but was not dealt with completely.

## Transmutations of $N_2$ and oxicarbonaemia without respiration of carbon monoxide

### 3) *Recapitulation of experiment*

In 1955 mortal accidents occurred in Paris due to carbon monoxide poisoning. Official laboratories made a systematic study on 42 welders from different factories. The investigation, which lasted four years, confirmed that oxicarbonaemia always struck this type of worker.

The CO analysis was made by different methods. Here are some results in $cm^3$ of CO per liter of blood. Please recall that the safety limit is 4 $cm^3/1$, that oxicarbonaemia is obvious at 10 $cm^3/1$, and that the danger point is 15 $cm^3/1$.

*Factory I*

A worker with 19 $cm^3/1$.

*Factory II*

Worker A = 15 $cm^3/1$
Worker B = 9 $cm^3/1$
Worker C = 6 $cm^3/1$

*Factory III*

Worker K = 14 $cm^3/1$
Worker N = 12 $cm^3/1$
Worker P = 14 $cm^3/1$
Worker R = 15 $cm^3/1$

*Factory IV*

Worker D = 14 $cm^3/1$
Worker E = 11 $cm^3/1$
Worker F = 14 $cm^3/1$

*Factory V*

Worker G = 13 $cm^3/1$
Worker H = 14 $cm^3/1$
Worker L = 12 $cm^3/1$
Worker M = 9 $cm^3/1$
Worker S = 10 $cm^3/1$
Worker T = 11 $cm^3/1$
Worker U = 7 $cm^3/1$
Worker Y = 4 $cm^3/1$

Worker Y of Factory V was a manufacturer of sheet-iron working a few yards away from the solderers and oxycutters. Therefore he did not inhale the air which came in contact with the incandescent sheets.

This factor indirectly confirmed that only the air which had passed over the incandescent iron was causing the endogenous production of carbon monoxide.

The possible explanations of this phenomenon are numerous, I know, but none of the classical explanations proposed has been verified (e.g. by air pressure, oxygen pressure, etc.).

I immediately suggested that here was a new aspect of nitrogen metabolism. There is oxygen in CO and also in air. However, in the former there is C and in the latter there is $N_2$. My supposition was that an unknown biological mechanism at the level of the red blood cell modifies the nitrogen at the level of the atom's nucleus, so that a group of two nuclei of nitrogen molecules modifies the internal condition of the nucleons. (The nitrogen of the air becomes metastable by licking the incandescent iron, but it remains nitrogen; that is why it was impossible for the chemist to find carbon monoxide in the inhaled air.) I wrote:

$$2\,N_{14} \rightarrow C_{12} + O_{16}$$

## Other observations regarding the link between nitrogen and carbon-plus-oxygen

The $N_2$ and CO link was verified long ago. The reader will recall that these two have noticeably the same molecular mass and a few common physico-chemical characteristics.

In the reactions I have observed, the nitrogen has been in the molecular form $N_2$ and the oxygen in atomic form, although there is always $O_2$ *in vitro.*

It is very interesting to compare these results with the observations made by artificial satellites. Oxygen ($O_2$) dissociates rapidly under low energy (ultra-violet) radiations. In the thermosphere at an altitude of 120 km, $N_2$ is four times more abundant than $O_2$. At 300 km 99.5% of the $O_2$ is dissociated into atomic oxygen, whereas the nitrogen (N) at this altitude is only dissociated at 1 to 2% as compared to $N_2$. The dissociation is total only at an altitude of 1000 km, where the ionizing actions are considerable. (Above 1,000 km there is helium and above 2500 km there is hydrogen.)

In other works I have shown that the energies situated in the ultra-violet (which is of medium energy) cause the nuclido-biological displacement of oxygen. Plant and animal enzymes thus emit an energy equivalent to that of a photon associated with ultra-violet. This would explain why in nuclido-biological reactions oxygen is never in the form of $O_2$ but is always in the form of O, whereas there are no nuclido-biological reactions with N, but only with $N_2$. (This is at least true in everything I have observed thus far.)

Of course, not everyone immediately agreed with my conception of the phenomenon of transmutation. M. Loeper, a French specialist very well known for his studies on pathological cases concerning the endogenous production of carbon monoxide, thought that a pressure reduction at the level of the air cell (pulmonary alveolus) was the cause of bad oxidation in the blood, thus causing the production of CO instead of $CO_2$. Loeper's position of authority did not prevent Professor Desoille from concluding in *Archives of Professional Diseases* (July–August 1963) that there is "no correlation whatsoever between the partial pressure of oxygen and the carbon monoxide in the blood."

Thus it was once again confirmed that the pressure of carbon monoxide in the blood is not due to the presence of oxygen.

# XIII

# SULFUR

Sulfur appears as a "fritting" of two nuclei of oxygen. The most abundant form of sulfur is $S_{32}$ $(2.0_{16} \rightarrow S_{32})$.

Let us remember that the $O_2 \rightarrow S$ relation explains the very corrosive role of sulfur at high temperatures. It is the equivalent of a strong oxidation. Sulfur and oxygen are two chemical aspects of the same nuclear origin, so that when there is—at least in biology—strong oxidation in the young and active cell, there is a concentration of oxygen. This explains the presence of sulfur in the fast biological reactions of oxidative-reduction (appearance and disappearance of O). It will be necessary to ascertain whether this fact can be applied for the detection of cancer.[1]

The biological sulfur $(O_2)$ enters into the constitution of the essential amino acids. There is from 0.3 to 2.4% S in proteins. This is also the case in the egg's development process. This biological sulfur becomes mineral sulfur when it combines with H, as when an egg dies or rots.

In cellular metabolism five sulfured coenzymes have been identified. Sulfur is the element of transition. Four of these coenzymes come into play in the metabolism of carbohydrates, lipids, and proteins.

Sulfur $(O_2)$ is an element as vital as nitrogen $(C + O)$, fabricated by plants as well as by some living organisms. The latter has been experimentally proven in the case of plants and can be easily confirmed for animal cells, for example in the hen egg.

The identity $O_2 \rightarrow S$ can also be verified in mineral chemistry:

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[1] It is the same for the increase of K, which results from O: $Na + O \longrightarrow K$, and has been detected in cancerous tissue.

everyone knows that metals burn not only in sulfur vapors but in oxygen as well. The same is true of carbon. (There is thus $CS_2$ with S and $CO_2$ with O.)

Besides discussing the "production" of sulfur by certain plants (watercress, cabbage, etc.) and some mushrooms, we should note some facts concerning the production of mineral sulfur.

When water is spilled on incandescent charcoal, one "smells sulfur." Although it is said to be a chemical reaction that provokes the release of the sulfur contained in the charcoal, it can be a condensation of oxygen.

When lightning strikes close by, one also smells sulfur. Scientists know that electric discharge can give ozone ($O_3$), but doesn't it also produce $SO_2$?

The gas of Lacq, France, contains 18% sulfured hydrogen which must be purified, thereby losing all its $H_2S$. It then goes through a dryer, after which it is again found to contain some sulfured hydrogen—as if sulfur had been produced in the dryer. This fact has remained unexplained.

According to my thinking, here is what happens (hypothesis to be verified): the gas is heated in order to dry it; the water dissociates in part into $H_2$ and O. There is thus a possibility of "frittage" ($O_2 \rightarrow S$, which is found in the presence of 4H), hence the possibility of a chemical combination $H_2S$ which liberates 2 H. However, S is produced, just as when water is spilled on incandescent charcoal.

Sulfur is found in glutathione, in the $B_1$ vitamins, etc. It is often accompanied by phosphorus, for the organism transforms one to the other. This phenomenon will lead to the revision of many pharmaceutical products, since sulfur enters into the composition of many organic products such as sulfamides, penicillin, etc.

In mineralogy, the composition of metals includes sulfur or oxygen ($O_2 \rightarrow S$). Lead, zinc, copper, and mercury are most often formed by sulfurs in the earth's depths (by pressure?) and oxides on the earth's surface. Likewise iron, calcium, etc., often have S or O compositions.

There are many cross-references which show that the probable origin of sulfur is oxygen, that it is a "condensate" of two atoms of oxygen, and that in nuclei acids the biological reaction is $O + O \rightarrow S$.

In previous books I have cited an experiment consisting of the production of sulfur with thiobacilli. For this effect the inside of a test tube is rubbed with a wadding soaked in sodium-thiosulfate. The quantity of sulfur thus deposited is insignificant. The thiobacilli and an appropriate nutritive solution containing no sulfur are then put into the tube. The thiobacilli proliferate and produce sulfur in quantities considerably higher than those which carpeted the tube's inside walls at the beginning of the experiment. Thus, the result is not a concentration but a creation.

The test tube (Erlenmayer type) is isolated by a cotton cork which works as a filter. (The air always contains some $SO_2$, but the quantity is too small to be able to start a culture; that is why this thio-sulfate [hyposulfit] of sodium is added.) The aerobic development of the thiobacilli shows that the latter need the oxygen of the air. O is their "raw material" for "producing" S.

However, this example shows that it is not always advisable to start with chemically pure products purged of sulfur in an atmosphere without sulfur. It is untrue to say that the experiment will be conclusive only if there is no sulfur in the beginning of the operation; such an experiment—in this special case—would be likely to fail. It is most important to know the sulfur weight at the beginning and end of the operation. The difference between them reveals the endogenous production by transmutation.

# XIV

# CHLORINE

Chlorine probably had numerous origins.

Plants seem to be able to produce it. Branfield[1] gives a quantitative analysis of the ashes of some plants and remarks that chloride is found in rushes, water lillies, sphagnum moss, ryegrass and nettles, growing where there is only fresh water.

Chlorine is a vital element of great importance. If life originally sprang from the sea—where the salts are essentially chlorides—if our blood plasma is essentially a liquid salted with sodium chloride, there is a reason. Why is it not salted with sulfates, carbonates, nitrates, etc.; why chlorine?

The chlorine content in an organism seems to be constant. There are approximately 9 g/1 of NaCl in the plasma. (Fish have organs which are able to eliminate the sodium chloride excess; the water contained in their flesh is only salted at approximately 9–10 g/1.) This suggests that life began in water having the same initial content of NaCl, thereby making Na and Cl vital elements. There could not possibly be life without the proper proportions of these two elements.

If the chlorine content varies only to a limited extent, it is because chlorine is a regulator and a reversible element. It may appear from nuclido-biological reactions, thus remaining constant and independent from exterior sources. Let us recall a few reactions:

$$N_2 \rightarrow C + O$$

$$Na \rightarrow Li + O$$

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[1] Branfield, *Continuous Creation,* Routledge & Kegan Paul Publ., London, 1950.

An organism contains Na and C, and

$$^{23}_{11}\mathrm{N} + {}^{12}_{6}\mathrm{C} \rightarrow {}^{35}_{17}\mathrm{Cl}$$

The relation between Na and Cl is obvious. Hence an organism has elements enabling it to produce Cl endogenously.

Oxygen with interplanetary lithium originally produced sodium. It is possible that sodium and chlorine could have appeared at that time.

Nitrogen, which is activated in various ways, produced oxygen and carbon.

Let us point out that the reactions cited above are isomers of the following ones:

$$\begin{aligned}
\mathrm{Cl} &\rightarrow \mathrm{C} + \mathrm{Na} \\
&\rightarrow \mathrm{C} + (\mathrm{Li} + \mathrm{O}) \\
&\rightarrow \mathrm{C} + \mathrm{O} + \mathrm{Li} \\
&\rightarrow \mathrm{N}^2 + \mathrm{Li} \\
&\rightarrow \mathrm{Si} + \mathrm{Li}
\end{aligned}$$

Nitrogen could thus have given silicon, and the latter combined with Li produced Cl.

Or, still another representation of the same reaction:

$$\begin{tikzcd}
\mathrm{N}_2 \arrow[r] & \mathrm{C} \arrow[dd] & + \mathrm{O} \arrow[d, dash, bend left] & \\
& & \mathrm{O} + \mathrm{Li} \arrow[r] & \mathrm{Na} \\
& \mathrm{C} + \mathrm{Na} \arrow[r] & \mathrm{Cl} &
\end{tikzcd}$$

proving that Na and Cl could have originated simultaneously from $N_2$, with one atom of Na for one of Cl. Hence, no compound other than NaCl is possible by way of transmutation.

It seems that potassium can only be a subsequent creation (as is the case in an organism). If $\mathrm{K} \rightarrow \mathrm{Li} + 2\ \mathrm{O}$, then K ought to have been produced in two phases. It derives from Na + O (as in the organism), i.e. from (Li + O) + O. But if sodium chloride is present, one must expect an oxydo-nucleonic addition giving NaCl with KCl.

Of course, if Na can take O it can also take H. In NaCl solutions potassium chloride will be formed at the same time as $(Na + H) \rightarrow Mg$. Such is the case with the potash lies of the Stassfürt type, which are found also in Alsace, France.

We cannot reject the possibility that fluorine is linked to chlorine. We have:

$$Cl_{35} - O_{16} \rightarrow F_{19}$$

$$Cl_{37} - O_{18} \rightarrow F_{19}$$

or we can have the opposite.

From the reactions $N_2 \rightarrow C + O$ and $Na \rightarrow Li + O$, one may conclude that C and Li, produced by nitrogen and sodium, give:

$$C + Li \rightarrow F$$

Since oxygen is available, one has $F + O \rightarrow Cl$.

Furthermore, $F + C \rightarrow P$, so that a phosphorus production occurs. The elements P and F are often together (in bones, ores).

It is easy to see that the whole system of Nature is maintained by a constant balance of a few elements.

I shall point out many hypotheses accompanied by cross-references. For the time being they are only open roads for a more complete study.

# XV

# MANGANESE AND IRON

The manganese-iron link was verified long ago by agronomists. Plants require specific bacteria for absorption of manganese and iron. However, curious phenomena have appeared to researchers: a manganese excess produces the same effects as a lack of iron. In other words, an excess of manganese impedes the assimilation of iron, and vice versa. Many of these researchers have recently been pointing out a source of protons in these phenomena. But they could not discover the process which developed these protons.

Besides these phenomena, which agronomists have been studying for fifty years, a study is now being conducted on the use of the above-mentioned bacteria to enrich manganese ores.

Another fact attracted my attention: manganese formations on some cave walls and on the temples of Banteay Srei in Cambodia are struck with a "black disease." The surface of these stones becomes black and this black layer is 5% Mn, although there is only 0.05% Mn in the stone. This increase in Mn did not seem to be due to a simple migration, since the total manganese contained in the outer layer was greater than that which the entire stone could contain. In my first book (1960) I had already foreseen the possibility that iron and manganese are separated by only a proton.

$$Fe_{56} - H_1 \rightarrow Mn_{55}$$

I asked the conservator of the monuments to find out if there were iron in the stones. An analysis of the pink sandstone revealed 5 to 15% iron, depending on the stone's origin.

It then had to be ascertained that it was iron which had become manganese. Microorganisms (actinomycetes and bacteria) were set apart and a culture on ferrous sulfate was started in a laboratory. Manganese was produced.

In 1963 after ten years of research, Professor Pierre Baranger (chief of the laboratory of organic chemistry at l'Ecole Polytechnique in Paris) verified that during germination manganese had disappeared while an equal amount of iron appeared.

Professor Baranger made the following verification: in leguminous seeds germinating in a soluble manganese salt added to water, a great part of the manganese disappears while an equal amount of iron appears. The manganese that disappears represents 25 times the manganese weight of the seed. Thus nature works wonders; it works with a coefficient of security so that if the seeds do not find good conditions for germination they have enough vigor in their diastases to germinate anyway.

The Mn content in seeds is variable according to the seed's species. In the buckwheat seed there are 30 mg of Mn per kg of fresh matter and in a 45% sifted flour there are 7.5 mg/kg.

⁂

Manganese is found in the blood and in all the tissues; it is a "giver" of oxygen. Its important role in biology, however, is based on the fact that the peripheral electrons of the N layer are weakly joined, largely because the sub-layer "d" of layer M is incomplete. Therefore there are many valences and a facility in passing from one oxide to another.

Manganese is used often by doctors who have found that a manganese deficiency causes some types of allergies. (It has been verified with the spectroscope that in 50% of all allergies the plasma has suffered a loss of Mn.) A prescription of 5 mg of Mn, taken twice a week for ten weeks, can cure asthma, hay fever, and other intolerances.

Agronomists also widely use Mn to get rid of the bad effects of sea salt in the soil. (50 kg per 2½ acres make sowable dried-up fields which have been reclaimed from the sea.)

The biological role of manganese is certainly important in man and animal, but it has not been studied enough. Its role is best known in plants. Some plants cannot, at a certain stage of their development, "fabricate" the necessary manganese and therefore must find it in the soil. This manganese will not become assimilable until the manganic bacteria proliferate.

The presence of Mn has been observed in some enzymes. There is a certain oxidizing enzyme in the lacquer tree which fixes the oxygen on a latex alcohol. But this catalytic action of the enzyme is linked to the presence of Mn. If Mn is missing, there is a total inhibition of the enzyme. The absence of Mn, however, does not indicate a deficiency of this element. The deficiency originates most of the time from the difficulty the roots have in assimilating Mn when the soil has an overly alkaline pH.

Some plants are able to produce the missing manganese, while others (oats, etc.) are not. The same is true of animals at certain periods: a small reduction of Mn in the diet of female rats causes them to stop nursing. Male rats become sterile.

The human organism seems to contain enzymes which allow iron to change into manganese and vice versa. A manganese deficiency comes from a pathological problem in the production of a specific enzyme. When this is the case, an organic manganese supplement becomes "necessary."

Iron is a vital element which is indispensable to animals and plants. It has been established that iron is also linked to the process of photosynthesis.

Nature "chose" manganese to constitute the stock—normally oxidized and stable—which is the purveyor of oxygen and metabolizes the ferrous ion. (It seems that "the enzymes called oxydases owe their property of fixing oxygen to their ever-present manganese," wrote G. Bertrand.)

It is from such a reaction that Life borrows the necessary iron. One can understand now why variations of Mn content do not have much effect on a healthy person. It is not as Mn that manganese comes into play in chemical reactions. Rather, this happens after it has been transformed into iron. The organism is sensitive to variations of Fe, not of Mn!

Iron is present almost everywhere. Even in "pure clay" (kaolin) there is 2% iron oxide. In other clays there is 10 to 20%, and in bauxite 30%.

There is no need to look for iron's origin in the center of our planet; it is a "surface formation" at the level of the earth's crust, even in the case of the so-called "deep lies."

Lies found deep in the ground can be carbonates. How can this be explained? There is neither $CO_2$ from the air nor $CO_2$ brought by water. One can see from the reaction I observed what the process is: the silicon of the primary rocks can, with Li, give Fe. But other nuclei of Si, when under pressure, can become $C + O$. Hence we have the chemical elements for the formation of the carbonates.

The oxygen in turn can give $O + O \rightarrow S$, under conditions of pressure, so that there are sulfurs (pyrites) in the depths but oxides on the surface.

"On the surface, and often at a certain depth, superficial alterations have transformed the carbonate into a pure hematite, a formation difficult to explain since a mere ordinary and superficial alteration should give limonite and not hematite," says F. Blondel.[1] He goes on to say, "The hematite production on the surface is not well-clarified."

However, we have seen that there is oxide on the surface, due to an endogenous production of oxygen. (Oxygen can also be liberated from potassium to give lithium.)

At the level of the nucleon an abundance of Si, along with a situation of stable saturation produced by 4.Li, results in an abundance of Fe.

There is 91.64% $Fe_{56}$ and 5.81% $Fe_{54}$, since around $Si_{30}$ there is $4.Li_6$ instead of $4.Li_7$. The 2.21% of $Fe_{57}$ comes from $4.Li_7$ with $Si_{29}$, whereas 0.34% of $Fe_{58}$ comes from $Si_{30}$.

Manganese, which has an odd number of protons, cannot have an odd number of neutrons. There will then be an odd-even number so that the number of neutrons will be superior to the number of protons by at least five units. (This is also the number of neutrons plus protons in the preceding element, vanadium.) The minimum then is 30 neutrons, which give 15 nucleons.

The following odd number is copper. $Cu_{63}$ has five more neutrons than protons. Manganese thus cannot have any more or less

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[1] *Chroniqe des Mines Coloniales*, Sept. 1955.

than five neutrons in conjunction with the number of its protons. That is why there is no isotope: there is 100% $Mn_{55}$.

From this fact it is clear that only the isotope 56 of iron can give Mn by losing one proton.

## Manganese and bacteria

For many years it appeared that the presence of manganese was linked to the presence of microorganisms. Many studies have been made to this effect, but here again research has been interpreted according to a classical chemical reaction. The same phenomenon can be explained by biological transmutations: the bacterium takes H from Fe in a medium poor in ions of hydrogen (high pH—basic). There is thus an increase of Mn. On the other hand, if there are too many H ions (low pH—acid medium) the bacterium, in order to re-establish the equilibrium, takes H; Mn disappears, becoming Fe. Precise research had never been done to determine the source of Mn which was "fixed" by the bacteria, nor where the "restituted" Mn went!

If Mn is "restituted," this seemingly means (in terms of classical chemistry) that the solution gets richer in Mn to the detriment of the bacteria. A systematic study of the influence of pH must be made again using ferrous solution and having in mind not a simple exchange but a transmutation. An exchange may occur, but that doesn't explain the appearance of Mn in such great quantities. The correct explanation is transmutation, and it was verified.

It seems that the bacterium envelopes itself with a layer rich in Mn. This phenomenon has an industrial application: manganobacteria in a slightly basic solution, sprayed over finely-ground ores very poor in Mn, cause a proliferation of these bacteria which, in their porous membrane of Mn, are very easily separated when floating. The result is a concentration of Mn.

However, a microbiological study of Mn shows that there is not only a bacterium involved. In the bottom of the Atlantic and Pacific oceans nodules rich in manganese have been found and "fished" on a large scale. These nodules have been studied biologically everywhere (in the U.S.A. by Ehrlich, Mero, etc.[1]), but no one has thought to make a systematic experiment without manganese, in ferrous solution. The given explanation is that in the sea the nodules are formed from a bacterian action which oxidizes the manganese in order to allow it to fix itself on the nodule.

*Fig. 10 In a Petri dish, associations of selected bacteria are cultured in mineral solutions fixed by a gelose. A manganese powder is then sowed into the culture. After a certain time, a rapid proliferation is established and the ferro-bacteria transmute the manganese into iron. The iron oxide drag is visible here in this photograph taken by L. Kervran.*

*This is the first photograph ever made of the transmutation of manganese into iron.*

Be that as it may, the general conditions for the proliferation of the bacteria which "fabricate" the manganese are now known. Associations with actinomycetes initiated the industrial studies whose first application was the enrichment of ores poor in man-

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[1] H. Erlich, "Bacterial Action on Manganese in Nodules Enrichments," *App. Microb.*, 1963, II–I, 15–19.

ganese but rich in iron. The presence of the bacteria transmuting Fe into Mn is certain here. One can increase their proliferation and activity considerably by controlling the temperature and pH and by adding 0.1% of peptone to the solution. (These microorganisms are heterotrophic.)

To show how numerous are the mangano-bacteria (found in all types of soil along with other microorganisms), here are some data for a soil in which pH= 6.7, prepared for a culture of oats. (Numerals refer to number of bacteria per gram of humid earth.)

| | (in millions) |
|---|---|
| Diverse bacteria | 225 |
| Actinomycetes | 4.8 |
| Mushrooms | 0.045 |
| Mangano-bacteria | 0.315 |

(Analysis by M. I. Timonin)[1]

(The mangano-bacteria were counted by the Gerretsen Method.)

Hence without sowing bacteria in a natural soil, one finds 315,000 mangano-bacteria per gram of earth; one may, at will, either annihilate them or favor the activity.

The above data are not given here as an average. They may vary greatly.

A soil (superficial layer) gave:

| | | |
|---|---|---|
| Total bacteria | 564.2 | million * |
| Actinomycetes | 2.3 | million |
| Mushrooms | 0.0338 | million |
| Denitrifying organisms | 10.6 | million |
| Mangano bacteria | 255.0 | million |

* per gram of earth, thus 800 times more mangano-bacteria than in the preceding example and twice as much total bacteria.

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[1] See Bibliography.

*Fig. 11 Angkor-Tom: "black leprosy" (manganese) invades the monuments.*

## Geology

The manganese link with iron is observed in its ores. One often finds 15 to 20% Fe in ferruginous clays. The ores are classified in four categories:

| | | |
|---|---|---|
| Manganese ores | 40 to 63% Mn | 0 to 10% Fe |
| Ferruginous ore of Mn | 25 to 35% Mn | 10 to 30% Fe |
| Iron ore containing Mn | 5 to 20% Mn | 30 to 40% Fe |
| Iron ore | 0 to 5% Mn | 45 to 70% Fe |

For example, the Ouenza ore is an iron ore which is 4% manganese. It remains a hematite.

The Kizova ore (of Czechoslovakia) is a ferruginous ore of Mn with 26.85 MnO and 32.56 FeO. It is an oligonite.

On the other hand, the Moanda ore, found near Franceville, which contains 50% Mn, is an ore of manganese.

The Pre-Cambrian rock in this région (N.E. of the Gabon, 500 km east of Libreville) contains an important lie of iron ore. This shows that Fe and Mn can have the same rock of origin but that the change from Fe to Mn probably occurs from causes other than biological ones.

It is clear that Mn and Fe combine well. The microorganisms which initiate this liaison have been sampled previously and the production of Mn from Fe in the laboratory has been accomplished successfully. Private laboratories are even determining in which economical conditions such an operation can be launched industrially.

# XVI

# VARIATIONS OF MINERALS IN DRIED FRUITS

Many scientists now see the impossibility of explaining the mineral variations in dried fruits by means of chemistry alone. I cannot cite here all that has been brought to my attention concerning this subject. Notwithstanding, I shall mention an article by H. C. Geffroy which appeared in the review *La Vie Claire* (December 1966) and gives an analytical comparison of a fresh almond and a dried one. According to Lucie Randoin, the article points out, there is 87% water in a fresh almond and only 4.4% water in a dried one. Here are some of the results Geffroy gives of Miss Randoin's analysis (for 100 g of almonds):

- —Nitrogenous matter
  - 5.67 g in the fresh almonds
  - 18.10 g in the dried almonds
- —Fat
  - 2.19 g in the fresh fruit
  - 54.20 g in the dried fruit
- —Mineral salts
  - 0.96 g in the fresh fruit
  - 2.50 g in the dried fruit

It is obviously impossible to support the classical explanation according to which the difference in composition is due to desiccation, for in that case there would be an equivalent concentration of all components.

In another review, *A Table* (April 1967), Mr. Geffroy draws attention to a comparative chemical analysis of the fresh plum versus the dried. The results are slightly different from those cited by Lucie Randoin, but these minor differences might have been due to the type of soil used.

Since Miss Randoin's figures are more detailed and since she specifies different kinds of fruit, we shall use her results.

The dried prune, when analyzed, has 2.4 g of water (per 100 g) less than the fresh plum. But the carbohydrates are seven times more concentrated in the dried prune. Desiccation alone would increase the organic and mineral components 6.2 times. The lipids and proteins increase only three times. It is as though they diminished relatively, and it is probable that molecular transformations of a biochemical order changed these lipids and proteins into carbohydrates.

Minerals increased only three times; sodium, 3.3 times; potassium, 3.8 times; magnesium, 4.4 times; phosphorus, 5 times. On the other hand, sulfur, which increased 6.1 times, kept its relative rate of increase unaltered. Iron multiplied by 7.2; copper by only 1.6. Manganese diminished greatly: there was 9.17 times less manganese than if there had been only desiccation.

From this we can see how important it is for dieticians to know the respective variations and to be aware of the difference between taking fresh and dried fruit. Let us take some results given in the "Table of Composition of Food" by Lucie Randoin (from the Academy of Medicine). The calculations pertain to 100 g of seeds.

—in dried soya beans, 580 mg of P
—in germinated soya beans, 67 mg of P
—in dried soya beans, 280 mg of Ca
—in germinated soya beans, 48 mg of Ca

Where did the phosphorus disappear to once the soya beans had germinated? (There was 8.6 times less.) Where did the calcium go? (There was 5.8 times less.)

Let us take simpler cases where desiccation does not enter into play (at least in principle; we shall see later that there is something else).

In the green pea there is:

| | S | P | Mg | Ca |
|---|---|---|---|---|
| when green | 60 | 122 | 42 | 26 |
| when dried | 219 | 380 | 130 | 60 |

These abnormalities did not surprise anyone. If there had been merely desiccation (loss of water), the ratio between the minerals would have remained the same.

Let us take the case of the banana:

| | S | P | Mg | Ca |
|---|---|---|---|---|
| fresh | 12 | 28 | 35 | 11 |
| dried | 36 | 90 | 105 | 21 |

We can see that in the drying process S and Mg become three times more concentrated while Ca multiplies less than twice and P less than 3.2 times.

The P/Ca ratio is:

2.5 in the dried fruit
4.3 in the fresh fruit

For the fig:

| | S | P | Mg | Ca |
|---|---|---|---|---|
| fresh | 10 | 30 | 21 | 32 |
| dried | 34 | 116 | 72 | 170 |

The dried/fresh ratio is 3.4 for S and for Mg. On the other hand, it is 5.3 for Ca and 3.8 for P. There is a slight increase in P, but a large increase in Ca.

In grapes, the phosphorus content changes from 20 to 145; Mg changes from 10 to 36, Ca from 20 to 40. Although P increases 7.2 times, Ca only doubles while Mg increases 3.6 times and sodium 11 times.

## Variations of oligo elements in dried fruits

Here are some results, according to L. Randoin, of a few cases of variations in oligo elements:

In the dried chestnut, iron is multiplied by 2.3 and copper by 1.08, so that Fe/Cu = 1.33 in the fresh chestnut and 2.86 in the dried—a 117% increase. These findings seem to indicate that some copper became iron.

However, for the fig we have:

$$Fe/Cu = 1.50/0.06 = 25 \text{ in the fresh fruit}$$
$$3.0/0.35 = 8.57 \text{ in the dried fruit}$$

Hence Fe/Cu is 191% higher in the fresh chestnut than in the dried. Iron only doubles, while the water content is 3.4 times less. On the other hand, copper increases 5.8 times. Thus, some iron disappeared and the amount of copper increased.

In the peach the concentration of mineral elements is five times greater; the water content is 3.58 times less. But it is not the same for the oligo elements.

The Fe/Cu ratio is:

$$0.40/0.05 = 8 \text{ in the fresh fruit}$$
$$4.0/0.26 = 11.1 \text{ in the dried fruit}$$

There is thus ten times more iron and five times more copper, indicating that the very noticeable variation of Fe/Cu does not derive from Cu and that iron has another origin.

In the pear there is a great variation of Fe/Mn:

$$0.40/0.06 = 6.6 \text{ in the fresh fruit}$$
$$1.80/0.20 = 9.0 \text{ in the dried fruit}$$

meaning an Fe/Mn increase of 36%.

For the apple it is the opposite:

$$Fe/Cu = 0.40/0.10 = 4 \text{ in the fresh fruit}$$
$$1.44/0.58 = 2.48 \text{ in the dried fruit}$$

For Fe/Mn we have:

$$0.40/0.04 = 10 \text{ in the fresh fruit}$$
$$1.44/0.20 = 7.2 \text{ in the dried fruit}$$

Thus there is a different enzymatic behavior in the pear than in the apple. In both, Fe/Cu = 0.40/0.10 = 4 in the fresh fruit, whereas Fe/Cu = 9 in the dried pear and 2.48 in the dried apple, due to the formation of copper in the dried apple.

# XVII

# AN INTERPRETATION OF AN ANALYSIS MADE ON RYE-GRASS

The interpretations of this analysis by the Laboratory of the Société des Agriculteurs de France[1] were included in the same sheet in order to gather together all the numerical values necessary for the understanding of the results.

Dosages of magnesium, calcium, and copper were given to 1,000 seeds of rye grass from Italy (Rina Variety). These seeds were not germinated but were kept as controls (column 5).

A similar lot (in two Petri dishes, 500 seeds per dish) was germinated for 29 days on porous ashless paper soaked with Evian water (column 6). At the end of the experiment, the remaining water was measured (430 cm$^3$ were used for the entire culture). The Mg, K and Ca contents of the Evian water are indicated in column 7.

The seeds were germinated under a plastic sheet in order to avoid any introduction of dust. These seeds were similar in weight to the ones being kept for later comparison (column 5). The composition of the Evian water is in column 7. The total of the elements introduced in the Petri dishes is in column 8.

With no supplement for the seeds other than water, it was found that the harvested plants had a different content of Mg, K and Ca (column 6). The differences between (6) and (8) are shown in column 9. These differences are expressed in percentages in column 10.

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[1] Officially recognized by the French Ministry of Agriculture for arbitration and expertise in cases of litigation regarding fertilizer analysis.

Composition per cent

| | | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|
| | | 100 seeds | 1000 seeds + porous, ashless paper + 430 $cm^3$ Evian Vegetation 29 da. | Input from 430 $cm^3$ of Evian water | Total Input | Balance Sheet | ±% |
| Interpretation of the Analysis | Water | 272 mg | 15441 mg | | | | |
| | Dry matter | 2035 mg | 3329 mg | | | | |
| | Ashes | 112 mg | 324 mg | | | | |
| | Magnesium | 3.02 mg | 3.20 mg | 10.32 | 13.34 | −10.14 | −335% |
| | Potassium | 6.97 mg | 16.67 mg | 0.39 | 7.36 | +9.31 | +133% |
| | Calcium | 6.00 mg | 36.50 mg | 33.11 | 39.11 | −2.61 | −6.67% |
| | Copper | 0.021 mg | 0.10 mg | 0 | 0.021 | +0.079 | +376% |

Mg, Ca, Cu: atomic absorption
K: flame emission

Analysis made July 2, 1971

## Interpretation

There were 3.02 mg of magnesium in the seeds. With the addition of water there should have been 13.34 mg, however there were only 3.20 mg. There was a 10.14 mg "loss," i.e. 335%.

For the potassium there was a 9.31 mg increase, i.e. 133% more.

The calcium did not decrease much, but the copper increased by 376%.

## An important lesson

Mg diminishes by 10.14 mg, while K increases by 9.31 mg. Notwithstanding, we could not conclude from this experiment alone that when K increases, Mg decreases (for although they compensate each other on the ponderal plane, the difference in nucleons on the atomic plane corresponds to the nitrogen content, which was not measured).

Although the reaction would be valuable for the various stable isotopes of Mg and N, as well as K, we will not write ${}_{12}Mg + {}_{7}N :=: {}_{19}K$ without conducting research on the intermediary N. This is because there is another possible reaction in the mitochondria: Mg giving Ca by nuclear addition of O. The excess Ca which cannot escape makes the pH rise, thus triggering the transmutation of Ca into K by taking away an H proton from Ca. K remains and can escape through the membrane while H, now liberated, makes the pH of the mitochondria diminish. Thus it is clear that the subtraction $K - Mg$, for example, does not necessarily indicate the intermediary. Nature mostly operates by transmutations with ±H or ±O. But whatever the intermediate mechanisms, one fact is verified: Mg decreases and K increases, in this specific experiment. (One should be careful not to generalize, because each plant behaves differently.)

This research was initiated in the hope of confirming previous work by verifying precisely that Ca does not vary in the cultivation of a plant that is unable to "make" the calcium indispensable to its metabolism. That is why the culture was made with Evian water, which is rich in calcium.

The calcium absorption by the rye-grass is remarkable since the water provided 33.11 mg and 36.50 mg were found in the plants (for lots of 1,000 seeds). This means that all the calcium that was fixed in the plant, including what the seed contained, came from the water. This process is characteristic of plants unable to make their own calcium. Experiments of the same kind in waters either rich or poor in calcium reveal the differing behavior of plants able to manufacture their own calcium.

## Remarks

The behavior of magnesium is interesting to observe. One can see that the seeds contain 3.02 mg of Mg, while after germination the plants contain only 3.20 mg of Mg. This shows that germinations made with distilled water do not permit precise study of the biological transmutation phenomenon: it was necessary to supply 10.32 mg of Mg with the water to verify that in the culture a great quantity of Mg disappeared (a disappearance of approximately three times the amount of Mg contained in the seed). An experiment involving several lots totaling 21,000 seeds (50 grams) of rye-grass showed that the Mg variation is slightly noticeable in demineralized water. The same series of experiments also showed a very small variation of K, which is normal since in this case one is only "gambling" on the reserves of the seed. But here, with a small amount of K being provided by the water, the total potassium is more than doubled, whereas there is a consumption of the magnesium that was provided.

## Conclusion

The mineral elements given to the soil should not be those taken away with the harvest; their choice should depend on what was transmuted by the plant to give what was gathered at the harvest. The latter is what we call "substitution," whereas classical agronomy arrived at the sad policy of unbalancing soil and plants with the erroneous "restitution" technique.

Our case is made manifest by the behavior of Mg. If we limit ourselves to an analysis of seeds and plants, we might think that there is little change in Mg content and say, along with those who practice restitution, that bringing Mg to the soil is useless. But we see that it is important to bring Mg, that the plant uses this element after transforming it. On the contrary it is useless, despite appearances, to provide K if the plant can obtain Mg, since the plant produces K. Besides, several experiments have shown that more K is found in the plant than what was originally given to the soil. (A frequent origin of K is Ca — H.) The whole classical technique of mineral fertilization must be reevaluated, especially in schools of agriculture.

# XVIII

# TRANSMUTATION OF RADIOACTIVE WASTES

Do the reactions which I propose have a possible application for the destruction of radioactive wastes?

At first glance one might remark that my reactions have not been observed in the presence of radioactive phenomena. But one should not dismiss a possible application *a priori,* without studying it, and I have done no research on radioactive substances.

An objection presents itself: since these very transmutations which were studied and applied are happening at a biological level, it is unthinkable to anticipate that microorganisms could transmute radioactive wastes into stable nuclids.

The destructive effect of the radioactive radiance is being utilized to kill cells and to sterilize various products.

But nothing is absolute! Not even this law of the biological effects of radiation!

A bacterium which can support ten million roëntgens for eight hours has been discovered! The mortal dose for man is 500 roëntgens. This bacterium, of the *Pseudomonas* type, was discovered in 1958 in Los Alamos, U.S.A., in the water of a nuclear reactor. It liked the medium so much that it reproduced every twenty minutes.

A little later in Lucas Heights, Australia, a verification of the same kind was made. In stored heavy water there were two million bacteria per $cm^3$. Only 1,000 of these bacteria were left when the heavy water came out of the reactor. The content rose to 10,000 at the exit of the ion exchanger. These bacteria were of the *Pseudomonas*, *Bacillus*, and *Achromobacter* types. It can be seen that these bacteria can multiply in heavy water, which is not conducive to the life of most organisms.

However, we can see from the above that some bacteria can be cultured very readily on radioactive substances. It would be wise to find out both if these bacteria can help make the transmutations, and which ones they can make. Transmutations can also be made by mushrooms, algae, and enzymes.

Here is a theoretical example: if strontium 90 could be "fritted" with fluorine, it would give non-radioactive silver ($Sr_{90} + F_{19} \rightarrow Ag_{109}$), providing that the fluorine could enter in this manner in a nuclido-biological reaction.

Studies should be made to find out if $C_{14}$ and $K_{40}$ enter into the reactions of transmutations. It is probable in the case of $K_{40}$, for noticeable variations of this nuclid are found in the potato, for example. One thing is true: it is an almost stable nuclid. If formal proof were given that it did enter in the nuclido-biological reactions to give a stable or short-lived nuclid, however, this would constitute a breach with the actual theory of radioactivity.

A study[1] was carried out by L. Magos, Tuffrey, and T. W. Clarkson (Research Council Laboratories of Carshalton, England), who used grindings of rat kidneys homogenized with adduction of $HgCl_2$ (radioactive isotope $^{203}Hg$). Samples were tested at the Geiger counter at staggered times. The period of this isotope is 46 days. However, the diminution of activity corresponding to the disintegration of this radioactive isotope was much stronger than anticipated.

Where did the mercury go? Since it disappeared, everyone believed that it had "evaporated." But here again, isn't this an unverified assertion, deduced from the sole fact that mercury "volatilized"?

Meanwhile, it became apparent during the experimentation that mercury does not "volatilize" regularly. For according to the law of diminution of radioactive activity, there should have been a regular curve, exponential and well-known. However, a counting made sixteen hours after the first verification showed clearly that there was a diminution of mercury, conforming to

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[1] "Volatilization of Mercury by Bacteria," *British Journal of Industrial Medicine*, October 1964, pp. 294–98.

the law of radioactivity. But after 32 hours there was an unexpected diminution of mercury. After 48 hours the difference took on great proportions.

The merit of these researchers was in thinking that the phenomenon could be produced by a microbian action, that the latent period (which lasted at least sixteen hours) could correspond to the incubation period of a bacterial colony. Cannot the effect of toluene be explained by the fact that it kills the bacteria? However, this hypothesis was *a priori* hazardous because it was believed that bacteria do not attack heavy metals, the latter resisting all actions of biological products.

Penicillin kills bacteria, and mercury disappearance follows the same law as does a sterilized solution in the autoclave.

There is 50% more mercury lost in 48 hours in a contaminated medium. This event is not imputable to the disintegration of the radioactive isotope.

If one takes a sterile sample and inoculates it with only $1.10 - {}^5$M of $HgCl_2$ which has already started to lose its mercury, one verifies that there is no latent period. The proliferation is immediate and in 24 hours 60% of the initial activity subsides, whereas a non-inoculated sample kept for later comparison loses only 2%.

The identification of the most active bacteria revealed a *Klebsiella aerogenes,* a bacterium of the *Proteus* type, an active microorganism which could not be identified, and a great number of other microorganisms carrying on little or no activity at all. In the city water used for the experiment was found the *Pseudomonas pyocyanea,* which is very active. A *Diplococcus* was also found, but it does not die from toluene; it only becomes partially inhibited.

Unfortunately, researchers considered nothing but the disappearance of mercury by volatilization. Nevertheless, they verified their theory. They declared the phenomenon to be a natural one, basing their hypothesis on the diminution of activity measured with the Geiger counter. Thus, haven't undisputed results received a weak interpretation, lacking essential analysis and measurement?

The researchers did not suspect that the disappearance was due to the biological transmutation of mercury. Evaporation is negligible *a priori;* mercury boils at 360° C and its vapor tension is very low (40 to 50° C). But the experiments were conducted at the ambient temperature of 20° C! This fact should have alerted the researchers and could have prevented them from adopting the postulate of evaporation.

This experiment leads us to qualify what we said about radioactive elements: it was not clear to us whether superior organisms (animal and vegetal) performed biological transmutations on radioactive elements. However, the behavior of bacteria is always full of surprises. Regarding the transmutation of iron into copper, I mentioned in a previous book[1] that some bacteria proliferate in pure sulfuric acid. I also cited some *Pseudomonas* which live in the heart of an atomic reactor in heavy water and receive more than 1,000 times the mortal dose for human tissue. The same is true with the *Micrococcus radiodurans* which resists 3,000 times the mortal dose for a mammal. During the experiment on mercury it was also found that there is a *Pseudomonas* species which "digests" radioactive mercury, making of it another element unidentified to this day. But what happened to the excess neutrons in the radioactive nucleus? Since there is a decrease in radioactivity, there should be no transmutation into another radioactive element. Might a "conversion" of neutrons into protons possibly have occurred? Only what remains at the end of the experiment will allow the pronouncing of a verdict.

The perturbations caused by $\Upsilon$ rays impede the reproduction of ADN. There is a progressive death of the cells. However, the speed of reproduction is generally considerable in a bacterium, which means that the bacterium's enzymatic activity is considerable. This explains how bacteria can resist an irradiation several thousand times greater than the dose that vegetal or animal matter can take.

Have we not here an open field where research concerning the elimination of radioactive wastes can be conducted? I indicated this as a hypothesis in 1960. Don't experiments of the type cited here seem perhaps to demonstrate that it is indeed happening? If this possibility were to be established, it would be a great event since we would then be able to study the destruction of the radioactive wastes which pose such a threat to humanity.

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[1] *Transmutation à Faible Energie* (2nd edit.), Maloine Pub., 1972, p. 179.

# XIX

# HOW TO MAKE EXPERIMENTS WITH BIOLOGICAL TRANSMUTATIONS SUCCESSFUL

In order to succeed in transmuting elements biologically it is necessary to abandon certain concepts of the so-called "exact" sciences, which are exact only for simple and isolated cases foreign to biology. As I have already stated, biology is too complex a science to be compared with these "exact" sciences. It is comprised of too many interdependent parameters to be completely accessible nowadays—even with the help of computers—by scientific methods based upon hypotheses which are solely mechanical. I must therefore reject the groundless assertion that all natural phenomena are reducible to the phenomena of calculations. Anyone subscribing to this idea will have an increasingly hard time proving his point as more and more of life is revealed to us.

In the following review of a few general principles it is important to beware of committing the opposite error by extrapolating certain transmutations and saying to oneself, "Since Nature can transform one element into another, it will be enough to have only one element at our disposal and Nature will take care of the rest!"

The transmutations are operations requiring a specific production of enzymes and a medium allowing the physiological development of cells (or microorganisms). One kind of plant will thus make a transmutation that another cannot make. Or else, a transmutation will be made in one direction in a growing plant, whereas it will be made in the opposite direction in a germinating seed of the same species. The same is true with animals: a reaction will take place in one direction under a certain set of conditions, and again in the opposite direction, with the same animal, when different interior and exterior conditions are met. On the other hand transmutation may take place in no direction at all, regardless of conditions, thereby requiring the animal to obtain a specific element from outside. Generalizations in biology reveal an ignorance of life's complexity.

A transmutation is not always absolute. For example, it is often impossible for a plant, seed, or animal cell to make the transmutation into a specific element if this element is not already present to serve as a catalyst. This principle should be kept in mind. Let us recall Jacob, Lwoff, and Monod, Nobel Prize winners who showed that for a gene to be active requires the "influence" of a certain element which "releases the brakes" and prevents the synthesis of the enzyme.

That is why it is usually vain to try to produce an element with biological transmutation if that element is not already present. In other words, what should be sought is the increase of an element (which always leads to the diminution of another), not its appearance from zero.

One should never start with absolutely pure products. The metabolic conditions of the animal or vegetal cell must be retained in order to verify an increase of the elements, a proof which will have no room for contention on the part of those chemists who are prone to reject everything new *a priori.*

## Generalities

### *Conditions for transmutation*

Many kinds of seeds have been germinated in my experiments: watercress, lettuce, parsley, etc. The leguminous plants most often used were fava beans, soya beans, etc. For practical reasons, however, lentils and vetch were most often elected. Their size is uniform and they are easy to calibrate and not too large, thus eliminating the possibility of irregular germination. Poor germination of one seed can cause an appreciable error in calculations.

Doubly-distilled water should not be used. Again, a chemical preparation designed to satisfy the rigorous conditions of "exact" sciences would lead to excessive simplification since, biology being complex, there is no life without several interactions. The term biochemistry itself means that the biological precedes the chemical.

In other words, I consider it an error in such experiments to use an absolutely pure culture medium in studying the variation of an element. One should proceed with a complex medium which is close to the natural medium but missing in the element to be studied. The results will then be quite different. In the former case there are too many deficiencies and poor metabolism; the transmutations are of 1 to 3% only. Thus arguments arise. In the second case the variations are always over 10% depending on the element, often 20 to 30% (sometimes ten times more) for plants, and 30 to 300% for some animals.

Nevertheless it is sometimes impossible to completely exclude a certain element at the start, so as to measure its exact production after the transmutation process. Experience shows that there are cases where, for certain cultures, some elements are indispensable at the start. Proliferation will fail to take place if the amount of these elements is too small.

## *Microorganisms*

That is why I am not in favor of the sterilization of seeds, soil, etc. I have heard that precise research can be made only on sterilized seeds in a sterilized liquid or solid medium. If the microorganisms are excluded, however, the results will be whimsical. This omission would be a confession that the activity of the microorganisms disturbs chemical research, that the purpose of the research is not really clear.

Studies have revealed that various enzymes (the permeases) allow biological membranes to receive certain molecules but not others. It seems that there are perennial permeases which are constantly being synthesized, while others are synthesized only in the presence of the molecule to which they must obtain entrance. Hence the results from a sterilized medium are totally different from those obtained in the presence of microorganisms.

If one wishes to germinate seeds in a vat, it is necessary that the plant grow in optimum conditions for vegetation; the earth must be alive, i.e. rich in microorganisms. This earth should be well mixed and homogenized. An aliquot portion should be set apart for use in measuring the element on which the balance sheet is to be established. At the end of the experiment the plant and soil must again be analyzed.

### *The water*

The water used should preferably be source water. It is inadvisable to use distilled or doubly-distilled water, for then the pH must be readjusted by the addition of a calcium salt to place it between 7.3 and 7.5.

The best by far is natural, chemically untreated water. I recommend Evian water which is quite good for research on phosphorus since it does not contain that element at all. In this case it is unnecessary to add a calcium salt. Evian water contains it naturally, making its pH favorable: $pH = 7.25$. Here is what an analysis of Evian water gave (limited to those ions that may interest us): $Ca^{++} = 0.07715$; $Mg^{++} = 0.2432$; $So_4^{--} = 0.0096$; $Na^+ = 0.00552$; $K^+ = 0.0089$; $Fe^{++} = 0.00001$; $NO_3^- = 0.00254$; no measurable trace of P or Mn; silica ($SiO_2$) $= 0.011$. The figures are all in grams per liter.

## Phosphorus variation

### *Preparation of seeds*

As I explained, it is preferable to use calibrated lentils or vetch. A small pack of 125 grams will do. One should be careful to purchase lentils from the last harvest. Some are too old and therefore too dry. In order to secure the success of the experiment one should verify in advance the germination power of the lentils by trying them (100 lentils in a Petri dish). 99% of the seeds should be perfectly germinated. Any kind of water can be used for this first try (faucet water, for example). The seeds should be hand-selected to eliminate those that have changed color or deteriorated in the slightest degree (for example, those whose color is too brown as compared to the green lentils). The lentils should be divided into lots, and for this there are two options:

> —Prepare lots of ten grams each, weighed to the centigram, and write down the weight of each lot which will be put in a crystallizing dish.
>
> —Or, do not weigh the lentils at all, and use 100 of them, for example. A lot of ten grams of lentils contains approximately 130 to 140 lentils. A lot of 100 lentils weighs approximately 7.5 grams; the average weight of one lentil is between 70 and 80 mg. It is 30 to 40 mg for vetch.

The advantage of counting the seeds is that there will be an identical number of young plants in each crystallizing dish, while with the other method there may be ± one seed. It is easier to maneuver with the counting method, since a defective seed, unnoticed during selection, can be replaced. For an experiment to determine P variation, after putting aside five lots of 100 seeds to serve as a control, place the rest of the seeds in a basin and cover them with Evian water.[1] They should be left there 24 hours. They should be rinsed in clean Evian water in order to remove all traces of dust, and because the 24 hour stay in the water causes a visible darkening of the defective seeds. (At this point the seeds have begun to rot and will not germinate well. They will contaminate the others, probably causing inaccurate results.) Plunging the seeds in Evian water does not provide them any phosphorus; hence there will be no repercussion in the analysis. Thus, one should take 100 seeds from each crystallizing dish and place them—side by side without touching—on a double layer of porous ashless paper (ten lots of 100 seeds = 75 grams).

### *The germination*

We should not forget that what is sought is the phosphorus variation. The ten crystallizing dishes containing the seeds receive a thin layer of Evian water which saturates the double-layered porous paper on which the seeds are placed. These receptacles are placed in a greenhouse or in a light room near the

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[1] This only works for research on P variation (because Evian water contains no phosphorus). The technique of washing with Evian water is not to be applied in research on Ca, Mg, and K.

window so that they may receive good light while maintaining a temperature of 22 to 25° C. The receptacles should be arranged in two rows of five each or in one line. It is most important to place them in such a way that they will receive a maximum of light. For every receptacle there should be a corked bottle full of Evian water (100 to 125 $cm^3$) with a tube through the cork; the tubes' extremities are placed in the center of each crystallizing dish, touching the porous paper. These bottles are placed upside-down so that the porous paper is kept constantly wetted with water. The humidity of the room must be maintained between 55 and 60%. There will be no need to fill up the bottles a second time.

After fifteen days there will already be appreciable results, but they will be variable from one experiment to another. In Germany, Hauschka published results obtained from several germinations of watercress. These germinations were made every fourteen days for a year. Hauschka started one lot at the new moon, another at the full moon, and so on. He gives diagrams of variations for $K_2O$ and $P_2O_5$, K and P varying in opposite directions with a 16% average, and both changing directions depending on the position of the moon. In watercress the phosphorus decreases if the germination starts the day of the full moon. Hauschka's diagrams[1] also indicate an influence of the solar cycle. Studies concerning cosmic influence are now being conducted in several countries.

## *Analysis*

The germination should be terminated two weeks after the beginning of the experiment (which was started at the full moon) by putting the crystallizing dishes in a drying stove at 60° C. They should be left there 48 hours, but if need be they can be left only 24 hours with the thermostat set at 90 or 100° C.

Right after cooling, grind the young plants in a mortar. Or, use the sulfo-nitric acid method.

This destruction can be done in different ways. In general, every laboratory chief has his own technique. Nevertheless, I would like to point out that the acid being used for the destruction acts on matter not yet incinerated which still contains some water.

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[1] *The Nature of Substance,* ed. Vincent Stuart (London 1966).

The pH of the acid will thus rise, and it will be necessary to supply more acid in order to maintain the pH at 4.8, an optimum level for the extraction of all phosphorus.

Notwithstanding, the method using sulfo-nitric acid is preferable ($100\ cm^3\ HNO_3 + 10\ cm^3\ H_2SO_4$). The mineralization is done as it is taught to laboratory assistants: heating, sudden discharge of nitrous vapors, cooling. The black and thick liquid thus obtained is slowly heated by adding 80 $cm^3$ of a mixture of 20 $cm^3$ of $H_2SO_4$ in 1,000 $cm^3$ of $HNO_3$ until discoloration. Add 25 $cm^3$ of doubly-distilled water and heat again until the nitrous vapors disappear. When it is cool, strain the liquid from which the aliquot parts will be taken for the dosage of the element.

The lots of seeds which were not germinated and which were being kept for eventual comparison go through the same process: desiccation at 100° C, grinding, destruction with sulfo-nitric acid, analysis, etc.

Analysis must be done on the sulfo-nitric mother solution (on an aliquot part 25 $cm^3$). The amount of phosphorus is determined by adding a sulfo-molybdic solution (classical method). The phosphorus content will show a very significant decrease, but further investigations are necessary because the process is not the same in all plants.

Hence, when oats are germinated in water very poor in limestone and absolutely free of phosphorus, there is a phosphorus increase in the germinated plants after six weeks.

One may conduct research on manganese and iron variation in a similar way. In fact, there will be an Mn decrease and a corresponding increase of Fe in the germinating seed. (Let us recall that there is one more proton in $^{56}_{26}Fe$ than in $^{55}_{25}Mn$.)

Some plants, such as rye-grass, make Mn, while others, such as oats, cannot. In some plants Mn decreases.

It seems to me preferable to conduct this specific experiment in an autonomous way, i.e. not using an aliquot part from the preceding experiment relative to phosphorus. In fact, the experiment can be made even more dramatic by adding to the Evian water (which does not contain any) 10 mg of $MnSo_4.7H_2O$ for 10 $cm^3$ of water (2 mg of Mn), which is approximately ten times more Mn than one lot of 10 g of seeds would contain. (This is true for plants which cannot make their own Mn.)

The experiment is conducted in the same manner as the preceding one, including the destruction with sulfo-nitric acid. Mn and Fe are then weighed by the usual methods.

Analysis will verify that there is much more Fe after germination, whereas Mn could have completely disappeared. This experiment indicates the power of the enzyme responsible for this transmutation of Mn into Fe.

## Research on Mg and Ca variation

Using the preceding methods one may study the variation of Mg and Ca in germination. If Evian water is used, it is necessary to measure the quantity of water used and its Mg and Ca content.

A precaution should be taken, though: when the seeds are soaked in water one day before the germination (to eliminate the deteriorated seeds) distilled or doubly-distilled water should be used. Evian water would make it impossible to determine the quantity of Mg and Ca absorbed by the seeds.

The analysis of Mg and Ca requires some precautions. In fact there are interferences of their ions which are divalent, and there is a risk of possible substitution in many reactions.

Specialists in analysis are well aware of this and know which method to use when these two elements are simultaneously present. Here are some figures concerning the content of these elements in fresh seeds: 60 to 140 mg of Ca in leguminous plants, for 100 g of seeds; 80 to 200 mg of Mg, depending on the species, variety, and soil. The different research conducted on Mg variation during germination has shown a 9 to 16% decrease.

## Complementary research

### *Potassium variations*

Many experiments with microorganisms have shown an increase in potassium when N and Mg are provided. This indicates the reaction ${}_{7}N + {}_{12}Mg :={}_{19}K$.

With the bacteria of saltpeter there is an increase of K and a decrease of Ca. This is the reaction ${}_{20}Ca - {}_{1}H :=: {}_{19}K$.

It is possible to note the K variation in germinating seeds:

1) Lots of 20 g of watercress seeds are analyzed to make a dosage of K. Other lots, germinated in distilled water without the addition of salt, render 0.505 g of $K_2SO_4$ per lot.

If magnesium nitrate is added to the distilled water, there will be 0.570 g of $K_2SO_4$ (an average for three lots) which means 0.065 g more than with pure water, or 11.4% more due to the simultaneous presence of N and Mg.

The variations of K are complex, for they can produce Ca and vice versa. They may also come from Na (${}_{11}Na + {}_{8}O :=: {}_{19}K$).

The K increase will be quite pronounced if the germinating process is begun during the full moon and terminated at the new moon. The result will be the opposite of the P variation (experiment conducted by Hauschka[1]). The variation is greater for most seeds at the end of autumn.

**Note:** Studies on potassium are delicate because there could possibly be an exchange between the potassium contained in the glass and the solution in the receptacle. An exchange is also possible during manipulation, heating, or when the solution contains an ion monovalent like ammonium. In other cases (for receptacles made of Pyrex, quartz, plastic, or metal) the exchange is negligible, but it is safer to make a preliminary experiment since some plastics give a potassium salt in the polymerization, and this salt is never totally eliminated.

2) The link between Ca and K can be verified in the following: in lots of watercress seeds (20 g each) 0.18925 g of $CaSO_4$ was found. The germination was done in distilled water in which 0.200 g of $K_2CO_3$ was added to each lot. After the germination there was 0.22175 g of $CaSO_4$.

Ca increase: 0.0325 g, i.e. 11.88% more Ca (average on four experiments).

Conversely, if a calcium salt is added to the water, K increases. In distilled water, with no salt added, 0.505 g of $K_2SO_4$ was found for every lot of 20 g. When calcium nitrate was added the average increase was 0.0725 g, i.e. 14.37%.

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[1] *The Nature of Substance.*

# XX

# AGRICULTURE

Classical agriculture (by this I mean the science that is taught in schools) is a huge imposture which is frightening in its cynicism. It recommends the use of complete fertilizers, the word "complete" being identified with N, P and K, as if these three elements were the only ones to be found in plants. Its basic postulate is to restore in quality and quantity the soil's elements taken from it by the yearly harvest. One may say that this agriculture has enclosed itself in a dilemma:

a) If the law of restitution is to be satisfied (whereby one implicitly recognizes that elements other than N, P, and K are taken away at harvest), the plant would have to find these other elements in the soil in limitless amounts.

b) Or, plants themselves must make these elements found at harvest and not provided for the soil. Implicit in this alternative is a transmutation of elements through a biological channel.

Otherwise, what kind of explanation can be given for the continual removal of sulfur from the harvest, for example? Let us take a crop of oats and circumscribe our study to a yield of 4000 kg per hectare (1 hectare = 2.471 acres). In the grain alone (without taking into account what is in the straw) there are 8 kg of sulfur per hectare. Where does this sulfur come from in impermeable and clayey soils, as in the case of oats?

It is not a question of migration, for from where would sulfur migrate? The same question can be posed regarding other elements. With zinc, for example, we find 120 g for 4000 kg per hectare of oats. There are also 160 g of manganese per hectare.

After a few centuries of cultivation this adds up to many kilos.

Not all these elements, however, exist in the soil in such quantities. Plants find what they need, depending, of course, on the plant and on the soil. One should not generalize. It must be established whether or not the soil contains elements that the plant will utilize to fix other elements not found in the soil, which are necessary to its growth. This being established, all conditions must allow the transmutations to take place. The latter usually occur in the presence of microorganisms for which the rhizome must provide the conditions for a vigorous proliferation. Thus we must have the synthesis of a biological agriculture which is far-removed from classical agriculture, concerned only with providing N, P, and K.

## Application of biological transmutations

Biological transmutation explains the basic process of biological agriculture, whatever the specific method. The biodynamic method, as well as other methods involving active processes, uses decoctions (fermented solutions of some plants very rich in various oligo-elements) to balance the acidity of the soil. The oligo-elements are indispensable to the enzymes; the enzymes (whose work is somehow activated by the activity of certain vegetals and even mammals) are in turn responsible for the biological transmutations.

The activation of this enzymatic action by the plants also explains the increasing success of phytotherapy and aromatherapy.

The attempt to provide plants with even a small amount of elements saturates them with these elements and creates an imbalance in them and in the soil. There arises a deficiency in other elements, and certain natural reactions are impeded. Everything becomes fragile, the soil's health deteriorates, and the reactions of the vegetal organism cease, making it susceptible to parasitic invasion—hence the necessity for the use of pesticides. Biological agriculture, on the other hand, considers which elements should be brought to the plant to be transformed into those elements found in the final stage of metabolism. The agriculture of the 19th and 20th centuries is dying, whereas biological agriculture is now taking hold.

May the reader take heed against the so-called "verifications" made by past professionals of agronomy. These findings are often illusory.[1] Analyses have shown discrepancies of 30 to 300% in all that has been published—even by official document.

It is quite sad that such data could possibly have been published, for they manifest clearly the incompetence of many laboratories. The figures are too exaggeratedly different and contradictory to be taken seriously. I shall not expatiate further upon this unfortunate example which betrays the low level at which some research workers are operating. However, I shall return to these errors later.

Let us take care of the work ahead of us and be unperturbed by skepticism. We are meeting with opposition that is increasingly animated, yet one only reacts against that which has become a threat. As a friend wrote me, "The vigor which you are meeting is beneficial. The weight and worth of the antithesis reveals the certainty of the thesis."

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Agronomists have always recognized that virgin soil, never before cultivated, will provide a good harvest without the aid of manure or fertilizer. Little by little, however, deficiencies arise because some specific elements are found missing after the harvest.

These agronomists have noticed furthermore that allowing the earth to rest (lie fallow) for a few years restores its lost elements. They solved the problem by establishing a rotation cycle in which a fallow period is planned. Leguminous plants such as clover and lucern-grass are sown and they "fix" the nitrogen, thus shortening the necessary length of the fallow period.

Agronomists explain this phenomenon by saying that the missing elements are brought by dust, by animals, by migrations through the soil, etc. These are simplistic explanations, neither followed up nor confirmed by any sort of experiment. To say that

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[1] See French Academy of Agriculture Bulletin, 1970.

these "ghost" elements come from a progressive solubleness of the insoluble composites of the soil is another simplistic assertion. In order to discard objections of this sort I have presented data concerning the soluble and insoluble. The traditional notion of solubility is far too arbitrary: an insoluble composite may be dissolved by the secretion of radicles, by microorganisms, etc. It is a mistake to separate the soluble from the insoluble in the laboratory. The acid arbitrarily chosen to dissolve the mineral compounds of the soil has nothing in common with the multiple and specific acid secretions of the radicles, nor does it have anything in common with the microorganisms of the soil which dissolve these elements insoluble in water but soluble in acids.

Around 1600 a Flemish chemist, Jean-Baptiste Helmont, planted a tree in a pot containing 200 lbs. of earth. After five years the tree had gained 164 pounds. The earth had also gained weight, but only two ounces. Helmont had not supplied any mineral elements, taking care only to water the plant. He hoped to prove that water had become solid matter.

This summary experiment teaches us little, but it is a case where the origin of matter stimulated research.

In the mid 19th century in Nantes, Grandeau demonstrated that a field which rests a few years tends to regain its balance. If the soil is too acidic or too basic, it eventually becomes neutral.

Garola confirmed this observation at the end of the 19th century. In Germany Rudolph Steiner started experiments of this nature and in 1925 founded a "school of balanced agriculture" in Switzerland. The Swiss Pfeiffer took over. His books were published in French. The one most relevant to our concern is *Fécondité de la Terre,*[1] and here are a few examples of his observations:

### *Lawn and daisies*

In order to produce a beautiful English lawn it is necessary to have earth containing limestone. Whenever limestone is missing, daisies spring up in the lawn. For a gardener that is the signal to correct the soil. The less limestone there is, the more daisies. Pfeiffer analyzed the ashes of the daisies and verified that they were rich in lime. Since the daisies grew precisely when there

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[1] Edit. Les Triades, Paris 1949 (réédit. 1966).

was no more lime in the soil, Pfeiffer asked himself, "Where did this lime come from?" He could not find the answer.

One could not say, of course, that lime came from migration, for in that case the grass itself would have had some too.

For Pfeiffer this provided an example of the soil's natural tendency to find balance. When lime is missing, plants poor in silica grow and their ashes are rich in lime. Hence when stems and leaves fall in autumn, the soil gains the missing lime. These examples of interactions are frequent in nature. However, a mystery persisted: what was the source of the lime in the daisies?

### *Various observations*

Pfeiffer's work raises other questions. Buckwheat has a marked affinity for sand; silica is very rich in calcium. Let us examine why.

Wheat likes soil relatively rich in lime. The incineration of its straw gave, for a specific field, a weight of ashes which was 6% of the original dry weight of the straw. In these ashes there was 5.8% lime and 67.5% silica. On the other hand, if clover mixed with the same wheat is sown in the same field, the clover—which grows better in siliceous soil—gives 35.2% lime and 2.4% silica in its ashes.

The amount of silicon and calcium in most plants is independent of the amount present in the soil. The plants' composition is constant, depending on the species (at least roughly constant, for the quality may vary with the soil). Cultivated digitalis (fox glove) may not contain digitalis; parsley may not have vitamin D, etc.

The oak, a tree indigenous to granitic or slaty regions (i.e. soil rich in silica) where limestone is sometimes completely absent, may contain limestone, largely in its wood and bark. (Up to 60% lime has been found in its ashes.)

The engineer Simoneton reproduced the following already known experiment: [1]

Slips of geranium grow quite well in a sand of pure silica; they are watered with rain water or distilled water, with no organic element added and with no other mineral but silica. An analysis of these plants shows, however, that they produce lime in addi-

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[1] Research by Lakhovsky, "La Matière" and "Le secret de la vie."

tion to other elements. Fresh sand containing bacteria is used, not sterilized sand. This sand, called "pure," contains, besides silica, traces of seven elements (representing 0.17%) of which 0.15% are iron oxides, titanium, calcium and aluminum.

To conclude this part of the chapter let us cite one of the numerous experiments made on the English experimental farm of Rothamsted by Lauwes and Gilbert, two great scientists of the second half of the 19th century.

A commercial garden produced a culture exclusively of clover for 17 years. It was mowed two or three times a year and was sown with seed every four years without the use of fertilizer. Regarding this experiment Lauwes and Gilbert write, "A singular fact was verified . . . this piece of land, devoid of fertilizer, gave cuttings so abundant that if one were to add what had been taken away over 17 years, one would arrive at these figures: 2636 kilos of lime, approximately 1255 kilos of magnesia, over 2150 kilos of potash, approximately 1255 kilos of phosphoric acid, and 2636 kilos of nitrogen."

Figures from a study[1] made in France in 1955 indicate that the plants took 1,500,000 tons of potash per year. 300,000 tons were provided by manure and 450,000 by potassic fertilizer. Hence the fields were given only half of what was taken away from them.

The soil does not contain such reserves of potash. How then could 750,000 tons be taken every year?

The reader understands better, now, that plants have two ways of producing potassium: from sodium, by the reaction sodium + oxygen = potassium, and from calcium, by the reaction calcium − hydrogen = potassium.

I would like to recommend the research recently conducted in Ohio by J. Benton Jones, an account of which appeared in *Science* magazine (4/2/65, p. 94). An experiment of this sort opens a new channel for research. But here again we find verification of a phenomenon without any explanation.

The oligo-elements are indispensable. They enter into the structure of the coenzymes. If there is no metal in the coenzyme, the enzyme remains ineffective. With these important oligo-elements molybdenum (Mo) is found. Mr. Jones discovered a deficiency of potassium in leaves of hybrid corn and at the same time verified that the leaves were too rich in molybdenum.

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[1] Reinberg, *Le Potassium et la Vie*, P.U.F., Paris 1955.

| Plants deficient in potassium | | Normal plants | |
|---|---|---|---|
| Potassium (%) | Molybdenum (parts/million) | Potassium | Mo (ppm) |
| 0.97 | 2.0 | 2.70 | 0.5 |
| 0.56 | 4.0 | 2.49 | 0.9 |
| 0.52 | 2.8 | 1.73 | 0.7 |

One can see that under a certain level of K there is an Mo decrease.

After that, Mr. Jones made a systematic study by changing the doses of potassium given to the soil. Here are the results which I shall give in kilograms per hectare (1 hectare = 2.471 acres). (See Fig. 12)

| Potassium given to the soil | Degree of deficiency in K | Composition of the leaves | |
|---|---|---|---|
| | | (K %) | Mo (ppm) |
| 0 | severe | 0.57 | 4 |
| 36 | light | 1.79 | 1.2 |
| 72 | null | 2.28 | 0.9 |
| 108 | null | 2.49 | 0.9 |

The amount of molybdenum does not change when there is adequate potassium. The diagram shows the simultaneous variations of potassium, calcium, magnesium, and molybdenum. Although the author makes no comment, the reader will rapidly make the comparison. Calcium diminishes, but potassium increases. Let us note that the calcium and magnesium are almost parallel. This can be explained: the plant needs calcium to make the magnesium of its chlorophyll, and the more calcium is given, the more the plant enriches itself in magnesium (up to a detrimental limit, of course). Conversely, if there is not enough calcium, there will not be enough magnesium. It should be noted that even without any potassium being provided, it will be found in the leaves, but four times less than if it had been given abundantly.

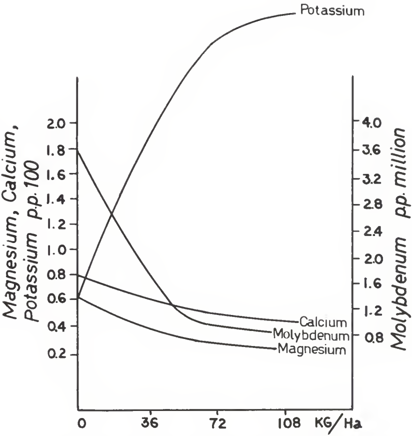

*Fig. 12 Variations of K, Ca, Mg and Mo in corn leaves, depending on the K input in the soil (according to Benton Jones).*

This experiment leads us to a general statement: the origin of the molybdenum cannot be detected. But an interesting conclusion to which this experiment brings us is that a plant rich in potassium will be poor in molybdenum (one of the most important oligo-elements).

Agronomists should then know that an excess of potash, even if it is supplied by manure, leads to a deficit in molybdenum.

It is well known that a fruit sickness called "bitter pit" in the U.S.A. results from an overly rich supplement of K in comparison with Ca. Tomatoes have a Ca deficiency if too much K is present.

One may compensate with Mg which, becoming Ca, will reestablish K/Ca.

If potassic fertilizers are exhausted some day it would not be so catastrophic for the agronomists who use them. They may be obtained either industrially or directly from the soil in at least two ways. Yeasts and microscopic seaweeds can produce potassium from sodium; other microorganisms can produce it from calcium.

Already a few companies are producing microorganisms to be utilized in agriculture. Yeasts of all kinds are made industrially, molds (penicillin, etc.) as well.

The problems of deficiency in animals and vegetals require closer study. Cattle breeders and agronomists will be forced to recognize the phenomenon of biological transmutations, a phenomenon which, although everyone has already observed and used it, is not understood—thus its application has been limited.

This is the prediction of the leaders of all the associations which advise and apply the biological culture in France, Italy, Switzerland, Germany, England, etc. These leaders are the elite of the agricultural world. They have observed that chemistry does not explain all of biology, that too much confidence in chemistry, where biology is concerned, is an error responsible for much damage.

Excess in any domain is inevitably paid for one day or another. We are often advised to use 250 kilos per ha (100 kilos per acre) of potassic fertilizers at 50% $K_2O$, or 625 kg/ha of sylvinite at 18% $K_2$), although cereals on the average do not take away more than 40 kilos per ha of $K_2O$ per year. Thus ¾ of the $K_2O$ is lost.

How much land is lost in America! In the west of Europe the harm is less visible for the time being, for the common sense of the peasant has helped to postpone the reckoning.

The development of parasites is also a consequence of biological imbalance. Thus agronomists have had to consult their colleagues who understand the necessity for developing biological culture.

The mechanism of these biological transmutations teaches us what to give the soil, according to the following conditions: that the soil be alive, that it be rich in microorganisms, and that the proliferation of the latter be possible. If the soil is too much damaged by chemical abuse, one must reconstitute it. This can take time, especially if there is no humus (an essential part of living soil).

## A simple experiment: the formation of calcium in the germination of cereals

Here is a simple and convincing way to demonstrate the validity of biological transmutation. For practicality I have chosen to give a simple and essential experiment with germinating seeds. (Experiments on man and animals are very complex.) The experiments involving microorganisms give rise to problems which can be handled only with great skill.

Many kinds of seeds have been used and the variation of different elements has been studied. Nevertheless, for the sake of illustration it would be better to limit ourselves to an experiment in which the variations are quite great. Here is our example: let cereals germinate in a medium without calcium and witness the increase of calcium after germination.

The author conducted this experiment using wheat and oat seeds from a biological culture. One hundred hand-selected homogeneous seeds were incinerated in order to determine their calcium weight. (The figure obtained was compared to the average weight found in different seeds, from dozens of analyses of thousands of seeds. This was done in order to insure that no grave error had been committed during the manipulation or analysis of this 100 seed lot.)

One hundred identical seeds were germinated in vats, on porous ashless paper saturated with a fertilizing solution of salts dissolved in water. The solution was free of calcium. After six weeks the vegetation was arrested by placing the young plants in an electric oven. The plants were then incinerated and analyzed in the same manner as that used with the first lot of seeds.

More than twenty such experiments were performed, essentially on oats, by changing the moment when the sprouting was begun, extending or shortening the time of culturation, or using different varieties of seeds. Here are the results obtained. The values are given in milligrams per unit (for every seed or for every plant). For lots of one hundred seeds, these numbers must obviously be multiplied by 100. One may operate on lots involving many hundreds of seeds.

| | Wheat | Oats | Oats |
|---|---|---|---|
| | "Roux clair" | "Noire du Prieuré" | "Panache de Roye" |
| Weight | 32.98 | 37.96 | 24.48 |
| Calcium (in one seed) | 0.0386 | 0.0372 | 0.0235 |
| Calcium (in one plant) | 0.129 | 0.155 | 0.106 |

There is 3.34 times more calcium in the wheat; 4.16 and 4.51 times more calcium in the oats.

Augmentation of this kind cannot be the result of errors in computation of results. Nevertheless, the chemical analysis was confirmed by a modern and specific physical method of great sensitivity: analysis by spectrophotometry of atomic absorption. The converging results were communicated to the Head of Agriculture of France on the 1st of December, 1971, by the chemist-engineer Z. E. Zündel.

### *Commentary*

These numerical values ask for some remarks. In biology one should never generalize. These experiments have shown us that calcium increases in great proportions in some plants. Every plant reacts differently (or, rather, every species of plant). That is why the increase is greater for oats, whereas in some plants—rye-grass, for example—the calcium does not increase. Hence we learn a lesson: plants able to make their own calcium can grow very well in clayey and siliceous soil, whereas others cannot make their own calcium and must be given it. (The variations of Mg and K in oats were also studied.)

Other observations of ours have proved interesting to many scientists. For instance, the effect of the moon is very important for the formation of calcium. In the previously mentioned experiment, the germination operation was begun at the new moon and terminated at the second full moon, which followed in approximately six weeks.

I can give only an outline of this relatively simple research on the germination of seeds. However, I remain at the disposal of all those who can afford to reproduce such an experiment, to whom I can give all the useful details. If they do not have the material means for the analysis, they may entrust the analysis of their seeds and plants to a laboratory equipped for such research.

The importance of such an experiment in terms of its application is in knowing whether the calcium increase occurs during the germination only, or whether the whole plant becomes richer in calcium (to the detriment of another element which is transformed into calcium—here, potassium). In the latter case the soil's composition would be modified by the stubble remaining in place after harvest. There is here a very interesting study to be made by a laboratory of biological agriculture.

I have reported the qualifying observations made by Pfeiffer on different plants (e.g. the daisies in the grass) which enrich the soil with limestone. Another example, very well known by horticulturists, is the case of azaleas. A culture of these plants was made in a soil of heath, an acid soil devoid of limestone. The soil analysis showed that it became too rich in limestone and the cultivation could be continued only by removing a layer of soil and replacing it with the soil of heath, or by cultivating plants which cannot make calcium. This example is another illustration revealing a substitution of calcium with another simple body, which would have to be determined in the case of every cultivation.

The whole secret of biological culture is yet to be discovered with the study of substitution. This phenomenon cannot be studied by reason alone; it must include concrete experimentation.

The present form of agriculture, to which our biological agriculture is opposed, leads to the ruin of soil and heath and will eventually bring about the death of humanity. Already man is poisoned by all sorts of pesticides or by mineral excess. Phosphates, while favoring the proliferation of some plants which invade the waters, simultaneously deprive the water of oxygen and, little by little, make all life—animal and vegetal—impossible.

Let us then heed the advice of the specialists of agro-biology in order to insure the good health of the vegetal kingdom and of man.

# XXI

# NUTRITION

It is universally known that one of the chief concerns of the times is the problem of nutrition. Vitamin pills have great success among those who are not sure that they are getting the proper diet. The source of protein is a mystery quickly solved by the nutritionist who gives his impatient patient as much protein as he fears he needs.

Theories about nutrition are based upon the old academic chemistry which declares that nothing is lost and nothing created; everything is transformed. Therefore, to be safe, extras of everything are given—plus always a little something in case of a leakage. Thus a chemical accountancy is forced upon modern man whose mind is centered on the capitalization of matter. Health is synonymous with capital. Proteins, minerals and vitamins are caused to be retained internally in any way possible. If the iron's desire is to leave the body, one employs a fixative so that it will remain there long enough to provide energy for meeting the day's activities. In such a way chemistry has sold its soul to the merchants, the muses of the research workers; these workers are told what to produce in accord with the needs of the times.

Medical doctors often do not know the contents of the drugs they prescribe. Merchants provide them with brief pamphlets which are too seldom read. More time is spent in the politics of big business than in curing the patient.

It is hoped that biological transmutation, which is intended for everyone's understanding, will awaken man from his lethargy. There is no need to surrender oneself to strangers who aim to manipulate consumption during the next decade. This new science with its clarity of exposition, its thousands of proofs, and its chief witness—the order of the world—will guide man in such a way that he will be able to choose his food himself, according to his own needs.

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The findings concerning calcification alone should suffice to convince anyone concerned with proper nourishment, about the significance of biological transmutation. It does not help in any way to take into account the mineral calcium found in the food, for our organism rejects the majority of this calcium and fixes the rest of it but imperfectly. (When it is hot, especially, one rejects more of this element than one ingests.)

The phenomenon of transmutation, unobserved by dietitians, proves the caloric balance sheets based solely on the chemical reactions of carbon oxidation to be inadequate. The research done with the calorimeter will not prove satisfactory since some elements, due to enzymes and various physiological conditions, can be transmuted with absorption or emission of energy. This is enough to show how incompatible are the complex determinations of the energetic balance sheets, setting forth the simplistic view accepted to this day by almost everyone.

We have seen the impossibility of relying completely on chemistry. Several medical doctors understand that a diet rich in calcium does not necessarily strengthen the bones. Decalcification is sometimes caused by a deficiency of the enzyme which transmutes sodium into magnesium. If, however, it is due to a deficiency of the enzyme which transmutes Mg into Ca, it is advisable to strengthen the bones with potassium and organic silica.

When calcium is being used by plants, this element, with the help of other enzymes, may produce potassium and magnesium (as do the bacteria of saltpeter).

Decalcification may then occur when salt-free diets are prescribed, especially chloride-free diets.

Silica seems to be a superior element for the strengthening of

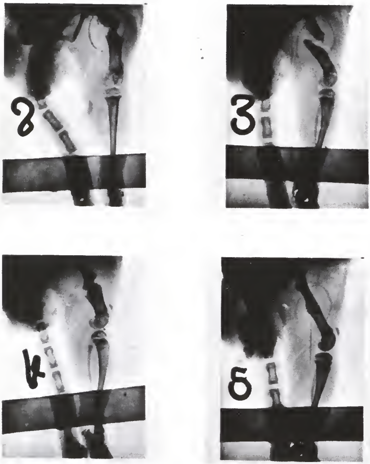

*Fig. 13 Action of vegetal silica in recalcification. Broken femurs of rats—10th day.*

*Photos 2 and 3: controls receiving a diet normal in calcium. (One can see that the repair has just begun.)*

*Photos 4 and 5: rats receiving a supplement of vegetal silica. (The soldering is neat and the callus is forming.)*

the bones. One must still refrain from excessive intake, as with any kind of food, but the tolerance is great. That is why it can possibly be used without medical control. The excess is eliminated by the urine, thus horsetail is a diuretic for many people.

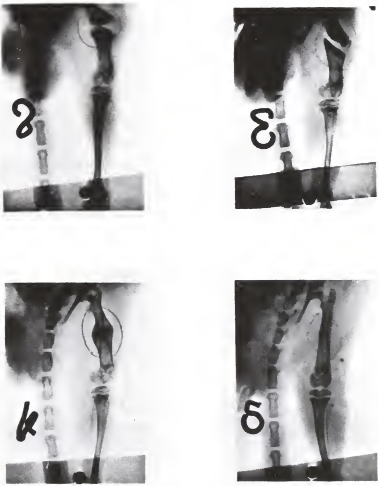

*Fig. 14 Action of vegetal silica in recalcification. Broken femurs of of rats—condition on 17th day.*

*Photos 2 and 3: slow progress in controls (diet with normal amount of Ca). Very little change in 7 days.*

*Photos 4 and 5: rats receiving a supplement of vegetal silica. Almost complete soldering. The callus shows from its opacity that the limestone density is greater than in the remaining part of the bone, which is transparent (4).*

The action of horsetail is rapid: nails which break easily, an early sign of decalcification, become normal within two weeks with a horsetail extract; horsetail decoctions take a while longer.

Spectacular results have been obtained with fractured bones. An experiment was made in a specialized nutritional laboratory where young rats were subjected to a controlled diet.[1]

These rats were divided into two lots of three each. One of the lots received a normal diet which included a fairly generous amount of calcium. The other lot had an extract of horsetail added to its food. X-rays of all the rats were taken ten days after their bones were broken. It was clear that the ingestion of vegetal silica had already healed the bones. An X-ray taken on the 17th day showed that the cure was complete, whereas with calcium alone, X-rays taken on the 17th day showed that the bones were not yet healed.

On the other hand, Professor Delbet demonstrated many times to the Academy of Medicine that it is beneficial to increase the usual allowances of magnesium. The cases of decalcification, much more frequent nowadays, are due in part to our "industrial" modern diet which is deficient in magnesium. White bread and white salt are preferred for business and aesthetic reasons, to the detriment of our health.

It would be beneficial if a systematic study were made, under medical control, in nurseries, kindergartens and high schools. There is much to be learned from the conclusions that would be made concerning the food that is provided there.

Statistics taken from January 1957 to November 1963 in Copenhagen showed that 80 children, from three to four months old, died suddenly. Although they had been given milk, their deaths were caused by a lack of calcium. Accidents of the same type were observed in a hospital in Paris. A post-mortem study showed that these sudden deaths, occurring in the cradle without warning, were caused by a spasm of the glottis which turned upside-down and obstructed the trachea.

Many hospital dietitians and even pediatricians do not yet know that these spasms, which are caused by a lack of calcium in the contractile cells of the blood, cannot be fought with calcium. Only magnesium can cure these spasms; the same applies to rickets. It seems that these unfortunate children had a defi-

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[1] *Transmutation à Faible Energie* (2nd edit.), Maloine Pub., 1972, p. 100.

ciency of an enzymatic order; therefore, they had difficulty in transmuting sodium into magnesium. They should have been given more magnesium directly. Of course, one should be careful to give a supplement of magnesium to patients subjected to salt-free diets, to avoid decalcification.

Cereals and whole flours are richer in magnesium than meat products. We do not advise taking magnesium in the form of sulfate, this salt being purgative and irritating to the mucous membrane of the intestines.

When animals travel by truck or rail it is advisable to triple their intake of magnesium a few weeks before the trip, in order to strengthen their skeletons. This will permit them to travel without the risk of a fracture, especially the pig and calf which, due to modern methods, have "grown too fast."

More could be written about dietetics in the light of the biological transmutations. It is expedient to expose the problem of decalcification since that is the most classical among the problems of nutrition. The reader will have to go back to previous chapters if he wants to understand more about the subject, succinctly treated here. In order to understand the problem of decalcification he will have to study closely all of the chapters in which calcium is involved. Once again, this book is intended only as a catalyst; its goal is to arouse in the reader—and hopefully in the minds of scientists—enough curiosity so that they will pursue the subject on their own.

I shall end this chapter with a story which illustrates in the most dramatic and clear manner the problem of nutrition.

A doctor advised a pregnant woman to take iron when he discovered that she was deficient in this element. But because iron cannot be fixed in the body he also advised her to take with the iron something to fix it in the intestines. The woman, who did not believe in taking too many pills, was somewhat shaken by the "news" that she was lacking iron. She went home and told her husband, who was well-acquainted with the phenomenon of biological transmutation. The husband reassured her that everything was all right, but that she would simply have to take more cereals and chew them more thoroughly in order to assimilate the manganese well and activate her metabolism. The husband then advised her to make her next appointment with the doctor in the afternoon instead of in the morning. A month later she went to the doctor, who declared that she had done well to follow his advice for there was plenty of iron now!

What happened was this: cereals (especially whole wheat, brown rice, etc.) are rich in manganese. But we know that manganese changes into iron ($Fe_{56} - H_1 \rightarrow Mn_{55}$). The pregnant woman had a slow metabolism, so her husband advised her to see the doctor in the afternoon; by that time the manganese had changed into iron. A woman with a more active metabolism has plenty of iron within a few hours after breakfast.

Iron content varies with every individual and must not be administered mechanically. The biological transmutations promote the serenity of the physiological man as compared to the paranoia of the world of the "quick" pill.

# XXII

# MEDICINE

A time will come when the biological transmutations will be fully instituted and practiced in medicine. The health that modern man has is temporary, lasting just for the time it takes for the last pill to wear off. When a symptom of a sickness begins to appear one shuts it in mechanically with whatever new pill is on the market. If one unit is not enough, one takes two, etc.—for months, or even for life. Rather than seeking quality, one turns to quantity. Quantity overwhelms the sickness and baffles it for a while, but like a balloon pressed against the water, the sickness springs out stronger than ever in another place. In medicine, as it is practised by many doctors, there is no intelligence involved. Everything is arranged so that nothing will be lost. When something disappears, everyone is worried and hurries to replace it immediately—and, to insure the success of this mechanical operation, a supplement is administered. From a comprehensive physiological understanding man has shifted to the purely mechanical. The body is but a factory without a foreman where all the machines run wild. A man is hired to put things together. But the task is so difficult that he gives up the job and another is hired.

The "replacement" of an element is a primitive approach, born out of defects in understanding. This mechanical attitude makes man a frightened being who is out of place in this world. This pattern of thinking and practice impedes progress and, worse, leads man to the loss of his mental faculties. With the proper understanding he could evolve and become the man he is meant to be, not a compulsively busy one, wasting his time patching up his sorrows and pains.

The phenomenon of biological transmutations brings man back to life and reality. By studying and making use of them man will recover the health he lost a long time ago. Health means not only to be able to do one's work with a certain required strength, but to be a clear thinker who can spend time learning about the wonders of this world. To be healthy is to be able to grow and perceive; it is also the ability to learn from others with humility. An artificially induced physical health is temporary. True and complete health must encompass the mind as well as the body; it implies happiness and understanding. The application of the biological transmutations can be a guide for the safe conduct of man.

## Calcium is not always the answer

The problems of decalcification and the strengthening of the bones must be investigated all over again. We have seen how fractured bones can be healed rapidly by means of organic silica (see chapter entitled "Production of Calcium From Silicon"). We have learned how horsetail, which is quite poor in calcium, can help heal fractured bones. Spring horsetail, as compared to summer horsetail, is rich in organic silica—not in mineral silica which is, on the contrary, decalcifying.

Fresh green vegetables (young plants), radishes, etc., contain a large amount of silica. We now know it is due to the ingestion of fresh grass that milk-cows can excrete more calcium than they ingest, without decalcifying. The pregnant woman who breastfeeds her baby may correct her diet by adding a small amount of horsetail to her food in order to avoid decalcification. This is now recognized without dispute and is being applied commercially in France.

Many articles include names of authors [1] who have referred to my work, citing spectacular results obtained in the attempt to strengthen the bones with organic silica. The chief surgeon of a hospital asked for my assistance when he found himself confronted by a delicate case: a young man with bones broken very badly in an accident. The classical treatment of Vitamin D plus

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[1] R. Haegel, "Calcifications et Transmutations Biologiques," *La Nouvelle Hygiène*, Paris, Sept. 1966.

a phospho-calcic salt failed to bring about any improvement. However, the administration of organic silica healed the bones rapidly. I could cite various other examples.

At that time Professor Delbet had already arrived at the understanding that it does not help much to ingest calcic phosphates. He wrote, "It is questionable whether calcium phosphate is formed in the bones," and, "we do not know how the calcic phosphates come to the skeleton," for calcium has never been found approaching the bone.

In 1962 a Canadian author, H. Selye, wrote a whole book about what he called "calciphylaxis," which he defines as "a diffuse hypersensitivity" in which "the tissues react . . . because of an intense and local calcification"—a purely dialectical explanation. Unfortunately, he concludes, "The nature of the local mechanism of calcification is one of the most important problems of biochemistry which has not been resolved." He had no knowledge of my work.

The question of calcification commands us to revise all our notions about dietetics, for it is useless to take into account the mineral limestone found in food. Our organism rejects most of this limestone and fixes the rest but poorly. In general, one rejects ingested calcium when it is hot. The mineral limestone comes in part from magnesium, when the latter is produced in excess.

## Charnot's research [1]

In the autopsy of a tuberculous patient, Charnot noticed a strengthening of the bones and a simultaneous anomaly in the percentage of magnesium, accompanied by a lack of silicon in the bones.

Magnesium and silicon are two of man's main sources of limestone. The verification of this fact served as the starting point for systematic research on tuberculous guinea pigs, establishing that tuberculosis is always accompanied by decalcification. Silicon disappears before calcium; that is an early sign of decalcification. But when organic silica is given, a rapid calcification of the caverns occurs.

[1] "Le Silicium dans l'Osteomalacie le Darmous et la Turbulculose," C.R. Acad. Med., Paris 1947.

When silica disappears, calcium leaves the bone. If organic silica is administered, the calcium returns. Whatever interpretations one may conceive, one fact is irrefutable: the two elements are linked.

Charnot also remarked that there is a link between potassium variation and decalcification. (See chapter entitled "Potassium-Calcium.") This fact inspired him to utilize the actions of silicon and potassium in the treatment of rheumatism.

To a patient whose rheumatism was so bad that it deformed her fingers and joints, Charnot gave bicarbonate of potassium with an extract of organic silica. An X-ray was taken before the treatment. After 6 days of treatment another X-ray was taken. It revealed a complete cure.

To another patient, suffering from a decalcification of the knees, he again gave organic silica, this time extracted from plants. The silica was given with bicarbonate of potassium. After a month of daily treatment the knee was healed.

To a woman who was badly decalcified he gave, for several consecutive days, an amount of calcium superior to the amount she was excreting; nevertheless, she excreted more silica than she ingested.

Though one can learn from this that potassium and silicon bring calcium to the bone, thus curing rheumatism without having to depend on the ingestion of calcium, he should be careful not to generalize. Excessively heavy doses of silica—especially the mineral ones—cause decalcification. Charnot's experiment is cited here as an example for the reader of how biological transmutation occurs in man's body.

The impracticability of an absolute reliance on chemistry has become clear to several doctors. For example, a diet rich in calcium does not necessarily strengthen the bones properly. This is the understanding of those concerned about promoting efficient diets. One of them, Dr. Plisnier (Belgium), made various observations which make sense in the light of biological transmutation. In his book *Save Your Health* he states a few observations which I can cite but incompletely:

a) A delayed dental growth in children receiving a diet normal in calcium (according to the old, classical dietetics which prescribes fruits, vegetables, milk, cheese, and meat) was corrected in a matter of a few weeks. The children were given instead a regimen excluding milk and cheese (which are considered great sources of assimilable calcium).

b) This same diet, poor in calcium, allowed the rapid repair of a fracture. The patient was a woman in her sixties who had broken her femur which, in spite of two operations and a diet rich in calcium, could not be healed.

In medical reviews, authors are universally recognizing the contradictions which present themselves—concerning sodium, potassium, magnesium, or, most of the time, calcium.

Let us not accept blindly the dictums taught us. We have been told that the practice of substitution is essential, that if calcium appears it is because it has been displaced—by magnesium, for example. This is a position taken for the sake of conformity, to satisfy the "non-creation" dogma. Those who affirm the substitution theory have never weighed the magnesium and calcium before and after the experiment.

Those who believe in the substitution theory say that the total $Mg + Ca$ is constant. This is an unfounded assertion, for the relative constance they have observed results from the fact that Mg decreases and Ca increases. The sum of $Mg + K + Ca$ is constant. But as far as some scientists are concerned, the element lost from an organ has gone to some other place!

I remind the reader of the experiments made in the Sahara Desert where for six months petroleum workers excreted an average of 320 mg more calcium every day than what they ingested, and this without decalcification!

All that has been written on the metabolism of calcium which does not take into account the biological transmutations must be studied all over again, as there are important facts medicine must begin to use.

## The thyroid and the metabolism of calcium

In the chapter entitled "Sodium and Potassium" I indicated that the transmutations of the latter seem to depend on the aldosterone. But in the chapter devoted to magnesium, I made no allusion to the endocrinal secretions on which the magnesium-calcium link may depend. In order to orient research which would help determine the enzyme capable of accomplishing the transmutations, it seems useful to cite a few findings:

The role of the thyroid in the regulation of mineral metabolism has been studied in vertebrates and especially in fish, by M. Fontaine (1954).[1]

The lowering of the water salinity of the outside medium stimulates the thyroidian formation of the fish, says M. Olivereau (1948), whereas the opposite, the elevation of the salt rate in the inside medium, makes the thyroid decrease its activity.[2]

Nigrelli (1952) believes that it is the variation of the Ca/Mg ratio in the water which influences the thyroidian activity of the fish.[3] This is also recognized by Professors Berg and Rasquin; Olivereau admits it also (1955). Etienne (1958) studied the actions of the K, Mg, and Ca ions on the thyroidian function of trouts.[4] There are many others, such as Koch (1942), who studied the influence of the thyroidian hormone on the osmotic regulation of the fish.[5]

Hence many individual discoveries have shown that the enzyme which regulates the relation between Mg and Ca seems to be secreted by the thyroid. The stimulating action would depend on Mg, which leads one to believe that Mg provokes an increased thyroidian activity.

This dependency of the Ca/Mg ratio on the activity of the thyroid is extremely variable according to the species of fish, all of which do not react in the same manner to a concentration of the Na, K, Mg, and Ca ions in the water. It seems that this dependency is apparent—in varying degrees—in all vertebrae; in the case of man, Leriche has verified links between calcic excess and hyperpara-thyroidism.

A fault in calcium metabolism thus seems to be linked to a modification of the thyroidian and para-thyroidian activity.

All endogenous formations of calcium seem to be connected with the thyroid and parathyroid. The action of K has also been studied: K increases thyroidian activity as does Mg; Ca does not.

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[1] Archives Soc. Physiologie, 7, C.55 to C.78 (Paris).

[2] C.R. Soc. Biologie, p. 124, 176 (Paris).

[3] Zoologica, 37, 185–189 (Paris).

[4] C.R. Soc. Biologie, 152, No. 2, p. 308–312 (Paris).

[5] Ann. Soc. Roy. Zool. Belge, 73, p. 164–172.

But calcium may also come from silica (and there could be a simultaneous action of Mg, K and Si, producing Ca) so that one must find a link between organic silica and the activity of the thyroid.

It has been established that people with tuberculosis suffer a decalcification. Dr. A. Charnot proceeded with an analysis of 29 organs or parts from both a healthy guinea pig and a tuberculous one so he could weigh the silica. Here are some results, given in grams for 100 grams of fresh organs:

| Organ | Healthy Guinea Pig | Tuberculous Guinea Pig |
|---|---|---|
| Lungs | 0.0059 | 0.0058 |
| Liver | 0.0053 | 0.0068 |
| Kidneys | 0.0046 | 0.0055 |
| Brain | 0.0093 | 0.0104 |
| Heart | 0.0072 | 0.0073 |
| Pancreas | 0.0061 | 0.0044 |
| Thyroid | 0.0234 | 0.0533 |
| Surrenal | 0.0418 | 0.0390 |
| Blood | 0.0452 | 0.0554 |
| Cerebellum | 0.0663 | 0.0686 |
| Teeth | 0.0505 | 0.0463 |
| Bone | 0.0491 | 0.0412 |
| Skin | 0.0657 | 0.0573 |
| Hair | 0.0899 | 0.0530 |

The silica rate is the same in the spleen as in the pancreas. Young guinea pigs have a thymus rich in silica.

One can see that in the teeth and bones the silica rate is high in the healthy guinea pigs but low in the tuberculous ones. This reduction of silicon precedes the reduction of calcium, as if it were the lack of silica which caused the lack of calcium. This is interesting because falling hair and nails is the early sign of decalcification.

One can see that the thyroid is relatively much richer in silica than the other organs. Here the tuberculous subject has a silica rate twice as high as that of the healthy subject.

This relative abundance of silica suggests that the thyroid plays an important role in the metabolism of calcium. I do not think that this observation has been made before. That is why it will be fruitful to compare all the research made concerning the role of the thyroid in the metabolism of Mg, K, Si, and Ca.

There are some other cases where the action of the thyroid could be associated with magnesium. I have already stated the variations of Mg in cancer, as cited by Delbet. If the thyroid is removed when the cancerous tumor is operated on, the reappearance of cancerous tissue is much more pronounced.

Would this not come from the fact that the regulation of the Mg metabolism together with that of K and Si is perturbed? Wouldn't this be an ideal ground for the cancerous proliferation?

## Heart failure

Groups of M.D.'s (some of them professors at the Faculty of Medicine) wishing to learn more about the basic problems of their discipline asked me to teach them the mechanism which had so far remained unexplained by biochemistry: the potassium increase in the blood despite a diet deficient in potassium. They had read my first books where I explained how the endogenous production of potassium was possible. This knowledge had opened for them new horizons in the explanation of the mechanism producing heart failure. (Death occurs when there is an exaggerated increase of potassium in the blood serum.)

It is known that the body cell (the nervous cell is no exception) is rich in potassium, although it lives in the midst of a nourishing liquid rich in sodium.

The potassium can go from the inside to the outside of the cell wall (called cellular body) and back again. In some cases the same is true with sodium—a normal balance is achieved by a much higher potassium content inside the cell. Because of this, there is outside the cell an intermediate potential between K and Na, leaning toward K. In the serum there is a potential leaning toward that of Na.

Let us recall that compared to that of the hydrogen electrode, the potential of sodium is negative: —2.175 volts. The potassium potential is even more negative: —2.924 volts; thus K behaves more negatively than Na which has 0.209 volts. One can imagine a battery where the positive pole is Na and the negative pole is K. (The reader will recall that the differences of potential to which the nervous fibers are sensitive consist only of some tens of millivolts. There is a degree of rest and a degree of excitation. Thus great mixings of K and Na are possible, since in a pure state there would be 209 millivolts difference.)

However, if one ends up with a ratio such that the difference between the potentials on each side of the nervous cell wall is too small, excitation is not possible. The nerves are blocked and heart failure results.

In the case of heart failure the potassium increase in the plasma can rise so high that the difference of potential from that of the inside of the nervous cell becomes insufficient and there is a blocking of the nervous influx. This, of course, is a simplified figuration, for the biological reality is always much more complex.

In order to prevent a dangerous increase of K in the blood, some doctors thought to maintain a severe regimen including a minimum of potassium. In spite of a significant deficiency of K in the food, the potassium level continued to rise, causing an eventual accident.

Confronted with such a failure, others thought that the dangerous K increase in the blood called for removal of this serum too rich in K and the injection of an artificial physiological serum at 9‰ of NaCl, containing no K. Unfortunately, this direct injection of sodium into the blood circuit provoked an immediate death.

There is, in the logic of the biochemist, another reason for believing that sodium should be given. When the potassium increased, there was an intense, unexplained "leakage" of sodium. The subsequent reasoning was thus: since the sodium goes away and there is not much of it left, we must give it to the organism!

The nuclido-biological reactions which I had observed helped to explain what was happening. An hormonal disorder (of the surrenal) provokes the continual synthesis of the aldosterone, thus transmuting the blood's sodium into potassium.

Hence, in this case the potassium increase in the blood has nothing to do with the oral ingestion of potassium, because it is the sodium of the blood plasma which becomes potassium. It is only the sodium ingestion that one should change, and it is understood that by an injection of artificial serum—water salted with sodium chloride—the blood receives a fresh and abundant afflux which transmutes immediately into potassium and causes death. A salt-free diet is traditionally imposed, but for a lasting cure one should act on the surrenal.

## Addison's Disease

In December 1963 a chief endocrinologist of one of the largest hospitals in Paris asked me to give some doctors an exposé on potassium. This professor wanted to show his assistants, interns, students, pharmacists, laboratory chiefs, etc. the formation process of potassium and the disappearance of sodium, since the sodium "leakage" and the potassium risings remained unexplained. A typical example is Addison's Disease, where the percentage of sodium in the blood plasma decreases while the percentage of potassium increases.

It had been established in 1927 by Bauman and Kurland that the potassium increase in the blood serum was caused by a malfunctioning of the cortico-surrenal.

In 1931 Hastings and Compere, in a surrenalectomy on a dog, verified that on the second day the increase of K in the plasma can exceed the normal balance by 50%, causing death to occur a few days later (at which time there is six times more K than normal).

The potassium also increases in the cell. Harrison and Darrow in 1938, Buell and Turner in 1941, verify this in the rat.

This observation invalidates the arguments of people who say that the increase of K in the blood serum is caused by a "leakage" of K from the cell. The researchers previously cited provided proof that it is the total potassium which increases; it is not a case of the simple removal of an ion.

In Addison's Disease the symptoms are aggravated by an excessive supplement of potassium in the diet. The disastrous role of potassium with regard to cortical malfunctioning has been confirmed on surrenalectomized animals by Allen, Nilson, Kendall, Cleghorn and Mc Vicar.

The plasmatic sodium, which falls in cases of cortical malfunctioning, rises under the effects of D.C.A. or cortisone. The plasmatic potassium, which rises in cases of cortical malfunctioning, is decreased by D.C.A. or cortisone. The opposite effect which these have on Na and K was established in 1948 by Green, in 1939 by Kuhlman, and in 1940 by Tookes. D.C.A. can act so intensely that it can cause a loss of the K stored in the cell.

Darrow demonstrated that under the influence of D.C.A. a deficit of intracellular K causes an alkalosis. This alkalosis (increase of Ca), linked to K, has been confirmed by specialists of endocrinology.

Thorn, in 1941, demonstrated a different effect caused by cortisone on Na and K in Addison's Disease. An excess of cortisone (or D.C.A.) can lead to such a loss of K that decalcification results. It was never understood why the lack of K caused the lack of Ca!

Rheumatism treatments with cortisone (200 mg/day) modify the Na/K equilibrium. Long treatments can lead to fatal troubles by causing the atrophy of the gland which secretes these hormones (resulting in a reduction of the cortex matter).

In this treatment of rheumatism, as in the treatment of Addison's Disease, the amount of potassium excreted is greater than the amount ingested. This negative balance sheet is accompanied by a negative calcium balance sheet, showing that the disappearance of K is accomplished directly by the transmutation of the latter into Ca.

## Cushing's Disease

Here, the opposite is true: an hormonal excess leads to a sodium increase in the blood.

The alkalosis in this disease is corrected simply by giving potassium.

Cushing's Disease is caused by excess surrenal activity which in turn is often produced by a tumor of the hypophysis, no longer able to control the surrenal. The latter then produces an abnormal quantity of cortisone and other steroid hormones. One knows the effects of excessive injections of cortisone. Excess tension, a loss of minerals in the skeleton and a poor endocrinian function are the consequences, and together they may ultimately cause death.

Cushing's Disease has been considered incurable. It has always been treated by surgery: by the partial removal of the surrenal and the removal of the tumor in the hypophysis. It has also been treated with gamma or X-rays, an attempt which always causes damage to adjoining tissues.

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People who undergo cortisone treatment typically excrete more K than they ingest. For us this fact was one of the leads in researching the enzyme which provokes the transmutation of Na and K and which seems to be of the same group.

The secretion of ACTH from the hypophysis under traumas such as hemorrhages, severe burns, violent physical effort, acute infections, bad wounds, operational shocks, strong emotions, etc., also causes a large secretion of K. I believe that in this case we should study the possibility of giving a physiological serum (Na). Whoever deals with the excretion of K must also consider the Na consumption, since Na is needed to replace K. Hence water, salted with NaCl, should be given as liquid intake to avoid a possible loss of K.

Above all, one should not commit the grave error—which is still being made—of saying that since the organism is losing K, one should introduce more of this element. (This is similar to returning to an organism its wastes!) Actually a large injection of KCl could be dangerous because it might cause a local and lethal concentration in the cells.

It is by using precise balance sheets that we have established the reality of the biological transmutations. It can be seen that this "new" science clarifies much that has remained mysterious thus far (concerning the metabolism of potassium, for example). This evidence must surely oblige everyone to return to his studies in biology. Indeed, the facts have been seen for a long time. It was no disappointment for me to learn that they had been discovered before me. Quite the contrary—I was thrilled, for this merely proved me to be correct.

# EPILOGUE

*When one is confronted with a fact which is in opposition with a prevalent theory, one must accept this fact and abandon the theory, even though the latter, supported by great men, may be generally subscribed to.*
*Claude Bernard*

This book is essentialy a document of experiments which I hope will be sufficient to establish the undeniable reality of the phenomenon confronting us. It was necessary to limit the treatment of the subject, leaving the door open concerning the different applications of these newly discovered reactions. I hope the examples cited here will not only help the reader understand the mechanisms but will encourage him to proceed in his own field with each particular problem.

The preceding pages have demonstrated that the biological transmutations of the elements do not in any way oppose the laws of chemistry. Chemistry is the science of the displacement of the electrons situated in the peripheral layers of the atoms. It is the science of the molecules, not of the nucleus of the atoms.

The phenomenon that I have unveiled exists at the level of the atom's nucleus. Thus it is a new science, quite different from chemistry which is simply the end result of the transmutation phenomenon and therefore possesses certain limitations.

Einstein never stated that his laws were applicable to biology. He always insisted on the fact that they were relevant only in his particular field of research.

Open-minded physicists know well that not all the laws of physics are applicable to living matter, a fact which made Louis de Broglie write, "It is premature to reduce the vital process to the quite insufficiently developed concepts of 19th and even 20th century physics and chemistry."

Along the same line R. H. Dicke in *The Theoretical Signifi-*

*cance of Experimental Relativity* (New York) said that there is now emerging a lessening of the original infatuation with the proofs related to the law of general relativity.

More and more physicists now oppose the rigid attitude of certain specialists. One of these physicists, H. Prat, a professor at the Faculty of Science, wrote: "In fact all our physical and biological laws are more or less based on the implicit acceptance of the notion of identity. They should all be studied over again and made more flexible."

As a further example the eminent physicist Brillouin wrote, concerning the healing of tissues, etc.: "That is why so many scholars think that our actual laws of physics and chemistry cannot explain such strange phenomena." [1]

In the atomic field everything is brought to the level of Einstein's theory. This confusing attempt to generalize is not being made universally, however. Other scientists declare, "The equations of Einstein remain valid, but it now appears that they might be incomplete." (*The Sciences,* July 1964). Also, "A new examination, the complete revision of our ideas, will lead us to the conclusion that there are accommodations to be made with relativity."

I do not oppose Einstein. I only oppose his unconditional followers who did not understand their master and who applied in all fields laws whose capacity Einstein himself had circumscribed.

But who reads Einstein? Many of the popular books on relativity are written by professors who misunderstand these laws and who continue to apply automatically the false calculations made by previous authors.

"It is only for these bodies of reference (Galilian bodies, i.e. those which make a rectilinear and uniform movement, exempt of rotation) that the validity of the principle of relativity was admitted. . . ." wrote Einstein.[2] And, "The physical interpretation of the space and time Euclidean continuum . . . was possible by virtue of the law of constancy of light velocity . . . which the theory of General Relativity could not maintain. . . ."

Einstein's position before his death was that there are several valid theories, each completely distinct and applicable in its own

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[1] *Vie, Matière et Observation,* A. Michel Pub., Paris 1959.

[2] *La Relativité,* Payot Pub., Paris 1956.

field. Yet now many passionately support Einstein's theory while others completely oppose it. Physicists are divided, and I have no wish to take part in their debate.

What is important is that doctors, biologists and agronomists are already applying the biological transmutations. Some doctors apply them empirically without completely understanding them. The same is true with agronomists who leave a deficient field lying fallow for a few years, after which period the land regains the elements in which it was deficient. Also, many bone specialists know that the bone is formed without calcium.

The entire genesis and evolution of our planet needs to be restudied in light of transmutation, which opens new horizons to geologists and philosophers, as well as to metaphysicians. The latter can find grounds for meditation in the fact that the vital phenomenon of life is not chemistry alone.

This does not mean that the recognition of biological transmutation is another step towards comprehending Life. On the contrary, I would say that it is a step toward demonstrating that Life is more complex than some bio-chemists would like to believe.

"When one makes a general theory," said Claude Bernard, "the only thing of which we are certain is that all of these theories are false, absolutely speaking. . . for they should be modified with the growth of science, so much the more since sciences are less advanced in their evolution. What distinguishes the scholar is not making discoveries in which chance plays a great role, but finding the laws which govern the phenomena."

It is the exaggerated specialization in every field of science which condemns the modern scientist, isolating him from other disciplines. For many, science today is just another job, where the employee has lost his sense of adventure.

Let us again recall that the transmutations at low energy are a phenomenon totally different from the one actually studied in nuclear physics. The transmutations observed here were all of a biological nature. They lead us to recognize that the natural structure of atoms is different from that structure resulting from the technique used in the study of nuclear physics. The nucleus set is formed of sub-sets which can be separated with a relatively small amount of energy. More particularly, most of the reactions studied can occur with the movement of an atom of hydrogen or an atom of oxygen, thus with $\pm H$ or $\pm O$.

If this is a general principle, however, it must be said that the group of protons O can neither be separated from one nucleus nor joined to another. The same is true of H. What is now called "Kervran's Effect" is thus limited to certain reactions which are the same in biology. An example is the metamorphosis of rocks, under pressure effects and temperature which have no basis of comparison with the energies of fusion, or fission, calculated by classical nuclear physics. Hence one may have an exchange of one proton in ${}_{11}Na \rightleftarrows {}_{12}Mg$ or ${}_{13}Al \rightleftarrows {}_{14}Si$. This leads us to the complementary hypothesis that the above movements of protons would occur only to introduce or take away a single proton from one of the sub-sets.

Thus it can be understood why in geophysics one observes the "Kervran's Effect" kind of transmutations and only these, although laboratories using high pressure for the synthesis of minerals come across the same transmutations. Our findings are thus confirmed by a different agent and both converge in the concept of a nucleus formed of "cleavable parts."

I hope that the reader who has attentively read this work will be aided by the knowledge of the phenomenon of biological transmutation. More books will be translated from French into English in the future. These books will, of course, include new experiments made by those who are now applying the biological transmutations in their respective fields of research. In view of this fact the theoretical aspect of our subject has been neglected in this work.

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