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Cause, Final Cause, and Montessori Thought [1]

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Prior to her death in 1952 Dr. Montessori collaborated with an Italian mathematician, Luigi Fantappiè. Fantappiè was interested in theoretic physics and Montessori in education. Through their discussions a link was made between the scientific phenomena of entropy and syntropy with causality and finality. There is an unending stream of information on the subjects of causality and entropy, and practically nothing scientific on the subjects of finality and syntropy. It is my purpose here to focus on these areas as a window for us to explore our work with children in terms of theory and practicality.

To begin with it will facilitate things if we come to some understanding of terminology. For the purpose of this discussion here are some definitions:

Causality: One can talk to contemporary scientists or read their books and find little reference to causes or to causality, yet those who are concerned with the question "What is causal explanation?" have found It necessary to discuss this topic. It has a history. In ancient and mediaeval times to have scientific knowledge was to know perfectly, to know something is so because of the causes that make it to be as it is. Thus, early on, our understanding of science was based on the search for cause. The dictionary states that causality is the relation between cause and effect which arises out of our experience with things and which is carried over into the constitution of the things themselves. Ergo, nothing happens without a cause.

Entropy: The word entropy was coined from the Greek by Rudolf Clausius In 1865 to mean transformation. Entropy is used as a measure of the unavailability of energy. Clausius called the constant transformation of motion into heat, entropy, with its ultimate extrapolation being: The entropy of the universe tends towards a maximum state. The universe is running down!

Syntropy: A binding force that promotes order and harmony in the universe.

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Finality: The principle that everything is predisposed towards a specific end. A direct and genuine expression of creation, teleological in nature.

We see evidence all around us of a disintegrating world structure. The environment is being pushed to its limits and has begun to turn back on us with major warnings that if our excesses are not curtailed our very existence is threatened.

On the economic front security has waned in the predictable inflationary spiral that has thwarted the dream of prosperity for all. Projections about food production are startling - starvation and malnutrition has been predicted for millions by the turn of the century.

And what about world peace! Does it not seem certain that chaos will reign. Conflict after conflict has continued to break out all over the world even without the influence of the superpowers. Today the threat of nuclear war seems more imminent than we could have imagined just a decade ago.

At the same time as we witness this world-wide disorder there seems to be linking forces, wallowing in some sort of primordial dust which indicates that something else is at work. It seems to say that ‘there Is an order of which all things are consequence’. It is being brought to the foreground by new-wave scientists, philosophers and theologians who are searching for purpose and structure beyond the simplistic reliance on traditional empirical phenomena.

Causality has been at the foundation of scientific investigation since the days of Aristotle. For Aristotle, causes are reasons or explanatory factors that make scientific knowing possible. He recognized only four basic possibilities:

1) questions of fact
2) questions of reason
3) questions of existence
4) questions of nature

All four questions are Intimately connected with the concept of causality. Aristotle’s analysis underpinned scientific investigation for centuries and was proliferated in

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Western thought. But today science is in a period of flux, principles and facts that at one time were regarded as fundamental are being called into question.

In the 19th century Charles Pierce, scientific logician and psychologist, offered his doctrine of fallibility which sought to undermine the philosophical conception of scientific knowledge which he described as "four venomous errors obstructing the path of science". He claimed the following scientific assumptions to be unacceptable:

1) The self-corrective method of science can yield 'absolutely certain' conclusions which are by their very nature exempt from correction in the light of further inquiry.
2) Some things 'can never be known'.
3) Some facts of science are basic, ultimate, independent and utterly inexplicable.
4) Certain 'laws' or 'truths' currently accepted in the sciences have received their final and perfect formulation.

Today it is widely acknowledged that all cognitive claims in science are — in principle —subject of further scrutiny and possible revision; so that in this sense the fallibility of scientific inquiry has become commonplace.

Max Born, one of the architects of quantum mechanics made the confession that "after a lifetime of work in physics he was convinced at his early belief in the superiority of science over other modes of Thought as a way of achieving objective knowledge of the world was a self-deception".

The question we must ask ourselves Is, does scientific inquiry ever yield assured knowledge of the world? We are not here denying the existence of cause and effect but are pointing the way to accept that all scientific parameters do not have to be causal.

There are other, perhaps unknown factors involved.

Entropy theory, a direct result of causal thought, owes its prominence to the second law of thermodynamics. This law states that: 'Heat will, of its own accord, flow only from a hot object to a cold object". The full significance of this law means that the total entropy of the universe is increasing because, in time, all matter tends to lose available energy. The universe in therefore running down, that is, over-all, the energy lost in heat

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that does not perform work will ultimately overwhelm the thrust for structure and organization, producing ultimate disorder and complete homogenization of all matter.

Let us look at this idea in another way. Heat tends, of itself, to flow from a hotter body to a cooler one — never the reverse. The flow ends when the temperatures of the two bodies are equal. Entropy is this tendency to equality, to equilibrium, to uniformity. Take the law of the conservation of energy, that is, the amount of energy in the universe is always the same — it can neither be increased nor lessened. The law of entropy records the qualitative change in such energy. Some of it passes into a state in which it is no longer available for work. In any machine, therefore there is a loss of available energy because of the dissipation of heat through the machine itself. The second law of thermodynamics states that the entropy in any closed system tends to increase to the maximum (to maximize uniformity and equilibrium — that amount of energy available for work). Matter, therefore, is moving from a diversified state to a less complex one.

In juxtaposition to the scientific evidence that supports entropy theory, we have scientific evidence to support evolution — the continued expansion of the universe from the most simple singular element, hydrogen to more and more diversified forms.

This process might be called ‘complexification’ and is believed to be discernable throughout the whole cosmos. It is exemplified by the ascent of life on earth.
So, we have two conflicting theories in the cosmos: entropy and evolution. Entropy measures the loss factor, the exhaust of what Is burned up in the movement toward form and evolution points to order and structure.

In his lecture at the AMI Congress In 1979 Richard Saizmann explains that we must be careful in our interpretation of the second law of thermodynamics and the resultant entropy - related doomsday. He states that entropy is not a force, but a unit of measurement, like the gram or meter, which quantifies the amount of tension available for work in the system.

Now I want to talk about a gifted scientist - Albert Szent-Gyorgyl. Szent-Gyorgyi is a Hungarian-born biochemist who won two Nobel prizes for his work in discovering vitamin C and on muscle structure. His background is unique. He started out in anatomy and then moved into physiology. He found this work too complex and went into pharmacology. This also was too complex for him and he became a bacteriologist.

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He found bacteria in a small universe in itself and descended to the level of molecules, becoming a chemist. After several decades he found even molecules too complex and started work on electrons in quantum mechanics. In recent years Szent-Gyorgyi has ascended again to the cellular level and has made some remarkable contributions to cancer research. He has theorized that the behaviour of a cell depends on the equilibrium of two substances — one which tries to make the cell multiply and one which inhibits its multiplication.

Further on in Mr. Saizmann's lecture he identifies Szent-Gyorgyi as one who "points to mounting evidence for the existence of a genuine cosmic force; syntropy (the opposite of entropy) — through the influence of which forms tend to reach higher and higher levels of harmony." Szent-Gyorgyi conceives of an innate drive in living matter to perfect itself and suggests that such a syntropic principle can be found even at the sub-atomic level.

Now we have to be very careful with such information. You can't just go off and discuss such unproven principles with your ordinary scientist who is still clinging to causal definitions.

But there are other views that seem to converge. David Bohm, physicist and author of *Causality and Chance in Modern Physics*, talks about two orders that exist in the physical world — the explicate and the implicate. The explicate is the unfolding outer order of the world of things. The implicate or enfolded order pays attention to inner aspects which enfolds the explicate, giving it meaning. He pursues the idea that this implicate order is not a dependent aspect of the content, but rather 'the independent ground of the existence of things' — that on which the outer or explicate order is based. Bohm uses the idea of the hologram and the lens to contrast the two orders.

In the hologram a total content is enfolded in the movement of waves, through the use of laser light beams - a function which might be expanded in principle over the entirety of space and time.

Finalistic phenomena cannot be reproduced by man and are therefore more difficult to conceive. Let's look at the works of Piere Teilhard de Chardin, a Jesuit Father, and paleontologist. In the Phenomena of Man he states:

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"*From an inward point of view, constantly confirmed by ever-increasing harmonies, the different objects of science become visible in proper perspective and in their true proportions. We see life at the head, with all physics subordinate to it. And at the heart of life, explaining its progression, the impetus of a rise of consciousness*."

He explains that "*the impetus of the world can only have its ultimate source in some inner principle, which alone could explain its irreversible advance towards higher psychisms*." Chardin attempts to provide a coherent vision of the process of evolution starting from the formation of our planet through the emergence of life, and later thought, to an imagined end state or Omega Point.

Causality is important for the scientific ordering of nature, and it will not be oppressive if human beings feel free to step out of the world of things and into the world of relations. "In the world of relation", writes Martin Buber, "man finds guaranteed the freedom of his being and of being." The man to whom freedom is guaranteed does not feel oppressed by causality. And this corresponds to the thinking of Maria Montessori.

Dr. Marta Montessori talked about the concepts of Finality and Causality in Education in 1950 at one of her last conferences which was held in Perugia. She held that causalistic phenomena are those produced by determinate causes and are reproducible by experimentation. From the principle of causality is derived the idea of entropy. In traditional education the teacher is said to be the cause of the development of the intelligence and will of the child. Lesson plans and dictates overshadow exploration and spontaneity. It is a causal system, reproducible because it is predictable. You might even picture the teacher as an emitting source (warm) and the children as the receiving source (cool) and the resulting entropy is the amount of 'tension' available for work in the system.

The Montessori method was born out of scientific investigations using empirical data. In his book *Education for Human Development* Dr. Mario Montessori Jr. states that ''Montessori education is based on an empirical experiment with children in concrete life situations. Maria Montessori herself was so struck by what she called 'the discovery of the child' that she never felt the need to build up a theoretical system. It was not theories that were important to her, but the child itself and its spontaneous behaviour."

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An empirical experiment, built along inductive lines, does not negate the causal situation, it just de-emphasises it. A theoretical system developed from deductive logic is significantly based on cause and effect. Dr. Montessori recognized the value of scientific inquiry but did not envelop it to the exclusion of other possibilities. This is what people like Charles Pierce, Max Born, David Bohm, Teilhard de Chardin and Albert Szent-Gyorgyi have inferred if not suggested directly. The science of cause and effect is only part of what is going on — there are other, perhaps unexplainable, factors that make the functioning of life complete.

Dr. Montessori's discovery of the quality of the absorbent mind and her recognition of special periods of heightened interest in the child called sensitive periods cannot be attributed to causal logic. They seem innate — spontaneous and of unknown origin. Her understanding of the role of human tendencies in the development of the child and adult underscores this connection to things which cannot be explained by ordinary science.

Maria Montessori was a scientist that knew something existed beyond science. In *The Formation of Man* Dr. Montessori talks about "a form of unconscious memory that retains its fixed images even through generations and minutely reproduces the character of the species". This unconscious memory is called the mneme. The mneme stores potentiality in the form of nebulae which have the power to direct the future tissues so that they can form complicated and structurally complete determined organs. What is it that propels this unconscious memory? Montessori calls it the Horme which corresponds to what the French philosopher M, Bergson called the elan vitale — the driving force of the universe.

With such lofty ideas it is easy to understand how Dr. Montessori comprehends the Finalistic phenomena. These phenomena are a direct and genuine expression of creation and are teleological in nature because they embody the notion that final cause exists and there is a design or purpose in nature. In that 1950 conference Dr. Montessori said: "In order to clarify these opposite concepts (causality and finality) I want to use a very good example. Throw a stone in stagnant water. The stone disappears and goes to the bottom; immediately concentric ripples are formed, first small ones, then larger and larger until they disappear. Now let us suppose we took a film of this episode and ran it backwards. What would happen? First there would be the surface of still water and then from the outer part we would see ripples; and the ripples would increase and

form concentric circles, gradually clearer and smaller and at the end of it, all of a sudden a stone would emerge One process is degenerative and the other generative".

While it is evident on most levels that rocks do not jump out of the water, this example serves to illustrate the kind of power or force that is at work in the mind of the child. It is a unifying force taking direction from inner drives which take it to seek its own perfection. It is a creative energy that permits the child in the Montessori environment to participate in her development — to be an agent of her own self creation. In Montessori education, optimal relationships between children and adults and an optimal environment stimulate and give support to this spontaneous development.

Montessori teachers are trained to respect the self directed activity of the child. They observe the child according to scientific critera and make reports on these observations. The secret of childhood is disclosed, not from adults' probing the child with a set of external measurements, but from the 'spontaneous manifestations' of the child acting freely in a prepared environment.

Montessori materials appeal to the child's inner needs offering him the opportunity to work independently and to have his own experiences with this carefully designed material. Freedom of choice Is an essential aspect of the Montessori environment. This enables the child to choose from amongst a variety of activities, confronting him with alternatives and developing independence.

Montessori schools assist the child in becoming part of her culture. Primary, elementary and secondary environments offer the opportunity to engage in activities that enlarge the child's cultural horizons. Through these efforts intellectual as well as spiritual development occurs. Maria Montessori said that: "The task of the child is the construction of man oriented to his environment and adapted to his time, place and culture."

These are some of the tenets that compel us to think of Montessori education in the direction of finality. As everything in the universe leans towards a specific end, we may say that life moves towards a finality not established by man, but external to him. Dr. Montessori said that all the universe is predisposed to a final end. She believed that the future would be better and said that "we must have faith in man and be optimistic".

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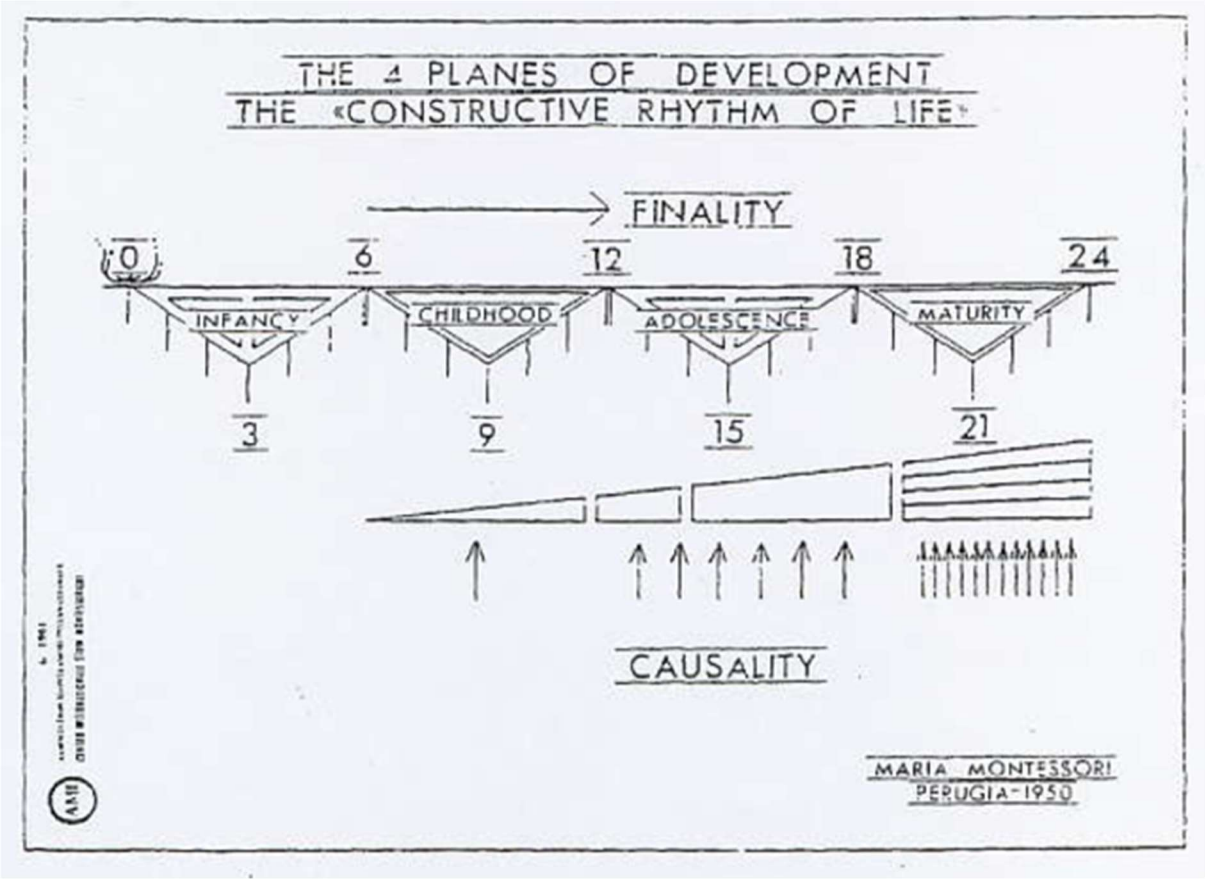
During that conference in 1950 Dr. Montessori introduced this schematic representation of the four planes of development comparing them to ordinary education.



The flame at birth represents the psychic charge of life and the line that ensues to age 24 and beyond is the line of life. The red triangles of the first and third planes of development signify periods of construction and the blue triangles of the second and fourth planes signify periods of consolidation. Each triangle is a cycle of development requiring a different set of learning conditions and a different approach based on the characteristics of the child during that time-frame.

The first and third periods are times of dramatic change where the child undergoes major physical and psychic transformations. In the former he is creating his individual personality and his place in the family. In the latter he is creating a social personality and a place in community and society at large. The second and fourth periods are more tranquil and the child's directives help him to integrate the accomplishments of the previous period. Between the eges of six and twelve there is an integration of universal

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structure and how societies function. Between the ages of 18 and 24 there is an integration into the society itself. Montessori education recognizes these different tendencies and creates an environment adapted to the needs manifest in each plane of development. It is in the direction of finality because of the creative energy of the child seeking his own perfection.

On the other hand, ordinary education does not begin until the age of six. The inclined plane represents a gradual increase in learning from age 6 to 24 and the arrows indicate the intensification of subjects as the child ages. From ages 18-24 there are four divisions which represents the time for specialization. The whole area is shaded in grey to indicate the boredom inherent in the system. It is causalistic because the teacher is said to be the cause of the child's learning (effect).

What are the implications of these finalistic concepts in terms of what we do in the classroom? How do we provide an environment that supports the goals of Montessori education?

During the first plane of development the children's house experience allows the inner directives of the child to focus on meaningful activity, ft is through th\i activity that we discover the finalistic nature of the child. We observe how she builds her concentration and develops her will through interacting with the materials. We also observe the manifestations of the absorbent mind and how the child's interests gain momentum as she passes through the various sensitive periods. This environment of things permits the child to 'use' material to construct an objective view of the world. Her experience is process rather than end oriented.

How do we support the inner directives of the child during the second plane of development? How do we continue to build on this 'process orientation'. We need to examine our environment to ensure that our explanations are open-ended and not given as a set of unchanging rules. Think about the first-level history experiments. Is it more important for the children to develop predetermined conclusions from what they observe or to have a general questioning attitude about the experience?

We need to examine the role of questioning in the environment and the way in which answers are provided. What is the function of control of error? What is error? At what point do we say that the quantity of teacher-made materials limits the creativity and

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responsibility of child. We need to continually examine our environments to make sure there is a balance between what we give and what the child is responsible for developing. Above all it is important for us to acknowledge and recognize a special energy or unifying element at work within the child, helping him to become what he is to be.

Some of you touched on this energy earlier this week when you talked about why you are in the classroom. I heard statements like:

"It is a creative environment."
"It is a healing environment."
"There is something special about seeing a child beam when he comes to know that he knows."

The traditional teacher has to be concerned with results and ends; therefore causes and effects underscore the methodology. Montessori's view of life, and in particular the second plane of development, forces us to look beyond cause and discover ways to allow for continued self-construction. Surely the whole thrust of cosmic education embodies this principle and exemplifies Dr. Montessori's idea of the finalistic phenomena; that is, we are all part of an organic whole, working and creating a supranature that continues to improve life on earth.

In 1938 Dr. Montessori wrote: "Life appears as a worker, as an agent of creation. Its various components are led by their several Instincts to perform special functions directed to the maintenance of the order in nature. Each task is indispensable: each individual Is concerned more with the advantage of evolution of the whole in which all take part, than with Its own salvation {reciprocal altruism). Thus, the purpose of life Is shown to go beyond the limits of life Itself. It enters a field much wider than the restricted alms of self-preservation and self-perfection."

In conclusion I would like to share with you a poem written by Albert Szent'Gyorgyi at the end of his book Crazy Ape which urges that science be used to better man's condition, not to destroy him through war.

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"God! Let me praise you
by improving my corner of your creation
Bij filling this little world of mine
with light, warmth, goodwill and happiness."

Phil Gang

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