

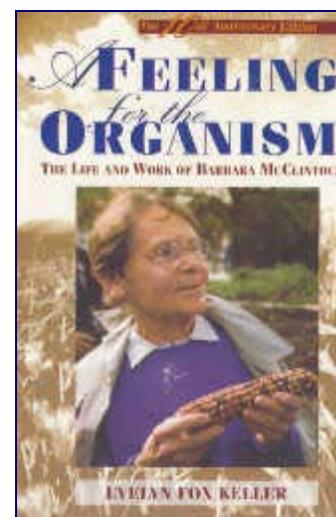
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A READER'S JOURNAL

A Feeling for the Organism Life and Work of Barbara McClintock by Evelyn Fox Keller

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What if you discovered that the fruit and vegetables that you grow with your own hands will keep you

healthier than those you buy from a supermarket or even from a local farmer's market? How would that change your life? It was this possibility which led me to study the work of Barbara McClintock which is laid out so thoughtfully and carefully by the author in this book.

My first contact with the above idea came from the Russian lady, Anastasia (ann-uh-STAH-see-uh), in the Ringing Cedars Series written by Vladimir Megré, which were translated into English in this decade. In my review of Book 3 of the Series, [The Space of Love](#), I wrote that the chemical exudations of a human who is planting seeds and cultivating the plants create plants which have adjusted their nutrients to the requirements of that human's physiology. The plants grown by one's own hand can act as a doctor's diagnosis, prescription, and dispensing pharmacist to correct health problems while they are only incipient, not detectable by one's human doctor's examination or invasive technological instruments.

In my review of Book 3, I wrote:

[[Space of Love, footnote 1](#)] I had been doing some study of neuroscience with Prof. Robert Sapolsky of Stanford, and believe that I have found the process by which the gardener, the garden, and the soil are interconnected in an exquisite feedback loop. Plants have lots of transposable genetic events which Barbara McClintock's work predicted ("jumping genes"). There is apparently a complete feedback loop which goes from gardener to seed to plant to produce to gardener which creates health in people who garden and eat their own produce. When you plant the seed or the seedling, it receives chemical information from the moisture in your breath, the perspiration of your hands, among other things, and that information acts as a "stressor" on the plants and leads to the moving of sections of genes around so that they code for new proteins exactly designed to re-balance whatever incipient imbalances in one's body could lead to illness. Plants, in other words, can act as our personal physician if we allow them to by planting and eating food planted, nurtured, and harvested in local gardens.

In my September, 2007 Good Mountain Press DIGESTWORLD Issue No. 097, I wrote an extended commentary on [JUMPING GENES and SEEDS AS PHYSICIANS](#) in which I expanded upon the above theme. But most importantly 2008 for me and Del was the year that I began planting vegetables in our home garden for the first time. Previously I had various kinds of fruit growing here, such as Celeste figs, Navel and Honeybell oranges, Meyer lemons, grapefruit, wild cherries, avocados, loquats, blackberries, and wild strawberries, but during the next planting season in the Spring, I bought a small hand tiller and devoted half of our flower bed to growing vegetables. I had grown up eating vegetables that were home-grown by my parents and grandparents, and had noticed the improvement of taste those had from the store

bought ones, I">I had never equated "better taste" with "better for you", up until recently. Two of my new heroes are Anastasia, whose life is the subject of the Ringing Cedars books and Barbara McClintock whose life is the subject of this present book.

Anastasia knew nothing of the transposition of genes in plants, but she knew that the plant was adjusting to her body, a knowing which came down from countless generations of ancestors who lived in the Ringing Cedars area of Siberia, a portion of Siberia not on anyone's cognitive map until Megré began to write books mostly dictated to him by Anastasia. From Anastasia we can learn of the healthy effects of growing one's own vegetables, something that is becoming a growing trend in Russia by urban families who own small dachas in the country and work them on weekends and vacations. From Barbara McClintock, we can learn of the genetic mechanism which makes it possible for our home-grown plants, via custom-designed genes, to produce the exact proteins our body needs to maintain a long, healthy existence. We have the circumstantial evidence of thousands of years of Anastasia's ancestors, many of whom lived well past their hundredth birthday, and the scientific evidence of over fifty years of Barbara McClintock's life(1).

There is another aspect of Barbara McClintock's life and work which attracted me. She is the latest of a long series of scientists who as true innovators found their ground-breaking work in their fields spurned by establishment scientists when it first appeared, often for decades, often until some independent body had re-discovered and confirmed the work of the innovator. Mendel's basic research in smooth and wrinkled peas indicated in the 1870s the presence of a factor which we today call genes, but, until William Bateson in the early 1900s resurrected Mendel's work and labeled the new field, genetics, Mendel remained an outcast, the very man whose work made possible the field of Barbara McClintock's work. [Ignatz Semmelweis](#) discovered the cause of and the cure for puerperal fever which was killing hundreds of thousands of women in Austria in the 19th Century, and he was condemned as a madman and jailed in an insane asylum for his suggestion that medical doctors wash their hands in a sterile solution when going from a dissecting table to a delivery room!

It was the lugubrious treatment given innovators such as the above which led Thomas S. Kuhn to write his classic 1962 book, [The Structure of Scientific Revolutions](#). In Kuhn's view, the current state of the world acts on scientists as blinders do on a horse: they keep the scientist and the horse from getting skittish by eliminating the shadows moving in their peripheral field of view. New innovations act as shadows and the establishment scientist must ever keep "eyes forward" and ignore them. As much as Evelyn Fox Keller tries in this book to keep from tarnishing the reputation of those scientists who belittled and ignored McClintock's work for decades, the stain is clearly there for all to see. Not until the Queen of Jumping Genes met the King of the Nobel Swedes(2) was the consensus swayed in McClintock's direction and she at last received recognition as a true innovator, especially for her discovery of transpositioning of genes in plants, which according to scientific dogma at the time was completely contraindicated by the grand Central Dogma of genetics. One would hope that this latest destruction of a cognitive map which did not match the territory of the world would convince all scientists to suspect their own maps from now on, but few scientists are able to survive in the world of shadows without their discipline's custom-made blinders in place. For her part, Barbara McClintock simply explored the territory and reported what she found, something for which the world will be forever grateful.

Here are some comments from a research professor in biology, Dr. Rollin D. Hotchkiss, which will give us a flavor for what it was like for a colleague of McClintock in trying to understand her work. What Hotchkiss says we will find echoed repeatedly throughout the book, including the eponymic reference to "a feeling for the organism."

[page xi] Foreword Evelyn Fox Keller's insightful biography can now interpret and extend . . . to a broad crescent of readers who care about interesting people or about how science advances. In particular, I hope it will bring scientists-to-be a deeper

understanding of one of the exemplary paths to scientific achievement. And — for a culture that believes itself to be an enlightened, thoughtful one — Keller's calm recital of how McClintock faced professional gender hurdles and prejudices is a factual reportage that can give every reader, male or female, a vicarious experience of these problems. Moreover, her analysis of McClintock's scientific work — int its broad context — describes some difficult aspects of modern genetics and itself constitutes a significant contribution to the broad history of thought.

[page xiii] *Foreword* Always wanting to communicate, she strove in later years to control her almost explosive style of speech — tempering it easily to the *level* of her listeners, but much less successfully to their *thinking rate or attention span*. . . . After many such sessions, I eventually grasped her fundamental postulates about Dissociator and Activator; without sufficient "feel for the organism" of field corn, I didn't develop my own conviction beyond my admiration for hers. Like many others, I felt bewilderment rather than doubt about the masses of information she reported.

[page xiv] *Foreword* An expert microscopist first of all, she had studied innumerable minute details scrutinized at the high power setting, always making the all-important step of returning to survey in the lower power to see just where she was "on the big scale." But she also had an inner "viewing lens" that mentally portrayed a far bigger map — a panorama of the whole cellular and anatomical display — spreading over into the fourth, or time, dimension of what happened to the chromosomes in various cells and tissues during the whole development of the mature corn plants. With such a vivid inner vision, and a rapid-fire delivery, she would often leap the full range from microscopic observation — to model — to conclusion — to result in the grown plant, within a sentence, or a brief "cluster of words." And back and forth!

[page xvi] *Foreword* Luckily, Evelyn Fox Keller has created her own word pictures that summarize the adventures of meandering genes. With, of course, the help of professional advances made in the meantime and hindsight, she has done the still hard world of personally mastering these ideas and rendering them more accessible to all of us. She has not stopped with a romantic or intuitive grasp of them — nor does she trivialize or treat scornfully the honest misunderstandings or difficulties that came up. She works to convey the pitfalls and obstacles the actual participants traversed and moreover to see them in their own time frame.

What exactly does McClintock mean by her "feeling for the organism"? I cannot say for sure, but there is plenty evidence in this book that points to a method that McClintock has of obtaining information about the subjects of her experiments. To clarify what I mean, consider the process of obtaining information. Something exists outside in the world and after you have received *information* that something exists inside of you. Take a detailed look at the process of "informing" by breaking it into its constituent parts: *in-forming*. This is a process by which you enter into the object of consideration by concentrating your focus of attention fully inside of the object so that you become *in-formed*, or *inside of the object*, doing whatever the object is doing, and during that imaginative process, what the object is doing is revealed to you. This is such an intimate process that, although the results you receive are describable, the very process you used to acquire the results is ineffable and therefore indescribable.

Perhaps it would help if I described how I first came to understand the process of *in-forming*. It came to me from W. K. Chesterton's book [The Innocence of Father Brown](#), full of stories of the priest-detective who solved mysteries using that process. In the "Twelve Fishermen" story, Father Brown apprehended the perpetrator of a heinous crime that had been committed right in the sight of unsuspecting observers while he was writing down some notes in an isolated darkened room out of sight of the crime. In that small room, he had deduced both the existence of the crime and identified the criminal as he listened to the footsteps in an adjacent hallway. How was Father Brown informed of the existence of this invisible

crime? Better to ask the question, "How did Father Brown go about *in-forming* himself of the crime?"

[from my [Gospel of St. Mark Review](#)] He heard the quick steps of waiters delivering food and recognized the pattern by imagining himself as a waiter, placing himself imaginatively into the person making the step . Then he heard slow-paced steps of the honored guests that were being served. Another pattern. He continued his writing until a strange thing happened: the steps of a waiter coming from the kitchen suddenly turned into the steps of a honored guest. When this repeated itself several times, he put himself in his imagination into the steps he heard and realized suddenly that the only reason one would perform such a quick change of pace was that one wanted to appear to be a waiter to the other waiters and a honored guest to the other guests. Since both guests and waiters wore formal attire, the switch was possible. The waiter/guest removed the precious silver knives from the dining table as a waiter and was ready to leave the building with them as a guest when Father Brown confronted him with the crime. Our word "information" is a very flattened form for expressing this interesting process — to get information, we must *in-form* ourselves into the person or situation from which we wish to obtain information.

Barbara McClintock similarly placed herself inside the organisms she examined under her microscope, and thus *in-formed*, she developed her results which she attributes to her having "a feeling for the organism." It is not surprising that this recurrent phrase was used for the title of this book — a book title that refers to an indescribable process which much of the book is devoted to describing. Here's how the author describes the process. Keller is talking about McClintock in the next passage and describing her *in-forming* as "identification" with her material.

[page xxii] She herself cannot quite say how she "knows" what she knows. She talks about the limits of verbally explicit reasoning; she stresses the importance of her "feeling for the organism" in terms that sound like those of mysticism. But like all good mystics, she insists on the utmost rigor, and, like all good scientists, her understanding emerges from a thorough absorption in, even identification with, her material.

After spending several pages describing what brought me to this book and what I brought to this book with me, I'd like to review what the author and McClintock brought to this book. The first item to cover the author brings up in her Preface; it has to do with the meaning of meaning, specifically the meaning of dissent in science.

[page xx] A new idea, a new conception, is born in the privacy of [one's] dreams. But for that conception to become part of the body of scientific theory, it must be acknowledged by the society of which the individual is a member. In turn, the collective effort provides the ground out of which new ideas grow. Scientific knowledge as a whole grows out of the interaction — sometimes complex, always subtle — between individual creativity and communal validation. But sometimes that interaction miscarries, and an estrangement occurs between individual and community. Usually, in such a case, the scientist loses credibility. But should that not happen, or, even better should it happen and then be reversed, we have a special opportunity to understand the meaning of dissent in science.

What is the meaning of dissent in science? Plainly spoken, it is when an original idea is born, but one which cannot have sprung from the already present data and dogma of science. To the innovator, the original idea is a gift from the spiritual world which accompanies hard work and luck, such as happened with McClintock's discovery of "jumping genes". To established science, that same original idea is rejected as a dissent or rebellion, as a storming of the bastions of science by an infidel, or worse, one of the faithful, who, like McClintock, has somehow been led astray. Where Keller says "*sometimes* that interaction miscarries", I would say that the interaction *often* miscarries. Any original idea in science is deemed a threat to the entire scientific establishment's community, and the history of science is replete

with examples of such ideas being squelched, ridiculed, and ignored for decades or even centuries in some cases. In the case of Immanuel Velikovsky, his ideas were treated that way, and after the establishment had done it best to blast them out of existence and the heat had cooled down, the same establishment used Velikovsky's ideas to explain the very things it had earlier ridiculed him for claiming to be true(3). In Velikovsky's case, the estrangement has never been reversed, a situation which Keller blithely ignores in her analysis above, but such unrepentant estrangement cannot be ignored. But, given that the estrangements of many scientists were later reversed, such as McClintock, Mendel, Giordano Bruno, and Ignatz Semmelweis, to name only a few, how one could claim that this is a "special opportunity to understand the meaning of dissent in science." It is beyond me how anyone could say to the husbands and families of the quarter-million women who died in childbirth *after* a cure had been found by Semmelweis but was ignored by the establishment, "This was simply a learning opportunity." If it were a learning opportunity for science, science has shown repeatedly in the hundred plus years after Semmelweis was jailed that science's treatment of such "dissent" has become more virulent instead of less. Science today has developed a dogma which leads to dissenters being declared heretics if they dare violate its tenets. The scientific establishment has become the religion of the modern day, and its inquisitions are just as deadly in its effects as those of earlier religious establishments.

Perhaps some of you may not be familiar with scientific dogma, thinking that dogma only existed in religious circles. This next passage should disabuse you of that notion as the man who discovered the DNA molecule created the very dogma that Barbara McClintock was later to disprove.

[page 5] The picture that thus emerged — DNA to RNA to protein — was powerful, satisfying, and definitive. Francis Crick dubbed it the "central dogma," and the name took.

The disastrous effects of this "central dogma" of Crick's cannot be as easily traced as those of the Vienna doctors whose dogma allowed them to kill thousands of women having babies by allowing them to take their hands from cadavers and place them in live women's vaginas. But, if we examine this central dogma of DNA to RNA to protein, allowing only a one-way flow, it allows absolutely no possibility of the sweat from a home gardener changing the proteins of the plants he seeds, cultivates, harvests, and eats to keep him healthy. That central dogma's effect was to keep from the public for many decades the possibility of plants adjusting their proteins to help the humans who planted and ate them. Only time will tell how many people died prematurely who could have been saved by this knowledge of the benefits of home gardens.

If the bad effects from Crick's "central dogma" can be laid at his feet, then the good effects from Barbara McClintock's destroying that dogma can be attributed to her. She single-handedly gave credence to the life's work of another woman, Anastasia, who is spreading news of the benefits of home-grown fruits and vegetables to her beloved "dachniks" all over Russia and through Megre's books to people all over the world. Obviously this is an idea whose time has come to everyone from peasants to professors.

In this next passage, Barbara describes her bootstrap process, the one in which she first discovered how to identify individual chromosomes in corn or maize. Note the negative interaction with her boss which ensues. To his credit, he did not attempt to take credit for her work, but he was clearly upset that she had found so quickly what he had strove to discover for so long.

[page 40] The year before, while working as a paid assistant to another cytologist, she had discovered a way to identify maize chromosomes — to distinguish the individual members of the set of chromosomes within each cell — somewhat to the dismay of her employer, who had been working at the problem for a long time. "Well, I discovered a way in which he could do it, and I had it done within two or three days-the whole thing done, clear, sharp, and nice." He was not overjoyed with her success. "I never thought I was taking anything away from him; it didn't even occur to me. It was just exciting that here we could do it-we could tell one chromosome from another, and so easily! He had just looked at the wrong place, and I looked at another place." The end of a friendship,

perhaps, but the beginnings of a career; having found the "right place to look," McClintock was to spend the years that followed doing just that.

This reminds me of a story of a guy whose furnace broke in mid-winter and he called in a furnace expert to fix it. The expert spent a couple of minutes looking over the furnace, pulled out a wrench, banged on the furnace, and it started working again. The expert presented the owner a bill for \$500. The owner said, "Wait a minute! This is pretty expensive. I want an itemized bill." The expert took the bill and wrote down: "Banging on the furnace, \$5 Knowing where to bang on the furnace, \$495." Knowing the right place to bang or to look is what constitutes genius and Barbara clearly was a genius. Listen to what Marcus Rhoades, who knew her in the beginning and followed her career over fifty years, said about her (Page 50), "I've known a lot of famous scientists. But the only one I thought really was genius was McClintock."⁽⁴⁾A truly original idea when it arrives from the spiritual world and appears in a person's mind, earns that person the title of *genie-ous*, as if it were a genie which had carried the idea to the person's mind.

Harriet Creighton discovered the genius of McClintock early on, and came to appreciate it. Her explanation of how so many people misunderstood McClintock reveals a deep truth, namely, sometimes when you asked her a question, you received an answer for the question you should have asked instead.

[page 54, 55] But Creighton found that she was also learning a technique that may have been even more valuable [than cytological analysis]; she was learning a method of following McClintock's discourse — which, even then, she recalls, many found dense and "hard to follow." Her discovery was that what sometimes seemed like non sequiturs in McClintock's line of thought were in fact a response "to the question you have been asking at the moment"; she was addressing the doubt "you should have had."

Two areas of early microbiological genetic research were done using the fruit fly *Drosophila* and the common corn, *maize*. It was like a horse race as to which would win: McClintock jockeyed Maize out of the gate to an early lead with *Drosophila* close behind on the rail. Down the stretch, *Drosophila's* jockey discovered the extra-large chromosomes in his steed's saliva and moved back into the lead. It was a race that both would win, and the big winner at the ticket window would be humanity with its new-found knowledge of the deep mechanisms of genetics. T. H. Morgan discovered at one point that Creighton and McClintock had found the correlation between genetic and chromosomal crossover and announced a paper was to follow in two weeks. When it did, the slow-reproducing corn for the first time finished ahead of the fast-reproducing fruit fly!

[page 59] With *Drosophila*, one need not wait an entire growing season to learn the results of genetic crosses; one can get a new generation every ten days. Creighton recalls Morgan's saying, "I thought it was about time that corn got a chance to beat *Drosophila!*"

This next passage reveals the kind of quantum leaps which McClintock's thoughts took as she pondered relationships between easily observable variations of coloring on leaves and minuscule changes at a chromosomal level. She was at the time and may still be the only human able to make such correlations.

[page 65, 66] Her story of the identification of one of these new phenomena illustrates McClintock's unique style of thinking. "As I was going through the field, I saw plants that were variegated — part dominant and part recessive. I didn't look at the variegated plants, but somehow or other they stuck in my mind." That fall she received a reprint from California in which variegation was described. A small chromosome was also identified that night, it was suggested, be related to a genetic fragment that seemed to be "getting lost," thereby causing the pattern of variegation. "As I was reading this paper I said, 'Oh, this is a ring chromosome, because a ring chromosome would do this.' " Although a ring chromosome had in fact recently been observed for the first time,

neither McClintock nor her colleagues yet knew of its existence. Her reasoning was as follows: "Everything had been discovered that you would expect if you broke a chromosome and the fusions occurred two by two. That is, if you had a chromosome that had two parts to it, you could invert [one] and get an inversion. Or you could get a deletion. At this point you say, well, the reverse of a deletion is a ring chromosome. Why weren't people reporting ring chromosomes? They weren't. Therefore, these ring chromosomes must have a mechanism of getting lost. . . . So I wrote to these people and said, 'I think that what you have is a ring chromosome, and I think that they have a means of getting lost in sister strands exchange.' The response from California was: 'It sounds crazy, but it's the best thing we've heard.' "

Everyone was excited, especially in Missouri when she arrived at the research facility and heard them all talking about ring chromosomes, seeing them everywhere. She got scared when it suddenly it occurred to her, even though it had a "ring of truth" to it, she had never confirmed that they were ring chromosomes, but when the data was in, she was proven right about the presence of ring chromosomes. She had gotten "a feeling for the whole situation of which this was a component part".

[page 67] "Then I got scared. I said, 'My goodness; they are now calling them ring chromosome plants when they have never seen a ring and don't know!' When the first plant was ready, my hand was actually shaking when I opened up the plant to get out the material to be examined. I took it right back to the lab and examined it immediately. It had rings, and it was doing exactly as it was supposed to do, and every other plant that I had deduced was a ring chromosome plant was doing exactly as I expected it to."

Here is another example where McClintock explains how she in-forms herself of what's going on inside the cell on a microscopic level.

[page 69] Given the state of knowledge at that time — a good three decades before biologists would be able to match a molecular description to the processes McClintock was observing under the microscope — her interpretation emerges as something of a *tour de force*. Marcus Rhoades recalls once saying to her: "I've often marveled that you can look at a cell under the microscope and can see so much!" She said, "Well, you know, when I look at a cell, I get down in that cell and look around." He laughs, "I'll never forget that," he says. This is one of the many instances in which "looking around" paid off; without being able to say quite what it was she was seeing, she was able to arrive at a functional description that, except for the absence of biochemical terminology, accords remarkably well with contemporary analyses.

Barbara McClintock was like a female Henry David Thoreau whose Concord was a cornfield. She made detailed inspections of corn at every level, from the shape and color of its leaf, to the spots on the kernels of corn, to the chromosomes with the nucleus of its cell. She was a cytologist, a geneticist, a naturalist, a biologist, and even more. She was rarely wrong, except in one case where she thought she had made a mistake in judgment and later found it was a simple recording error!

[page 102] So adept did she become at recognizing the outward signs of those structural alterations in chromosomal composition that she could simply look at the plants themselves and know what the microscopic inspection of the cells' nuclei would later reveal. "Before examining the chromosomes, I went through the field and made my guess for every plant as to what kind of rings it would have—would it have one, two, or three, small or large, which combination? And *I never made a mistake*, except once. When I examined that one plant I was in agony. I raced right down to the field. It was wrong; it didn't say what the notebook said it should be! I found that. . . I had written the number from the plant adjacent, which I had not cut open. And then everything was all right."

There was another aspect to her research work that was unique. Other researchers could delegate mundane tasks to assistants, but McClintock could not as her own skills were so detailed and intricate that she barely knew how they operated and was helpless to explain them to others.

[page 103] Since her days as a young graduate student, she had always carried out the most laborious parts of her investigations herself, leaving none of the labor, however onerous or routine, to others. In this she did as almost all beginning scientists do. But most scientists, as they mature, learn to delegate more and more of the routine work to others. There are, of course, exceptions, and Emerson, who, according to Harriet Creighton, "didn't regard anything as routine," was one. He prided himself on doing his own work. For McClintock, more than pride was involved. Her virtuosity resided in her capacity to observe, and to process and interpret what she observed. As she grew older, it became less and less possible to delegate any part of her work; she was developing skills that she could hardly identify herself, much less impart to others.

The nature of insight in science, as elsewhere, is notoriously elusive. And almost all great scientists — those who learn to cultivate insight-learn also to respect its mysterious workings. It is here that their rationality finds its own limits. In defying rational explanation, the process of creative insight inspires awe in those who experience it. They come to know, trust, and value it.

"When you suddenly see the problem, something happens that you have the answer — before you are able to put it into words. It is all done subconsciously. This has happened too many times to me, and I know when to take it seriously. I'm so absolutely sure. I don't talk about it, I don't have to tell anybody about it, I'm just *sure* this is it."

McClintock recounts an incident in which she was stuck on how to describe the entire meiotic cycle of *Neurospora*. She walked out and sat beneath two rows of giant eucalyptus trees on the Stanford campus, suddenly she jumped up and headed back to the laboratory, confident she was going to solve the problem. Later as she presented the results of her work at a seminar, she said "what happened under the eucalyptus trees" was crucial to her success. Clearly she was describing her "in-forming" process.

[page 117] Knowing that "everything was going to be all right," she found that, where before she had seen only disorder, now she could pick out the chromosomes easily. "I found that the more I worked with them the bigger and bigger [they] got, and when I was really working with them I wasn't outside, I was down there. I was part of the system. I was right down there with them, and everything got big. I even was able to see the internal parts of the chromosomes — actually everything was there. It surprised me because I actually felt as if I were right down there and these were my friends."

In Chapter 8 Transposition, the author gives us the details of how McClintock discovered the process of "jumping genes" or transposition. It began simply with her noticing patches of color on corn leaves which didn't seem to belong there.

[page 121] As part of her continuing investigations of the new mutations produced by the breakage-fusion-bridge cycle, McClintock had grown a culture of seedlings produced by self-pollination of plants in whose early development one or both chromosomes 9 had been newly broken. Depending on the particular kind of breakage cycle that had occurred in the parent plants, these young seedlings included a number of familiar variants of the basic green color of most young seedlings: they might be white, light green, or pale yellow. But unlike other mutants that had been studied in corn, these "mutations" were apparently unstable within the life of a single plant. In each mutant seedling, streaks or spots of color could be seen that didn't belong-patches of pale yellow or green in a white leaf, or patches of normal green in a light-green or yellow leaf. The genetic instability that these patches reflected had been described in other organisms under the names of mutable genes, variegation, or mosaicism; but only rarely had such

variation been seen in corn. In this crop "mutable genes" seemed to be everywhere.

McClintock soon noticed that seedlings had a certain rate of mutation and that pointed to something which was controlling the mutation.

[page 123] McClintock's constant rates of mutation provided an instance of developmental regularity, directly linked to genetic events. The mutations acted as a tracer, allowing a history of cell differentiation to be read off; and that history turned out not to be random. She knew she was "onto something very important." For her, the question of how gene action might be regulated had always been a pressing one. "It seemed to me that if you look at the overall organism and how it develops, these things we call genes just *had* to be controlled." Her long familiarity with the outward life cycle of the corn plant and with the replication cycles of its chromosomes had trained her to see and think in terms of process. Now she was certain that she had a clue to the control of genetic events in normal development.

She began to notice that one cell seemed to be gaining what another cell lost, and she was at a loss to explain it fully, but she knew the process was important. It turned out to be the key indication that a gene had been transposed from one position in the chromosome to another — the first jumping gene had been spotted!

[page 125] Two years later she knew that what she was observing was a form of controlled breakage (or dissociation) in the chromosome — her first glimpse of transposition.

Why did it take her two years? Why did she work in that direction for so long? That was a question put to her by Evelyn Witkin. Her answer is revealing and especially important to me because I went through a similar stage while investigating my insights into how [dolphins](#) communicate and how the doylic memory trace works. As I began to work in each area, the data I found confirmed what I initially suspected must be the case, e. g., the amount of auditory cortex in the dolphin brain should be the same as the visual cortex in the human brain. The work had to be done, but I always knew what the answers would be ahead of time and all the puzzle pieces fell into place.

[page 125] Years later, Evelyn Witkin — at the time a young bacterial geneticist on fellowship at Cold Spring Harbor — asked her how she could have worked for two years without knowing what was going to come out. "It never occurred to me that there was going to be any stumbling block. Not that I had the answer, but [I had] the joy of going at it. When you have that joy, you do the right experiments. You let the material tell you where to go, and it tells you at every step what the next has to be because you're integrating with an overall brand new pattern in mind. You're not following an old one; you are convinced of a new one. And you let everything you do focus on that. You can't help it, because it all integrates. There were no difficulties."

It turns out that Witkin was the only one who really understood at the time what McClintock was doing. (page 137) When McClintock published a paper on transposition of genes, the title "The Origin and Behavior of Mutable Loci in Maize" gave little clue in 1950 to the importance of what she was discussing to the history of genetics and human life. Witkin said back then that what McClintock was finding was "completely unrelated to anything we knew, and it was like looking into the twenty-first century." (Page 137)

This statement of Evelyn Witkin turns out to be prescient because in the beginning part of the twenty-first century, a young Russian girl revealed to the world that plants can act as diagnosing physician, prescribing physician, and dispensing pharmacist to cure ailing human beings. This is a capability which would be scoffed at by scientists today, were it not for the work by the now Nobel-Laureate, Barbara McClintock

which proves that genes can be transposed and in the process create new proteins, and that transposition can be created by signals coming in from the outside of the DNA itself — a final complete contradiction of the so-called "central dogma" of genetics laid down by Francis Crick.

But that central dogma acted as impenetrable wall, a paradigm barrier in Kuhn's terms(5), for everyone but McClintock who refused to accept its so-called existence — she flowed through it as if it didn't exist and after some forty or so years of work, it didn't exist anymore.

[page 178] Part of the problem was that the idea of transposition remained simply indigestible. But by now, she was genuinely puzzled. Why was transposition so heretical? By this time, biologists had become amply familiar with the fact that viral DNA was readily inserted into (and released from) bacterial DNA, often carrying pieces of the bacterial chromosome with it. In some cases, more than one site of insertion had been identified. What, then, was so different about the release and insertion of pieces of resident DNA? It seemed to her simply illogical to consider one reasonable and the other not. What kind of invisible barrier kept transposition beyond the range of acceptability?

It was not the first time she had encountered such a seeming lack of logic in her colleagues. The cause? For McClintock it was what she calls "tacit assumptions" — an implicit adherence to models that prevents people from looking at data with a fresh mind. These tacit assumptions impose unconscious boundaries between what is thinkable and what is not. Even glaring lapses of logic become invisible: "They didn't know they were bound to a model, and you couldn't show them. . . even if you made an effort."

McClintock recognized the "central dogma" as a model, and models generally irritated her because she looked directly into the heart of nature itself and found *no models* there! Kuhn said that the youngest scientists or those new to a given field are least bothered by extant paradigms or models. McClintock remained young at heart and always acted as if she were new to her field, and thus, she liked her younger colleagues. She already knew a lot about what Kuhn was going to write later.

[page 178, 179] She found no difficulty with young scientists, but she felt that with too many of her colleagues age brought on a hardening of the mental arteries. Years of reading the literature, of listening to seminars, make it more rather than less difficult for them to become aware of their hidden assumptions, to hear something new. The unfamiliar becomes increasingly unthinkable, and people forget that their interpretations of data are subject to change; they forget that theories and models come and go. The greatest danger, she finds, comes when people try to explain everything on the basis of what they think they know. "That's why models, when they first begin to be promulgated, are so bothersome to me." Out of sheer enthusiasm, the model gets mistaken for reality. "The central dogma," she says, "is one of these."

In this next passage, she waxes lyrical as she extols the virtues of looking at the territory instead of the maps, models, and dogmas of science. As Alfred Korzybski put it in 1933 in his classic work, [Science and Sanity](#), "The map is not the territory; it can not represent all of the territory." There is all-ways even more .

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[page 179] Molecular biologists weren't thinking about eukaryotes. "They had no feel for what these cells had to undergo in development," according to McClintock. "Organisms can do all types of things; they do fantastic things. They do everything that we do, and they do it better, more efficiently, more marvelously. . . . Trying to make everything fit into set dogma won't work. . . . There's no such thing as a central dogma into which everything will fit. It turns out that any mechanism you can think of, you will find — even if it's the most bizarre kind of thinking. Anything . . . even if it doesn't make much sense, it'll be there. . . . So if the material tells you, 'It may be this,' allow that. Don't turn it aside and call it an exception, an aberration, a contaminant. . . . That's what's

happened all the way along the line with so many good clues."

The challenge for investigators in every field is to break free of the hidden constraints of their tacit assumptions, so that they can allow the results of their experiments to speak for themselves. "I feel that much of the work is done because one wants to impose an answer on it," McClintock says. "They have the answer ready, and they [know what they] want the material to tell them." Anything else it tells them, "they don't really recognize as there, or they think it's a mistake and throw it out. . . . If you'd only just let the material tell you."

How could "McClintockian" become a "code word for the unscientific" among certain scientists unless they were so blinded by the dogma of their field that they were unable to see genius as it walked and talked among them? (Page 193) There are conservative scientists who accept her finding and perhaps the most generous of them might regard it "as an interesting, even surprising, new mechanism, but not as one that fundamentally challenges either the autonomy or the primacy of the DNA." Clearly a discovery which overturns single-handedly the mighty "central dogma" of genetics must be considered a fundamental change, so far as I am concerned. How about you, dear Reader?

All of the above is but prologue to what I consider to be the most important aspect of Barbara McClintock's discovery of transposition of genes in chromosomes: it provides a scientific basis for the work of Anastasia which claims improved health and well-being for people who sow, cultivate, harvest and eat their own food in small, local gardens. Now that McClintock has shown that plants have jumping genes, we can understand how these genes once transposed can produce custom-designed proteins to overcome any deficiency present in our body *before it causes deterioration of our health*. And, at the end of the day, do we *not* want and desire earnestly a doctor who prescribes for us medication that keeps us from having to go to the doctor in the first place?

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Footnote 1. Anastasia's life and work have been public about ten years or so, and is being derided and ignored by the public as much as McClintock's scientific findings were derided right up to the point where she received a Nobel Prize in 1983. The impact of her work has yet to correlated with that of Anastasia, something which I hope to provide a bootstrap into beginning.

[Return to text directly before Footnote 1.](#)

Footnote 2.

[page vii] *Author's Note on the Tenth Anniversary Edition: Five months after this book first appeared, Barbara McClintock was awarded the Nobel Prize. With that award she was instantly transformed into a scientific heroine and a darling of the media.*

[Return to text directly before Footnote 2.](#)

Footnote 3. The surface of Venus being incandescent, catastrophes changing the face of the Earth, radio waves from Jupiter are just three of dozens of IV's predictions which the past fifty years since "Worlds in Collision" have proven to be true, and yet in the last chance the AAAS had to vindicate Velikovsky, they ridiculed him in public.

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**Footnote 4.** Another scientist, thrown out by McClintock from her lab, Joshua Lederberg, said it less gently, "By God, that woman is either crazy or a genius." (Page 142)

[Return to text directly before Footnote 4.](#)

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Footnote 5. Thomas Kuhn's presentation of the concept of scientific paradigms was not to reach the world until 1962 when he published [The Structure of Scientific Revolutions](#). Kuhn could not have cited McClintock's work in his classic work because it had not been vindicated at the time he wrote. He pressed a rarely used word meaning "model", namely *paradigm*, to refer to the sturdy levees which scientific dogma builds up against the flood of innovation.

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