Selected pages from Storms, E., *The Science Of Low Energy Nuclear Reaction.* 2007: World Scientific Publishing Company.

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The book, "The Science of Low Energy Nuclear Reaction" is about a newly discovered, but generally rejected, phenomenon called "Cold Fusion". This phenomenon, first made known by Profs. Fleischmann and Pons in 1989, has been investigated by hundreds of researchers and found to be real and important. The considerable evidence supporting their discovery is summarized in this book.

The term cold fusion applies to nuclear reactions that take place within special solid environments at or near room temperature. The process produces a wide range of nuclear products, the main one being helium-4 when deuterium is present in the environment. This fusion reaction produces considerable energy without emitting harmful radiation. Similar nuclear reactions can also result when normal hydrogen is present in a special environment.

Besides being a new discovery, the energy resulting from cold fusion has the potential to solve some serious problems and change how civilization uses energy. Regardless of the difficulty in replicating and explaining the effect, the discovery is too important to reject or ignore. This book and others now available show why and how this source of energy needs to be developed.

In addition to showing what has been discovered, many theories proposed to explain the effect are examined. Because the behavior can not be explained by conventional models, considerable imagination has been applied, much of which is in conflict with logic and well accepted physical laws. In addition, many proposed theories are also in conflict with observation. This book tries to separate imagination from well documented behavior.

The first several chapters describe the personal experience of the author and would be interesting to anyone, whether they have a scientific background or not. Later chapters describe the science in great detail and would only be of interest to scientists. Sufficient detail is provided, based on 1070 citations to published papers and 104 figures, to show that the Myth used to reject cold fusion is not correct.

An example of the approach taken in the book is provided by the Preface and the Table of Contents, as provided below.

PREFACE

Figure 1. Stanley Pons and Martin Fleischmann with examples their cold fusion cells. (From Special Collections Dept., J. Willard Marriott Library, University of Utah)

March 23, 1989 can now be acknowledged as a major event in the long history of scientific discovery, on par with the discovery of fission, which gave us the atomic bomb and electrical power from nuclear reactors. On this date, Profs. Martin Fleischmann and Stanley Pons announced to the world a new nuclear process they claimed was a method to fuse two deuterons together. For many reasons, their work was rejected or used as an example of bad science. Only now, 18 years later, and after a lot of hard work by hundreds of open-minded scientists can the importance of the discovery be fully understood and appreciated. It is the challenge of this book to assemble the evidence provided by numerous studies done in laboratories located all over the world and to show that a new and important discovery did in fact take place, contrary to what many people were led to believe.

Who are these men who were threatened and mocked after making such an historical discovery? Very few people knew Stanley Pons as the chairman of the Chemistry Department at the University of Utah. However, many people in science recognized Martin Fleischmann's name and reputation. He is a major contributor to and teacher in the field known as electrochemistry. Born in Czechoslovakia and narrowly escaping the Nazi plague, he settled in England where he taught at the University Southampton from 1967 until he retired. He was awarded just about every scientific honor England has to offer a scientist. Hearing his name, many people trained in chemistry took notice, at least at first. However, as often happens when important discoveries are made, a vocal group of influential people rejected the new idea. Fortunately, a few stubborn people continued to work in obscurity and have now proved the claims are real. In so doing, they risked their reputation and, in a few cases, their livelihood. Even Pons had to emigrate to France to avoid the harsh treatment provided by his own countrymen.

This book is mainly about the science of what was discovered in laboratories located in many countries by hundreds of researchers. My own research has provided me with a useful vantage-point for evaluating this work. Several goals have been attempted. Many people have contacted me wanting to learn about the subject and how they might see the cold fusion effect for themselves. Hopefully, this book can answer their many questions and show them where to look for more information. My second goal is to summarize the large accumulation of information. Such a summary is necessary because many observations are not accessible in easily searched journals and conventional databases. As a result, evidence for the effect is scattered and its full meaning is difficult to appreciate. Much work is only described in obscure conference proceedings that can be obtained from sources listed in Appendix D. My third goal is to describe what took place at the Los Alamos National Laboratory (LANL), where I worked when the announcement was made by Fleischmann and Pons. Everyone who was involved in trying to replicate the claims at LANL remembers the intellectual excitement at the Laboratory as being in the highest tradition of science. Such unique events are worth remembering and sharing as rare examples of what can and should happen. Finally, I hope when the considerable collection of observations are viewed in their totality, rational evaluation will replace blind skepticism and unfounded ignorance. My opinions alone need not be accepted because more than 1060 publications have been cited in which the primary information can be found. Indeed, only by viewing a wide assortment of observations can an understanding be achieved. This situation is rather like trying to visualize a complex jigsaw puzzle that makes sense only after a large number of pieces have been assembled. In this case, some of the pieces are so strange it is hard to believe they belong to the same puzzle. In addition, many critical pieces are still missing. As a result, little agreement can be found among scientists about what the puzzle actually looks like. My personal view is offered in the hope that it will make the puzzle a little easier to understand.

Unlike many scientific fields these days, this one is driven by observation rather than by theory. No theory explains all of what is known to be true, even though many explanations have been proposed—some plausible and some not. At this stage, theories are expected to be incomplete and very limited in their application, rather like the maps provided by early explorers or like biology before genes were understood. To make matters worse, many times people do not make clear which part of their theory is based on accepted knowledge and which part is based on imagination—again very much like early maps. Nevertheless, it is important to realize that acceptance of data is not dependent on an explanation being provided, any more than a river can be ignored just because it is not on the map. Data stands on its accuracy, consistency, and eventually on universal experience. Therefore, my main effort will be to show what is known empirically and separate this clearly from what is not known without trying to fill the gap with excessive imagination. This is a treasure hunt using clues to shrink the large area of ignorance to a smaller area where we can start digging. As we dig, small nuggets of understanding will emerge, which should be carefully examined. These nuggets should not be tossed aside just because the entire ore-body has not been uncovered.

After reading all that has been published about the subject and enjoying many successful replications, I'm absolutely certain the basic claims are correct and are caused by a previously unobserved nuclear mechanism operating in complex solid structures. Consequently, this book is not an unbiased description of the controversy. This is not to say that all studies are correct. In fact, many studies contain significant errors and a few are completely wrong. Indeed, I have great sympathy for those who reject the claims. These problems would have been reduced if papers had experienced competent peer review. Instead, papers were either rejected out of hand by most peer-reviewed journals or published with only minor changes in conference proceedings. As a result, other scientists, even the open-minded ones, have reason to ignore the work. Nevertheless, enough good work has been published to clearly show the reality of the phenomenon. This good work needs to be acknowledged and supported without the distraction poor measurements provide. My task here is to make this process easier by showing the agreement between well-documented studies.

I would like to apologize to those who consider themselves "skeptics," which is an honorable title I sometimes assume for myself. In the future, perhaps by the time you read this book, cold fusion will be an accepted phenomenon and the idea of someone doubting its reality will be as improbable as someone doubting that the Earth goes around the Sun. At such time, a reader might find my harping on the reality of cold fusion to be silly and unnecessary. Unfortunately, at the present time, many people still think the idea is nonsense and approach the subject the way the Church approached Heliocentric astronomy 500 years ago. I hope this book will be accepted as a better telescope. If this considerable body of work is dismissed as error, what does this say about the competence of modern science? Is it rational to believe that many modern tools only give the wrong answer when they are applied to cold fusion?

While at LANL, as described in Chapter 2, I had a unique view of how events unfolded, at least within LANL. During this time, I investigated the science of cold fusion and, after "retiring" in 1991, continued the work in my own laboratory. This experience taught me to accept the reality of these "impossible" claims. Chapter 3 summarizes some of these lessons. Evidence provided by hundreds of others is discussed in later chapters, where a huge collection of experience is evaluated and put into perspective. Even people working in the field are not fully aware of what has been discovered. As the reader will soon learn, the novel effects occur only in unique and very small locations. These locations are discussed in Chapter 5. Methods used to initiate the anomalous effects are described in Chapter 6 and detection of the resulting behavior is discussed in Chapter 7. Development of a proper theory has been one of the great challenges of the field. Consequently, some explanations are offered and evaluated in Chapter 8. As will become clear, cold fusion is not cold, except in comparison to hot fusion, and it is not normal fusion. Unlike hot-fusion, which is used to "explain" cold fusion by applying high-energy physics, an explanation should be based on solid-state physics and chemistry. Consequently, the observations need to be viewed through a different lens than is applied to hot fusion. Chapter 9 tries to show what all this information means and what should be done next. A very brief summary of the phenomenon is provided in Chapter 10, which might be worth reading first. The implications of this discovery are so profound that people need to accept its reality and be prepared to enjoy the consequences of its eventual application. The only uncertainty remaining is which country will first gain the benefits and how soon.

As for my background, I came to the Los Alamos National Laboratory (LANL), Los Alamos, New Mexico, first in 1956 and again in 1957 as a summer student and returned as a staff member in 1958 after getting a Ph.D. in radiochemistry from Washington University, St. Louis. Prof. Joseph Kennedy, my research professor, had been the director of the Chemical and Metallurgical Division at the secret laboratory in Los Alamos during the war and co-discovered plutonium. Thanks to his encouragement, I joined a steady stream of graduates from the University he was recruiting for the peace-time Laboratory. This was a time when the Laboratory was changing from the primitive conditions existing during the war to what was to become a major national laboratory located in a place of unusual beauty. It was an ideal place to do creative work because competent people who knew science and scientists were administering the laboratory at that time. I was hired to study the thermodynamic and phase relationship properties of very high melting point materials[1] used in reactors designed to provide power or propulsion in space, a useful and exciting subject even though the intended machines were never built. Nevertheless, my work was productive and satisfying, resulting in more than 100 publications, a book[2], and teaching sabbaticals at several universities including the University of Vienna, Austria. I did not need another project and I was content to believe the theories everyone else accepts in nuclear physics. Besides, Carol, my wife, could have done without the scientific mistress cold fusion later became for me. To some extent, this book describes a personal awakening to the realization that what is taught and thought to be true in nuclear physics is only partly correct. A totally unexplored environment in which nuclear interaction can take place apparently exists within solid materials.

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